The Post-Issue Performance of IPO Banks: International Evidence

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With a comprehensive dataset of 58 countries over the period 1987-2010, this paper investigates the effect of IPO on bank performance, measured by efficiency scores estimated using the stochastic frontier approach. Post-issue underperformance is found over the IPO years. This paper further examines the long-run performance of IPO banks beyond the IPO years with regression analysis and finds that IPO banks' cost efficiency improves while profit efficiency deteriorates after IPO. This study also documents the declining trend of cost efficiency after IPO, although the trend of post-IPO profit efficiency is country-dependent – an upward trend for U.S. banks and a downward trend for non-U.S. banks. It is also observed that large banks are associated with higher cost efficiency and lower profit efficiency, a higher capital ratio leads to low efficiency and banks relying more on traditional interest-generating businesses are more efficient.

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1. Introduction

Initial public offering (IPO) has been an important way for small private firms to raise capital and grow. It can also be used by large private firms to become publicly traded. During the wave of privatization in the transition economies during the past two decades, IPO served as a common way to privatize formerly state-owned firms. According to the World Bank, IPOs accounted for 75 percent of total privatization value in 2007 globally. Although the U.S.A. had been the lead issuer of IPOs in terms of value prior to 2009, some emerging economies have also become important players in the IPO market. A recent example of a successful IPO is Facebook Inc., which raised US$16 billion in 2012. In emerging countries, the IPO of the Agriculture Bank of China (ABC) in 2010, which successfully raised US$22.1 billion, is an example of recent issues. IPOs are now prevalent across the world and industry. How do the firms that undergo IPOs perform? In other words, what are the effects of ownership structure change on IPO firms? This is the question to be answered in this study. Specifically, this paper focuses on the banking industry and investigates the effect of IPO on bank performance.

Although post-IPO performance has been extensively studied in the literature, as reviewed in Section 2, there is a very limited number of IPO studies covering the banking industry. The banking industry is different from other industries in that it is heavily regulated and so the behavior of IPO banks may be different than IPO firms in other industries. The lack of comprehensive study on IPO banks warrants another study on the performance of banks that undergo IPO. This study examines the post-issue performance of IPO banks with international data by focusing on cost efficiency and profit efficiency estimated using the stochastic frontier approach. To the best of my knowledge, this is the first paper that focuses on the efficiency change of IPO banks with international data.[1] In addition, most of the studies on post-IPO performance focus on the years immediately after IPO (e.g., 5 years after IPO). This study examines IPO bank performance beyond the IPO window with regression analysis and provides long-run evidence. With a dataset that covers 58 countries over 1987-2010, bank efficiency is estimated using the translog function and stochastic frontier approach. The cost and profit

[1] Among others, Loughran and Ritter (1995) provide evidence regarding post-IPO investment performance and Jain and Kini (1994) document the operating performance of IPO firms.

efficiency scores are a measure of bank performance relative to the best-practice bank that employs the same amount of input and generates the same amount of output. Unlike other industries where private firms are not required to disclose their financial information, both public and private banks must disclose financial information to regulators. This makes it more convenient to construct a control sample for the IPO banks. The efficiency of IPO banks is evaluated in the absolute level and compared to the efficiency of private banks over the same period. In a preliminary examination, efficiency is compared before and after IPO, and with a control sample that matches IPO banks based on country, bank type and size for Years -1 to +5. It is observed that IPO banks are more cost efficient but less profit efficient than the control banks over the IPO years; both efficiency measures deteriorate gradually with time after IPO. In order to investigate the long-run performance of IPO banks beyond the IPO window, this study further employs the methodology developed by Berger et al. (2005) and examines the selection and dynamic effects of IPO with regression analysis. It is found that IPO banks are less cost efficient than private banks over the whole sample period, although they are found to be more efficient than the private control sample for the Years -1 to +5 in the preliminary examination. IPO banks are more cost efficient after IPO, especially in the earlier years following IPO; however, cost efficiency deteriorates gradually with time. These findings are robust with the full sample and subsamples of non-U.S. banks or U.S. banks.

With profit efficiency as a performance measure, different selection and dynamic effects of IPO are found for U.S. banks and non-U.S. banks. The regression analysis shows that non-U.S. IPO banks are more efficient in generating profit than private banks over the whole sample period, while U.S. IPO banks are less efficient than their private counterparts. Post-IPO profit efficiency is lower than the pre-IPO level but sees an upward trend for U.S IPO banks. There is no significant difference in post-IPO profit efficiency for non-U.S. banks, and a downward trend is observed. The different evidence of bank profit efficiency with the two subsamples implies that IPO banks in different countries may behave differently and the evidence seen with data from one country might not be generalized to other countries.

In addition, this study finds bank size, capital ratio and business orientation are all determinants of bank efficiency. Large banks are more efficient in cost management, but less efficient in generating profit; banks that maintain a higher level of capital are less efficient and banks that rely more on traditional interest-generating banking business are found to be more efficient.

The remainder of the paper is organized as follows: extant literature is reviewed in Section 2; the data and methodology is described in Section 3; the empirical results are presented and discussed in Section 4; and the final section concludes.

