Financial Market Development and Bank Efficiency: A Cross-country Analysis

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Abstract

This paper examines the causal relationship between banking efficiency and capital market development using aggregate data of more than 130 countries during the period of 2007 to 2011. By employing the structural equations model (SEM) and the three-stage least squares (3SLS) approaches to estimate that causality, we can overcome the simultaneous bias problem while testing the four hypotheses on the association between banking efficiency, capital market development, ease of access to bank loans, and ease of raising funds through the capital market.

Empirically, we found that banking systems around the World were still inefficient, suggesting that that it would take time for the global banking system to overcome the impact of the global financial crisis (GFC) 2007/08. More importantly, there is evidence that the deeper the capital market is, the less efficient its banking system would be. In contrast, banking efficiency can positively influence the development of the capital market. Thus, we suggest that for any economy around the World, an improvement in banking performance and efficiency rather than capital market should be a priority.

Keywords: financial market, banking efficiency, data envelopment analysis, structural equations model, 3SLS

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1. Introduction

The financial sector plays an essential role in any economy. Levine (2005) classified functions of the financial sector into five categories as (1) producing information ex-ante about possible investment and allocating capital; (2) monitoring investments and exerting corporate governance after providing finance; (3) facilitating the trading, diversification, and management of risk; (4) mobilising and pooling savings; and (5) easing the exchange of goods and services. Since the rapid development of financial market, the interaction of banks and capital markets is emphasised in the literature. Economic theory suggests banks and capital markets can be seen as competing sources of financing because one sector develops at the expense of the other (Jacklin & Bhattacharya, 1988; Allen & Gale, 1999). However, these intermediaries can be also considered as complementary to one another, especially in the case of securitisation. Banks firstly determine credit quality of borrowing firms and then the capital market finances the borrowers, thus mitigating financing frictions. In turn, capital market development reduces the cost of bank equity capital that enables banks to raise the extra capital needed to expand loan activities and riskier investments (Song & Thakor, 2010). Consequently, researchers should be aware of a 'two-way nexus' between the banking system and the capital market (Bossone, 2010).

Most studies examined the significance of bank monitoring and screening in capital market development and indicated a positive relationship. If banks effectively assess credit quality, then granting and renewing bank loans, this should provide positive signals to outside investors, especially in the case of newly-established borrowers (Fama, 1985; Diamond, 1991). In addition, others also indicated that bank lending reduces the information costs related to accessing equity and securities markets. Existing borrowing relationship with banks would either reduce under-pricing for firms when IPOs (James & Wier, 1990) or lower the cost of external debt capital (Datta et al., 1999), thus supporting the view that banking relationships are valuable in the pricing of corporate public debt. In the same line, Drucker and Puri (2007) also found that issuers with prior lending relationships achieve significantly lower underwriter spreads and, for underwriter, this relationship improves the likelihood of receiving underwriting business. In addition, recent studies on the relationship between banking efficiency and stock market performance show mixed results. Several studies suggested the positive relationship between cost efficiency changes and stock returns

(Beccalli et al., 2006; Liadaki & Gaganis, 2010). However, others reported the opposite results, for example, in Asia and Latin America (Ioannidis et al., 2008).

Bossone and Lee (2004) proposed the 'systemic scale economies' hypothesis and found that the cost-efficiency effects of technological changes are accelerated for banks operating in deeper and more efficient capital markets. They also found that small banks in large markets are more cost-efficient than those in small systems. Therefore, they suggested that larger capital markets would improve banking efficiency.

In contrast with previous studies, this study investigates the causal relationship of banking efficiency and capital market development by using the structure equation model (SEM) and three-stage least squares (3SLS) approaches. Data Envelopment Analysis (DEA) with the use of financial ratios is employed to arrive at efficiency scores in the first stage and those efficiency scores will be linked with the development index of the capital markets in the second stage using SEM. Therefore, this study would help to shed a light on whether banking efficiency would enhance capital market development and vice versa.

