ACCEPTED VERSION

Kai Du, Nicholas Sim

Mergers, acquisitions, and bank efficiency: cross-country evidence from emerging markets

Final publication at http://dx.doi.org/10.1016/j.ribaf.2015.10.005

http://hdl.handle.net/2440/96237

Accepted Manuscript

Title: Mergers, Acquisitions, and Bank Efficiency:
Cross-Country Evidence from Emerging Markets

Author: Kai Du Nicholas Sim

Mergers & Acquisitions in the Banking Industry

Does M&A generate efficiency gains for acquiring banks, target banks, or both?

1)

Kai Du

School of Economics and Entrepreneurship, Commercialisation and Innovation Centre

University of Adelaide

Adelaide, SA 5005

Australia

Tel: +61 8 8313 7422

Fax: +61 8 8223 1460

Email: kai.du@adelaide.edu.au

(2) (corresponding author)

Nicholas Sim

School of Economics

University of Adelaide

Adelaide, SA 5005

Australia

Tel: +61 8 8313 4927

Fax: +61 8 8223 1460

Email: nicholas.sim@adelaide.edu.au

Mergers, Acquisitions, and Bank Efficiency: Cross-Country Evidence from Emerging Markets

Abstract

In emerging countries, bank mergers and acquisitions (M&A) are frequently motivated by the objective of promoting stability in the banking industry. However, the evidence that M&A can lead to better performing banks is tenuous at best. In this article, we investigate if this tenuous relationship could be due to the treatment of target and acquiring banks as the same type in empirical analysis, which overlooks the possibility that M&A may affect these banks differently. Using panel data on six emerging countries, our results confirm that the effect of M&A is generally weak except when our regressions are implemented separately for target and acquiring banks. For the latter, we find that target banks tend to be more efficient after an M&A but no efficiency improvements are found for acquiring banks. These results suggest that in emerging countries, bank M&A can lead to efficiency improvements for the combined entity, although target banks are mainly the ones to benefit from it. They also highlight the importance of distinguishing between target and acquiring banks so as to obtain sharper estimates of how M&A might affect bank performance.

Key Words: Emerging Countries, Mergers and Acquisitions, Bank Efficiency

JEL Codes: G1, G2

Running Title: M&A and Bank Efficiency in Emerging Countries

1

1 Introduction

The perception that the mergers and acquisitions (M&A) of banks can lead to better bank performance has strong intuitive appeal but lacks empirical support. In principle, firms may benefit from M&A through the transfer of new management technologies and best practice during consolidation, and from having a larger market share, greater market power, and economies of scale post-M&A.[1] Given the potential benefits that M&A may bring, it is perhaps not surprising that M&A activities have in recent years proliferated in the global banking industry, especially in emerging economies. However, the evidence that M&A can actually improve bank performance and efficiency remains somewhat limited in academic research. This apparent paradox is best summed up by Pilo and Santomero (1998), who note that empirically, there is "*no statistically significant gain in value or performance from merger activity... Yet, mergers continue.*"

One possible hypothesis for the tenuous empirical relationship between bank M&A and bank performance is that acquiring and target banks are different, and therefore, react differently following an M&A. For example, there is evidence that acquiring firms (i.e. firms that acquire) tend to underperform after an M&A, either in the form of generating negative abnormal returns for stockholders (Andrade *et al.* 2001)[2] or a decline in efficiency levels (Avkiran 1999).[3] On the other hand, as target firms are usually less efficient than acquiring firms before the merger,[4] there is room for them to capitalize on the traditional advantages of M&A. Consequently, if it is mainly the target banks that benefit from M&A, an empirical analysis that does not differentiate between acquiring and target banks could create an impression that the link between M&A and bank efficiency is weak, even if M&A were indeed beneficial for target banks.

In this paper, we examine some cross-country evidence on whether the effect of M&A on bank efficiency differs for target versus acquiring banks. For this study, we obtain data on six emerging countries – China, India, Indonesia, Malaysia, Russia and Thailand – and assemble a panel dataset

---

[1]Much has been written about the advantages and disadvantages of M&A in both academic and popular press. See, for example, http://www.moneymatters360.com/index.php/how-mergers-and-acquisitions-impact-businesses-17067/.

[2]See Bruner (2002) for a survey.

[3]There is little consensus on why acquiring firms may underperform after an acquisition. The main reasons given are related to non-value maximizing motives of executives in acquiring firms. For example, the managerial discretion hypothesis put forward by Jensen (1986) and Morck *et al.* (1990) postulates that M&A may be driven by managerial efforts to pursue personal gains at the expense of shareholders' interest. The hubris hypothesis of Roll (1986) suggests that managers of acquiring firm may be overconfident in his or her ability to manage the acquired assets, and this could lead to them having inflated perspectives about the value of the target firm.

[4]See, for example, Rhoades (1998).

2

on individual banks from 2002 to 2009. To estimate efficiency, we employ the data envelopment analysis (DEA) approach to construct an efficiency index, known as the DEA score, for each bank.[5] Using the DEA score as a measure of bank efficiency has the following advantages. First, the DEA approach estimates bank efficiency based on a production function with an unknown form. This nonparametric approach is sensible for our study as the alternative of specifying the production process for banks can be challenging,[6] given that the manner in which banks in different countries operate is not easy to capture parametrically. Second, the DEA score is a broader and more adequate measure of bank efficiency than measures such as financial ratios, which has been considered by the literature as well.[7]

Our focus on cross-country analysis facilitates the use of panel regression with interactive country-year fixed effects. By employing interactive country-year fixed effects, we can purge all country-specific factors that may affect the link between M&A and bank performance, regardless of whether they are time-varying or time-invariant, observed or unobserved.[8] These factors may be related to market structure, institutions, government regulations and policies, and macroeconomic covariates, which cannot be eliminated by descriptive analyses (e.g. Rhoades 1998), event studies (e.g. Cummins and Rubio-Misas 2006, Cummins and Xie 2008), and pooled regression analyses (e.g. Buch and DeLong 2004, Delis *et al.* 2011) that have been considered before in the literature.

In our empirical analysis, we have found it important to separate target from acquiring banks. In particular, we find that the effect of M&A on bank efficiency is statistically insignificant when both targets and acquirers are regarded as the same. However, when a distinction is made between them, we find that the targets – not the acquirers – are more efficient on average after a merger. This conclusion is not sensitive to sampling (such as omitting Russia and China, or the years coinciding with the global financial crisis "GFC"), alternative regression approaches (truncated versus OLS

---

[5]The ranges from one to infinity, where a score of one is assigned to the most efficient banks. See the Appendix for further discussion.

