The determinants of banking efficiency in Hong Kong 2004-2014

Hien Thu Phan, Sajid Anwar and W. Robert J. Alexander

University of the Sunshine Coast, Queensland, Australia

Corresponding author:

W. Robert J. Alexander
School of Business
University of the Sunshine Coast
Locked Bag 4
Maroochydore DC 4558
Queensland
AUSTRALIA

ralexand@usc.edu.au

The determinants of banking efficiency in Hong Kong 2004-2014

Abstract

The cost efficiency of the Hong Kong Banking sector over the period 2004 to 2014 is estimated by DEA window analysis. A second stage regression analysis finds that bank size and GDP growth are positively associated with efficiency, whereas revenue diversification and inflation are associated with lower efficiency. Stock exchange listing status is associated with lower efficiency but no clear relationship between measures of market structure and efficiency is found.

Keywords: cost efficiency, banking sector, DEA window, Hong Kong

Subject classification codes: G21, N25, C14, C24

1. Introduction

Hong Kong is a leading centre of international finance with 70 of the world's 100 largest banks operating there (KPMG, 2014). Studies addressing the efficiency of the Hong Kong banking sector (Kwan (2006); Drake et al. (2006)) cover only the period before the global financial crisis (GFC). This paper uses data over 2004-2014 to estimate bank efficiency using data envelopment analysis window analysis and then models the determinants of efficiency with a truncated regression model. Section 2 contains a brief review of the literature. The methods are outlined in Section 3 and the data in Section 4. Section 5 presents the results and Section 6 concludes.

2. Literature review

2.1Measuring efficiency

In the literature on bank efficiency, or decision-making unit (DMU) efficiency in general, data envelopment analysis (DEA) is a widely-used approach; recent examples include Garza-Garcia (2012), Tan and Floros (2013) and Nguyen et al. (2014). Developed by Charnes et al. (1978), DEA is a non-parametric linear-programming technique which does not require the specification of a functional form nor assumptions on the distribution of an inefficiency term. For a given bank, DEA identifies a peer bank or banks and then estimates the efficiency of that bank with respect to the best-practice bank, which is assigned an efficiency score of 100% or 1.

One of the difficulties with DEA is that it may identify too many DMUs as 100% efficient if there are too few observations relative to the number of measured inputs and outputs. Window analysis, introduced by Charnes et al. (1985), treats a DMU considered at different points in time as a distinct DMU, thereby increasing the number of degrees of freedom (Avkiran (2004); Asmild et al. (2004)) and should reduce the number of DMUs identified as 100% efficient.

2.2 Determinants of bank efficiency

Many studies of the determinants of bank efficiency focus on testing either the 'quiet life' hypothesis (QLH) or the 'information generation' hypothesis (IGH). The QLH (Berger and Hannan, 1998) considers the relationship between market power (or concentration) and efficiency. It suggests that banks with market power can attain supernormal profits without the need to strive for efficiency. In contrast, the IGH (Marquez, 2002) suggests that increasing bank competition causes a decrease in information-gathering capacity and a consequent increase in the probability of adverse borrower selection, making banks less efficient.

The IGH and QLH are, in effect, two sides of the same proposition, with the IGH suggesting a positive relationship between market power and bank efficiency, while the QLH suggests the opposite. The empirical evidence is mixed: for example, Maudos and De Guevara (2007) find that the relationship between concentration and cost efficiency, in the banking industry of fifteen EU countries over 1993–2002, is positive in the loan market but negative in the deposit market. Williams (2012), studying banks in Latin America over 1985–2010, finds the relationship between market power and efficiency is positive in asset markets but negative in deposit markets.

Factors other than competition may be associated with efficiency. For the transition economies of South-Eastern Europe, Fang et al. (2011) find that institutional development is positively related to bank efficiency. Tan and Floros (2013), for the Chinese banking system between 2003 and 2009, find that risk, bank size, inflation and economic growth are positively related to efficiency. For China over the period 2003-11, Wang et al. (2014) note the positive effect on efficiency of banking reform and disposal of non-performing loans. Also for China, Hou et al. (2014) find competition, risk taking and bank size to be positively related to efficiency.