In what follows, Section 2 proposes a detailed description of methodological approach and the data used in this study. Section 3 discusses the empirical results derived. Finally, section 4 concludes the paper.

2. The Empirical Models and Data

2.1. First-stage: Estimating the efficiency of various banking systems

Bank efficiency is popularly measured by Data Envelopment Analysis (DEA),[1] a nonparametric tool of the frontier approach. Another tool is stochastic Frontier Analysis (SFA), which belongs to the parametric method. We, however, choose DEA because it is less prone than SFA to specification error (Reinhard et al., 2000) and thus is more flexible.[2]

In DEA, the efficiency of a bank (or a Decision Making Unit – DMU) is measured by its ability to convert inputs into outputs.[3] For a set of n firms each using m inputs x_i

[1] A recent survey by Liu et al. (2013) pointed out that among 3134 non-theoretical research papers that employed DEA as the main methodology, the number of studies on the banking sector was the highest at 323 papers (about 10.31%).

[2] More details information about DEA and/or SFA are available in, for example, Cooper et al. (2006).

[3] One can argue that the bank achieves the highest efficiency if it can produce the most outputs from the given inputs (output-oriented), or if it can minimize the inputs used to produce a given set of outputs (input-oriented). For simplification, we assume a constant-returns-to-scale (CRS) situation where efficiency scores estimated from the two orientations are identical.

($i=1,\ldots,m$) to produce s outputs y_r ($r=1,\ldots,s$), Charnes et al. (1978) introduced the basic CRS DEA model as

$$EF_{j_0} = max_{u,v} \frac{\sum_r^s u_r y_{rj_0}}{\sum_i^m v_i x_{ij_0}} \quad (1)$$

subject to: $\frac{\sum_r^m u_r y_{rj}}{\sum_i^k v_i x_{ij}} \leq 1, \quad j = 1,..,n,$

$u_r, v_i \geq 0, \quad r = 1,..,s, \quad i = 1,..,m,$

Our approach is slightly different from the CRS DEA model above. In this article, we extend the idea of Ngo (2011) and argue that the whole banking system in an economy can be treated as a DMU, with the inputs and outputs are consequently measured at the aggregate or national level.[4] However, our study is different from Ngo (2011) as we overcome the pitfall of "mixing indices and volume measures" (Dyson et al., 2001) by using indices for all inputs and outputs,[5] following Avkiran (2011).

Allen and Carletti (2008) argued that although the relative importance of the different roles of banks varies substantially across countries, one of the most essential roles of banking system is to eliminate the information problems between investors and borrowers by monitoring the latter and ensuring a proper use of the depositors' funds. Following this intermediation[6]-alike approach, we argue that any banking system will try to maximize the amount of credit provided to the private sector as well as its net interest margin using the given deposits and overhead costs.[7] Therefore, our DEA model will evaluate the (output-oriented) technical efficiency of the banking systems among countries in terms of pursuing this goal.

Accordingly, our DEA model consists of two inputs and two outputs. The first input is the percentage of bank deposits to GDP ($Deposits$), which measures demand, time and saving deposits in deposit money banks (or commercial banks) as a share of GDP. The second input is bank overhead costs to total assets ($OCosts$), measured by the accounting value of a bank's overhead costs as a share of its total assets. Meanwhile, the

[4] In a similar manner but at regional level, Hasan et al. (2009) mapped all banks in the same region (or NUTS: Nomenclature des unites territoriales statistiques) and aggregated their financial data into the regional data.

[5] Dyson et al. (2001) argued that mixing indices and volume measures in DEA can lead to incorrect results in the efficiency scores. To deal with it, previous studies such as Halkos and Salamouris (2004); Depotis (2005); Ngo (2011) used unity as a dummy input while all indices were treated as outputs.

[6] This approach takes financial institutions as intermediaries standing between savers/lenders and borrowers/investors (Sealey & Lindley, 1977; Berger & Humphrey, 1997).

