The Application of Two-Stage Approach in Evaluating Domestic Mergers and Acquisitions Performance Efficiency in Egypt

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Abstract

The main aim of this research is to measure the impact of domestic Mergers and Acquisitions (M&As) on firm's performance and to determine M&As success and failure factors (i.e. weight efficiency, difference in efficiency, return on assets and return on equity) in the whole Egyptian market. The researchers used two-stage analysis; Data Envelopment Analysis (DEA) in the first step and censored regression technique (Tobit model) in the second step for sample of 21 firms listed in the Egyptian stock market (EGX) for 23 operations within the period from 2003 to 2015. The research found that there is enhancement in performance efficiency post M&As in both financial and non-financial sectors. The results showed significant relationship between both ROA and ROE with M&As performance efficiency indicating that these two factors are the most success factors affecting M&As performance

efficiency. Results found that there is insignificant relationship between difference in efficiency and M&As performance efficiency.

Keywords: Mergers and acquisitions, Data envelopment analysis, Tobit model, Weight efficiency, Difference in efficiency, Return on assets, Return on equity, Performance efficiency

1. Introduction

The recent changes in the global environment structure have forced domestic and multinational companies to strengthen their competitive and market position through different growth strategies. M&As have been the golden key to achieve the target market share through increasing profitability, increasing market share, penetrating new markets, gaining new brand competences, broadening business portfolio and capitalizing economies of scale (Tariq, Abdulati, & Radwa, 2011; Kau et al., 2004; and Luo, 2005).

Cross-border M&As have become an important factor in economic cycles and a trend in combining different business operations across various countries. Cross-border M&As happen between different nationality or home country firms and they can be either inward or outward. Inward cross-border M&As occur when selling domestic firm to foreign firm, while outward cross-border M&As occur when purchasing foreign firm by a domestic firm (Kang & Johansson, 2000).

Cross-border M&As require involved countries to have effective control regimes. Developing and Emerging economies (DEEs) countries face difficulties in keeping control and effective cross-border M&As, Egypt is an example for DEEs that lacks both adequate framework for M&As control, and Egyptian competition law regimes (Bassiouny & Badran, 2018). Since 1991, the Egyptian government has introduced major economic reforms in consistent with the new Egyptian stream for globalization and economic liberalization (Tariq, Abdulati, & Radwa, 2011).

Over the last few decades some of these M&As didn't achieve the intended results (Serhiy & Walter, 2015). Regardless of M&As history of failure, recently it is growing rapidly in many organizations to support their corporate strategies.

There are two key areas to be investigated to understand the M&As success/ failure; measuring performance efficiency for the firms and determining the main factors that causes success/ failure of M&As.

It is important to look continuously at the motives, objectives, and strategies while analyzing the M&As success or failure in pre- and post-M&As planning to compare and assess the impact of pre-and post M&As on performance efficiency (Sherman, 2010). Successful M&As are the ones that have led to expected benefits and their merged or acquired firms perform better than the parties would have done without M&As.

There are different factors for successful M&As such as experience from previous M&As, good preparations before and after the operation, good flexible strategy and clear goals with reasonable time horizon, competent supportive management with effective communication

channels across the M&As team, and due diligence (Appelbaum et al., 2003; Schraeder & Self, 2003; Gomes et al., 2007; Epstein, 2010; and Phillips & Zhdanov, 2012).

The research focuses more on the impact of efficiency and profitability as important factors for M&As success. The research focuses on other M&As success factors for the acquirer such as the size, age, foreign ownership, financial debt, acquisition frequency, and the financial/non-financial sector.

Conventionally, evaluating firm's performance usually employs the financial ratio method because it provides a simple description for both financial and managerial performance in comparison with previous periods and it gives the keys to improve them (Wen & Chin, 2005). Traditional financial ratio method is appropriate when the firm has only one input or produces one output. Wen & Chin (2005, p.471) declared that "if we used financial indicators to measure efficiency in an industry, it will lead to a problem of the weight assignment to each indicator". Ratio analysis provides relatively insignificant amount of information when considering the effects of economies of scale, the identification of benchmarking policies, the estimation of overall performance, the consideration of only two dimensions of operation, and the subjectivity of aggregation (Wang & Li, 2007; Koltai & Uzonyi-Kecskés, 2017).

Data Envelopment Analysis (DEA) allows management to objectively identify best practices in complex operational environments. Compared to conventional methods, DEA is a better way to analyze the data since it allows handling multiple inputs and outputs (with different units) in complex way and requires no prior assumption (Wang & Li, 2007) and it provides further analysis to trace the causes of inefficiencies (Koltai & Uzonyi-Kecskés, 2017). DEA technique is defined by Reda (2013, p.7) as "an efficiency measure of a production unit by its position relative to the best performance established mathematically by the ratio of weighted sum of outputs to weighted sum of inputs".

In most cases, Tobit model is useful as a second stage after DEA model. It was utilized to explain and investigate the determinants of efficiency to a set of explanatory variables. The Tobit model is a statistical model suggested by James Tobin (1958) to explore the relationship between independent variable (X) and dependent variable (Y). The word Tobit is taken from Tobin.

The researchers use DEA model due to close intervals for M&As periods (one year before and after the operation date) and high correlation among the variables. The DEA model solves the problems come from the discontinuous time periods and their inconsistency results.

Nevertheless, DEA model doesn't provide accurate information for the reasons behind efficiency differences. In the DEA literature, many advanced and consensus methodologies agreed to deal with such problems by using censored regression technique (Tobit model) which explain and investigate the determinants of efficiency to a set of explanatory variables.