[6]For example, the Stochastic Frontier Analysis (SFA) is a parametric approach.

[7]Rhoades (1998) employs 16 financial ratios to examine the impact of M&As on banks' profitability and balance sheet structure in the US banking industry, e.g. the ratio of various expenses to assets or operating revenue; the ratio of net income after taxes to average assets; the ratio of off-balance sheet items to total assets; and the net income-to-equity ratio. However, Halkos and Salamouris (2004) argue that the comparative advantage of frontier models in estimating efficiency, over simple ratio analyses, is that the frontier approach forms a comprehensive measure of bank efficiency that combines information on various financial ratios simultaneously. In fact, financial ratios may not capture efficiency adequately. For example, Avkiran (2011) finds that the correlation between financial ratios and efficiency scores is weak.

[8]For example, Beccali and Frantz (2013) find that the likelihood of M&A activities are associated with institutional determinants such as economic freedom, regulatory quality and industry size.

3

regressions), or even in the absence of country-year fixed effects and bank level controls.

To be clear, there are existing studies on how the effect of M&A on firm performance might differ for targets and acquirers – ours is not the first in this broader literature.[9] However, research on this question in the context of banks is somewhat limited. Among the papers that have done so, Goddard *et al.* (2012) look at how bank M&A in Asian and Latin American emerging countries may influence bank performance. However, unlike our paper, they focus on the effect of M&A on abnormal returns to the bank but not on bank efficiency, which is perhaps a broader indicator of bank performance. Using pairwise comparisons and cross-sectional regressions, Beccalli and Frantz (2009) examine the effect of bank performance in M&A between EU acquirers and worldwide targets. Shaffer (1993) and Focarelli and Panetta (2003) consider, among other issues, the implication of M&A in the US banking industry for target and acquiring banks. However, Beccalli and Frantz (2009), Shaffer (1993) and Focarelli and Panetta (2003) employ various measures of bank performance but not the DEA score, which has the advantage of being based on a flexible, nonparametric approach (i.e. the DEA approach). In fact, few have looked at the relationship between M&A and DEA-based bank efficiency compared with a larger, more general literature on M&A and bank performance.[10]

To our best knowledge, our paper is the first to utilize panel structures, particularly interactive country-year fixed effects, to deal with unobserved confounding factors when estimating the relationship between bank M&A and bank efficiency. Our paper is also one of the few to study this relationship in the context of emerging countries. This is relevant as policy makers of these countries may view bank consolidation as a means of strengthening the banking industry and promoting financial stability.[11] Moreover, in emerging markets, banks are especially relied upon as the primary source of external finance for business activities. For these countries, a strong banking system is important for coordinating and fostering economic development, as alternative market-based systems of finance could be trapped in an "underdevelopment equilibrium" (Da Rin and Hellman 2002). Finally, the existing literature on M&A and bank performance looks mainly at industrialized countries.[12] Consequently, what we know about bank M&A for industrialized countries may not

---

[9]See, for example, Andrade *et al.* (2001) and Bruner (2002).

[10]The broader literature on M&A and bank performance includes Drake (2001), Cuesta and Orea (2002), and Behr and Heid (2011).

[11]The website http://www.pwc.com/id/en/financial-services/mergers-acquisitions-indonesian-banking.html offers a case study on Indonesia. See, also, Hawkins and Mihaljek (2001) for an overview of bank M&A in emerging economies.

[12]The existing research on bank performance and M&A is mainly related to Europe, North America and Japan.

4

carry forward to emerging countries, which are likely to have weaker institutional environments, different regulatory burdens, and relatively underdeveloped financial systems.

The rest of the paper is organized as follows. Section 2 discusses the data sources and presents some summary statistics. Section 3 discusses the methodology of this paper. The baseline results and robustness checks are presented in Section 4. Section 5 concludes.

2 Data

We compile our dataset from the following sources: (a) the Bankscope database, which provides annual bank-level data on banks' finances and (b) the Zephyr database, which provides data on banks' restructuring activities such as mergers and acquisitions. Following the literature (see, *inter alia*, Buch and DeLong 2004, Behr and Heid 2011, Harjoto *et al.* 2012, Ayadi *et al.* 2013), we regard mergers and acquisitions as M&A activities in general.[13] We do not consider the implications of forced mergers, hostile takeovers, or distressed acquisitions, which, although beyond the scope of the paper, are important issues as well. In addition, we consider only completed M&As and not pre-merger activities such as M&A announcements, or transactions that have been withdrawn, are pending, or are terminated. Information on the number of acquirers and targets in our sample is provided in Table 1.

Table 1: Number of M&As: 2002–2009

China	India	Indonesia	Malaysia	Russia	Thailand
63	25	43	23	348	89

Our dataset contains 960 observations between 2002 and 2009, from 120 banks distributed across six countries - China, India, Indonesia, Malaysia, Russia, and Thailand. These countries are chosen for two reasons. Compared to countries with similar levels of development, these six countries have more complete bank-level information, which is important as the DEA approach does not handle missing data well, and relatively frequent M&A activities.[14,15] For our study, we focus only

See, for example, DeYoung *et al.* (2009) for a survey.

[13]One technical detail should be highlighted – in an acquisition, both acquiring and target banks remain as separate entities while ownership of the target is transferred to the acquirer. But in a merger, only a single entity emerges.

[14]For example, although Vietnam is an important emerging economy, we only have one M&A event during the sample period.

[15]For example, the Indonesian government encourages the consolidation of the country's banking industry to ensure

5

on commercial banks whose core business is centered on traditional banking activities. We omit bank holding companies as they may be involved in non-bank businesses such as investment funds, financial leasing, and insurance underwriting offered through their subsidiaries. Given the focus on commercial banks, our data is complied from unconsolidated bank statements from Bankscope, and not consolidated statements, which contain information on both traditional banking activities and non-bank businesses.[16]

We use the DEA approach to estimate the efficiency of banks (see the appendix for a more technical overview). The DEA approach is an attractive methodology for extracting information about the efficiency of banks based on a general production function with multiple inputs and outputs. This production function is nonparametric, which therefore obviates the need to specify functional forms (e.g. Cobb-Douglas) that may be incorrect (Berger and Humphrey 1997). Following the literature (see, inter alia, Berger *et al.* 1999, Focarelli and Panetta 2003, Drake *et al.* 2009), we estimate bank efficiency based on a production process with three input variables (fixed assets, total non-interest operating expense, and interest expense) and two output variables (net interest income and other operating income).[17] Interpretation-wise, bank efficiency is related to the quantity of outputs the bank in question can produce for the same quantity of inputs employed across all banks (see the appendix).