[7] For individual banks, it is common in DEA to evaluate their technical efficiency in terms of using labour costs to transfer deposits/borrowed funds into credit/loans and earnings (e.g. Gonzalez-Hermosillo, 1999; Beccalli et al., 2006; Hasan et al., 2009).

outputs are private credit to GDP ($Credit$) accounting for the credit by commercial banks to the private sector as a share of GDP and net interest margin (NIM) accounting for the value of bank's net interest revenue as a share of its interest-bearing assets (see Table 1).

2.2. Second-stage: Causality between the banking system and the capital market

A normal two-stage model ends up using (e.g. OLS, Tobit or truncated) regressions in the second stage to analyse the determinants of the efficiency scores estimated from the first stage (e.g. Hasan et al., 2009; Avkiran, 2011). This approach assumes that banks' efficiency depend on those determinants in a one-way direction: they can affect the efficiency scores but not vice-versa.

In contrast, some studies argued that a two-way nexus exists between banks' efficiency and other environmental factors. For example, Berger and DeYoung (1997) found an intertemporal relationship between problem loans (which is an environmental factor) and cost efficiency of U.S. commercial banks between 1985 and 1994 and suggested that a Granger-causality analysis is more appropriate. Such kind of causality between efficiency and other factors has also been analysed by Bossone and Lee (2004) using the iterative seemingly unrelated regression, or by Chortareas et al. (2011) using the dynamic generalized methods of moments. Consequently, we argue that the one-way analysis may suffer from the simultaneous bias (Wooldridge, 2016) and a two-way analysis for the relationship between banking efficiency and capital market development is needed. In this study, however, we employ the structural equations model (SEM) to analyse that causal relationship because SEM can answer a set of interrelated questions in a single, systematic, and comprehensive analysis (Gefen et al., 2000) by modelling the relationship between banking's efficiency and capital market's development simultaneously. Generally, our SEM is formed as follows

$$EF = \alpha_1 + \beta_1 CAP + \delta_1 EASY \quad (2)$$

$$CAP = \alpha_2 + \beta_2 EF + \delta_2 EQUITY \quad (3)$$

where EF and CAP are two endogenous variables and $EASY$ and $EQUITY$ are two instrumental variables.

EF represents the efficiency of the banking system and is obviously the efficiency scores estimated from the first stage DEA (see section 2.1 above). Following Fama

(1985) and Diamond (1991), we expect to see a positive relationship between EF and CAP. Thus, our first hypothesis is stated as

H1: The more efficient the banking system in a country is, the deeper its capital market is.

CAP is defined as the value of listed shares in the capital market to GDP. It is commonly used in the literature to proxy for the size of stock or capital markets (Cihak et al., 2012). Since our study employs a dataset of more than 130 countries, we follow the argument on the positive linkage between CAP and EF, as this relationship was found in the European region (Beccalli et al., 2006; Liadaki & Gaganis, 2010) as well as globally (Bossone & Lee, 2004). Consequently, our second hypothesis is

H2: The deeper the capital market in a country is, the more efficient its banking system is.

$EASY$ measures how easy it is to access bank loans in a country.[8] The easier it is to access to bank loans, the more borrowers can approach to banks, thus improving bank profitability and lowering some costs for banks. Therefore, the third hypothesis is formed as follows

H3: The efficiency of the banking system is positively associated with the ease of access to loans.

$EQUITY$ measures how easy it is for firms to raise money through the capital market.[9] Therefore, it is anticipated that an improvement in EQUITY would improve the size of the capital market (i.e. CAP), thus the fourth hypothesis is formed as follows

H4: The capital market development in a country is positively related to the ease for local firms to issue bonds or shares.

2.3. Data

It is worth to note that the data for our first-stage DEA were extracted from database constructed by Beck et al. (2000) while data for the second-stage SEM were obtained from the Global Competitiveness Index (WEF, 2016). Therefore, we initially considered a total of 140 banking systems in the Global Competitiveness Index database (WEF,

[8] Specifically, the survey question that had been asked was "In your country, how easy is it to obtain a bank loan with only a good business plan and no collateral? [1 = extremely difficult; 7 = extremely easy]" (WEF, 2016, p. 379).