2. Literature Review

In the IPO literature, initial underpricing, long-run performance of IPOs and the motives for the IPO have all been examined extensively. Of these, the studies on long-run performance of IPO firms are closely related to this paper. These studies either focus on the stock performance or the operating performance of IPO firms and vary with country and time coverage. With a sample of 1,526 IPOs in the U.S. over the period 1975-84, Ritter (1991) find evidence of the long-run underperformance of IPO firms; specifically, in the three years after IPO, the stocks of these firms significantly underperform compared to a set of control firms matched by size and industry. A more recent study by Jaskiewicz et al. (2005) examines the long-run stock market performance of German and Spanish IPOs between 1990 and 2000. They find investors realize an abnormal return of -32.8% and -36.7% for German and Spanish IPOs, respectively, three years after going public.

Jain and Kini (1994) are the first to investigate the change in the operating performance of firms as they make the transition from private to public ownership. They find that IPO firms in the U.S. exhibit a decline in post-issue operating performance, as measured by the operating return on assets and operating cash flows deflated by assets, relative to their pre-IPO levels, both before and after industry adjustment. They also find a significant positive relation between post-IPO operating performance and equity retention by the original entrepreneurs, but no relation between post-IPO

operating performance and the level of initial underpricing. Pástor, Taylor and Veronesi (2009) develop a model of optimal initial public offering that predicts firm profitability should decline after the IPO. The prediction of lower profitability is supported by the empirical evidence from a sample of 7183 IPOs in the United States over the period 1975-2004. Some other studies in the literature focus on evidence from other countries in the world, e.g., Pagano, Panetta and Zingales (1998) for the Italian market; Kutsuna, Okamura and Cowling (2002) for the Japanese market; and Khurshed, Paleari and Vismara (2005) for the UK market. All of these studies have documented a long-run decline in post-IPO operating performance, measured by the return on assets or operating cash flows deflated by assets, relative to their pre-IPO levels.

Most of the studies in the IPO literature are on non-financial industries and there is very limited coverage of banking industry. One of the very few bank IPO studies is by Houge and Loughran (1999). Examining a sample of 393 bank IPOs in the U.S. from 1983 to 1991, they observe poor post-IPO performance, especially among larger institutions with more aggressive loan growth. Their evidence suggests that the market may have fixated on the rapid growth of these institutions. A more recent study by Yin, Yang and Mehran (2014) examine the post-issue performance of Chinese banks and finds that IPO banks in China significantly outperform their counterparts prior to IPO, but the superior performance disappears immediately after IPO, consistent with the "window dressing" hypothesis and/or the arguments that firms time new issues to take advantage of windows of opportunity.

3. Data and Methodology

3.1. Measurement of Bank Efficiency

In this study, the post-IPO performance of banks is investigated with efficiency measures, i.e., cost efficiency and profit efficiency. These efficiency measures gauge the performance of a bank relative to the best-practice bank producing the same output with same input. That is, the cost of a bank is compared to the minimum cost and the profit is compared to the maximum profit of the best performers in the sample. Bank efficiency scores are estimated with the stochastic frontier approach. The Cobb-Douglas and translog models overwhelmingly dominate the applications literature in stochastic frontier and econometric inefficiency estimation. In this study the more flexible translog model is used. In general, the translog multiple-output cost function for K inputs and L outputs is

$$lnC = \alpha + \sum_{k=1}^{K} \beta_k lnw_k + \frac{1}{2}\sum_{k=1}^{K}\sum_{m=1}^{K} \gamma_{km}\, lnw_k lnw_m + \sum_{s=1}^{L} \delta_s lny_s + \frac{1}{2}\sum_{s=1}^{L}\sum_{t=1}^{L} \varphi_{st} lny_s lny_t + \sum_{k=1}^{K}\sum_{s=1}^{L} \theta_{ks} lnw_k lny_s \quad (1)$$

where y and w represents output and input, respectively, and C stands for total cost. In this study, a translog functional form with two inputs and four outputs is used to estimate the cost and alternative profit frontier function, respectively. To impose constant returns to scale, normalization of the output variables would be required. Following Berger, Hasan and Zhou (2009), the output variables and costs are normalized by total earning assets and the input variable is the ratio of price of funds to price of capital.[2] In so doing, the specification assumes homogeneity with respect to prices and constant returns to scale. The model (1) is modified as the following:

$$\ln\left(\frac{C}{w_2 z_1}\right)_{it} = \alpha + \beta_1 \ln\left(\frac{w_1}{w_2}\right)_{it} + \frac{1}{2}\gamma_{11} \ln\left(\frac{w_1}{w_2}\right)_{it} \ln\left(\frac{w_1}{w_2}\right)_{it}$$

$$+ \sum_{j=1}^{4} \delta_j \ln\left(\frac{y_j}{z_1}\right)_{it} + \frac{1}{2}\sum_{j=1}^{4}\sum_{k=1}^{4} \varphi_{jk} \ln\left(\frac{y_j}{z_1}\right)_{it} \ln\left(\frac{y_k}{z_1}\right)_{it} + \sum_{j=1}^{4} \theta_j ln\left(\frac{y_j}{z_1}\right)_{it} \ln\left(\frac{w_1}{w_2}\right)_{it}$$

$$+ year\ dummies + country\ dummies + lnu_{it} + lnv_{it} \quad (2)$$

[2] Bonin, Hasan and Wachtel (2005) normalize the output variables and costs by total loans.

where *i, t* index the bank and year, respectively, *j, k*=1,…, 4 index the four output variables and $\varphi_{jk} = \varphi_{kj}$; *C* represents total costs. The four outputs (y) are: total loans, total deposits, liquid assets, and other earning assets; there are two input prices (w): price of funds defined as interest expenses to total deposits and the price of capital measured by non-interest expenses to fixed assets; bank outputs and total costs are normalized with total earning assets (z) to reduce heteroskedasticity and allow banks of any size to have comparable residual terms from which the efficiency scores are estimated. The normalization by one of the input price (w_2) ensures price homogeneity. [3]

Differences in bank efficiency from country to country may be attributable to the legal, institutional and macroeconomic conditions of their country of origin and the markets in which they operate. Country effects are included in the estimation of the frontier. A time trend is allowed to influence the efficiency of the banks to reflect the impact of technology shifts and other time-dependent effects. That is, both country and time effects are included in the estimation of the frontier.