Table 2 offers some summary statistics on the input and output variables. Two main observations can be made about banks in our sample. First, most of the banking cost was related to capital expenditure: the mean interest expense (which is a capital expense) was nearly three times that of expenditure on fixed assets (or sunk cost) and 50 per cent larger than that of the non-interest operating expense. Second, net interest income was by far the most important source of revenue for banks, implying that our sample banks relied mainly on conventional businesses such as loan lending.

that all consolidated and incumbent banks are able to meet the requirements of the Basel III Accord before 2019 (Hadad *et al.* 2013).

[16]Our bank level information is drawn from financial statements that are prepared under international accounting or international financial reporting standards whenever available. If not, we utilize information prepared under local generally accepted accounting principles.

[17]The idea is that fixed assets, non-interest operating expense and interest expense are costs that will be incurred for "producing" the outputs of banks, such as interest and non-interest income.

6

Table 2: Summary Statistics on the Input and Output Variables

Variable type	Variable name	Mean	S.D.	Min.	Max.
	Fixed assets	134.10	365.57	0.10	4,408.04
Input	Non-interest operating expenses	226.12	562.97	0.27	6,765.93
	Interest expenses	361.03	945.50	0.26	12,292.96
Output	Net interest income	329.47	820.46	0.25	9,757.92
	Other operating income	141.90	411.37	0.08	6,479.06

Notes: (1) All variables are expressed in US $million. (2) The sample period is from 2002 to 2009.

3 Empirical Approach

Our estimation approach follows a two-step procedure. In the first step, we estimate the efficiency of banks using the DEA approach. Intuitively, the DEA approach first estimates the most efficient production frontier using all bank-year observations. The efficiency level associated with the most efficient banks (i.e. the efficiency frontier) will then be used as a reference such that the efficiency levels of other banks are calculated relative to it. The relative efficiency of a bank is expressed by the DEA score, which ranges from one to infinity. The frontier banks will have a DEA score of one, while banks that are relatively more inefficient (compared to the frontier banks) will have increasingly larger DEA scores. In the second step, we regress the DEA efficiency scores on the indicators of target and acquiring banks, which are constructed as follows: $Target_{ikt}$ (or $Acquirer_{ikt}$) is equal to one if bank i in country k at time t had been a target (acquiring) bank in a successful M&A at time t or before.[18]

We omit banks that had gone through M&A both as a target and acquirer.[19] This simplifies our analysis because for these banks, it would be difficult to disentangle the effect of M&A as a target from that as an acquirer. In any case, very few banks in our sample were both targets and acquirers,[20] and our results are similar whether or not these banks are included in our analysis.

Our main estimating equation relates the DEA score (DEA_{ikt}) to $Target_{ikt}$ and $Acquirer_{ikt}$

---

[18]For instance, if bank i in country k is acquired at $t-1$, then $Target_{iks} = 1$ for $s \geq t-1$ and $Target_{iks} = 0$ for $s < t-1$.

[19]For example, Bank Danamon in Indonesia was acquired by Deutsche Bank in 2002 and it became an acquirer in turn in 2008.

[20]There were fewer than ten banks, or about 1% of all banks in the sample, that had engaged in an M&A both as a target and acquirer.

7

based on

$$\log(DEA_{ikt}) = \beta_1 \, Target_{ikt} + \beta_2 Acquirer_{ikt} + \gamma' C_{ikt} + \alpha_{ct} + u_{ikt}. \tag{1}$$

where α_{ct} is the interactive country-year fixed effects and C_{ikt} is a vector of control variables. The interactive country-year fixed effects capture time-invariant cross-country heterogeneity as well as country-specific factors such as policies, or macroeconomic (global) shocks that may affect countries differently. For instance, M&A could be spurred by bank deregulation policies, which in fact occurred in China prior to its accession into the World Trade Organization (WTO). M&A can also arise for compliance reasons, which was the case for Indonesia complying with the Basel III Accord. Besides policies, other factors such as market structure, institutions, and culture may play a role in business transactions and affect the ease with which M&A transactions take place (Delis *et al.* 2011). Therefore, the interactive country-year fixed effect is useful as it collectively captures all country-level information, which eliminates the need for country-level controls.

Eq. (1) does not contain bank fixed effects as there is too little "within" variation in $Target_{ikt}$ and $Acquirer_{ikt}$. To see why, consider a bank that was not involved in an M&A – its $Target_{ikt}$ and $Acquirer_{ikt}$ variable would be zero and have no "within" variation. For a target bank, its $Target_{ikt}$ variable is equal to zero before it was taken over, and equal to one after the merger. Besides this switch from zero to one, there is no other "within" variation in $Target_{ikt}$. The same argument can be made about the $Acquirer_{ikt}$ variable for acquiring banks as well.

To account for bank-specific heterogeneity, we include a vector C_{ikt} that contains the log of total assets and the log of total equity of bank i, expressed in millions of US dollars and deflated by the CPI of each country. We use these variables for two reasons. Firstly, total assets and total equity are the only complete bank level variables that have not been used to compute the DEA scores. The DEA approach, as we recall, uses up five bank level variables (three inputs and two outputs) and this limits the number of bank level variables available as controls. Secondly, total assets and total equity are proxies for bank size, which could be correlated with bank efficiency as well as the likelihood of becoming a target or an acquirer. For example, the size of banks matters as larger banks usually have more "dry powder" with which to make an acquisition. Moreover, bank size and bank performance could be linked, for instance in a positive manner as larger banks are likely to benefit from economies of scale, or in a negative manner from lower productivity growth

8

owing to bureaucratic and organizational burdens (Delis *et al.* 2011).