The researchers use two-stage analysis; non-parametric technique which is (DEA) in the first step and censored regression technique (TOBIT model) in the second step. The DEA approach with TOBIT model is used for evaluating the efficiency performance pre and post

M&As transaction and solving weight assignment problem, insignificant amount of information, and unreliable accounting data resulting from using financial ratio method.

2. Literature Review and Hypotheses Development

The literature for the impact of M&A on firm's performance efficiency is divided into two sections according to methods of performance evaluation; the first section examined the effect M&As on the firms' financial performance using DEA approach, and the second section examined DEA results using a second stage analysis technique through Tobit analysis.

2.1 Studies Examined the Impact of M&As on Firm's Performance Efficiency Using DEA Approach

First group of studies found that M&A operations have inefficient post-M&A. Allen & Boobal-Batchelor (2005) examined the efficiency of acquirer and target Malaysian banking sector before and after M&As during the period from 1996 to 2002. The sample population included 10 domestic Malaysian commercial banks, 11 Malaysian Islamic banking, 13 Malaysian foreign banks, and 3 Singaporean banks. Allen & Boobal-Batchelor found that acquiring banks did not achieve their efficiency levels. The acquiring banks maintained inefficient in post- M&As year.

Reda & Isik (2006) measured and examined the productivity and efficiency change of Egyptian conventional banks during the period from 1995 to 2003. Reda & Isik covered the sample of 24 banks listed in EGX. Reda & Isik found that 22 percent from Egyptian commercial banks of the sample size had technical inefficiency. In general, the least efficient percentage was found in smaller banks.

Halkos & Tzeremes (2014) investigated the degree of efficiency gains pre- and post M&As operations over the period from 2007 to 2011. The sample included 45 Greek banking industries. The results showed that efficiency gains had decreased in a year before and a year after the Greek fiscal crisis, and had increased in the last year of analysis (2011). The study also found that if M&As is undergone between two efficient banks, then the newly combined bank will not create operating efficiency gains.

A second group of studies found that M&A operations have efficient post-M&A. Ariff & Can (2008) examined the profit and cost efficiency of Chinese conventional banks undergone M&As operation over the period from 1995 to 2004. The sample of the study based on 28 Chinese banks. The results showed that the profit and cost efficiency was higher in the post- rather than pre- M&As operation.

Gandhi & Shankar (2013) measured the performance efficiency of Indian retailers' firms. The data sample included 18 Indian retailing firms during the period from 2008 to 2010. The results confirmed that under DEA approach 12 retail firms from 18 were considered as efficient and the remaining 6 firms were considered as inefficient.

Alsarhan, Al-Shammari, & Alenezi (2015) investigated the efficiency in the Kuwait investment sector during the period from 2008 to 2010 post M&As operation. The sample included 40 companies. The results of the first stage showed that there was increase in

efficiency of investment sector with the exception of 2008 due to the global financial crisis.

Khalad, Mazila, & Badrul (2015) assessed the Libyan banks efficiency during the period from 2004 to 2014. The sample included 9 Libyan banks that were divided into 5 specialized and 4 commercial banks. The results showed that in first stage there was an improvement in the average efficiency scores in the Libyan banks.

Čupić & Širaňová (2018) examined the influence of the accession of Slovakia to the European Union on the efficiency of Slovak banks. The sample included 148 observations from 2000 to 2013. The result showed that the bank efficiency increased after the accession of Slovakia to the European Union.

Nassim, Asadollah & Jalil (2018) evaluated the efficiency of Iranian plastic producing companies by using DEA. The sample included 17 manufacturing companies. The result showed that 2 Iranian companies out of selected 17 were efficient, Also, 9 out of 17 plastic producing companies were productive.

Bai, Jin & Chiu (2019) examined the efficiency gains between strong and weak China's railway sector over the period 2011-2015. The DEA results revealed that geographically meaningful M&As were better than the megamerger and coalition in creating efficiency gains due to the special characteristic of the railway sector economics.

A third group of studies compared the efficiency for post-M&A among banks sectors. Kaur & Kaur (2013) compared public and private Indian banks that undergone M&As through determining the cost efficiency over the period from 1990 to 2008. The sample of the study consisted of 28 Indian banks for both sectors. DEA results found that that public sector banks were less efficient than private sector banks. Also, the study found that the M&As operation had a significant impact on Indian banks efficiency.

Abbas, Azid, & Besar (2016) compared the performance in terms of efficiency and effectiveness between conventional and Islamic banks. The sample of the study included 6 Islamic and 27 conventional banks working in Pakistan during the period from 2004 to 2009. DEA results found that efficiency and effectiveness was positively higher in conventional banks than in Islamic banks, and it was found that Islamic banks' performance was lower than conventional banks. Khalad, Mazila, & Badrul (2015) found that the specialized banks were more efficient than commercial banks.

2.2 Studies Examined DEA Results Using a Second Stage Analysis Technique Through Tobit Analysis

This group highlights the literature studies that extended their DEA analysis through Tobit model to investigate reasons behind DEA results.

Mostafa (2007) assessed the market efficiency performance of the top listed Egyptian companies using 2003 operating data in Egypt. The study sample included 62 listed companies. Mostafa found that when assessing efficiency, the size of firm was not relevant. The results also indicated that both Age and Brand variables were significantly positive to performance at level 0.01.

Tobit regression results in Ariff & Can (2008)'s study suggested that more profitable banks tended to be more efficient. There was a significant positive relationship between non-interest income to total income and efficiency. Khalad, Mazila, & Badrul (2015)'s second stage results showed that there was positive relationship between capital adequacy, size of operation, and ROA with bank efficiency. Alsarhan, Al-Shammari, & Alenezi (2015)'s results of the second stage suggested that government participation, Islamic firms, total assets, and total revenues were the factors that affected efficiency in the investment sector in Kuwait. Abbas, Azid, & Besar (2016)'s Tobit model showed that Age, capitalization, size, non-markup expenditure, and loan ratio had significant positive impact on efficiency and effectiveness.

