Does CSR Engagement Affect Banking Efficiency in the Context of a Stochastic Cost Frontier?

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Abstract

This paper examines the effect of corporate social responsibility (CSR) on the cost efficiency of banks across countries with the measure of CSR compiled from the EIRIS database. We consider CSR as an environmental variable, which allows us to associate CSR with cost efficiency. The empirical results fail to support the greenwashing hypothesis, but partially support the altruistic and strategic motives. Since it takes time for a bank to achieve a higher CSR score, a bank tends to be altruistic in the short-run, while a bank tends to be strategic in the long-run.

Key words: CSR score, stochastic cost frontier, environmental variables, altruistic motive, strategic motive

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I. Introduction

The banking industry has found it difficult in the past decade to earn large profits due to the shrinking spread in developed countries, resulting possibly from keen competition among domestic and foreign banks. The banking system plays a critical role in an economy (Levine (2005) and Shen and Lee (2006)) not only because of the safe and sound services it provides, but also because many people are involved in the service chain. If some banks go bankrupt, then people are considerably affected due to their dependence on the banking sector for liquidating money and scarce loanable funds will fail to be allocated efficiently among alternative projects. Therefore, financial institutions are sometimes said to be "too big to fail."

The 2008 global financial crisis created chaos in the banking systems of the U.S. and many other countries. The imprudent behaviors of some banks gave rise to bankruptcy and falling stock markets. Owing to these financial catastrophes, regulators and supervisors have started to attempt to stem any future chaos and reorganize the structure of the financial industry. Facing such a challenging environment, banks are also looking for other ways to maintain financial stability. Although its definition may vary, corporate social responsibility (CSR) is prevalent among different spectrums of industries. It is thus worthwhile for banks to rethink their profit-making doctrine they follow and start to carry out CSR activities to compensate society. However, why should banks initiate CSR activities? Does it pay to be good? These are the questions we want to investigate in this study.

To answer the above questions, this article establishes three hypotheses in Subsection III.B corresponding to three motives for banks' engagement in CSR, i.e., altruism, strategic choices, and greenwashing. Using the translog cost frontier, we are able to estimate the cost efficiency of banks, which can be further related to a set of environmental factors, including CSR indices. By inspecting the effect of CSR indices on cost efficiency, one can formally test for those hypotheses and thus infer which motive can better describe banks' behaviors.

The idea of CSR dates back to Bowen (1953), and its definition

encompasses voluntary corporate actions designed to enhance social situations (Mackey, Mackey, and Barney (2007)), or corporate actions not forced by law that attempt to provide some social benefits (McWilliams and Siegel (2000)). Friedman's (1970) well-known response is: "a corporation's responsibility is to make as much money for stockholders as possible" (p. 32). His admonition is that pursing profits leads to social welfare. Moreover, Davis and Blomstrom (1975) identify CSR as "the managerial obligation to take action to protect and improve both the welfare of society as a whole and the interest of organizations" (p. 6).

Porter and Kramer (2011) propose a broad explanation of CSR as creating shared value (CSV), which stresses the connection between societal and economic progress and prosperity. Firms do good, which is the doctrine of CSR, and further do good to create shared value for the society while providing goods and services. It is a brand-new concept for banking sectors to apply in reality. Socially responsible investment (SRI) is one of the principles for firms to abide by when making investment decisions. In compliance with SRI, environment, social, and governance (ESG) are three elements for firms to follow.

The current paper thus first compiles the CSR score from the EIRIS database, which covers the domains of human rights, human resources, environment, community involvement, business behavior, and corporate governance.[1] Whether the index is correlated with cost efficiency will then be examined under the framework of the stochastic cost frontier. It is noteworthy that most previous works relate the CSR score to the financial performance of firms, instead of technical efficiency in the context of the stochastic frontier approach (SFA). This paper attempts to fill the gap in the literature.

Many academic research works on the performance of financial institutions have concentrated on standard financial ratios, such as return on assets, return on equity, Tobin's Q, or the cost/revenue ratio. However, frontier efficiency measured by e.g., DEA and SFA, which evaluate

[1] EIRIS is one of the largest independent SRI research organizations worldwide. Its core business is undertaking research into corporate environmental, social and governance (ESG) management, and performance. It provides global coverage, offering data on more than 80 research areas for some 2,800 companies in Europe, North America, and Asia Pacific.

deviations in performance from those of the best-practice banks on the efficient frontier, is superior to the above financial ratios for most regulatory and managerial purposes. This is attributed to the fact that frontier efficiency measures are applied to eliminate the impacts of variations in prices and other market factors affecting financial performance ratios in order to yield better estimates of the primary performances of managers.

Given that a cost function can be used to describe a production technology with multiple inputs and multiple outputs and that a one-step estimation procedure outperforms a two-step estimation procedure (see Footnote 4), we choose to estimate the cost frontier whose inefficiency term is associated with a set of environmental variables. This allows us to investigate the determinants of efficiency, on the one hand, and to control for the environmental differences faced by banks, on the other hand. In addition, we calculate measures of scale and scope economies for the sample banks against the estimated cost frontier, because Berger, Hunter, and Timme (1993) suggest that scale and scope economies be measured on the efficient frontier.

The rest of the paper is organized as follows. Section II briefly reviews the relevant literature regarding the assessment of bank efficiency and the relationship between CSR and corporate financial performance (CFP).[2] Section III introduces the stochastic cost frontier model. Section IV depicts data collection, defines variables, and presents descriptive statistics. We specifically explain how to construct the CSR score in greater detail. Section V conducts our empirical study and analyzes the results, while Section VI concludes the paper and mentions some limitations of the research work.