Concerning the use of the DEA efficiency score (in log) as the dependent variable, we would like to highlight two points. First, recall that the DEA score measures the efficiency of a bank in a certain year relative to the grand efficiency frontier. This frontier, however, is fixed, as it is estimated using all bank-year observations. Consequently, banks located near the frontier (i.e. already very efficient) are unlikely to see much efficiency improvements. For this reason, we focus on banks that are further away from the frontier. To do so, we consider the subsample of banks belonging to the least efficient two-thirds of the efficiency distribution. In other words, banks from the top one-third of the efficiency distribution are omitted. While this rule is ad-hoc, the robustness check reported in Section 4.3 shows that the results are similar regardless of which "efficient banks" (such as the top 25% or top 50% most efficient banks) are excluded from the sample.[21]

Second, the DEA score is "truncated" at the value of one. In their paper, Simar and Wilson (2007) suggest using truncated regression to estimate a model such as Eq. (1).[22] We have done the same as our focus on banks further from the frontier implies that a subset containing the most efficient banks would be "truncated" away from the sample. Moreover, truncated regression would be appropriate here as we have a large enough sample to ensure that it performs reasonably well in terms of getting the inference "right".[23] That being said, unlike Simar and Wilson (2007), who recommend bootstrapping for inference, we use robust standard errors. This is because their work is based on iid data, which is unlikely to hold here. Besides, which bootstrapping scheme is suitable for panel regressions with dependent DEA scores is still an open question.

---

[21] Refer to our forth robustness check in Section 4.3.

[22] Simar and Wilson (2007) discuss the types of data generating process that are coherent with the use of truncated regression in the context of DEA estimation.

[23] In their simulation exercise, Simar and Wilson (2007) show that with a sample size of 400, conventional standard errors perform reasonably well if truncated regression is used for modeling the DEA score (see p. 47). Our work satisfies this criterion as we have roughly 600 observations. Nonetheless, it should be pointed out that one of the objectives of Simar and Wilson (2007) is to show that bootstrapped standard errors can work even better, but their bootstrapping scheme is not feasible for our study as it is not designed for panel data.

9

4 Results

4.1 DEA Scores

The first step is to estimate the DEA score for each bank in each year. Table 3 reports some summary statistics on the DEA scores for each country. The mean DEA score ranges from 1.236 (China) to 1.633 (Indonesia), hence on average, the most efficient banks during 2002 to 2009 were Chinese banks and the least efficient banks were Indonesian banks.

Table 3: Summary Statistics on the DEA Scores

	Overall	China	India	Indonesia	Malaysia	Russia	Thailand
Mean	1.424	1.236	1.595	1.633	1.297	1.418	1.366
Median	1.418	1.177	1.636	1.606	1.294	1.431	1.360
Std. Dev.	0.210	0.227	0.143	0.119	0.051	0.110	0.222

To observe the time series properties of bank efficiency, Figure 1 plots the yearly averaged DEA score for each country. Except for India, bank efficiency generally improved across all countries during the sample period. Among them, the average bank efficiency in Thailand improved the most but the worst performers towards the end of the sample were Indian banks. Interestingly, there were systemic variations in bank performance across countries. For instance, the average efficiency scores of banks were generally low (more efficient) in 2003 and 2004, but high (less efficient) in 2005. The only exception was China, which experienced uninterrupted improvement in average bank efficiency throughout the sample period. This trend could have been policy-driven, as China had implemented a series of bank deregulations during this period as agreed upon for its entry into the WTO.

4.2 Baseline Results

Table 4 reports our baseline results. Column (1) reports the estimates from a pooled regression of the log of DEA score on *Target* and *Acquirer* only. Without including interactive country-year fixed effects and bank-level controls, Column (1) suggests that M&A can lead to efficiency improvements in target banks, which is shown by a negative and statistically significant coefficient on *Target*. (*Note*: Higher efficiency levels are represented by lower DEA scores). However, for

10

Figure 1: Annual Averaged Bank Efficiency
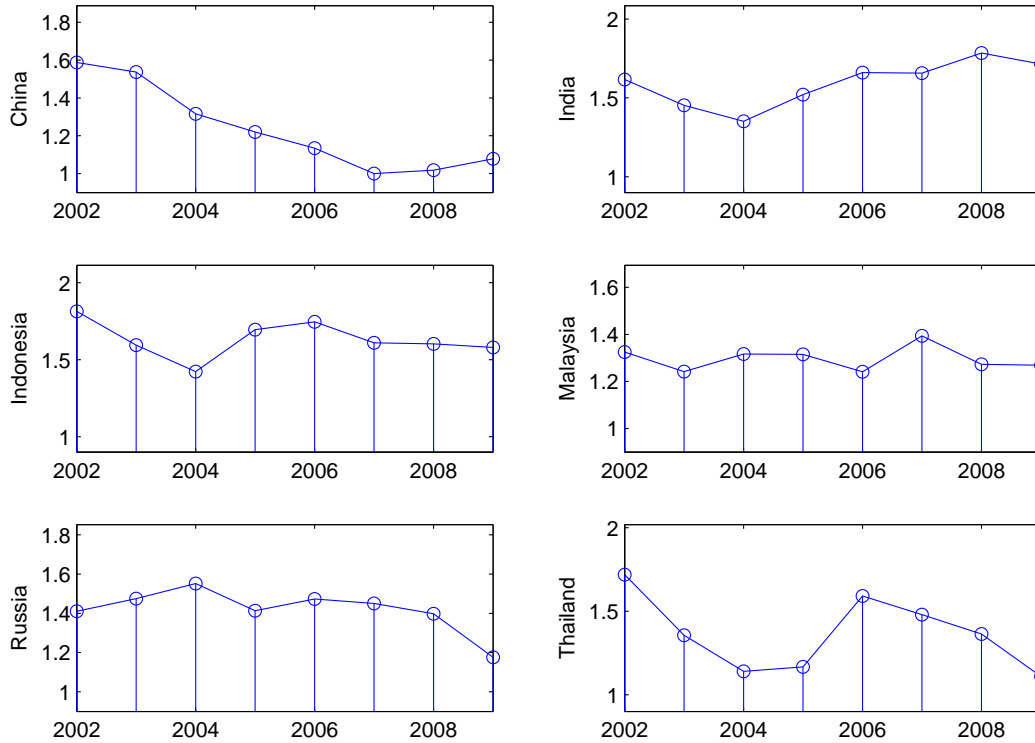
acquiring banks, the effect of M&A is statistically insignificant. This suggests at first pass that the effect of M&A on bank efficiency is asymmetric, benefiting mainly target and not acquiring banks.

The regression in Column (1), while simple, provides a starting point for us to ask: to what extent are the qualitative findings in Column (1) caused by omitted information, such as cross-country heterogeneity that is time-invariant (e.g. institutions, culture) or time-varying (e.g. policies, business cycle shocks), or omitted bank attributes?