Kaur & Kaur (2013) Tobit regression results suggested that the cost inefficiency among Indian conventional banks was related to allocated efficiency rather than technical inefficiency. Gandhi & Shankar (2013) Tobit results showed that number of retail outlets and M&As were considered as main factors that affected the Indian retailers' efficiency.

Wanke, Maredza, & Gupta (2017) final sample size included 90 units involved the combination of 9 banks in South Africa for the period from 2003 to 2012. Their Tobit results revealed that bank type and origin impact virtual efficiency levels. However, due to the oligopolistic structure, harmony (scope) and scale (size) effects were negligible.

Chih, Liang & Huang (2018) investigated DEA to measure cost and profit efficiency for Taiwan commercial bank for a period of 9 years between 2004 and 2012. Tobit result indicated that the SME lending had a positive effect on the cost and profit efficiency. In private M&A, foreign M&A invested bank had relatively better profit efficiency underwent to merge.

Čupić & Širaňová (2018) Tobit result suggested that efficiency of Slovak banks was not affected by macroeconomic conditions and banking reforms. They found large banks were more efficient than small banks, and foreign banks were more efficient than domestic banks.

In conclusion, previous studies investigated the effect of M&As on firm's performance efficiency using either DEA approach only or DEA approach with Tobit model with a sample comprised from either companies (investment or insurance companies) or banks (Islamic or conventional banks), but they did not show the impact of M&As on the whole economic market.

According to the previously discussed literature, the researchers conclude that there are two main gaps need to be filled:

1. There is a gap in assessing the impact of M&As in the whole Egyptian economic market (financial and non-financial).

2. There is a gap in measuring the effect of M&As on Egyptian firm's performance efficiency using two stage analysis approach; DEA and Tobit model.

Based on the underlying literature, the following research hypotheses are formulated as follows:

H_1: There is a significant positive relationship between M&As and the increase in firms' performance efficiency.

H_2: There is a significant positive relationship between M&As performance efficiency and weight efficiency.

H_3: There is a significant positive relationship between M&As performance efficiency and difference in efficiency.

H_4: There is a significant positive relationship between M&As performance efficiency and rerun on assets.

H_5: There is a significant negative relationship between M&As performance efficiency and return on equity.

3. Research Methodology

The researchers use two main stages; DEA and Tobit models which are used to measure the impact of M&As on firms' performance efficiency. DEA was used to test the first hypothesis, Tobit model is used to test second, third, fourth and fifth hypotheses.

3.1 Data Description and Sample

The time period for this research ranges from 2003 to 2015. The research population consists of both financial and non-financial firms listed in the Egyptian stock market (EGX) which are involved in M&As operations within the research time period. The research population includes both acquirer and target firms that are listed in the EGX at the M&As operation time. If the acquirer or the target is unlisted, the operation is to be omitted from the research sample The acquirer firms within the research population are to be listed in the EGX a year before and a year after the M&As operation time. The target firms within the research population are to be listed in the EGX a year before the M&As operation time.

There are no Merger operations within the research time period. The population for Mergers in Egypt is 13 operations for 13 firms within the period of 1996 to 2000. The population for the acquisition operations in Egypt is 183 operations for 175 acquirer firms and150 target firms, some of acquirer firms are involved in more than one acquisition operation. The total number of the acquirer firms involved in M&As operation in Egypt is 215 firms. The total number of the target firms repeatedly involved in acquisition operations (i.e. involved in more than one acquisition operation) is 194 firms.

This research focuses on domestic M&As operations for firms listed on Egyptian stock market that follow (EAS) No.29. The researchers exclude cross-border and the acquirer firms that are not fully control.
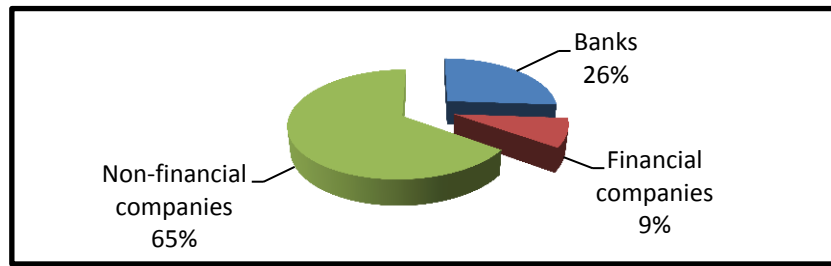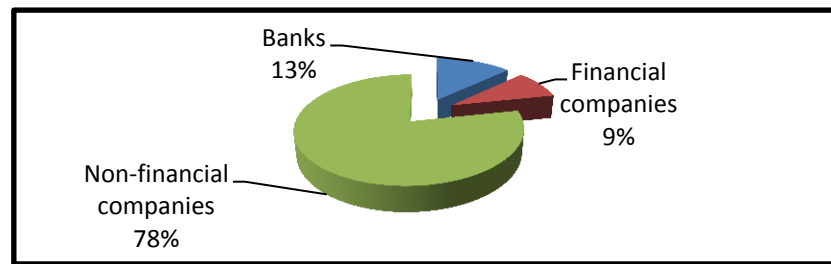
Figure 1. The acquirer sample type

Figure 2. The Target sample type

The final sample for Acquirer companies as shown in Figure 1 is 21 firms including 2 financial companies, 6 banks, and 13 non-financial firms for 23 operations within the period from 2003 to 2015. The final sample for the listed target companies as shown in Figure 2 is 23 companies including 2 financial firms, 3 banks, and 18 non-financial firms.