[9] The specific survey question was "In your country, to what extend can companies raise money by issuing shares and/or bonds on the capital market? [1 = not at all; 7 = to a great extent]" (WEF, 2016, p. 379).

2016) and then excluded ones that DEA's data ($Depostis$, $Credit$, $OCosts$ and NIM) are not included in Beck et al. (2000).

Table 1 indicates the descriptive statistics of inputs and outputs used for the 2007-2011 periods. Given that our sample ranged from at least 85 countries in 2009 to at most 92 countries in 2008, our sample satisfies the "rule of thumb" about the number of inputs and outputs (Dyson et al., 2001) for an DEA application.[10]

Table 1. Descriptive statistics of the inputs and outputs for the first-stage DEA model

Year	2006	2007	2008	2009	2010	2011
Number of countries	89	91	92	85	87	86
Deposits: Bank deposits to GDP (%)						
Mean	61.1842	18.9942	66.8316	71.8417	71.2018	70.0213
Standard Deviation	52.7183	53.9273	56.7379	59.8140	58.8802	59.3080
Minimum	4.3164	4.5477	4.7100	4.9256	5.0152	4.8274
Maximum	357.9822	376.2313	394.5980	376.6712	333.8566	325.1802
OCosts: Bank overhead costs to total assets (%)						
Mean	3.3464	6.3206	3.2059	4.0887	3.2300	3.2749
Standard Deviation	3.0899	1.9198	5.0734	9.7600	2.7545	2.5741
Minimum	0.2454	0.3810	0.1094	0.2562	0.1240	0.4496
Maximum	25.0806	8.0650	48.6748	90.2566	17.2419	15.7039
Credit: Private credit provided by deposit money banks to GDP (%)						
Mean	63.3531	11.1575	72.5831	74.4274	71.8238	70.3915
Standard Deviation	49.6095	55.7351	51.6269	54.1982	54.2327	54.5690
Minimum	4.6732	4.7643	4.7931	4.8534	4.5702	4.4135
Maximum	269.2849	272.8089	220.8115	261.8022	271.7810	284.6218
NIM: Net interest margin (%)						
Mean	4.0952	6.3032	3.6655	4.0462	4.0686	4.1991
Standard Deviation	2.7384	2.1016	2.0478	2.4215	2.6031	2.4758
Minimum	0.2668	0.5222	0.1248	0.5365	0.2087	0.5512
Maximum	15.3020	9.2820	10.3277	12.4186	12.1826	12.0543

Source: Beck et al. (2000)

[10] Avkiran (1999) suggests the product of the number of inputs and outputs should be less than the sample size for the analysis to discriminate between the units. Dyson et al. (2001) argued further that the number of observations should be at least twice the product of the number of inputs and outputs. Sathye (2001) and Cooper et al. (2006) proposed that sample size should be at least three times the sum of total inputs and outputs.

In addition, Table 2 provides a descriptive statistics of variables that are used in the second state of the analysis. Data for EASY and EQUITY are obtained from the WEF (2016) while data for CAP is obtained from Beck et al. (2000).

Table 2. Descriptive statistics of variables used in the second-stage SEM analysis

Year	2006	2007	2008	2009	2010	2011
EASY: Ease of access to loans, 1-7 (best)						
Mean	3.5687	2.1599	3.6742	3.2650	3.0309	3.0314
Standard Deviation	0.9643	0.9135	0.8652	0.7836	0.8019	0.7682
Minimum	1.5052	1.8013	1.4245	1.5123	1.5217	1.6287
Maximum	5.5145	5.5119	5.4316	4.9793	4.9756	5.2710
EQUITY: Financing through local equity market, 1-7 (best)						
Mean	5.1185	4.3908	4.5580	4.0086	3.7028	3.7825
Standard Deviation	0.9421	0.8050	0.6943	0.7009	0.7871	0.7860
Minimum	2.4214	2.6327	2.3816	2.0769	1.9297	1.9085
Maximum	6.5237	6.2385	5.7912	5.3081	5.1833	5.4418
CAP: Stock market capitalisation to GDP (%)						
Mean	64.7579	23.1664	63.9918	52.4134	55.0400	49.0737
Standard Deviation	67.6575	73.1080	72.0177	66.4850	60.8821	54.4310
Minimum	0.5722	0.6219	0.5509	0.4292	0.3723	0.3683
Maximum	408.8358	480.2278	569.4619	524.4122	431.4609	396.8751

