Are foreign banks in China on an equal footing with Chinese domestic commercial banks?

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Abstract

We investigate how foreign banks in China perform when compared against domestic banks for 2008-2010. The main test uses *total income* as the dependent variable in stochastic frontier analysis (SFA). Repeating Cobb-Douglas and Translog based tests with *interest income* as the dependent variable benchmarks foreign banks against domestic banks' traditional strength. When *non-interest income* is used as the dependent variable, domestic banks are benchmarked against foreign banks' traditional strength. SFA finds foreign banks less efficient on domestic banks' traditional strengths and vice-versa. Efficiency rankings can be used by bank management interested in better understanding their positioning in the industry.

JEL classification: C67; G21

Keywords: Chinese banking; foreign vs domestic banks; ranking; SFA

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1. Introduction

Banking was for a long time perceived as a domestically-focused business activity, with locally-owned banks part of the communities within which they operated. Foreign owned banks existed in two contexts only – as offices in key financial centres outside the banks' country of origin, and through the networks of the (predominantly) British overseas banks, which were specifically established to undertake business in their colonies or other less-developed economies.[1] As these less developed countries sought to establish more economic independence, the foreign banks often got squeezed out, to the extent that Tschoegl (1987) could note that foreign-owned retail banks were extremely rare phenomena.

One of the factors that limited the spread of foreign-owned bank operations was the set of regulatory restrictions that applied. These did not stop banks that were regarded as sound from being able to open representative offices, branches and even subsidiaries in global financial centres such as London, New York and Hong Kong, but it made it difficult for them to spread far beyond those centres.

Regulation was not the only problem, however. A potentially greater challenge was recognition. The development of a successful banking business requires confidence on the part of potential local customers, and although international banks may be in strong financial positons, they can still be subject to what is referred to as the *liability of foreignness*. Miller and Parkhe (2002, p.58) present this as particularly applying in respect of bank costs, and note that "any foreign-owned bank operating in a host country is likely to experience increased costs, reduced operating efficiency and profitability, and diminished competitiveness relative to host country banks".

The confounding evidence is that foreign banks sometimes succeed in establishing operations in host country markets. Guillen and Tschoegl (2000) highlight the role of Spanish banks in Latin America, while To and Tripe (2002) look at the success of Australian banks in New Zealand. Since the early 1990s we have also seen much increased foreign ownership of banks in Central and Eastern

[1] See, for example, Jones (1993).

Europe (Bonin et al. 2005) and Latin America (Beck and Martinez Peria, 2010), such that foreign ownership is no longer the exception that it once was.

This paper focuses on the expansion of foreign banks into China, as international banks seek diversification and growth opportunities in one of the world's fastest growing banking markets. Understanding how existing foreign banks in China fare against the domestic commercial banks could facilitate more informed decisions for those planning a stronger presence or entering a new market.

Locally incorporated foreign banks in China are permitted to undertake the same types of renminbi (RMB) and foreign exchange business as their domestic counterparts. The China Banking Regulatory Commission (CBRC) points out that business carried out by domestic and foreign banks include services such as loans; deposits from the general public; negotiable instruments; trading bonds; letters of credit and guarantees; domestic and foreign settlements; bank cards; interbank lending.[2] According to Xu (2011), foreign banks have been granted equal status to domestic banks as of December 2006; Yao et al. (2008, p.1314) express this development by stating that "By 2006, foreign banks and their subsidiaries had no business or geographical restriction to serve Chinese customers."

Yao et al. (2008) and García-Herrero et al. (2006) discuss the reforms aimed at liberalizing the Chinese banking sector that include separation of policy and commercial lending in the late 1980s; removal of non-performing loans from large state-owned banks by using asset management companies (1999-2005); CBRC taking over from People's Bank of China in 2003 and tightening supervision while improving corporate governance; ownership reforms allowing listing of large state-owned banks in 2005 and 2006; gradual lifting of price and quantity controls while opening up to foreign competition. Consequently, as of 2007, foreign banks have been in stronger competition with domestic banks and these two groups can be benchmarked together enabling a more direct

[2] The same regulations also apply to banks set up on the Chinese mainland by financial institutions from the Hong Kong Special Administrative Region, the Macao Special Administrative Region, or Taiwan. In the current study's sample, Hang Seng bank (China) Ltd, and CITIC Ka Wah Bank (China) Ltd with home groups from the Hong Kong Special Administrative Region are considered foreign banks (see Article 72 in 'Regulations of the People's Republic of China on Administration of Foreign-funded Banks', http://www.cbrc.gov.cn/EngdocView.do?docID=2871, CBRC 2006).

comparison. Thus, the main aim of this article is to examine how foreign banks in China perform when compared against domestic banks and account for the impact of a selection of common firm-specific factors in the three-year post-reform period of 2008-2010.