A bank's cost efficiency score is determined by comparing its actual cost to the minimum cost of a best-practice bank that produces the same amount of output with the same input. It is estimated with the efficiency factor lnu, using some distributional assumptions. The profit efficiency of a bank is estimated by replacing total costs with total profit in model (2). Before-tax profit is used to measure total profit. Following the literature (e.g., Bonin et al., 2005; Berger et al., 2009), a constant amount of profit is added for all banks before taking the log in order to avoid negative profits for any bank observation. According to the definition, the cost efficiency score is higher than 1, and the higher the score the less efficient the bank is. The profit efficiency falls into the range of [0, 1], with a higher profit efficiency score being associated with higher efficiency.

3.2. Empirical Model for Regression Analysis

The empirical model is specified as the following:

$$\textit{Bank performance measures} = a + \beta 1 * \textit{selection IPO indicator} + \beta 2 * \textit{dynamic IPO indicator\_dummy} + \beta 3 * \textit{dynamic IPO indicator\_years since} + \beta 4 * \textit{control variables} \quad (3)$$

where *selection IPO indicator* is a binary dummy variable that equals one for all time periods for the banks that went IPO over the sample period, and zero for all other banks. The regression coefficient for this dummy variable indicates the efficiency difference between the listed banks and non-listed banks – selection effect; the variable *dynamic IPO indicator_dummy* represents a dummy variable that takes the value of one for all publically listed banks for all time periods following the IPO event, and equals zero for the periods prior to IPO and for all periods for all the other banks that have not gone public. This dummy variable captures the performance difference before and after public listing – the dynamic effect. To investigate the long-term effect of bank IPO, a variable that measures the number of years that has lapsed since IPO is included (*dynamic IPO indicator_years since*). This time variable equals one for the year following bank IPO, two for the second year following IPO, and so on. It equals zero for the years of and before IPO and for all other banks. This study follows the literature (e.g. Berger et al., 2005; Nakane and Weintraub; 2005) and deletes the observations in the year of and the year following the events. Thus the time variable starts with two for the second year following the change. This treatment tries to reduce the impact of the noises associated with the ownership change such as legal fees, consultant expenses, due diligence costs, updating of strategies, etc. that mostly incur around of the time of IPO.

This study controls for year and country fixed effects in the analysis to account for the changes in market and regulatory conditions, and different legal, institutional and macroeconomic situations of the countries of origin, respectively. The average bank total assets over the sample period ranges from about 10 thousand to 2 trillion U.S. dollars and the variation of bank size could have an impact on bank efficiency. The natural logarithm of total assets is used to control for bank size in the regressions. Bank capital ratio and interest income share are also included in the analysis to control for a bank's

[3] Bonin et al. (2005) and Berger et al. (2009) use two inputs: price of capital and price of funds as defined in this paper. However, Bos and Kool (2006) are able to identify five input prices with their dataset: the price of public relations, price of labor, price of housing, price of physical capital, price of financial capital.

risk attitude and business orientation, respectively. Banks that maintain a higher level of capital in their balance sheets tend to be more risk averse and are found to be less efficient in the literature (Yao et al. 2007; Yin, Yang and Mehran, 2013). Lin and Zhang (2009) observe that the banks' fee income ratio is negatively associated with the cost to income ratio, suggesting that banks engaging in more non-banking business are less efficient. This study uses interest income share as a proxy for business structure and hypothesizes that banks with a higher interest income in their income structure are more efficient.

3.3. Data

The sample covers bank holding companies, commercial banks and savings banks across the world over the period 1987-2010 with data provided by Bankcope. By excluding the countries that have fewer than five banks and/or no IPO banks during the sample period, 58 countries are included in this study.[4] The dataset used in the estimation of bank efficiency scores includes 849 IPOs and 11651 other banks that did not go public over the sample period. Table 1 shows the summary statistics of the variables in the stochastic frontier model (2).

Table 1. Summary statistics of the variables in the stochastic frontier model

Variables	No. of observations	Mean	Standard deviation	Minimum	Maximum
Total cost	124080	1958.21	108694.5	0.002	2.00E+07
Pre-tax profit	124088	1085.30	152740.1	-437954	4.38E+07
Loans	123937	7536.08	287783.9	0.001	4.46E+07
Total deposits	123769	10796.86	531195.7	0.02	1.36E+08
Liquid assets	108740	2300.90	117728.1	0	1.43E+07
Other earning assets	124087	7830.97	468090.6	0	9.23E+07
Price of funds	123769	0.59	127.3	0.0000312	44441
Price of capital	122854	10.14	581.1	0.000661	111703
Total earning assets	124087	15357.93	728952.9	0.1	1.33E+08

Notes: total cost and pre-tax profit are the dependent variables in the stochastic frontier model (2). Loans, total deposits, liquid assets and other earning assets are the four outputs in the model. Price of funds and price of capital are proxies for bank inputs, which are defined as the ratio of interest expenses to total deposits and the ratio of non-interest expenses to fixed assets, respectively. Total earning assets is used to normalize bank outputs, total cost and pre-tax profit. All variables are denominated in million U.S. dollars except for price of funds and price of capital, which are ratios.