Source: Beck et al. (2000) and WEF (2016)

3. Results and Discussions

3.1. Efficiency of the banking systems around the World

In the first stage, the CRS DEA models were applied on yearly-data of a total 132 countries as in Equation (1). From the DEA results, it is obvious that high levels of inefficiency existed in the banking systems around the World, with the average efficiency scores ranged from 0.614, i.e. 38.6% inefficient, to 0.681, i.e. 31.9% inefficient (see Figure 1). Additionally, Figure 1 also shows the effect of the global financial crisis (GFC) where a decrease in the average efficiency from 0.660 in 2008 to 0.635 in 2009 was recorded.[11] Last but not least, the fall in efficiency of those banking systems in 2011

[11] Since our data is unbalanced, and especially because the purpose of this study is for analysing the two-way nexus relationship between banking systems' efficiency and capital markets development, we have not analysed the productivity change over time for those banking systems. However, it is still applicable to do so and we leave this type of analysis for future studies.

suggests that it would take time for the world banking system to overcome the impact of the GFC.

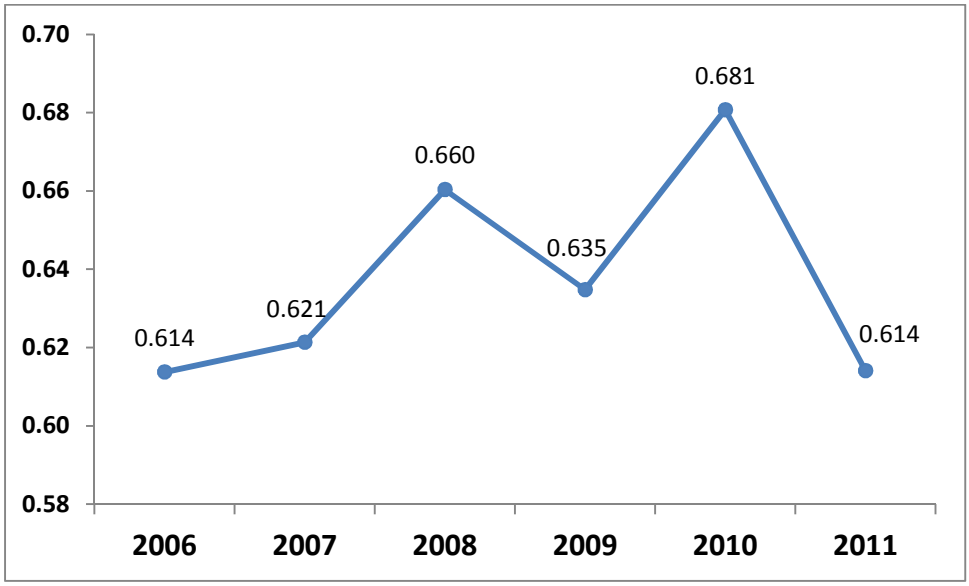

Figure 1. Average efficiency scores of banking system around the World

3.2. Causality between banking systems' efficiency and capital markets development: SEM analysis

In this section, the three-stage least square (3SLS) method[12] was applied to examine the two-way nexus between banking efficiency and capital market development. The estimates of the coefficients of our SEM in Equations (2) and (3)[13] are presented in Table 3 and Table 4.[14]

For the impact of banking efficiency on capital markets, i.e. Equation (2), technical efficiency of banking system is found to have a significantly positive effect on capital market development (see Table 3); thus our first hypothesis *H1* cannot be rejected. This finding is consistent with earlier suggestion by Song and Thakor (2010) that banking efficiency would reduce financing frictions. Similarly, Thakor (1998) emphasised that if banks are inefficient, they may drive the borrowers away from the market and consequently the capital market cannot develop. In addition, EQUITY is also found to be significantly positive, thus the hypothesis *H4* cannot be rejected as well.