3.2 Analyzing the Sample Data Using DEA and TOBIT Model

The researchers use two-stage analysis; DEA in the first step and censored regression techniques (Tobit) model in the second step.

3.2.1 DEA Model Implementation

The researchers use DEA software solver LV8 (2014) and running data using CCR tool, DEA model formula is introduced bellow according to William (2014):

$$Y_i = \frac{\sum_{r=1}^{s} u_r\, y_{ri}}{\sum_{j=1}^{m} v_j\, x_{ji}}$$

Where,

Y: refers to the efficiency.

i: is the decision making unit (DMU).

X_{ji}: amounts of input.

Y_{ri}: amounts of output produced from inputs.

U$_r$: weight assigned for output.

Vi: weight assigned for input.

S: number of output.

M: number of input.

r = type output for entity i (1, 2, .. to s)

j = type input for entity i (1, 2, .. to m)

Meaning that $0 < Yi \leq 1$

Table 1. Summarizes the DEA inputs and outputs variables and their measurement for financial firms' sample

	Financial firms variables	**Measurement**
Inputs	**Operating expenses**	Fees and commission+ Administrative expenses+ Other operating expenses (found in I.S).
	Interest expenses.	Interest on deposits + Cost of bank loans (found in I.S).
Outputs	**Net interest income**	Interest income – Interest expenses (found in I.S).
	Non-interest income	Fees and commission + Foreign exchange gain+ Stock dividends and investment on sales gain+ Other operating income (found in I.S).
	Total amount of loans and advances (net of allowances)	Over draft term loans+ Bills receivables (found in I.S).

As shown in Table 1 for the financial firms' sample, the researchers use two inputs (operating expenses and interest expenses) and three outputs (net interest income, non-interest income and total amount of loans and advances).

Table 2. Summarizes the DEA inputs and outputs variables for non-financial firms and their measurement

	Non- Financial firms variables
Inputs	Total Asset extracted from balance sheet at fiscal year-end.
	Stockholders' Equity extracted from balance sheet at fiscal year-end.
Outputs	Operating Revenue extracted from income statement at fiscal year-end .
	Net Income before tax extracted from income statement at fiscal year-end .

As shown in Table 2 for non-financial firms sample, the researchers use two inputs (assets

and stockholders' equity) and two outputs (operating Revenue and net income).

3.3 DEA Results

DEA results are divided into two parts; results for financial and non-financial sectors pre-post M&As operation, and results for target firms for both financial and non-financial sectors pre M&As.

The researchers conduct a comparative analysis for the acquirer DEA score pre- and post-M&As to test the impact of the efficiency of acquirer and target on the combined firm efficiency.

3.3.1 DEA Results for Financial and Bank Sectors

Table 3. DEA results for both acquirer and target sample for financial and bank sectors

no.	Acquirer Financial and Bank Sector	Acquirer Before M&A		Firm name (target)	Target Before M&A		Acquirer After M&A	
		DEA	Rank		DEA	Rank	DEA (Y)	Rank
1	Pioneers Holding	0.419	7	Arab Dairy	0.204	7	0.1638	8
2	National Development Bank	0.312	8	National Glass & Crystal Co	1	1	0.1887	7
3	CIB-Egypt	0.741	4	Commercial International Brokerage Co. (financial)	0.193	5	0.9616	4
4	Credit Agricole	0.583	5	Egyptian American Bank (financial)	0.945	2	1	1
5	National Societe Generale Bank (NSGB)	1	1	Misr International Bank (MIBank) (financial)	0.494	4	1	1
6	Arab International	0.578	6	Suez Canal Company for	0.092	12	0.5829	5

	Bank			Technology Settling				
7	Saudi Egyptian Investment & Finance	1	1	Giza Cables	0.22	6	1	1
8	Arab African International Bank	1	1	Misr America International Bank (financial)	0.666	3	0.4872	6

According to Table 3; it appears that both (NSGB) and Saudi Egyptian Investment & Finance Bank (which were efficient in both cases) kept the DEA score=1 for pre and post M&As, while, AAIB score post M&As decreased from 1 to 0.4872 to settle in the 6th rank which means that M&As operation wasn't a good decision for it. On the other hand, Credit Agricole Bank increased its DEA from 0.5825to reach 1 and to jump from the 5th to the 1st rank which means that M&As operation was an appropriate decision for it. In addition, CIB-Egypt maintained its 4th rank despite of the increased DEA score from 0.7412 to 0.9616.

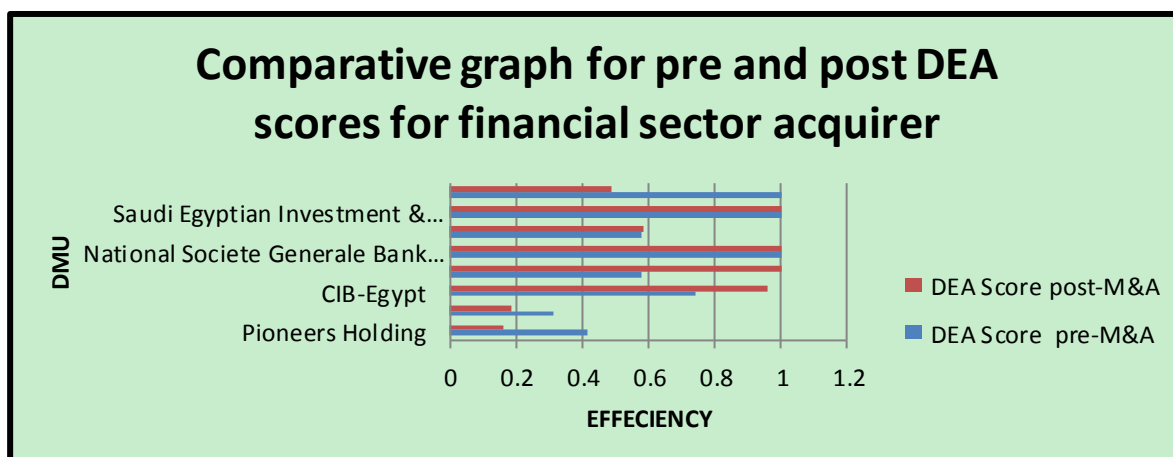Figure 3. Comparative analysis between pre and post M&A efficiency scores for the financial sector acquirer