The main reason policy makers and regulators in developing countries often encourage foreign bank presence is to improve the structure and competitive efficiency of a country's banking system. Lin (2011) maintains that *green field* investments dominate foreign bank entry into China where new branches are established, rather than being based on the acquisition of existing banking businesses, which would generally be limited by the authorities. Foreign banks can nonetheless be credited with contributing to improvement of domestic banking through efficiency spillovers. The micro-level channels include (1) *enhanced competition* in the banking market due to foreign banks' presence, (2) emulation by domestic banks of *innovative products and services* offered by foreign banks, and (3) *dissemination of talent* from foreign to domestic banks (Deng et al. 2011). Xu (2011) reports strong empirical evidence suggesting that foreign bank entry in China has led to a more competitive and efficient banking industry. For example, Xu (2011) finds a significant negative correlation between foreign bank presence and domestic bank net interest margins (i.e. enhanced market efficiency), and a positive correlation with non-interest income. Such findings can be construed as the results of technology spillovers where innovative products and services are emulated by domestic banks. Thus, s*pillovers bring foreign and domestic banks closer*, adding credibility to benchmarking where these two cohorts' performances are compared against a common efficient frontier.

Almost a decade ago, Berger and deYoung (2006) reported that in Latin America, in transition states of Eastern Europe and in other regions, regulatory barriers to foreign bank entry were being lowered. A similar process unfolded in China in the first half of the 21st Century but foreign banks in China are still growing as they open more branches. According to PricewaterhouseCoopers (2012, p.21) "They are yet to benefit from increases in operational efficiency and economies of scale". This quotation further motivates the current article to measure the operational or technical efficiency of foreign banks against domestic banks, where *technical efficiency* is defined as the efficiency of banking operations in converting key financial inputs to financial outputs that comprise bank

intermediation. Furthermore, the article extends the benchmarking analysis to exploring the impact of various firm-specific factors on shaping inefficiency (discussed in the next section).

In section two, the rest of the article unfolds with an overview of literature on bank efficiency and a brief discussion of how to model bank intermediation, followed by section three outlining data and method. Section four reports main findings, and section five offers concluding remarks.

2. Literature on bank efficiency and modeling bank intermediation

A number of older publications have also compared the performance of domestic banks against foreign banks in various countries. For example, Berger et al. (2009) make a general statement that, on average, foreign banks are usually more efficient than or at least as efficient as private domestic banks, and more efficient than state-owned banks in developing nations; their study is based on stochastic frontier analysis (SFA) estimates of profit and cost efficiency of thirty-eight Chinese banks across 1994-2003. On the other hand, Lensink et al. (2008) who use SFA on a sample of 2095 banks across 105 countries (1998-2003) report a general finding of *less* (cost) efficient foreign banks. An earlier study that has also found *less* (profit) efficient foreign banks is Hasan and Marton's (2003) SFA on the transitional economy of Hungary. Claessens et al (2001) suggest that market inefficiencies and outmoded banking practices in developing countries should give an advantage to foreign banks, who might suffer an information disadvantage as they attempt to enter more developed markets, a conclusion also affirmed by Berger (2007). This is consistent with what Berger et al (2000) refer to as the distinction between the global advantage and home field hypotheses.

Consistent with the prior research, we would expect that domestic Chinese banks would be able to use their banking relationship advantages to be relatively more successful at generation of interest income. By contrast, because of their weaker local relationships but greater technical capabilities, the foreign-owned banks should be more successful at generation of non-interest income. Furthermore, given the somewhat mixed findings in literature, it is worthwhile to continue to benchmark foreign banks against domestic banks using more up-to-date data. In the case of the Chinese banking sector, a comparison is timely following the major banking reforms of the 21st Century where spillover effects

would have opened the door for domestic banks to catch up with foreign banks in terms of more efficient operations. Table 1 in Lensink et al. (2008, p.836) provides a broader summary of the findings in literature on the efficiency of foreign versus domestic banks.