Specific to the Honk Kong banking sector, Kwan (2006) found that, between 1992 and 1999, technological innovation, bank size, deposit to asset ratio, loan to asset ratio, provision for losses and loan growth were all positively related to efficiency. Off-balance

sheet activities were found to negatively affect efficiency. For Hong Kong, over 1995-2001, Drake et al. (2006) found that efficiency was not significantly affected by Hong Kong's accession to the People's Republic of China, the South East Asian crisis or financial deregulation.

3. Method

3.1 Measuring cost efficiency

Banks can be thought of as multi-product firms (Sealey and Lindley, 1977), producing a number of outputs (y_i) using a number of inputs (x_i) having prices (w_i), with the objective of minimizing total costs. DEA permits evaluation of the relative efficiency of DMUs without imposing *a priori* weights on the inputs and outputs. In solving an LP problem simultaneously for a set of DMUs, weightings are chosen that maximise the efficiency score of each DMU relative to the best-performing peer or peers. Following Banker et al. (1984) and Fare et al. (1985), this study uses a variable-returns-to-scale cost minimization model of cost efficiency, which is defined as the ratio of a bank's estimated minimum cost to produce a certain output to the actual cost of production.

The data available allow measurement of two outputs: earning assets other than loans (y_1, the sum of total securities and other investments) and total loans (y_2). There are three inputs: total deposits (x_1), total physical capital (x_2) and labour (x_3, measured by personnel expenses). The input prices are: w_1 (the ratio of total interest expenses to total funding), w_2 (the price of physical capital, which is the ratio of other operating costs to fixed assets) and w_3 (the price of labour which is the ratio of personnel expenses to total assets).

Efficiency scores of individual banks in a panel dataset could be estimated by establishing one best-practice frontier for all banks throughout the whole of the time period under analysis. This would be making the assumption that the production technology is unchanged over the whole period which seems unlikely. DEA window analysis specifies a 'window length': here, we use three years, which allows for an increase in the number of observations but without imposing unchanging technology over too long a time frame. The analysis is repeated by moving the window forward one period at a time.

3.2 Regression analysis of the determinants of efficiency

The truncated regression model in equation (1) is used to examine the determinants of cost efficiency.

$$EFF_{k,t} = \beta_0 + \beta_1 SIZE_{k,t} + \beta_2 RD_{k,t} + \beta_3 LISTED_{k,t} + \beta_4 MCON_{k,t} + \beta_5 INF_t + \beta_6 GDPG_t + \beta_7 CRISIS_t + \varepsilon_{k,t} \quad (1)$$

The dependent variable, $EFF_{k,t,}$ is the cost efficiency of the k^{th} bank in year t derived from the DEA window model.

The independent variables include the following bank-specific measures: bank size (*SIZE*, the natural logarithm of total assets), revenue diversification (*RD*, the ratio of non-interest income over total revenue) and listing status (*LISTED*, a dummy variable which is 1 if the bank is listed on the Hong Kong Stock Exchange and 0 otherwise).

The model also includes a number of market-level and macroeconomic independent variables. Market concentration (*MCON*) is measured either by the Herfindahl Hirschman index (*HHI*) or the concentration ratio (*CR3*). *HHI* is the sum of the market shares of each bank. The three-bank concentration ratio is the percentage of market share held by the three largest banks in the banking industry.

To account for the impact of the macroeconomic environment, three variables are included in the model: inflation (*INF*), the growth rate of gross domestic (*GDPG*) and a variable to capture the effect of the GFC (*CRISIS*, which is 1 for the 2008 crisis year and 0 otherwise).

4. Data

The sample is an unbalanced panel made up of 25 commercial banks, 5 investment banks, 6 bank holding companies and 5 finance companies. The data cover 2004–2014 and are from the Bankscope Fitch-IBCA database, which consists of the annual financial

statements of individual institutions. The macroeconomic data were sourced from the International Financial Statistics database (IFS) of the International Monetary Fund. All input, output and control variables were inflation-adjusted to base year 2004.