3.3.2 DEA Results for Non-financial Sector

Table 4. DEA results for both acquirer and target sample for non-financial sectors

Acquirer Non-Financial Sector	Acquirer Before M&A		Firm (target) name	Target Before M&A		Acquirer After M&A	
	DEA	Rank		DEA	Ran	DEA	Ra

						k	(Y)	nk
9	Olympic Group Financial Investments*	0.169	8	Cairo Feeding Industries	0.253	5	1	1
10	Orascom Telecom Media & Technology Holding	0.448	5	Beltone Financial Holding (financial)	1	1	0.6998	6
11	Sharm Dreams Holding for Tourism & Hotles	0.086	9	Rowad Misr Tourism Investment	0.088	13	0.0722	15
12	Egyptian Company for Tourism & Hotels	0.016	14	Tourism Urbanization	1	1	0.0734	14
13	Orascom Development Holding AG	0.356	7	Orascom Hotels and Development	0.04	15	0.5006	8
14	Orascom Construction Industries	1	1	Fertilized Egypt Co.	0.128	10	1	1
15	Telecom Egypt	0.0003	15	Vodafone Egypt	0.015	18	0.1913	13
16	Suez Cement	0.376	6	ASEC for Cement	0.203	8	1	1
17	Oriental Weavers	0.598	4	Moquette Mac	0.185	9	1	1
18	Talat Mostafa Group Holding	0.04	11	Alexandria Urban Projects	0.104	11	0.2021	10
19	Talat Mostafa Group Holding	0.04	11	El Arabia for Projects & Construction Development Co	0.02	17	0.2021	10
20	Talat Mostafa Group Holding	0.04	11	Alexandria Real Estate	0.059	14	0.2021	10

21	Sperea Misr Plastics & Chemicals	1	1	Plastichem	0.823	4	0.8194	5
22	National Navigation	1	1	Egyptian Shipping Transport	1	1	0.623	7
23	Arab Company for Touristic Projects	0.081	10	National Tourism & Hotels	0.028	16	0.2201	9

According to Table 4; it appears that, Orascom Construction Industries DEA score remained =1 pre and post the M&As. while Sperea Misr Plastics & Chemicals, and National Navigation DEA score= decreased from 1 to 0.8194, and 0.623 respectively to move their rank from the first to 5th and 7th ranks which means the M&As operation wasn't a suitable decision to be taken for both companies. On the other hand, the DEA score for some other companies increased post the M&As which are Olympic Group Financial Investments, Suez Cement, and Oriental Weavers from 0.1693, 0.3761, and 0.5977 respectively to DEA score =1 and they jumped from 8th, 6th, and 4th ranks to the first which means the M&As operation was a perfect decision for these three companies.
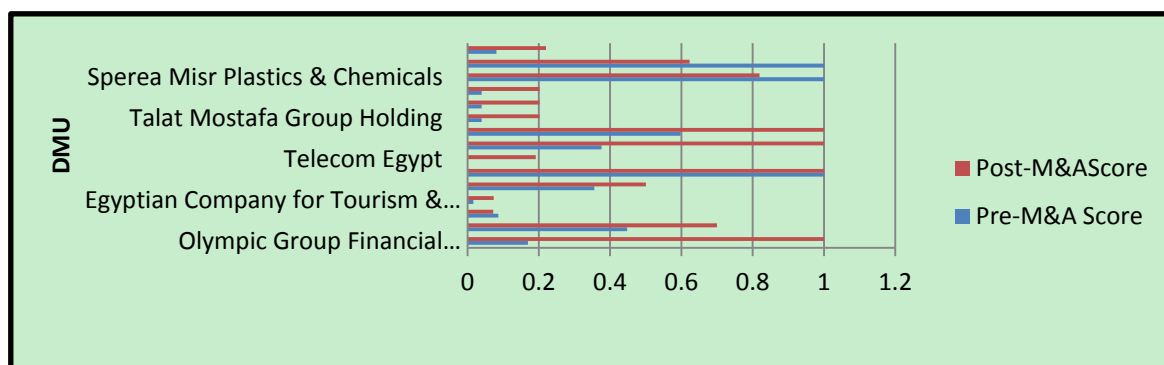

Figure 4. Comparative analysis between pre and post M&A efficiency scores for the non-financial sector acquirer

3.3.3 Comparative Analysis of Acquirer DEA for Pre- and Post- M&A

The result shows that there is no relationship between the DEA and the efficiency as the acquirer may be inefficient before M&A and becomes either efficient or inefficient after M&A, or the acquirer may be efficient before M&A and becomes either efficient or inefficient after M&A, or the acquirer may either efficient or inefficient before M&A and remains the same after M&A. This result goes with the results for second and third hypotheses.

Table 5. Inefficient acquirer increased its efficiency after M&A to reach efficient result

no.	Firm name Acquirer	Firm name	Target	Before Acquirer

	Acquirer	Before M&A		(target)		M&A		After M&A	
		DEA before	Rank			DEA before	Rank	DEA (Y)	Rank
4	Credit Agricole	0.5825	5	Egyptian American Bank (financial)		0.9451	2	1	1
9	Olympic Group Financial Investments*	0.1693	8	Cairo Feeding Industries		0.2534	5	1	1
16	Suez Cement	0.3761	6	ASEC for Cement		0.2026	8	1	1
17	Oriental Weavers	0.5977	4	Moquette Mac		0.1848	9	1	1

It appears in Table 5 that when inefficient acquirer acquired inefficient target, the result was efficient firm. This rule is true except in case of credit Agricole acquisition for efficient Egyptian American Bank.