The traditional intermediation executed by banks comprises incurring *interest expense* and *non-interest expense* to generate deposits, followed by writing loans to generate *interest income* (a major source of revenue for commercial banks) and *non-interest income* from service fees and sales commissions. Thus, in the current performance benchmarking exercise the objective of banks is considered as implementing this intermediation process to operate profitably. As such, accounting for both cost and revenue sides of the business ledger under profitability modelling is superior to cost efficiency modeling (Berger et al. 2009). The main performance test uses the parsimonious set of discretionary key inputs and principal financial outputs mentioned above to generate a parametric efficiency estimate for each bank using SFA. Yao et al. (2008), Jiang et al. (2009) and Avkiran (2011) use similar variables for Chinese banks.

Various firm-specific factors designed to explain inefficiencies are incorporated into SFA. For example, market share (of a bank's assets) can be a proxy measure for capturing scale of operations. Other firm-specific factors include cost-to-income as an overall efficiency ratio used by industry analysts; impaired loans-to-gross loans (or, non-performing loans ratio) as a measure of credit or asset quality; and interbank ratio as a measure of liquidity (ratio of *due from* banks to *due to* banks).[3] Another financial ratio of interest is the loan-to-deposit ratio; this ratio can be used as a firm-specific factor to acknowledge the impact of regulation on efficiency. For example, the loan-to-deposit ratio is decreed to not exceed 75% for all banks operating in China. This may limit the ability of foreign banks that operate smaller branch networks to raise deposits - with consequential lending limitations.

3. Data and method

The study examines years 2008 – 2010 to measure the performance of commercial banks in China. The sample excludes the three wholly state-owned policy banks and five joint-stock banks that

[3] The interbank ratio is the ratio of funds lent to other banks divided by funds borrowed from other banks. A ratio greater than 1 indicates that the bank is a net lender in the interbank market and is therefore more liquid.

are majority state-owned. Following reforms discussed in the introduction, 2008 marks the first reporting period that captures the operations for foreign banks when they can be considered as providing a range of products and services similar to domestic banks. The main data source was Wharton's Research Data Services and BankScope (by Bureau van Dijk). After accounting for missing data, we were left with 16 locally incorporated foreign banks and 32 domestic banks that consistently had data across all the variables for the three-year study period. In this sample, four of the Big Six foreign banks[4] and eight countries, as well as the main domestic commercial banks are represented (see Table 1). Thus, we obtain a balanced panel sample of 48 banks for 3 consecutive years from 2008 to 2010 for a total of 144 bank-year observations.

SFA is used to compare the performance of foreign banks in China against domestic banks. SFA is a parametric efficiency measurement method that explains the variation in organizational performance in terms of managerial efficiency, operating environment and statistical noise. Because SFA efficiency measures use the estimated average parameter values in the regression equation, efficiency estimates are not highly sensitive to large data changes at the organizational level. Fries and Taci (2005) claim SFA to be more appropriate in situations where measurement errors are more likely – such as transition economies.

Similar to the studies by Jiang et al. (2009) and Deng et al. (2011) on Chinese bank efficiency, this study relies on the one-step model proposed in Battese and Coelli (1995). The model consists of a production function and an inefficiency function where the two functions are solved in a single step. The panel model allows estimating both technical changes in the stochastic frontier and time-varying technical inefficiencies. As Lensink et al. (2008) point out, Battese and Coelli's one-step model has the advantage of estimating the efficient frontier and coefficients simultaneously, thus avoiding biased coefficients. In the current study, initially total income, defined as *interest income plus non-interest income,* becomes the dependent variable. The stochastic frontier function for panel data using the Cobb-Douglas function with two inputs is shown in the production function depicted in equation (1):

[4] According to PricewaterhouseCoopers (2012, p.21) "The Big Six banks, Bank of East Asia (BEA), Citibank, DBS, Hang Seng, HSBC and Standard Chartered Bank, together hire over 26,000 employees. Together these banks predict that by 2015, collectively they will employ over 41,000 people."

Production function: $ln(y_{it}) = \beta_0 + \beta_1 \ln(x_{1,it}) + \beta_2 \ln(x_{2,it}) - u_{it} + v_{it}$ (1)

Inefficiency function: $u_{it} = z_{it}\delta + W_{it}$

where $ln(y_{it})$, is the natural logarithm of total income and denotes the production in period *t* (*t* =1, 2, 3) for the *i*-th firm (*i* =1, 2, …, N); $\ln(x_{1,it}), \ln(x_{2,it})$, are the logarithm of the inputs of production associated with the sampled firms at time *t* (interest expense and non-interest expense), and v_{it} is the error term i.i.d. normally distributed. u_{it} is the inefficiency term comprised of two parts where W_{it} is defined by the truncation of the normal distribution with zero mean and variance σ^2, and $z_{it}\delta$ is the mean of inefficiencies modeled as a linear function of a vector of firm-specific factors. The SFA panel regression model does not require specification of the direction of impact of firm-specific factors, which can be observed from the signs of the parameters.