5. Results

Table 1 reports the results of six variants of the truncated regression model (equation (1)). Models 1 and 2 exclude the *CRISIS* variable while models 3 and 4 exclude macroeconomic conditions. Models 5 and 6 use all variables. Odd-numbered models use *CR3* and even-numbered models use *HHI* to account for market structure.

TABLE 1 ABOUT HERE

The coefficient on *SIZE* is positive and statistically significant at the 1% level for all models. The estimate is robust (0.10 to two significant figures) across all variants of the model, suggesting that larger banks are more cost efficient. The coefficients on both *RD* and *LISTED* are negative and significant at the 1 percent level in every model and these estimates are also very robust; the coefficient on RD is -0.3 to one significant figure and the coefficient on *LISTED* is -0.14 to two significant figures across all models. Banks with greater revenue diversification may be less efficient because of high costs associated with non-traditional activities. Costs associated with dividends and listing fees may also cause listed banks to have lower efficiency.

Results concerning the relationship between market concentration and cost efficiency are mixed, usually not being statistically significant.

The coefficient on *INF* is negative in all models, but only attains statistical significance in model 6 so not much confidence can be placed in a link between inflation and efficiency. GDP growth shows up consistently as positively related to efficiency; the coefficient on *GDGP* is positive and statistically significant in all six models and is reasonably robust across the different specifications. The coefficient on *CRISIS* is positive

for all tested models, but statistically significant only for models 5 and 6. A positive link between efficiency and the GFC could be the result of the dramatic decrease in deposit rates (and therefore costs) made by Hong Kong banks in response to GFC, from 2.423% in 2007 to 0.448% in 2008 (World Bank 2016).

5. Conclusion

This study employs DEA Window Analysis to measure the cost efficiency of Hong Kong banks and then examines the determinants of cost efficiency over 2004-2014. Bank size was found to be positively related to efficiency, while revenue diversification and listing status negatively affect efficiency. High rates of economic growth were found to positive influence efficiency.

There is no doubt that government action to ensure macroeconomic stability, in the form of strong GDP growth and low inflation, should make cost efficiency easier to manage, not just for banks, but for all firms. Banks themselves can improve efficiency by growing but, in the process of expansion, need to carefully manage diversification of services to avoid any negative consequences for costs. We fail to detect much influence on efficiency from the market structure of the Hong Kong banking sector, at least as measured by the *CR3* ratio or *HHI*, but this may be due to little variation in either of these measures over the sample period as their standard deviations are each a magnitude lower than their means, which is not the case for the other independent variables in the model.

Table 1: Determinants of cost efficiency in Hong Kong banking: truncated regression

	Dependent variable: cost efficiency (from DEA Window Analysis)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
SIZE	0.1020	0.1002	0.1004	0.1002	0.1022	0.1004
	(0.0104)***	(0.0104)***	(0.0109)***	(0.0110)***	(0.0102)***	(0.0099)***
RD	-0.3034	-0.3010	-0.3196	-0.3221	-0.2894	-0.2596
	(0.0647)***	(0.0654)***	(0.0683)***	(0.0688)***	(0.0644)***	(0.0637)***
LIST	-0.1439	-0.1434	-0.1418	-0.1428	-0.1447	-0.1415
	(0.0376)***	(0.0382)***	(0.0398)***	(0.0401)***	(0.0372)***	(0.0364)***
HHI	4.5538		3.7510		0.6558	
	(2.0756)**		(2.6971)		(2.8804)	
CR3		-0.8419		1.3641		-5.0105
		(1.7771)		(1.8124)		(2.0186)**
INF	-0.0062	-0.0126			-0.0185	-0.0303
	(0.0102)	(0.0102)			0.0119	
						0.0107)***
GDPG	0.0207	0.0195			0.0211	0.0268
	(0.0055)***	(0.0056)***			(0.0054)***	
						0.0058)***
CRISIS			0.0221	0.0691	0.1579	0.2574
			(0.0753)	(0.0644)	(0.0840)*	(0.0697)***

CONSTANT	-1.6333	-0.1406	-1.3626	-1.4778	-0.8479	2.4688
	(0.4714)***	(1.1425)	(0.5735)***	(1.1745)***	(0.6107)	(1.2750)*

Notes: 405 observations, standard errors in parentheses,

* p< 0.1, ** p< 0.05, *** p< 0.01.