4. Empirical Results

4.1. Preliminary Examination on Bank Performance around the IPO Event

This study first examines a subsample of the dataset that only includes the banks that underwent IPO during the period 1987-2010 and their private counterparts for the years around the IPO event, i.e., from Year -1 to Year +5. [5] The IPO banks' private counterparts match each IPO bank based on country, bank type and size. Specifically, for each IPO bank, a private counterpart is chosen from the same country that has the same bank type and is closest in size with the IPO bank at the year prior to IPO. The median efficiency of IPO banks is compared with their counterparts for the period of Year-1 to Year +5. [6] Figures I and II plot the efficiency measures of IPO banks and the control group for the event window of Year -1 to Year +5.

[4] The Netherlands and the United Kingdom did not have IPO banks during the sample period and thus are excluded from the dataset.

[5] A five-year post-offering window is consistent with the methods used in the empirical finance literature (Houge and Loughran, 1999; Lakonishok, Shleifer and Vishny, 1994; Loughran and Ritter, 1995; Spiess and Affleck-Grves, 1995; Brav and Gompers, 1997; Rajan and Servaes, 1997, among others).

[6] Median rather than mean efficiency is used because efficiency measures may be skewed and the mean is particularly sensitive to outliers. For robustness check purpose, mean efficiency measures are also examined and similar results are observed.

Figure I displays the median cost efficiency of IPO banks and their industry counterparts for Years -1 to +5 relative to the IPO. Cost efficiency is estimated using the stochastic frontier approach and the translog cost function illustrated in empirical model (2). As it measures the cost of a bank relative to the minimum cost of the best-practice bank that generates same amount of output with the same input, a higher value of cost efficiency is associated with poor performance. The solid and dashed bars in Figure I represent IPO banks and their private counterparts, respectively. It shows that for all seven years around the IPO event, IPO banks are more cost efficient than their control banks and show a different pattern than their private counterparts. There is an obvious efficiency gain from year 0 to Year +1 for IPO banks while the control banks' cost efficiency deteriorates during the same time. This can be explained by the noises associated with IPO such as legal fees, consulting expenses and other costs that are incurred at the year of IPO. The following efficiency loss of IPO banks for Years +2 to +4 are accompanied by an efficiency gain for the control banks. IPO banks have a marginal efficiency gain while control banks see efficiency loss in Year 5. The opposite pattern of efficiency change of IPO banks and the control group implies that the deteriorating performance following IPO does not go along with industry trend but is a particular phenomenon for IPO banks. Compared to the performance of Year -1, IPO banks are less cost efficient for three of the five post-IPO years, with a pattern of worsening performance.