There are six firm-specific variables in the inefficiency equation to explain bank inefficiencies, comprised of five financial ratios and a foreign bank indicator variable. As a test of functional robustness, we also report results from a Translog function model (see Christiansen et al. 1971, 1973) – which introduces a nonlinear relationship between the output (i.e. dependent variable) and the production factors by including a second order approximation of an initially linear-homogenous production. Hence, in the Translog model shown in equation (2), the second order of the input variables are added to the two inputs of production shown in equation (1). Translog production function provides a broader basis to describe the relationship between the output and input levels because the output variable may be correlated with higher order input variables.

Production function:

$$ln(y_{it}) =$$

$$\beta_0 + \beta_1(\ln x_{1,it}) + \beta_2 \ln(x_{2,it}) + \frac{1}{2}\beta_3(\ln x_{1,it})^2 + \frac{1}{2}\beta_4(\ln x_{2,it})^2 + \beta_5 \ln x_{1,it} * \ln x_{2,it} -$$

$$u_{it} + v_{it} \quad (2)$$

Inefficiency function: $u_{it} = z_{it}\delta + W_{it}$

As part of the robustness testing of the output variable, the dependent variable is split into its original components and two more models are independently tested based on interest income (1st robustness test) and non-interest income (2nd robustness test). Repeating Cobb-Douglas and Translog based tests with *interest income* as the dependent variable benchmarks foreign banks against domestic banks' traditional strength. Similarly, when *non-interest income* is used as the dependent or output variable, domestic banks are benchmarked against foreign banks' traditional strength, i.e. generating fees and commissions.

4. Results

Results from the main test based on Cobb-Douglas where total income is the output variable indicate a wide range of efficiency estimates (0.1425-0.9914) – sign of a discriminating analysis. Examining the two groups' overall mean efficiency estimates (foreign 0.5205, domestic 0.8160) and mean ranks (foreign 118, domestic 50) across 2008-10 indicates the foreign bank group to be substantially less efficient. Independent samples *t*-test and Wilcoxon rank sum test on the equality of distributions for foreign versus domestic banks efficiency estimates both reject the null that the estimates come from the same distribution at the 0.0001 level – thus adding statistical confidence to the key observation already made.

Table 1 shows banks sorted within the two groups on the initial 2008 ranks generated by the main test; this format allows monitoring of changes in ranking for a given bank across three years. For example, Citibank tops the ranks of the foreign banks in 2008 but is overtaken by Bank International Ningbo (from Singapore), initially in second place, in 2009 and 2010. When we follow these foreign banks under the output variable robustness tests, we notice that Bank International Ningbo is consistently ranked higher than Citibank under the 1st robustness test where the output variable in SFA is interest income only. On the other hand, under the 2nd robustness test, Citibank is consistently ranked higher than Bank International Ningbo and both banks occupy higher ranks in their efficiency to generate non-interest income compared to interest income. We also note that the mean rank for the domestic bank group for each year is higher than that of the foreign bank group – highlighting a

consistently higher efficiency for domestic banks under the main test and the 1st robustness test. This relationship is reversed under the 2nd robustness test where foreign banks are ranked higher in their generation of non-interest income.[5] Among domestic banks, China Merchants Bank occupies the first position in 2008-2009 but is overtaken by Shanghai Pudong Development Bank in 2010.

[Insert Table 1 about here]

SFA parameters using the output variable *total income* are reported in Table 2. Under the main test, the Cobb-Douglas production function is well-specified because all the input variables are highly significant. The signs of various coefficients are also as expected. A positive relationship between the output variable and input variables shown in the production function suggests that total income rises with an increase in different expense components that are part of the intermediation process.

[Insert Table 2 about here]

The estimated coefficients in the inefficiency function in Table 2 are of particular interest because they explain how firm-specific factors shape bank efficiency. For example, the positive coefficient for cost-to-income ratio is consistent with the expectation that higher costs would be encountered in more inefficient operations. This intuitive finding brings further confidence to modeling. Similarly, a positive coefficient for interbank ratio (the liquidity measure) suggests that a bank with a higher interbank ratio would have difficulty converting deposits to commercial or consumer loans and would instead lend to other banks in the wholesale market at narrower interest margins. This reduction in margins is captured as inefficiency in generating total income. In the breakdown of total income, we find this relationship also explains inefficiency in *interest income* generation (see first robustness test in Table 2). However, as would be expected, a higher *interbank ratio* corresponds to higher generation of *non-interest income* because a bank unable to maximize traditional lending activities would focus on fee and commission based business instead (see second robustness test in Table 2).