Table 6. Efficient acquirer neither increased nor decreased (remained the same) its efficiency after M&A with inefficient target

no.	Firm name Acquirer	Acquirer Before M&A		Firm name (target)	Target Before M&A		Acquirer After M&A	
		DEA before	Rank		DEA before	Rank	DEA (Y)	Rank
5	National Societe Generale Bank (NSGB)	1	1	Misr International Bank (MIBank) (financial)	0.4941	4	1	1
7	Saudi Egyptian Investment	1	1	Giza Cables	0.2202	6	1	1

	& Finance							
14	Orascom Construction Industries	1	1	Fertilized Egypt Co.	0.1277	10	1	1

It appears in Table 6 that when efficient acquirer acquired inefficient target, the result was efficient firm

Table 7. Efficient acquirer decreased its efficiency after M&A

no.	Firm name Acquirer	Acquirer Before M&A		Firm name (target)	Target M&A	Before	Acquirer After M&A	
		DEA before	Rank		DEA before	Rank	DEA (Y)	Rank
8	Arab African International Bank	1	1	Misr America International Bank (financial)	0.6663	3	0.4872	6
21	Sperea Misr Plastics & Chemicals	1	1	Plastichem	0.8233	4	0.8194	5
22	National Navigation	1	1	Egyptian Shipping Transport	1	1	0.623	7

It appears in Table 7 that when efficient acquirer acquired efficient target, the result was inefficient firm.

Table 8. Inefficient acquirer neither increased nor decreased (remained the same) its efficiency after M&A with efficient target

no.	Firm name Acquirer	Acquirer Before M&A		Firm name (target)	Target M&A	Before	Acquirer After M&A	
		DEA before	Rank		DEA before	Rank	DEA (Y)	Rank

2	National Development Bank	0.312	8	National Glass & Crystal Co	1	1	0.1887	7
10	Orascom Telecom Media & Technology Holding	0.4479	5	Beltone Financial Holding (financial)	1	1	0.6998	6
12	Egyptian Company for Tourism & Hotels	0.0163	14	Tourism Urbanization	1	1	0.0734	14

It appears in Table 8 that when inefficient acquirer acquired efficient target, the result was inefficient firm.

Table 9. T-test to compare between pre-post DEA for the acquirer

Paired Samples Test								
Paired Differences						t	df	Sig. (2-tailed)
95% Confidence Interval of the Difference								
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1 DEA_post - DEA_pre	.10039	.29948	.06245	-.02912	.22989	1.608	22	.122

For further investigation the researchers use the T-test to compare between post- DEA and pre-DEA for M&As operation. The results in Table 9 show that post DEA is higher than pre-DEA. Then the first hypothesis is accepted.

H_1: There is a significant positive relationship between M&As and the increase in firms' performance efficiency.

3.4 Tobit Model Implementation

A second-stage regression for measuring post-acquisition M&As efficiency performance is Tobit model and the model was modified and the researchers followed modified Tobit model

by Wu (2008) and Ahmad et al. (2017). The researchers also, use Stata 14.2 (Statistics Data Analysis 2015) to run data and get results for following formula.

$$Y_{i,T} = \beta_0 + \beta_1 \text{ WEIGHT\_EFF} + \beta_2 \text{ DIFF\_EFF} + \beta_3 \text{ROA} + \beta_4 \text{ROE} + \beta_5 \text{ RSIZE}$$

$$+ \beta_6 \text{ PROE} + \beta_7 \text{ CR} + \beta_8 \text{FDR} + \beta_9 \text{AGE} + \beta_{10} \text{OWNER}$$

$$+ \beta_{11} \text{ FREQ} + \beta_{12} \text{ FIN/NON} + e$$

Where,

Yi: DEA post M&As efficiency scores for the sample firms.

Table 10. Description for Tobit model variables and their measurements

Independent variables	Period	Definition	Measurement
Main Variables:			
WEIGHT_EFF	The financial year immediately before M&A for both firms acquiring and target.	Weighted-average of pre-M&A efficiencies of the acquiring firm, using total assets of the two firms in the year preceding the acquisition as the weights.	$\dfrac{\text{Total Assets acquirer + Total Assets target}}{2}$
DIFF_EFF	The financial year immediately before M&A for both firms acquiring and target.	The difference in efficiency between the acquiring firm and the target firm. It is calculated as the arithmetic difference in efficiencies between the two firms.	DEA acquirer − DEA target
ROA	The information in the year before the acquisition for the acquiring firm only.	Rate of Return on Assets for acquirer as indicator for The growth rate of total assets held by a firm.	$\dfrac{\text{Net Income Before Tax(NIBT)}}{\text{Total Assets}}$
ROE	The information in the year before the acquisition for the acquiring firm only.	The rate of return on equity for acquirer firm**.**	$\dfrac{\text{Net Income(NIBT)}}{\text{Equity}}$

Control Variables:

RSIZE	The financial year immediately before M&A for both firms acquiring and target	The relative size measured by the ratio of the target firm's total assets to the acquiring firm's total assets.	$\dfrac{\text{Total Assets (target)}}{\text{Total Assets (acquirer)}}$
PROE	The financial year immediately before M&A for both firms' acquirer and target.	Pre-rate of return of the target firm relative to that of the acquirer firm.	$\dfrac{\text{ROE(target)}}{\text{ROE(acquirer)}}$
CR	Current ratio for acquirer firm for the financial year immediately before M&A.	Current ratio	$CR = \dfrac{\text{Current Assets}}{\text{Current Liabilities}}$
FDR	Financial debt ratio for acquirer firm for the financial year immediately before M&A.	Financial debt ratio	$FDR = \dfrac{\text{Total liabilities}}{\text{Total Assets}}$
AGE	The information in the year of the M&A for the acquirer firm only.	Number of operating years for acquirer firm for date of M&A.	The year of operating –year of M&A.