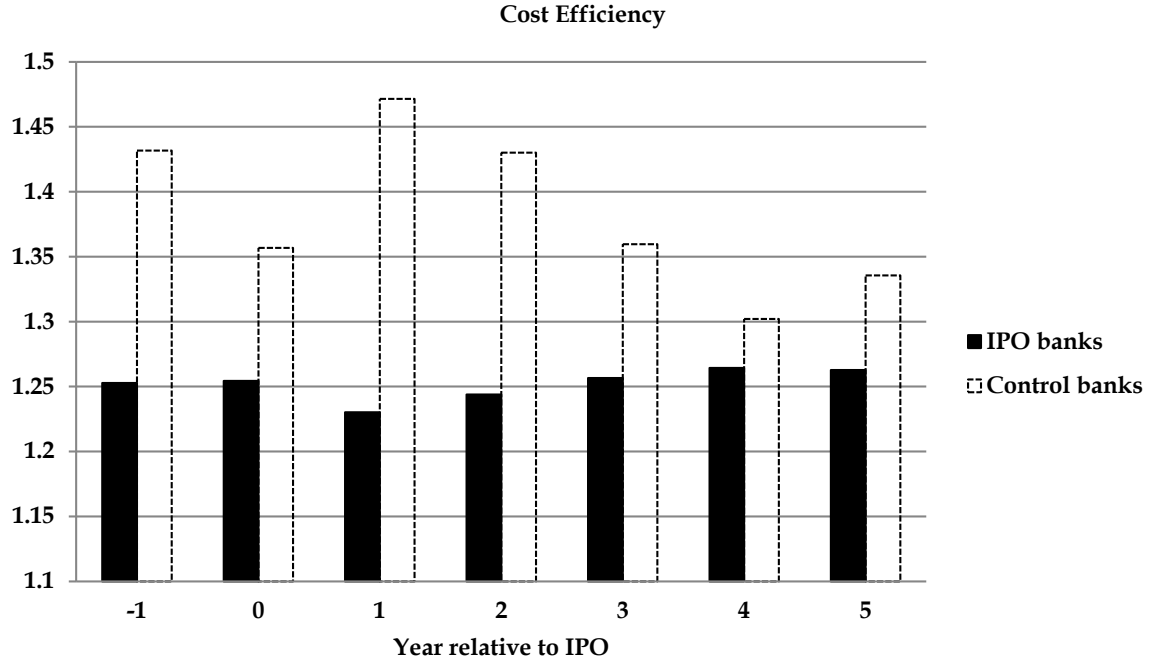

Figure I. Cost efficiency. This chart displays the median level of cost efficiency for the IPO banks in the world from 1987 to 2010 and their industry counterparts for Years -1 to +5 relative to IPO. Cost efficiency is estimated with the stochastic frontier approach and the translog cost function. It measures the performance of a bank relative to the best-practice frontier, with higher values representing worse performance. The *solid bars* represent IPO banks, while the *dashed bars* represent the control banks that match the IPO banks by country, bank type and bank size.[7]

Figure II shows the median profit efficiency of IPO banks and their control counterparts for the event window of Years -1 to +5. Profit efficiency is estimated with model (2) with total cost *C* being

[7] The IPO banks are matched with an industry counterpart based on country, bank type and size, which is measured with total assets at the year prior to IPO, e.g., an IPO bank in the U.S. that is a bank holding company is matched with a counterpart that is also a bank holding company in the U.S. and has similar bank size at Year -1. The counterpart bank must not be publically listed over the sample period of 1987-2010.

replaced with total profit, as described in Section 3. A higher value of profit efficiency is associated with a higher profit efficiency. Figure II indicates that IPO banks are less efficient in generating profit compared to their industry counterparts for all the years in the event window. In addition, a constant trend of declining profit efficiency is observed while the profit efficiency of their industry counterparts increases from Year -1 to Year 0 and stays pretty stable for the rest of the years in the event window. This provides additional evidence that IPO banks behave differently from their industry counterparts. Banks' profit efficiency deteriorates after the IPO.

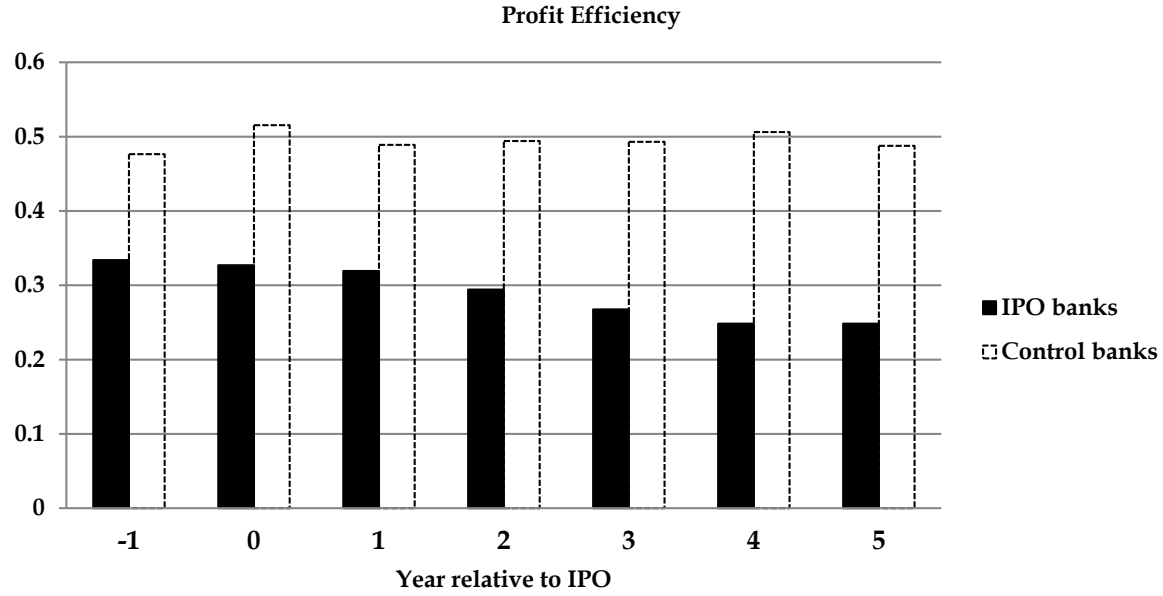

Figure II. Profit efficiency. This chart displays the median level of profit efficiency for the IPO banks in the world from 1987 to 2010 and their industry counterparts for Years -1 to +5 relative to IPO. Profit efficiency is estimated using the stochastic frontier approach and the translog profit function. It measures the performance of a bank relative to the best-practice frontier, with higher values representing better performance. The *solid bars* represent IPO banks, while the *dashed bars* represent the control banks that match the IPO banks by country, bank type and size.

Figures I and II only show the patterns of *median* efficiency measures and cannot reflect the performance of all banks in the subsample. For robustness purpose, this study conducts a nonparametric trend test across post-IPO years, developed by Cuzick (1985), that takes into consideration all the observations in the subsample. Panel A of Table 2 indicates that cost efficiency scores of IPO banks show a rising trend since the year immediately after IPO with Z=1.93 and Probability > |z| = 0.053, implying deteriorating performance over time after IPO. However, the control banks see an opposite trend from the test for the same time period. This confirms the evidence from Figure I that the deteriorating performance following IPO is peculiar to IPO banks.