In the main test, the strongest relationship is seen between market share and inefficiency. All else the same, the high negative coefficient for market share implies that a bank producing income more

[5] Full set of rankings based on the first and second robustness tests are available from the corresponding author.

efficiently or operating more profitably is likely to expand its scale of operations. A similar effect of market share is not found in generation of *non-interest income* evidenced by the insignificant coefficient of market share in the last column of Table 2 (although the sign is still negative). A possible explanation is that banks engaged in non-interest income generating business do not find expanding branches beneficial to collecting more fees and commissions.

The insignificant coefficient for the impaired loans-to-gross loans ratio in the first two tests in Table 2 suggests that non-performing loans are properly managed and do not have a substantial impact on efficiencies of *total income* and *interest income* generation. This can be construed as a characteristic of the high-growth Chinese economy where regulators and managers both consider non-performing loans as an acceptable price to pay for growth. In contrast, a significant association is found between impaired loans-to-gross loans ratio and inefficiency when *non-interest income* is used as the dependent variable. More important, the positive and significant coefficient of the foreign bank dummy variable where total income is the dependent variable suggests that foreign banks are *less* efficient than domestic banks. However, this conclusion is mainly due to the interest income generating business because we find the relationship is reversed in explaining non-interest income, i.e. foreign banks emerge as more efficient as would be anticipated. The insight gained through the dummy variable supports observations made earlier using Table 1.

In additional tests of robustness, the three tests in Table 2 are repeated using the Translog production function in equation (2). We find that the two inputs are still significant using *total income* and *interest income* as dependent variables, while their second order terms and the intersection term of inputs are mainly insignificant (see Table 3). The evidence suggests that adding the second order terms does not bring more power to explaining the output. The results indicate the relationship between output and inputs to be linear (Cobb-Douglas function) rather than non-linear (Translog). Results of the inefficiency function in Table 3 for the three tests are similar to Table 2, and more

importantly, the conclusion that domestic banks outperform foreign banks still holds in the first two tests where the dependent variables are total income and interest income, respectively. [6]

[Insert Table 3 about here]

The overall conclusion that domestic banks outperform foreign banks is consistent with the findings of Lensink et al. (2008) who report foreign ownership affects bank efficiency negatively. Hasan and Marton (2003) also find foreign banks are less efficient in a transitional economy. Furthermore, the significant goodness-of-fit, coupled with mostly statistically significant production and inefficiency function variables, indicate the presence of inefficiency and the overall strong explanatory power of the models. Summing up, the results in Tables 1, 2 and 3 suggest that domestic banks outperform foreign banks in generating total income or interest income but underperform foreign banks in generating non-interest income. It appears that both types of banks have maintained their traditional strengths in the early years following major reforms in the 21st Century.

5. Concluding remarks

SFA reports discriminating results regarding foreign banks being less efficient against domestic banks' traditional strengths and vice-versa. Rankings based on efficiency estimates can be used by bank management interested in developing a better understanding of their positioning in the industry. The findings can also be used by regulators for comparison against in-house ratings, as well as highlighting those banks that may need more scrutiny. Other reasons for multivariate benchmarking can be traced to the framework of Basel III which is expected to be fully implemented by 2019. That is, interconnectedness of the global financial system means peer comparisons are likely to be more important than simply checking a list of regulatory boxes for institutions. For example, as bankers consider entering the Chinese market, foreign banks that stand out under the main test as potential

[6] In the preceding tests, only one output was used in each model. To accommodate multiple outputs, we experiment with an output distance function (see Kumbhakar and Lovell, 2000) which simultaneously includes the outputs of *interest income* and *non-interest income*. The unreported results available from the corresponding author show the distance function model cannot discern well the inefficiency levels in our sampled banks evidenced by the low gamma value of 0.03 with a *p*-value of 0.76. These values suggest that the distance function setup is insignificant at the equation level and hence not appropriate to be used in the context of the current study.

candidates for emulation include Citibank of USA and Bank International Ningbo of Singapore. Among the domestic banks, top performers are two joint stock commercial banks, China Merchants Bank and Shanghai Pudong Development Bank.