[12] The results from other methods such as two-stage least square (2SLS) or full information maximum likelihood (FIML) are very similar to that of the 3SLS and thus are not reported.
[13] Notice that both OLS regressions for the relationships between CAP and EQUITY as well as between EF and EASY were statistically significant at 1% level, suggesting that EQUITY and EASY satisfied as instrument variables for CAP and EF, respectively, in our SEM.
[14] We have also test for our SEM where the variable-returns-to-scale (VRS) DEA efficiency scores are used instead of the CRS DEA scores, but the results are similar and thus are not reported. They are available upon request.

This confirms that local equity markets provide better risk sharing and a more efficient allocation of capital, thus improving capital market development (Laeven, 2014).

Table 3. Results of estimating for capital market development using 3SLS

	Coefficient	Standard Error	*t*-statistic
Constant	-430.680***	122.322	-3.521
EF	513.737**	180.007	2.854
EQUITY	37.636***	5.247	7.173

Notes: **** and ** denote the two-tails significance at the 1% and 5% levels, respectively*

In contrast, for the impact of capital markets on banking efficiency, i.e. Equation (3), capital market development is found to have a negative impact on banking efficiency (see Table 4), thus the hypothesis *H2* can be rejected. This is consistent with the view that banks and capital markets are competing sources of financing as one sector, either banks or capital markets, develops at the expense of the other (Jacklin & Bhattacharya, 1988; Allen & Gale, 1999). Hence, the development of capital market would attract firms to access funds directly from the markets rather than via bank lending channels. Furthermore, Table 4 also indicates that EF is positively associated with EASY, implying that the easier it is to access bank loans, the more efficient the banking system is. This finding is, unsurprisingly, consistent with Kwan and Eisenbeis (1997) suggesting a positive relationship between loan growth and bank's operating efficiency. Indeed, ease of access to loans, especially for newly-established and small enterprises in transition countries would potentially expand banks' portfolio, thus improving banks' operating performance. Therefore, the hypothesis *H3* cannot be rejected.

Table 4. Results of estimating for banking efficiency by using 3SLS

	Coefficient	Standard Error	*t*-statistic
Constant	0.493***	0.042	11.828
CAP	-0.001**	0.000	-2.888
EASY	0.068***	0.019	3.529

Notes: **** and ** denote the two-tails significance at the 1% and 5% levels, respectively*

Overall, we observed that an improvement in banking efficiency can enhance the development of the capital market; whilst deeper capital market hinders the performance of the banking sector. Thus, improving banking performance and efficiency would bring mutual benefits for banking system per se and capital markets in any economy, especially during the impact of the GFC. Since high-income countries have larger capital markets (Demirgüç-Kunt & Levine, 2001), our findings suggest that it would be better for them to pay more attention on the banking sector, rather than the capital market, to overcome the crisis.

4. Conclusions

This paper examines the causal relationship between banking efficiency and capital market development, using aggregate data of more than 130 countries during the period of 2007 to 2011. In the first stage, Data Envelopment Analysis (DEA) was employed to evaluate the efficiency of banking systems around the World. In the second stage, the structural equations model (SEM) and the three-stage least squares (3SLS) approaches were used to estimate that causality. Consequently, this overcomes the simultaneous bias problem while testing the four hypotheses on the association between banking efficiency, capital market development, ease of access to bank loans, and ease of raising funds through the capital market.

Empirically, we found that banking systems around the World were still inefficient, suggesting that that it would take time for the global banking system to overcome the impact of the global financial crisis (GFC) 2007/08. More importantly, we found that the deeper the capital market is, the less efficient its banking system would be. In contrast, banking efficiency can positively influence the development of the capital market. Thus, we suggest that for any economy around the World, an improvement in banking performance and efficiency rather than capital market should be a priority.

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