The same trend test is also performed for profit efficiency. In panel B of Table 2, a downward trend of profit efficiency is observed with Z=-2.87 and Probability > |z| = 0.004 while their control banks do not show a statistically significant trend. These trend tests further confirm the findings from Figures I and II that IPO banks' performance, according to cost efficiency and profit efficiency measures, deteriorates for the five years following IPO.

In summary, the preliminary examination of IPO banks and their private counterparts around IPO event shows deteriorating post-IPO bank efficiency, which is consistent with the general post-issue underperformance found in the literature.

Table 2. Non-parametric trend test

Panel A:	*Cost efficiency*						
	IPO banks				Control banks		
Year relative to IPO	Score	No. of observations	Sum of ranks	Year relative to IPO	Score	No. of observations	Sum of ranks
1	1	267	174258.5	1	1	163	52542.5
2	2	253	170537.5	2	2	144	45874
3	3	286	198773	3	3	119	33042
4	4	283	201402.5	4	4	94	24886
5	5	288	203781.5	5	5	76	21561.5
	z = 1.93				z = -2.8		
	Prob > z =0.053				Prob > z =0.005		
Panel B:	*Profit efficiency*						
	IPO banks				Control banks		
Year relative to IPO	Score	No. of observations	Sum of ranks	Year relative to IPO	Score	No. of observations	Sum of ranks
1	1	267	198302	1	1	164	49737.5
2	2	253	180387	2	2	144	41468
3	3	286	193307	3	3	119	34774
4	4	283	186824	4	4	94	30666
5	5	288	189933	5	5	76	21857.5
	z = -2.87				z = 0.18		
	Prob > z = 0.004				Prob > z = 0.86		

Notes: this table shows results of the non-parametric trend test developed by Cuzick (1985) for the efficiency measures of IPO banks and their industry counterparts for the five post-IPO years. Panel A is for the cost efficiency and panel B is for the profit efficiency.

4.2. Regression Analysis with Full Sample

The analysis so far has been focused on the performance of IPO banks around the IPO years. In order to see an even bigger picture, this study further employs the methodology developed by Berger et al. (2005) and examines the long-run performance of IPO banks through a regression analysis with full sample. The empirical model (3) is discussed in Section 3. The regression results are reported in Table 3.

Panels A and B of Table 3 display the regression results for cost efficiency and profit efficiency, respectively. As more than half of the IPOs in the sample are for U.S. banks, the regression results could be biased toward U.S. banks. For robustness purpose, two subsamples, one with non-U.S. banks, the other with U.S. banks, are used to re-run the regressions and the results are also reported in Table 3. In the full sample, the positive coefficient for the *selection IPO indicator* in Column (1) implies that over the whole sample period, IPO banks are less cost efficient than the other private banks. This seems at odds with the evidence in Figure I, which shows IPO banks are more cost efficient than their industry counterparts over the IPO years. One explanation could be that IPO banks improve cost efficiency in preparation for IPO but the improved cost management is not sustainable, which is supported by the deteriorating trend of cost efficiency for IPO banks following IPO. What Figure I shows does not reflect the whole picture and it is likely that for the years before Year -1 and after Year +5, the IPO banks underperform compared to their counterparts. This inconsistency could also be attributable to the fact that the selected control bank does not represent the whole industry. IPO banks could be more cost efficient than their counterparts but less cost efficient than the other banks in the industry.

The *dynamic IPO indicator_dummy* variable captures the differences in the performance of IPO banks before and after IPO – dynamic effect. The negative coefficient shows IPO banks are more cost efficient for the years after IPO than before. *Dynamic IPO indicator_years since* measures the trend of

bank efficiency after IPO. The positive coefficient confirms an upward cost efficiency score, which represents a deteriorating performance in the long run, which is consistent with the evidence in Figure I and the trend test. The two subsamples, Columns (2) and (3), provide very similar results except that U.S. IPO banks do not see a significant trend in their cost efficiency after IPO even though the coefficient has the same sign with that in Columns (1) and (2).

Table 3. The effect of IPO on bank performance

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: cost efficiency			*Panel B: profit efficiency*		
	Full sample	Non-U.S. banks	U.S. banks	Full sample	Non-U.S. banks	U.S. banks
Selection IPO indicator	0.150***	0.136***	0.187***	0.010***	0.023***	-0.013***
Dynamic IPO indicator_dummy	-0.125***	-0.173***	-0.112***	-0.023***	-0.003	-0.023***
Dynamic IPO indicator_years since	0.008***	0.016***	0.002	0.001**	-0.002***	0.003***
Total assets	-0.027***	-0.039***	-0.030***	-0.124***	-0.138***	-0.123***
Capital ratio	0.282***	0.373***	0.226***	-0.013***	-0.013***	-0.016***
Interest income share	-1.487***	-0.698***	-1.724***	0.046***	0.067***	0.050***
Constant	2.014***	1.161***	2.455***	1.575***	1.652***	1.259***
Country fixed effect?	Yes	Yes	N/A	Yes	Yes	N/A
Year fixed effect?	Yes	Yes	Yes	Yes	Yes	Yes
N	97753	15853	81900	98773	16367	82406
R-sq	0.199	0.238	0.208	0.808	0.818	0.810

Notes: This table reports the regression results of bank performance measures on bank IPO indicators. *Cost efficiency* and *profit efficiency* are estimated with the stochastic frontier model (2) and represent the distance of the performance of a particular bank from the best-practice frontier. *Selection IPO indicator* is a dummy variable that takes the value of one for all IPO banks, and zero otherwise; *dynamic IPO indicator_dummy* represents a dummy variable that takes the value of one for all publically listed banks for all time periods following the IPO event, and equals zero for the periods prior to IPO and for all periods for all the other banks that have not gone public; *dynamic IPO indicator_years since* equals one for the year following bank IPO, two for the second year following IPO, and so on. It equals zero for the years of and before IPO, and for all other banks. The control variable *total assets* is the logarithm of total assets in million US dollars, *capital ratio* is the ratio of equity capital to total assets, and *interest income share* is defined as the share of interest income in total operating income. Significance at 10, 5 and 1 percent are denoted by *, ** and ***, respectively. Data are obtained from Bankscope.