While there are no hard facts regarding the comparative efficiency of domestic versus foreign banks across different countries, the key finding of this study can be explained by how foreign banks have been establishing themselves in China, as well as learning effects enjoyed by domestic banks through spillovers. For example, *green field* investments often encountered in China are more costly because a foreign bank builds a branch network from scratch, including recruiting and training staff – as well as working on reputation – the costs of which have to be spread across a number of years. Equally important, during the initial years of operation when a foreign bank is competing against domestic banks, cost control is likely to be considered as of secondary importance because of the focus on expanding market share.

Findings on firm-specific factors explaining inefficiency indicate that the cost-to-income ratio commonly used in banking industry explains inefficiency observed in income generation, i.e. a higher ratio is associated with greater inefficiency. On the other hand, the association between inefficiency and market share is strongly negative, suggesting that more efficient income generation is associated with capturing greater market share as predicted by the efficient structure hypothesis (Berger 1995; Homma et al. 2014). Nevertheless, when the focus shifts to non-interest income only, the above relationship becomes statistically insignificant – pointing to a weaker link between branch network expansion and revenues from fees and commissions.

Finally, foreign banks are looking to expand services as renminbi internationalizes and interest rates are liberalized. Moving forward, foreign banks may focus their future activities in the following:

- Derivatives, interest rate and currency swaps, and bonds;
- Wealth management;
- Global expertise for Chinese corporations expanding offshore; and

- A number of Strategic Emerging Industries identified in the Chinese government's 12th five-year plan: biotechnology, new energy, high-end manufacturing, energy conservation and next generation IT (PricewaterhouseCoopers 2012) where foreign banks can rely on their overseas experience.

These issues reflect the difficulties that foreign banks are likely to face in overcoming the liability of foreignness, which makes it difficult for them to compete head on with mainstream Chinese banks. It will take time for Chinese consumers to become familiar with international bank brands, which means that unless a foreign bank acquires a Chinese bank, the foreign banks are likely to remain in a relatively disadvantaged position for some time.

References

Avkiran, N.K. 2011. Association of DEA super-efficiency estimates with financial ratios: Investigating the case for Chinese banks. *OMEGA-International Journal of Management Science* 39, 323-334.

Battese, G.E., Coelli, T.J. 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics* 20, 325-332.

Beck, T., Martinez Peria, M.S. 2010. Foreign bank participation and outreach: evidence from Mexico. *Journal of Financial Intermediation* 19, 52-73.

Berger, A.N. 1995. The profit-structure in banking-tests of market power and efficient-structure hypotheses. *Journal of Money, Credit, and Banking* 27, 404-431.

Berger, A.N. 2007. International comparisons of banking efficiency. *Financial Markets, Institutions and Instruments* 16. 119-144.

Berger, A.N., deYoung, R. 2006. Technological progress and the geographic expansion of the banking industry. *Journal of Money, Credit and Banking* 38(6), 1483-1513.

Berger, A.N., deYoung, R., Genay, H., Udell, G. 2000. Globalization of financial institutions: evidence form cross-border banking performance. *Brookings-Wharton Papers on Financial Services* 3. 23-158.

Berger, A.N., Hasan, I., Zhou, M.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., Wachtel, P. 2005. Privatization matters: bank efficiency in transition countries. *Journal of Banking & Finance* 29, 2155-2178.

China Banking Regulatory Commission 2006. Regulations of the People's Republic of China on Administration of Foreign-funded Banks. http://www.cbrc.gov.cn/EngdocView.do?docID=20080116D0F770B46656D8DAFF4313B4992E4E00.

Christensen, L, Jorgenson, D., Lau, L. 1973. Transcendental logarithmic production frontiers. *The Review of Economics and Statistics* 55(1), 28-45.

Christensen, L., Jorgenson, D., Lau, L. 1971. Conjugate duality and the transcendental logarithmic production function. *Econometrica* 39, 255-256.

Claessens. S., Demirgüç-Kunt, A., Huizinga, H. 2001. How does foreign entry affect domestic banking markets. *Journal of Banking & Finance* 25. 891-911.

Deng, Z., Guo, H., Kong, G. 2011. Efficiency spillovers of foreign direct investment in the Chinese banking system. *Global Economic Review* 40, 179-191.

Fries, S., Taci, A. 2005. Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking & Finance* 29, 55-81.

García-Herrero, A., Gavíla, S., Santabárbara, D. 2006. China's banking reform: An assessment of its evolution and possible impact. *CESifo Economic Studies* 52(2), 304-363.

Guillen, M., Tschoegl, A. 2000. The internationalization of retail banking; the case of the Spanish banks in Latin America. *Transnational Corporations* 9(3), 63-98.