As it turns out, the asymmetric nature of how M&A affects bank efficiency is unlikely to be an artifact of omitted information. To see this, Column (2) includes interactive country-year fixed effects to purge all country-level information. Despite doing so, the positive and statistically significant effect of M&A on bank efficiency (i.e. negative coefficient) for target banks remains, but there is still no evidence that acquiring banks can benefit from M&A. This conclusion continues to hold in Column (3), which adds the log of asset and the log of equity of banks to partial out

11

Table 4: Baseline Regressions

Dependent Variable:	(1)	(2)	(3)	(4)
		log(DEA)		
Target	-0.196***	-0.205***	-0.124**	
	(0.076)	(0.063)	(0.049)	
Acquirer	-0.071	-0.011	0.065	
	(0.071)	(0.059)	(0.053)	
Target+Acquirer				-0.0514
				(0.040)
log($Assets$)			0.160***	0.1642***
			(0.030)	(0.031)
log($Equity$)			-0.208***	-0.2134***
			(0.032)	(0.032)
Country-Year FE	No	Yes	Yes	Yes
Obs.	609	609	609	609

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.10.

idiosyncratic information that could be related to M&A decisions and bank efficiency.[24]

Columns (1)-(3) suggest that on average, M&A can lead to a 0.124 to 0.196 decrease in the DEA score for target banks (compared with non-M&A banks), which translates into a 0.67 to 1.06 standard deviation increase in efficiency.[25] While this benefit of M&A may seem nontrivial, it can be hidden from sight had we combined *Acquirer* and *Target* into a single indicator variable, say *Acquirer + Target*. For example, Column (4) shows that *Acquirer + Target* is statistically insignificant. In other words, had we regarded target and acquiring banks as the same, the link between M&A on bank efficiency (for both targets and acquirers) would appear to be non-existent. This, of course, is questionable as we know that M&A may improve the efficiency of target banks at the very least.

4.3 Robustness Checks

We now investigate if the asymmetric effect that M&A has on bank efficiency, which depends on whether the bank in question is a target or an acquirer, is robust. Our first robustness check,

---

[24]For instance, larger banks usually have access to better credit facilities for acquisitions than smaller banks do (Gorton *et al.* 2005), hence, bank size matters.

[25]For the sample of banks in the baseline regressions, one standard deviation of log(DEA) is 0.185.

12

reported in Table 5, examines whether the estimation results are sensitive to the choice of countries. Column (1) omits Russia from our sample as it is the only non-Asian country in our study. Despite doing so, the coefficient on *Target* is negative as before, while the coefficient on *Acquirer* now becomes positive and statistically significant. This suggests that for the Asian emerging countries under consideration, acquirers may become more inefficient after the takeover.

Next, Column (2) omits China from our sample. Unlike other countries, China had aggressively deregulated its banking industry to comply with certain requirements for WTO entry. Column (3) then omits both Russia and China, as these are the largest countries in our sample. The results show that despite omitting Russia, or China, or both, we still find that the benefit of M&A accrues mainly to target banks. This offers some support that our baseline results are not artificially driven by the choice of countries in our study.

Table 5: Robustness Check 1: Omitting China and/or Russia

Dependent Variable:	(1)	(2) log(*DEA*)	(3)
Target	-0.111*	-0.121**	-0.105*
	(0.057)	(0.048)	(0.055)
Acquirer	0.138***	0.065	0.139***
	(0.053)	(0.053)	(0.052)
log(*Assets*)	0.173***	0.179***	0.198***
	(0.033)	(0.032)	(0.036)
log(*Equity*)	-0.225***	-0.226***	-0.249***
	(0.036)	(0.034)	(0.038)
Country-Year FE	Yes	Yes	Yes
Russia Excluded?	Yes		Yes
China Excluded?		Yes	Yes
Obs.	514	564	469

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.10.

Our second robustness check, reported in Table 6, looks at how important the choice of sample period is for our results. This is motivated by two observations. First, our sample runs from 2002 to 2009, which contains the GFC that might affect both bank efficiency and M&A activities. Instead of using the full sample, Column (1) employs a subsample that excludes the GFC years of 2008 and 2009. Second, Column (2) omits the observations from 2005 and 2006 as banks were generally

13

less efficient in these years. We find that the coefficient on *Target* is negative and statistically significant (see Column (1)), but the coefficient on *Acquirer* is positive and statistically significant (see Column (2)). These observations are consistent with the idea that if M&A does improve bank efficiency on average, this improvement would come mainly from the target banks.

Table 6: Robustness Check 2: Omitting GFC years or 2005-6

Dependent Variable:	(1)	(2)
	log(DEA)	
Target	-0.189***	-0.067
	(0.063)	(0.052)
Acquirer	0.039	0.104**
	(0.071)	(0.051)
log($Assets$)	0.176***	0.131***
	(0.033)	(0.034)
log($Equity$)	-0.219***	-0.178***
	(0.035)	(0.036)
Country-Year FE	Yes	Yes
08/09	No	
05/06		No
Obs.	467	452

Note: Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Our third robustness check constructs a different "indicator" of M&A to capture the average yearly effect of M&A over time. We construct an integered variable for each target and acquiring bank, represented as $\widetilde{Target}$ and $\widetilde{Acquirer}$ respectively. These are defined as follows: $\widetilde{Target} = 1$ (correspondingly, $\widetilde{Acquirer} = 1$) for the first year after an M&A event, $\widetilde{Target} = 2$ ($\widetilde{Acquirer} = 2$) for the second year, up to $\widetilde{Target} = 7$ ($\widetilde{Acquirer} = 7$) that corresponds to the seventh year after the merger (the sample period is eight years). Unlike the coefficients on *Target* and *Acquirer*, which capture the total cumulative effect of M&A on efficiency, the coefficients on $\widetilde{Target}$ and $\widetilde{Acquirer}$ reflect the average yearly change in bank efficiency after the M&A. To see if the effect of M&A on bank efficiency diminishes further into the future, we include the quadratic terms of $\widetilde{Target}$ and $\widetilde{Acquirer}$ in separate regressions as well.

14

Table 7: Robustness Check 3: Alternative Indicators of Target and Acquiring Banks

Dependent Variable:	(1)	(2)
	$\log(DEA)$	
$\widetilde{Target}$	-0.029**	-0.079**
	(0.013)	(0.040)
$\widetilde{Acquirer}$	0.017	0.054
	(0.011)	(0.036)
$\widetilde{Target}^2$		0.010
		(0.007)
$\widetilde{Acquirer}^2$		-0.006
		(0.005)
$\log(Assets)$	0.162***	0.159***
	(0.030)	(0.030)
$\log(Equity)$	-0.210***	-0.208***
	(0.032)	(0.032)
Country-Year FE	Yes	Yes
$Obs.$	609	609

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.10.