Explanatory Variables:

Ownership	The information in the years before the M&A for the acquirer firm only.	Related to control and rights over the acquiring firm	A dummy variable if the ownership includes foreigners (=0) and (=1) if its ownership is domestic.
FIN/NON	The information in the year before the M&A for the acquirer	Financial and Non-Financial for acquirer	A dummy variable if the acquirer is Financial Firms

	firm only.		(=1) and for acquirer Non-Financial firms (=0).
FREQ	The information in the 5 years before the M&A for the acquirer firm only.	The frequency of the Acquirer involvement in more than one M&A operation to capture the possible different effect of acquisition between two independent firms from that of acquiring a subsidiary firm.	A dummy variable when acquirer involved in more than one M&A operation within 5 years is 1 and 0 otherwise.

Table 10 summarizes the Tobit model variables and their measurements. These variables are selected according to literature reviewed; they are classified into main variables, control variables and explanatory variables which are expected to have impact on M&As. It is worth mentioning that when using DEA application and Tobit model, the choice of inputs and outputs is critical in which the changes in the data, number, type of input and output factors are very sensitive to efficiency scores.

3.4.1 Data Analysis Using Tobit Model

This part demonstrates the second stage analysis in order to deal with truncated data from DEA result. DEA is used to measure the acquirer and target firm's efficiency while, Tobit –which is a kind of censored regression technique that fits no slack zero from DEA solution –determines the variables variation effect on efficiencies.

Table 11. Descriptive statistics for Tobit model variables

Variable		mean	Standard deviation	Min.	Max.
Y	**DEA Acquirer**	.5734913	.3703663	.0722	1
X1	**weight EFF**	15.15176	20.573	.0031483	65.0921
X2	**Diff Eff**	.0922435	.4445118	-.9837	.8723
X3	**ROA(a)***	.7738534	3.351319	-.082892	16.12797
X4	**ROE(a)***	990.335	4537.477	-1.422977	21785.39

X5	R.size	7.615831	32.99691	.0076814	158.8171
X6	PROE	-22.0116	293.1467	-1209.648	662.0322
X7	CR	1.7446	1.302455	.3499852	5.143012
X8	FDR	17.30435	12.32306	0	41
X9	AGE	558838.2	670768.6	184.9653	2339865
X10	Ownership	.4782609	.5107539	0	1
X11	FREQ(a)*	.6956522	.470472	0	1
X12	fin/non(a)*	.3478261	.4869848	0	1

*where (a) refers to acquirer.

The descriptive statistics for Tobit model variables are shown in Table 11 including mean, standard deviation, minimum and maximum values.

3.4.2 Tobit Results

Table 12. Results from testing Tobit model for all sample companies financial and non-financial sectors

	No.		Independent Variables	Sign from the model	p-value	Estimated coefficient	t test value	Sig.	Pseudo R2	Influential impact
	1		Constant	+ve	0.035*	.2311723		0.035*	0.9781	
Main variable	2	X2	Diff Eff	+ve	0.608	.0856444	0.53	0.608		10
	3	X3	ROA(a)*	+ve	0.011*	4.169676	2.98	0.011*		1
	4	X4	ROE(a)*	-ve	0.021*	-.0021443	-2.65	0.021*		2
Control variabl	5	X5	R.size	-ve	0.169	-.0482316	-1.46	0.169		6
	6	X6	PROE	-ve	0.453	-.0002338	-0.78	0.453		8

e	7	X7	CR	-ve	0.049*	-.1003338	-2.19	0.049*	3
	8	X8	FDR	-ve	0.870	-.0010094	-0.17	0.870	11
	9	X9	AGE	-ve	0.564	-5.42e-08	-0.59	0.564	9
Explanatory variable	10	X10	Ownership	-ve	0.138	-.234301	-1.59	0.138	5
	11	X11	FREQ(a)*	-ve	0.05*	.1266514	-2.13	0.05*	4
	12	X12	fin/non(a)*	+ve	0.423	.1638245	0.83	0.423	7

***Parameter is significant at the (.001) level.

**Parameter is significant at the (.01) level.

*Parameter is significant at the (.05) level.

*where (a) refers to acquirer.

According to Table 12; Tobit model test the influence of the acquirer DEA post the M&As. Pseudo R^2 is considered a measure for a goodness-of-fit, and it illustrates that the more variability between dependent variable and independent variable is indicator for better model. Pseudo R^2 is used in assessing multiple models that predict similar outcome on the same dataset but it cannot be used in interpreting independent Pseudo R^2 or in comparing Pseudo R^2 across datasets. Pseudo R^2 only has a meaning when compared to another pseudo R^2 of the same type, on the same data, predicting the same outcome for which higher Pseudo R^2 indicates which model better predicts the outcome.

As indicated in Table 12 regarding the main variables, weight efficiency and differential efficiency; the model couldn't verify these relationships. The model excludes the weight efficiency from the results. The model finds an insignificant positive relationship between the acquirer DEA post M&As and differential efficiency. The differential efficiency is the least influential variable after FDR variable to have any impact on an acquirer DEA post M&As. The model results could not prove the expected suggestion that when an efficient firm acquires an inefficient firm, they can share expertise with each other that would increase the target efficiency. Then H_2 and H_3 are rejected.