Hasan, I., Marton, K. 2003. Development and efficiency of the banking sector in a transitional economy: Hungarian experience. *Journal of Banking & Finance* 27, 2249-2271.

Homma, T., Tsutsui, Y., Uchida, H. 2014. Firm growth and efficiency in the banking industry: A new test of the efficient structure hypothesis. *Journal of Banking & Finance* 40, 143-153.

Jiang, C.X., Yao, S.J., Zhang, Z.Y. 2009. The effects of governance changes on bank efficiency in China: A stochastic distance function approach. *China Economic Review* 20, 717-731.

Jones, G. 1993. *British Multinational Banking, 1830-1990.* Clarendon Press: Oxford (England).

Kumbhakar, S.C., Lovell, C. 2000. Stochastic frontier Analysis. University Press, Cambridge.

Lensink, R., Meesters, A., Naaborg, I. 2008. Bank efficiency and foreign ownership: Do good institutions matter? *Journal of Banking & Finance* 32, 834-844.

Lin, H.D. 2011. Foreign bank entry and firms' access to bank credit: Evidence from China. *Journal of Banking & Finance* 35, 1000-1010.

Miller, S.R., Parkhe, A. 2002. Is there a liability of foreignness in global banking? An empirical test of banks' X-efficiency. *Strategic Management Journal* 23, 55-75.

PricewaterhouseCoopers 2012. *Foreign banks in China*, July.

To, H.M., Tripe, D.W.L. 2002. Factors influencing the performance of foreign-owned banks in New Zealand. *Journal of International Financial Markets, Institutions and Money* 12, 341-357.

Tschoegl, A.E. 1987. International retail banking as a strategy: an assessment. *Journal of International Business Studies* 18(2), 67-88.

Xu, Y. 2011. Towards a more accurate measure of foreign bank entry and its impact on domestic banking performance: The case of China. *Journal of Banking & Finance* 35, 886-901.

Yao, S.J., Han, Z.W., Feng, G.F. 2008. Ownership reform, foreign competition and efficiency of Chinese Commercial Banks: A non-parametric approach. *The World Economy* 31, 1310-1326.

Table 1

Relative efficiency ranks of Chinese banks sorted on year 2008 (main test) [a]

	2008	2009	2010
Foreign banks in China (N=16) and their home countries			
Citibank (China) [b] [United States of America]	73	102	104
Bank International Ningbo [Singapore]	78	101	85
Bank of Tokyo Mitsubishi UFJ (China) [Japan]	79	106	108
Crédit Agricole CIB (China) [France]	90	113	119
Royal Bank of Scotland (China) [United Kingdom]	91	138	142
HSBC Bank (China) [b] [United Kingdom]	95	116	109
Woori Bank (China) [Korea]	112	121	111
Standard Chartered Bank (China) [b] [United Kingdom]	114	120	117
Mizuho Corporate Bank (China) [Japan]	115	125	132
Hana Bank (China) [Korea]	118	127	129
Fubon Bank (Hong Kong) [Taiwan]	122	110	123
Nanyang Commercial Bank (China) [Hong Kong]	126	137	124
United Overseas Bank (China) [Singapore]	131	128	130
Hang Seng Bank (China) [b] [Hong Kong]	136	139	134
CITIC Ka Wah Bank (China) [Hong Kong]	140	135	133
Société Générale (China) [France]	144	143	141
Mean group rank (main test)	*110*	*123*	*121*
Mean group rank (1st robustness test)	*114*	*121*	*121*
Mean group rank (2nd robustness test)	*57*	*69*	*63*
Chinese domestic banks (N=32)			
China Merchants Bank	2	7	4
China CITIC Bank	6	10	3
Shanghai Pudong Development Bank	9	8	1
China Everbright Bank	13	19	12
Bank of Beijing	14	18	25
Industrial Bank	15	16	5
China Minsheng Banking	17	20	11
Huaxia Bank	21	26	24
Bank of Guangzhou	23	72	22
Shenzhen Development Bank	28	41	32
China Guangfa Bank	29	43	27
Bank of Shanghai	33	40	31
Huishang Bank	36	46	34
Shengjing Bank	37	30	35
Bank of Nanjing	38	45	39
Guangzhou Rural Commercial Bank	44	49	42
Bank of Ningbo	52	64	50
Harbin Bank	53	74	51
Nanchong City Commercial Bank	57	81	55
Bank of Dongguan	59	77	56
Bank of Hangzhou	60	99	58
Hankou Bank	60	99	58
China Zheshang Bank	62	84	61
Bank of Jilin	65	89	63
Shanghai Rural Commercial Bank	68	67	66
Beijing Rural Commercial Bank	70	71	69
Fujian Haixia Bank	76	80	75
Bank of Qingdao	83	87	82
Bank of Wenzhou	88	98	86
Fudian Bank	93	103	92
Bank of Fuxin	96	97	94
Chong Hing Bank	107	100	105
Mean group rank	*47*	*57*	*46*
Mean group rank (1st robustness test)	*47*	*57*	*44*
Mean group rank (2nd robustness test)	*74*	*82*	*76*