References

ASMILD, M., PARADI, J. C., AGGARWALL, V. & SCHAFFNIT, C. 2004. Combining DEA Window Analysis with the Malmquist Index Approach in a study of the Canadian banking industry. *Journal of Productivity Analysis,* 21**,** 67-89.

AVKIRAN, N. K. 2004. Decomposing technical efficiency and window analysis. *Studies in Economics and Finance,* 22**,** 61 - 91.

BANKER, R. D., CHARNES, A. & COOPER, W. W. 1984. Some models for estimating technical and scale inefficiencies in Data Envelopment Analysis. *Management Science,* 30**,** 1078-1092.

BERGER, A. N. & HANNAN, T. H. 1998. The efficiency cost of market power in the banking industry: A test of the `quiet life' and related hypotheses. *Review of Economics & Statistics,* 80**,** 454-465.

CHARNES, A., CLARK, C. T., COOPER, W. W. & GOLANY, B. 1985. A developmental study of Data Envelopment Analysis in measuring the efficiency of maintenance units in the U.S. Air forces. *Annals of Operations Research,* 2**,** 95 - 112.

CHARNES, A., COOPER, W. W. & RHODES, E. 1978. Measuring the efficiency of decision making unit. *European Journal of Operational Research,* 2**,** 429-444.

DRAKE, L., HALL, M. J. B. & SIMPER, R. 2006. The impact of macroeconomic and regulatory factors on bank efficiency: A non-parametric analysis of Hong Kong's banking system. *Journal of Banking and Finance,* 30**,** 1443-1466.

FANG, Y., HASAN, I. & MARTON, K. 2011. Bank efficiency in South-Eastern Europe. *Economics of Transition,* 19**,** 495-520.

FARE, R., GROSSKOPF, S. & LOVELL, C. A. K. 1985. *The Measurement of Efficiency of Production,* New York, Kluwer-Nijhoff Publishers.

GARZA-GARCIA, J.G., 2012. Determinants of bank efficiency in Mexico: a two-stage analysis. *Applied Economics Letters,* 48:52**,** 5060-5074.

HOU, X., WANG, Q. & ZHANG, Q. 2014. Market structure, risk taking, and the efficiency of Chinese commercial banks. *Emerging Markets Review,* 20**,** 75-88.

KPMG (2014), Hong Kong Banking Survey,
https://www.kpmg.com/CN/en/IssuesAndInsights/ArticlesPublications/Documents/Hong-Kong-Banking-Survey-2014-201407.pdf

KWAN, S. H. 2006. The X-efficiency of commercial banks in Hong Kong. *Journal of Banking and Finance,* 30**,** 1127-1147.

MARQUEZ, R. 2002. Competition, adverse selection, and information dispersion in the banking industry *Review of Financial Studies,* 15 (3)**,** 901–926.

MAUDOS, J. & DE GUEVARA, J. F. 2007. The cost of market power in banking: Social welfare loss vs. cost inefficiency. *Journal of Banking & Finance,* 31**,** 2103-2125.

NGUYEN, T. P. T., ROCA, E. & SHARMA, P. 2014. How efficient is the banking system of Asia's next economic dragon? Evidence from rolling DEA windows. *Applied Economics,* 46**,** 2665-2684.

SEALEY, C. W. & LINDLEY, J. T. 1977. Inputs, outputs, and a theory of production and cost at depository financial institutions. *Journal of Finance,* 32**,** 1251-1266.

TAN, Y. & FLOROS, C. 2013. Risk, capital and efficiency in Chinese banking. *Journal of International Financial Markets, Institutions & Money,* 26**,** 378-393.

WANG, K., HUANG, W., WU, J. & LIU, Y.-N. 2014. Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA. *Omega,* 44**,** 5-20.

WILLIAMS, J. 2012. Efficiency and market power in Latin American banking. *Journal of Financial Stability,* 8**,** 263-276.

WORLD BANK. 2016. http://data.worldbank.org/indicator/FR.INR.DPST?locations=HK