Using the new indicators, Table 7 shows that the coefficient on $\widetilde{Target}$ is negative and statistically significant, but the coefficient on $\widetilde{Acquirer}$ is statistically insignificant. Once more, this implies that only target banks had become more efficient on average after an M&A. To be specific, Columns (1)-(2) show that the DEA scores of target banks underwent an average yearly decrease by 0.029 to 0.079 points, while the quadratic terms of $\widetilde{Target}$ and $\widetilde{Acquirer}$ are statistically insignificant (see Column (2)). These results suggest that on average, the efficiency of target banks had increased steadily during the sample period of our study.[26]

When using the DEA score as a regressand, one issue to bear in mind is that the efficiency frontier is fixed across banks and years. This means that banks that were already near the frontier would not see much efficiency gains. For this reason, we initially left out the top one-third of banks nearest to the frontier, instead of using the entire sample of banks.

Given that this is ad-hoc rule, our fourth robustness check, reported in Table 8, re-estimates

---

[26]The statistical insignificance of the quadratic term could be due to the short sample period we have. In the longer run, we might pick up a slowdown in the average yearly efficiency gains enjoyed by target banks after an M&A.

15

Eq. (1) using three different subsamples. In Column (1), we omit only the 5% of banks nearest to the efficiency frontier. This sample now contains "near frontier" banks that were previously omitted from the baseline sample.[27] Given that these banks were already close to the efficiency frontier, including them into our regression would diminish the positive effect that M&A might have on efficiency, if such a relationship is present. Indeed, unlike our baseline results, Column (1) of Table 8 shows that M&A does not have a statistically significant effect on target bank efficiency. However, this statistical insignificance is reversed once the "near frontier" banks are removed from our sample. This can be seen in Column (2), which omits the nearest 25% of banks from the frontier.

Our next experiment involves removing the nearest 50% of banks. Intuitively, banks should have greater potential to improve the further away they were from the frontier. Hence, after extracting the 50% of banks nearest to the frontier, the remaining target and acquiring banks should both have a fair shot in becoming more efficient after an M&A. However, Column (3) shows that this is not the case. Although M&A tends to produce more efficient target banks as before, acquiring banks could become less efficient. Therefore, while all banks in Column (3) are far from the efficiency frontier, and thus, should have similar potential for efficiency gains, we again have evidence that the benefit of M&A accrues mainly to target banks.

Our fifth robustness check looks again at the results of Table 8 by using OLS regression (instead of truncated regression). Because the OLS estimates could be attenuated towards zero when the dependent variable is truncated, using OLS regression would make it harder for the null hypothesis (of a zero slope parameter) to be rejected and a statistically significant relationship between M&A and bank efficiency to be found. Table 9 confirms our intuition that the slope estimates of OLS regressions are attenuated towards zero. Despite this, M&A is found to have a statistically significant effect of improving the efficiency of target banks, but not of acquiring banks.

---

[27]Recall that the baseline sample omits the nearest 33% of banks to the frontier. Therefore, the top 6% to 32% of banks nearest to the frontier are included in Column (1) of Table 8, but were previously omitted from the baseline regressions.

16

Table 8: Robustness Check 4: Excluding Banks Near the Frontier

Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
			log(*DEA*)			
Target	-0.034	-0.004	-0.159***	-0.095**	-0.196***	-0.122**
	(0.035)	(0.032)	(0.048)	(0.041)	(0.073)	(0.056)
Acquirer	-0.011	0.032	-0.056	0.019	0.049	0.133**
	(0.028)	(0.029)	(0.048)	(0.045)	(0.059)	(0.053)
log(*Assets*)		0.191***		0.161***		0.114***
		(0.019)		(0.024)		(0.0030)
log(*Equity*)		-0.226***		-0.210***		-0.169***
		(0.021)		(0.026)		(0.032)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Top *k*% most efficient banks excluded	5%	5%	25%	25%	50%	50%
Obs.	908	908	717	717	478	478

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.10.

17

Table 9: Robustness Check 5: OLS Regressions

Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
			log(*DEA*)			
Target	-0.031	-0.005	-0.110***	-0.069**	-0.093***	-0.062**
	(0.035)	(0.032)	(0.033)	(0.030)	(0.0030)	(0.026)
Acquirer	-0.010	0.032	-0.037	0.022	0.027	0.086**
	(0.027)	(0.029)	(0.030)	(0.031)	(0.037)	(0.037)
log(*Assets*)		0.177***		0.117***		0.068***
		(0.018)		(0.017)		(0.018)
log(*Equity*)		-0.212***		-0.156***		-0.103***
		(0.020)		(0.018)		(0.018)
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Top *k*% most efficient banks excluded	5%	5%	25%	25%	50%	50%
Obs.	908	908	717	717	478	478

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.10.

18

5 Concluding Remarks

The proliferation of bank M&A has been a global phenomenon.[28] In many emerging countries, bank M&A has often been driven by policies for restructuring the banking industry in the hope of improving stability in the financial system (Hawkins and Mihaljek 2001). This is despite the limited evidence that M&A can lead to better performing banks.

In this paper, we have gathered some cross-country evidence on the relationship between M&A and bank efficiency that is based on a sample of emerging countries. The objective of our paper is to investigate if M&A could affect target and acquiring banks differently, and therefore, a failure to distinguish between target and acquiring banks could result in empirical analyses showing that the link between M&A and bank efficiency is weak. Our regressions offer some support for this claim as the effect of M&A on bank efficiency turns out to be statistically insignificant if target and acquiring banks are treated symmetrically. However, when they are not, we find that M&A can lead to improved efficiency for target banks but not for acquiring banks.

Our results suggest that M&A can improve the efficiency for the combined entity - it is just that much of this improvement comes from the targets. This result could be useful for policymakers when thinking about promoting M&A as a way to improve the banking system. For example, one related issue to our paper is cross-border M&A. If foreign acquiring banks can help domestic target banks in emerging countries become more efficient, then countries wishing to develop a better financial system might find it sensible to encourage such cross-border mergers. Another interesting direction is to look more deeply into why target banks are mainly the ones to benefit from M&A. This exercise of "inspecting the mechanism" would be a useful complement to our cross-country analysis, which focuses on offering broad evidence on the relationship between M&A and bank efficiency.[29]

---

[28]Before the global financial crisis which brought it to a standstill, the total value of global M&A transactions surpassed the Gross Domestic Product of Japan and nearly was comparable with that of the US. See http://www.bain.com/Images/BAIN_BRIEF_The_renaissance_in_mergers_and_acquisitions.pdf.