[a] In the main test, total income is the output variable specified in SFA and the bank-specific ranks reported in Table 1 are from the main test. Under the 1st robustness test, interest income becomes the output, and non-interest income is the output under the 2nd robustness test.

[b] Belongs to the group of Big Six foreign banks.

Table 2

Stochastic frontier balanced panel model parameters (Cobb-Douglas Function) [a]

	(Main test)	(1st robustness test)	(2nd robustness test)
Dependent variable	Interest income plus non-interest income (total income)	Interest income	Non-interest income
Production function [b]			
Intercept	2.08(0.000)	2.14(0.000)	0.15(0.467)
Interest expense	0.35(0.000)	0.45(0.000)	0.02(0.849)
Non-interest expense	0.55(0.000)	0.44(0.000)	0.91(0.000)
Inefficiency function (firm-specific factors)			
Intercept	0.09(0.035)	0.30(0.000)	-37.41(0.001)
Impaired loans-to-gross loans (asset quality) [c]	-0.34(0.165)	-0.38(0.129)	9.203(0.002)
Interbank ratio (liquidity)	0.004(0.005)	0.003(0.016)	-0.18(0.021)
Loan-to-deposit ratio (regulation)	0.15(0.002)	-0.04(0.606)	10.12(0.004)
Cost-to-income ratio (overall efficiency)	0.46(0.000)	0.40(0.000)	14.02(0.000)
Market share (scale of operations)	-41.77(0.000)	-22.59(0.000)	-1.43(0.192)
Foreign bank dummy	0.15(0.000)	0.33(0.000)	-24.32(0.001)
Goodness-of-fit	0.67(0.000)	0.99(0.000)	0.99(0.000)
LR test of the one-sided error	227.56	117.92	213.89
Number of observations	144	144	144
Mean efficiency estimate	0.7175	0.6311	0.4623

[a] SFA model assumes a truncated normal distribution of inefficiencies.

[b] All the variables take logarithm values in the production functions.

[c] Non-performing loans ratio.

Table 3

Stochastic frontier balanced panel model parameters (Translog Function) [a]

	(Main test)	(1st robustness test)	(2nd robustness test)
Dependent variable	Interest income plus non-interest income (total income)	Interest income	Non-interest income
Production function [b]			
Intercept	1.52(0.000)	1.63(0.000)	-0.50(0.446)
Interest expense	0.31(0.000)	0.32(0.000)	0.34(0.305)
Non-interest expense	0.72(0.000)	0.6(0.000)	0.79(0.115)
Interest expense, squared	0.13(0.000)	0.06(0.076)	0.20(0.185)
Non-interest expense, squared	0.07(0.058)	-0.02(0.672)	0.34(0.229)
Interest and non-interest expense, intersection	-0.11(0.000)	-0.01(0.724)	-0.28(0.161)
Inefficiency function (firm-specific factors)			
Intercept	-0.01(0.807)	0.11(0.019)	-43.64(0.000)
Impaired loans-to-gross loans (asset quality) [c]	-0.18(0.198)	-0.36(0.223)	9.63(0.000)
Interbank ratio (liquidity)	0.003(0.002)	0.002(0.136)	0.02(0.924)
Loan-to-deposit ratio (regulation)	0.08(0.013)	-0.11(0.116)	10.25(0.000)
Cost-to-income ratio (overall efficiency)	0.55(0.000)	0.42(0.000)	13.77(0.000)
Market share (scale of operations)	-7.41(0.003)	-3.97(0.145)	-1.63(0.121)
Foreign bank dummy	0.12(0.000)	0.27(0.000)	-22.01(0.000)
Goodness-of-fit	0.99(0.085)	0.99(0.000)	0.99(0.000)
LR test of the one-sided error	257.37	139.81	208.15
Number of observations	144	144	144
Mean efficiency estimate	0.7301	0.7356	0.4746

[a] SFA model assumes a truncated normal distribution of inefficiencies.

[b] All the variables take logarithm values in the production functions.

[c] Non-performing loans ratio.