The regression results for profit efficiency are displayed in Panel B. With full sample, Column (4) shows that over the sample period, IPO banks are more profit efficient than the private banks in the sample, although Figure II shows that IPO banks are less efficient than their counterparts over the period of Year -1 to Year +5. The negative coefficient for the *dynamic IPO-indicator_dummy* in Column (4) provides evidence that IPO banks' profit efficiency is lower after IPO than before, and the positive coefficient of *dynamic IPO indicator_years since* indicates an upward trend of profit efficiency after IPO. However, when U.S. banks are excluded from the sample, Column (5) shows similar evidence to Column (4), except for the deteriorating profit efficiency indicated by the negative coefficient for the dynamic time variable.

With U.S. banks only, Column (6) shows the same dynamic effects but the opposite selection effect to what is found with the full sample – IPO banks in the U.S. underperform compared to private banks over the sample period while the opposite is seen in other countries. U.S. IPO banks are less efficient in post-IPO years while in other countries there is no significant difference in profit efficiency after IPO. U.S. IPO banks see an upward trend while non-U.S. IPO banks show a downward trend of profit efficiency after IPO. The selection effect reported in Columns (4) and (5) are inconsistent with the evidence in Figure II and Column (6), which could be attributable to the overrepresentation of U.S. banks in the full sample. When country effect is controlled, Columns (4) and (5) show that IPO banks

in general outperform the private banks. However, with U.S. banks only, or without controlling for country effect, Figure II and Column (6) show that IPO banks underperform compared to their private counterparts.

Bank characteristics such as size, capital ratio and interest income share are controlled in all the regressions reported in Table 3. Consistent evidence is found with the full sample and the two subsamples. Large banks are more efficient in cost management but less efficient in generating profit; a higher capital ratio is associated with lower efficiency, and banks that focus on more traditional interest-generating business are more efficient.

5. Conclusions

This paper uses the stochastic econometric frontier approach to investigate the effect of IPO on bank efficiency in the world. With a comprehensive dataset that covers 58 countries and 849 IPOs over the period 1987-2010, this study examines the efficiency of IPO banks over the IPO years (Years -1 to +5) and compares them with a control group that is constructed by matching each IPO bank with a private counterpart based on country, bank type and size. This paper further examines the long-run performance of IPO banks with regression analysis that tests the selection and dynamic effect in the same model. The selection effect compares IPO banks' performance with all other private banks in the sample over the whole sample period and the dynamic effect captures the performance difference before and after public listing.

This study finds deteriorating cost efficiency and profit efficiency after IPO over the IPO years, which is consistent with the evidence of general post-issue underperformance found in the extant literature. In addition, IPO banks are found to be more cost efficient but less profit efficient than their private counterparts and show a different pattern around the IPO window than the control group.

The regression analysis with the full sample finds mixed evidence: some are consistent with what is found over the IPO years but others are not. Specifically, the regression results show the opposite selection effect to the evidence observed over the IPO years – IPO banks are less cost efficient than private banks and non-U.S. IPO banks are more profit efficient over the whole sample period. However, the lower profit efficiency of U.S. IPO banks compared to private banks is consistent with the evidence found over the IPO years. For the dynamic effect, with profit efficiency as a measure of performance, the post-issue underperformance is further supported by the evidence that the average profit efficiency after IPO is less than the pre-IPO level, especially for the U.S. banks. However, with regards to cost efficiency, it is found that IPO banks' cost efficiency is improved after public listing with the regression analysis, which is contrary to the evidence over the IPO years. The deteriorating trend of cost efficiency over the IPO years is supported by the regression results that show an upward trend of cost efficiency score, especially for the non-U.S. banks. However, the deteriorating profit efficiency is supported by the non-U.S. banks only as U.S. IPO banks show rising trend of profit efficiency after IPO.

The mixed evidence found in the regression analysis has some implications. First, as the regression analysis examines bank performance beyond the IPO years, the different evidence observed suggests that looking at bank performance only a few years after going public does not show the big picture. The post-issue poor performance could improve in the long-run. Second, this study measures bank performance by cost efficiency and profit efficiency, which give rise to different conclusions, e.g., IPO banks' cost efficiency improves after IPO while the profit efficiency deteriorates. This suggests that the measurement of performance is important and the conclusion of underperformance or outperformance is associated with a specific measure. Third, this study finds different evidence for U.S. banks and non-U.S. banks, e.g., profit efficiency shows an upward trend for U.S. IPO banks but a downward trend for non-U.S. banks. This implies that some evidence is country-specific. The evidence found in one country might not be applicable to the other countries.