[29]The closest paper on this issue is Correa (2009), who focuses on measures such as return on assets and equity as indicators of performance, but not bank efficiency.

19

References

Andrade, G, Mitchell, M, Stafford, E (2001) New evidence and perspectives on mergers. Journal of Economic Perspectives 15(2): 103–120

Avkiran, NK (1999) The evidence on efficiency gains: The role of mergers and the benefits to the public. Journal of Banking & Finance 23(7): 991–1013

Avkiran, NK (2011) Association of DEA super-efficiency estimates with financial ratios: Investigating the case for Chinese banks. Omega 39(3): 323–334

Ayadi, R, Boussemart, J-P, Leleu, H, Saidane, D (2013) Mergers and acquisitions in European banking higher productivity or better synergy among business lines? Journal of Productivity Analysis 39(2): 1–11

Beccali, E, Frantz, P (2012) The determinants of mergers and acquisitions in banking. Journal of Financial Services Research 43(3): 265–291

Behr, A, Heid, F (2011) The success of bank mergers revisited. an assessment based on a matching strategy. Journal of Empirical Finance 18(1): 117–135

Berger, AN, Demsetz, RS, Strahan, PE (1999) The consolidation of the financial services industry: Causes, consequences, and implications for the future. Journal of Banking & Finance 23(2): 135–194

Berger, AN, Humphrey, DB (1997) Efficiency of financial institutions: International survey and directions for future research. European Journal of Operational Research 98(2): 175–212

Bruner, RF (2002) Does M&A pay? A survey of evidence for the decision maker. Journal of Applied Finance 12: 48–68

Buch, C M, DeLong, G (2004) Cross-border bank mergers: What lures the rare animal? Journal of Banking & Finance 28(9): 2077–2102

Charnes, A, Cooper, WW, Rhodes, E (1978) Measuring the efficiency of decision making units. European Journal of Operational Research 2(6): 429–444

Cooper, WW, Seiford, LM, Zhu, J (2011) Handbook on Data Envelopment Analysis. Springer Science: Business Media

Correa, R (2009) Cross-border bank acquisitions: Is there a performance effect? Journal of Financial Services Research 36(2-3): 169–197

Cuesta, R A, Orea, L (2002) Mergers and technical efficiency in Spanish savings banks: A stochastic distance function approach. Journal of Banking & Finance 26(12): 2231–2247

Cummins, JD, Rubio-Misas, M (2006) Deregulation, consolidation, and efficiency: Evidence from the Spanish insurance industry. Journal of Money, Credit & Banking 38(2): 323–355

Cummins, JD, Xie, X (2008) Mergers and acquisitions in the US property-liability insurance industry: Productivity and efficiency effects. Journal of Banking & Finance 32(1): 30–55

Da Rin, M, Hellmann, T (2002) Banks as catalysts for industrialization. Journal of Financial Intermediation 11(4): 366–397

Debreu, G (1951) The coefficient of resource utilization. Econometrica 19(3): 273–292

20

Delis, MD, Molyneux, P, Pasiouras, F (2011) Regulations and productivity growth in banking: Evidence from transition economies. Journal of Money, Credit & Banking 43(4): 735–764

DeYoung, R, Evanoff, DD, Molyneux, P (2009) Mergers and acquisitions of financial institutions: A review of the post-2000 literature. Journal of Financial Services Research 36(2-3): 87–110

Drake, L (2001) Efficiency and productivity change in UK banking. Applied Financial Economics 11(5): 557–571

Drake, L, Hall, MJ, Simper, R (2009) Bank modelling methodologies: A comparative non-parametric analysis of efficiency in the Japanese banking sector. Journal of International Financial Markets, Institutions & Money 19(1): 1–15

Färe, R, Grosskopf, S, Logan, J, Lovell, CK (1985) Measuring efficiency in production: with an application to electric utilities. In: Managerial Issues in Productivity Analysis. Springer: pp. 185–214

Farrell, MJ (1957) The measurement of productive efficiency. Journal of the Royal Statistical Society. Series A 120(3): 253–290

Focarelli, D, Panetta, F (2003) Are mergers beneficial to consumers? Evidence from the market for bank deposits. American Economic Review 93(4): 1152–1172

Goddard, J, Molyneux, P, Zhou, T (2012) Bank mergers and acquisitions in emerging markets: Evidence from Asia and Latin America. The European Journal of Finance 18(5): 419–438

Gorton, G, Kahl, M, Rosen, R, May (2005) Eat or be eaten: A theory of mergers and merger waves. Working Paper 11364, National Bureau of Economic Research

Hadad, M D, Hall, M J, Santoso, W, Simper, R (2013) Economies of scale and a process for identifying hypothetical merger potential in Indonesian commercial banks. Journal of Asian Economics 26: 42–51

Halkos, G Salamouris, D, (2004) Efficiency measurement of the Greek commercial banks with the use of financial ratios: A Data Envelopment Analysis approach. Management Accounting Research 15(2): 201–224

Harjoto, MA, Yi, H, Chotigeat, T (2012) Why do banks acquire non-banks? Journal of Economics & Finance 36(3): 587–612

Hawkins, J, Mihaljek, D (2001) The banking industry in emerging market economics: Competitions, consolidation and systemic stability – an overview. Monetary and Economic Department, Bank for International Settlements Paper No. 4

Jensen, M (1986) Agency costs of free cash flow, corporate finance, and takeovers. American Economic Review 76(2): 323–329

Morck, R, Shleifer, A, Vishny, R (1990) Do managerial objectives drive bad acquisitions? Journal of Finance 45(1): 31–48

Rhoades, S A (1998) The efficiency effects of bank mergers: An overview of case studies of nine mergers. Journal of Banking & Finance 22(3): 273–291

Roll, R (1986) The hubris hypothesis of corporate takeovers. Journal of Business 59(2): 197–216

Santomero, A (1999) Bank mergers: What's a policymaker to do? Journal of Banking & Finance 23(2-4): 637–643

21

Shaffer, S (1993) Can megamergers improve bank efficiency? Journal of Banking & Finance 17(2): 423–346

Simar, L, Wilson, P W (2007) Estimation and inference in two-stage, semi-parametric models of production processes. Journal of Econometrics 136(1): 31–64

22

Appendix: An Outline of the DEA approach

In this appendix, we offer a sketch of the data envelopment analysis (DEA) approach. For a more in-depth discussion, the reader is referred to Cooper *et al.* 2011.