H_2: There is a significant positive relationship between M&As performance efficiency and weight efficiency.

H_3: There is a significant positive relationship between M&As performance efficiency and difference in efficiency.

There are other relationships indicated among the acquirer DEA post M&As, and the main variables; there is a significant positive relationship at the level of five percent between the acquirer DEA post M&As and ROA, then the most influential variable on acquirer DEA post

M&As is the return on assets of the acquirer a year pre M&As. This indicates that the more net income the firm has a year pre M&As, the more efficiency it will be post the M&As operation.

For a one-unit increase in ROA, there is an expected change of 4.169676 units in the acquirer DEA post M&As "y", holding other variables constant. These results indicate that the higher ROA a year pre M&As operation an acquirer has, the higher DEA this acquirer will have a year post the M&As operation. Then H_4 is accepted.

H_4: There is a significant positive relationship between M&As performance efficiency and rerun on assets.

The second most influential variable on acquirer DEA post M&As is the return on equity of the acquirer; there is a significant negative relationship at the level of five percent between the acquirer DEA post M&As and ROE. For a one-unit increase in ROE, there is an expected decrease of 0.021443 units in the acquirer DEA post M&As "y", holding other variables constant. This indicates that the more equity and fewer liabilities the firm depends on financing its assets a year pre M&As, the more efficiency it will be post the M&As operation. Then H_5 is accepted.

H_5: There is a significant negative relationship between M&As performance efficiency and return on equity.

As indicated in Table 12 regarding the control variables, the model finds a significant negative relationship between acquirer DEA post M&As and Current Ratio (CR) at the level of five percent indicating that the more liquid is the acquiring firm the more post-DEA performance it should have. CR comes in the third place for the most influential variables post the ROA and ROE.

The model indicates an insignificant negative relationship between acquirer DEA post M&As, and RSIZE, AGE, and Financial Debt Ratio (FDR) indicating the larger, FDR comes in the first place for the least influential variables, while AGE comes in the third place for the least influential variables. Although the relationship between acquirer DEA post M&As, and FDR is insignificant negative relation, but it indicates that the more Equity and fewer liabilities the firm depends on financing its assets a year pre M&As, the more efficiency it will be post M&As operation. These results go with the significant negative relationship between ROE and acquirer DEA post M&As.

The model indicates an insignificant negative relationship as well between acquirer DEA post M&As, and Pre-Rate of Return (PROE) indicating that the more profitable the target relative to the acquiring firm, the lower post-DEA performance the acquirer has. PROE comes in the fourth place for the least influential variables.

In the other hand, regarding the explanatory variables, the model finds a significant negative relationship between acquirer DEA post M&As and Frequency (FREQ) at the level of five percent. The model proves the high acquisitive acquirer is found to perform less efficient than other low acquisitive acquirer, indicating that acquirer with multiple M&As could not improve their post-M&As efficiencies. FREQ comes in the fourth place for the most

influential variables after the ROA, ROE, and CR.

The model does not verify the relationship among the acquirer DEA post M&As and both explanatory dummy variables; ownership, and Fin/Non as it indicates an insignificant positive relationship between acquirer DEA post M&As and Financial and Non-Financial (Fin/Non) and insignificant negative relationship between acquirer DEA post M&As and ownership.

4. Summary and Conclusion

The main objective of this research is to measure and explain success and failure factors for the M&As impact on firm's performance efficiency in the whole Egyptian market. The researchers use two-stage analysis; non-parametric technique in the form of (DEA) in the first step to evaluate the efficiency and censored regression technique (Tobit model) in the second step to evaluate success and failure factors.

The researchers use 21 firms listed in EGX including 2 financial firms, 6 banks, and 13 non-financial firms for 23 operations within the period from 2003 to 2015. The final sample for the target firms is 23 listed firms in the EGX including 2 financial firms, 3 banks, and 18 non-financial firms.

According to the research analysis for non-financial sector using DEA; Orascom Construction Industries DEA score remained =1pre and post the M&As. While Sperea Misr Plastics & Chemicals, and National Navigation DEA score decreased from 1 to 0.8194 and 0.623 respectively. In the other hand, Olympic Group Financial Investments, Suez Cement, and Oriental Weavers increased their DEA post M&As score from 0.1693, 0.3761, and 0.5977 respectively to DEA score =1 and they jumped from 8th, 6th, and 4th ranks to the first.

The results from Tobit model show that; ROA variable have significant positive relationship with DEA post M&As, while ROE variable have significant negative relationship with DEA post M&As. Differential efficiency variable has insignificant positive relationship between the DEA post M&As while there is significant negative relationship between FREQ and DEA post M&As.

In conclusion, regarding pre- M&A action; acquirer should develop a plan for M&A strategy, while in post- M&A; acquirer should evaluate performance and progress. The most common reasons for M&A success are to improve market strategy, operating efficiencies and enhancing growth of resources, technological expertise and firms' value. Studying the whole Egyptian economy efficiency before and after M&A opened the door for more analytical investigations for the impact of other different events and to deeply investigate the role of each variable on those events.

The generalization of this research's results is limited to the financial and non-financial firms that are listed on the EGX and follow EAS 29 of business combinations. The researchers exclude cross border M&As transactions and focus on one year pre and post the M&As.

5. Recommendations That Enhance Future Research

The findings of the research suggest that other methods like parametric method (confidence interval) could be used. A comparative study can be done to investigate the impact of M&As between domestic and cross border firms in the Egyptian market or between Egyptian firms and firms in other countries.

The results of the research also indicate that more studies could be done to measure performance efficiency for unlisted and listed firms that do not follow EAS (29).

Another useful outcome from the results recommends that more variables can be added to Tobit regression model, such as environmental variables.

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