This study also controls for bank-level variables and finds that large banks are associated with more cost efficiency and lower profit efficiency. Consistent with the extant literature (e.g. Yin, Yang and Mehran,2013), this paper finds that banks that maintain a high capital ratio in their balance sheet

are less efficient, and banks that rely more on traditional interest-generating business are more efficient.

This study contributes to the literature in several aspects. First, there is a lack of comprehensive study on IPO banks. Although there is a wealth of studies on IPO, most of the studies are on other industries, not banks. Second, this paper has broad country coverage. Among the few studies on IPO banks in the literature, most IPO studies are country-specific case studies, such as Houge and Loughran (1999), which focuses on U.S. IPO banks and Yin et al. (2014), which examines the IPO bank performance of Chinese banks. To the best of our knowledge, this is the first study that uses international data to examine the performance of IPO banks. Third, this paper measures bank performance with cost efficiency and profit efficiency estimated using the translog function and stochastic frontier approach. Most of the other studies simply measure firm performance with financial ratios. Fourth, this paper not only looks at the performance of IPO banks around the IPO years, as most of the extant studies do, but also examines long-run performance beyond IPO years with regression analysis. The findings of this study suggest that IPO banks could perform very differently in the long run than the time around IPO event. Therefore, the immediate performance following IPO does not display the whole picture. This study bridges that gap and shows evidence of long-run performance of IPO banks. The findings from this study provide some insight on the performance of IPO banks to bank regulators, managers and investors.

References:

Berger, A., Clarke, G.R.G., Cull, R., Klapper, L., Udell, G.F., 2005, Corporate Governance and Bank Performance: A Joint Analysis of the Static, Selection, and Dynamic Effects of Domestic, Foreign, and State Ownership. *Journal of Banking & Finance* 29, 2179-2221.

Berger A., Hasan, I., Zhou, M., 2009, Bank Ownership and Efficiency in China: What Will Happen in the World's Largest Nation? *Journal of Banking & Finance* 33, 113-130.

Bonin, J. P., Hasan, I., Wachel, P., 2005, Bank Performance, Efficiency and Ownership in Transition Countries. *Journal of Banking & Finance* 29, 31-53.

Bos, J.W.B., Kool, C.J.M., 2006, Bank Efficiency: the Role of Bank Strategy and Local Market Conditions. *Journal of Banking & Finance* 30, 1953-1974.

Brav, A., Gompers, P.A., 1997, Myth or Reality? The Long-Run Underperformance of Initial Public Offerings: Evidence from Venture and Nonventure Capital-Backed Companies. *Journal of Finance* 52, 1791-1821.

Cuzick, J., 1985, A Wilcoxon-Type Test for Trend. *Statistics in Medicine* 4, 87-90.

Houge, T., Loughran T., 1999, Growth Fixation and the Performance of Bank Initial Public Offerings, 1983-1991. *Journal of Banking & Finance* 23, 1277-1301.

Jain, B. A., Kini, O., 1994, The Post-Issue Operating Performance of IPO firms. *Journal of Finance* 49, 1699-1726.

Jaskiewicz, P., Gonzalez, V. M., Menendez, S. and Schiereck, D., 2005, Long-run IPO Performance Analysis of German and Spanish Family-Owned Business. *Family Business Review* 18, 179-202.

Khurshed, A., Paleari, S., and Vismara, S., 2005, The operating performance of initial public offerings: the UK experience. Working Paper (University of Manchester)

Kutsuna, K., Okamura, H. and Cowling, M., 2002, Ownership Structure Pre- and Post-IPOS and the Operating Performance of JASDAQ Companies. *Pacific-Basin Finance Journal* 10, 163-181.

Lakonishok, J., Shleifer, A., Vishny, R.W., 1994, Contrarian Investment, Extrapolation, and Risk. *Journal of Finance* 49, 1541-1579.

Lin, X., Zhang Y., 2009, Bank Ownership Reform and Bank Performance in China. *Journal of Banking & Finance* 33, 20-29.

Loughran, T., Ritter, J.R., 1995, The New Issues Puzzle. *Journal of Finance* 50, 23-51.

Nakane, M., Weintraub, D., 2005, Bank Privatization and Productivity: Evidence from Brazil. *Journal of Banking & Finance* 29, 2259-2289.

Pagano, M., Panetta, F., Zingales, Z., 1998, Why Do Companies Go Public? An Empirical Analysis. *Journal of Finance* 53, 27-64.

Pástor, L., Taylor, L. and Veronesi, P., 2009. Entrepreneurial Learning, the IPO Decision, and the Post-IPO Drop in Firm Profitability. *The Review of Financial Studies* 22, 3005-3046

Rajan, R., Servaes, H., 1997, Analyst Following of Initial Public Offerings. *Journal of Finance* 52, 507-529.

Ritter, J. R., 1991, The Long-Run Performance of Initial Public Offerings. *Journal of Finance* 46, 3-27.

Spiess, D.K., Affleck-Graves, J., 1995, Underperformance in Long-Run Stock Returns Following Seasoned Equity Offerings. *Journal of Financial Economics* 38, 243-267.

Yin, H., Yang, J., Mehran, J., 2013, An Empirical Study of Bank Efficiency in China after WTO Accession. *Global Finance Journal* 24, 153-170.

Yin, H., Yang, J., Mehran, J., 2014, Do Chinese Banks Perform Better after IPOs? *Managerial Finance*, forthcoming.