The DEA approach is a "data-oriented" approach for evaluating the performance of a set of entities called decision-making units (DMUs) which covert multiple inputs into multiple outputs. In this approach, technical efficiency is defined as "one minus the maximum equi-proportionate reduction in all inputs that still allows continued production of given outputs" (see Debreu 1951 and Farrell 1957). Based on this concept of efficiency, Charnes *et al.* (1978) and Färe (1985) developed the DEA approach to measure efficiency relative to a non-parametric, maximum likelihood estimate of an unobserved but true frontier.

The DEA efficiency score can be estimated in two directions, namely the input or output direction. The input direction measures the proportional reduction in input quantities possible while holding the output quantities fixed. The output direction measures the possible proportional increase in the output quantities produced without altering the input quantities employed. Given this duality, we adopt the output approach to estimate bank efficiency.[30] Based on this approach, the fundamental assumption is that all banks have access to the same production set, denoted as Ψ. Given input x, the production set is described by

$$\Psi = \{(x,\, y) \in R_+^{p+q} - x \text{ can produce } y \} \tag{2}$$

where any possible input and output combination is contained in this set. Based on the production set, we may define the output set, which is represented by

$$Y(x) = \{y \in R_+^q \,|\, (x,\, y) \in \Psi\} \text{ defined } \forall x \in \Psi. \tag{3}$$

The output set contains all possible output y that is feasible, given $x \in \Psi$. The best practice participants in the dataset are those on the boundary of this set.

The boundary enveloping all observations is called the Farrell efficiency boundary, $\partial Y(x)$, defined as

$$\partial Y(x) = \{y \,|\, y \in Y(x),\, \beta y \notin Y(x)\, \forall \beta > 1\}. \tag{4}$$

A feasible y, such that its product with the parameter $\beta > 1$ yields a value outside of the attainable set (i.e. $\beta y \notin Y(x)$), is the maximum output attainable for a given vector of inputs. The Farrell efficiency boundary is a collection of all such feasible values of y. By contrast, another feasible $\tilde{y}$, such that its product with $\beta > 1$ is within the attainable set (i.e. $\beta \tilde{y} \in Y(x)$), cannot represent the maximum output attainable. Therefore, $\tilde{y}$ is an inefficient level of output relative to the Farrell efficiency boundary, hence, is not contained in $\partial Y(x)$.

---

[30]One reason for choosing the output approach is that the inputs of banks are usually fixed in the real world. For example, there are regulations in each country for the minimum number of staff (such as four people at least) in each branch in order to avoid the moral hazards. Because the bank may not be able to minimize inputs such as manpower, it has to seek to maximize output.

23

The notion of inefficiency in the context of the DEA approach is expressed by the Farrell technical inefficiency distance, $\beta(x, y)$,

$$\beta(x,y) = \sup\{\beta > 0 \,|\, \beta y \in Y(x)\}. \tag{5}$$

In other words, given the maximum output, all other observations (e.g. on each bank and year) will be marked by β from the boundary $\partial Y(x)$. The Farrell technical inefficiency distance may be transformed into the Shephard (1970) output distance function defined as

$$\delta_{Output}(x,y) = (\beta(x,y))^{-1} = \inf\{\delta > 0 \,|\, \frac{y}{\delta} \in Y(x)\}. \tag{6}$$

The Shephard output distance function provides a normalized measure of Euclidean distance from a point $(x, y) \in \Psi$ to the frontier in a direction orthogonal to x (i.e. shortest distance). In particular, $\delta_{Output}(x,y) = 1$ implies that (x,y) are on the frontier, i.e. $y \in \partial Y(x)$ for a given x, while $\delta_{Output}(x,y) > 1$ implies that (x,y) are inside the frontier. In order to calculate $\delta_{Output}(x,y)$, we estimate what is called the "requirement set". This is a subset $\hat{\Psi}$ within the attainable set Ψ that envelops all observations, i.e. the set of maximum y for given levels of x. The "requirement set", which is found by linear programming, is described by[31]

$$\hat{\Psi} = \{(x,y) \in R^{p+q} \,|\, y \leq \sum_{i=1}^{n} \gamma_i y_i, \ x \geq \sum_{i=1}^{n} \gamma_i x_i, \ \sum_{i=1}^{n} \gamma_i = 1, \ \gamma_i \geq 0, \ i = 1, \ 2, \ ...n\}. \tag{7}$$

where $\hat{\Psi}$ is the smallest convex free-disposal hull that fits all observed data such that its upper boundary is a piece-wise linear estimate of the theoretical frontier, and $\gamma = (\gamma_1, \ldots, \gamma_n)$ are the weights for each input and output to create the hull. Using Eq. (7), we may compute the efficiency score for a specific observation j as

$$\delta_{Output}(x_j, y_j)^{-1} = \max\{\beta \,|\, \beta y_j \leq \sum_{i=1}^{n} \gamma_i y_i, \ x_j \geq \sum_{i=1}^{n} \gamma_i x_i, \ \sum_{i=1}^{n} \gamma_i = 1, \ \gamma \geq 0, \ \beta > 0, \ i = 1, \ 2 \,,...n\}, \tag{8}$$

where $\delta_{Output}(x_j, y_j)^{-1}$ is the DEA score, which represents the ratio between y_j and the optimal output. If we use the observation from bank i, country k and time t in the computation, the DEA score for this observation would be DEA_{ikt}, which is equivalent to $\delta_{Output}(x_{ikt}, y_{ikt})^{-1}$.

---

[31]This set can be estimated based on one of the two assumptions: constant returns to scale (CRS) or varied returns to scale (VRS). The CRS assumption assumes that the DMUs (or banks, in the context of this paper) are automatically working in their scale efficient size, which implies the efficiency frontier is a straight plane. The VRS assumes that the frontier is a convex curve and the DMUs could be achieving increasing returns to scale at low output levels compared with the observations on the frontier. Because the M&As could change the size of the banks, and bank size and efficiency could be nonlinearly related, we adopt the VRS assumption.

24