II. Literature Review

There are two approaches to estimating the efficiency of the banking industry: parametric and non-parametric. Stochastic frontier approach (SFA) belongs to the former approach, first proposed by Aigner, Lovell, and Schmidt (1997) and Meeusen and Van den Broeck (1997), and data envelopment analysis (DEA) is classified as the latter approach. Efficiency

[2] Here, we define CFP in terms of some financial ratios, e.g., return on assets, return on equity, net interest margin, and technical efficiency.

can be measured against either a production frontier, a cost frontier, or a profit frontier. The translog cost function has been popularly chosen by numerous empirical researchers and requires the availability of input prices and output quantities. The translog form is known as being flexible and allows for an interpretation on the marginal cost of production for banks (Clark and Speaker (1994) and Weill (2013)). This paper adopts SFA to estimate the cost frontier and then probes the relationship between CSR and cost efficiency. Huang and Liu (1994) and Battese and Coelli (1995) introduce a set of environmental factors to explain technical inefficiency, which allows practitioners to examine the determinants of technical inefficiency in different industries, including banks and insurance companies.

We treat the variable of CSR as an environmental variable in order to investigate the impact of CSR on banks' cost efficiency. Since there are few studies regarding the nexus between CSR and efficiency, we instead review some research works relating CSR to financial performance in different industries. Unfortunately, mixed results are found. We briefly review some of them below.

Vance (1975) claims that conducting CSR incurs extra costs for firms, since firms have to employ additional resources that would be otherwise used to produce goods and services in pursuit of maximizing economic profits (or minimizing production costs). Brammer and Pavelin (2004) and Nejati and Ghasemi (2012) argue that CSR is a misuse of allocating corporate resources, because the deployment of resources on CSR will put firms in a relatively economic disadvantage at the same time. Walley and Whitehead (1994) demonstrate a limited return on CSR engagement. Margolis and Walsh (2003) and Orlitzky, Schmidt, and Rynes (2003) reveal the positive relationship between CSR and CFP in a modest level, while Alexander and Buchholz (1978), Aupperle, Carroll, and Hatfield (1985), and Shane and Spicer (1983) fail to find any association of CSR with CFP. Moreover, Tsoutsoura (2004) documents a positive relationship between CSR and ROA (ROE) by using the KLD database.[3] Orlitzky, Schmidt, and Rynes (2003) and Rettab, Brik, and Mellahi (2009) also obtain positive

[3] Kinder, Lydenberg and Domini & Co. (KLD) is a social choice investment advisory firm that compiles a social performance database.

effects of CSR on financial performance, personnel commitment, and corporate integrity. Barnett and Salomon (2006) find that CSR and financial performance share a curvilinear relationship.

For the banking industry, most works solidly support that the link between social and financial performances is positive (Simpson and Kohers (2002)). Ohene-Asare and Asmild (2012) examine the efficiency of Ghanaian banks with CSR as one of the environmental variables and conclude that banks that are socially responsible may have economic advantages on profitability and efficiency.[4] Olulu-Briggs (2011) confirms a positive and strong correlation between CSR and financial performance in the U.S., U.K., and Japan. Specifically, they find that CSR not only benefits a bank's capital adequacy, but also helps it to accumulate competitive advantages in the long run. Alafi and Hasoneh (2012) also verify the same positive relationship, using data of housing banks from Jordan.

The foregoing inconsistent results may be interpreted by, e.g., Baron (2001) and Dam, Koetter, and Scholtens (2009), who affirm that different motives of corporations initiating CSR result in dissimilar associations of CSR with financial performance. There are three motives worth mentioning: altruism, strategic choices, and greenwashing.[5] The motivation for altruism usually predicts a negative correlation between CSR and CFP in terms of non-performing loans. Strategic choices support a positive association between CSR and financial performance, such as ROA, ROE, net interest income, and non-interest income. Greenwashing presents no significant effect of CSR on financial performance (Wu and Shen (2014)).

Some researchers deem that exogenous factors, such as the growth of an industry, may mitigate the connection between CSR and CFP (Russo and

[4] Ohene-Asare and Asmid (2012) utilize DEA to evaluate the relative efficiency of 21 Ghanaian banks spanning 2006-2008. Next, they use OLS regression to examine the effects of exogenous variables, including CSR, on the technical efficiency levels of the sample banks. This so-called two-step estimation procedure differs substantially from our SFA, which is able to take data noise into account. In addition, SFA can be used to investigate the nexus between CSR and (in)efficiency under the framework of one-step estimation. Wang and Schmidt (2002) confirm that one-step estimation is superior to two-step estimation.

[5] The altruism motive indicates that companies conduct CSR activities for their own sake. McWilliams and Siegel (2000, 2001), Baron (2001), Hillman and Keim (2001), and Bagnoli and Watts (2003) assert that firms especially engage in CSR for "strategic" or "profit-maximizing" reasons. According to Dam, Koetter, and Scholtens (2009), if no clear cost differences are observed between responsible and irresponsible corporations, then these firms are merely greenwashing. Hence, no effects will become evident in their earnings.

Fouts (1997)). This implies that non-systematic risk and macroeconomic conditions should also be considered in studying the nexus between CSR and CFP. There is also a growing consensus on the importance of environmental variables in efficiency estimation. Those environmental factors are uncontrollable of managers (see, for example, Battese and Coelli (1995), Dietsch and Lozano-Vivas (2000), and Kumbhakar and Wang (2007)). This paper sets the inefficiency term as a function of a group of environmental factors that contain microeconomic and macroeconomic variables, as well as CSR, in such a way as to test the foregoing three motives.

There is another interesting and related issue that has been examined, i.e., the cushion effect of CSR engagement on stock and bond prices, when firms are facing negative events. Using a sample of 399 firms listed on the S&P 500 over the period of 2000-2008, Shiu and Yang (2017) discover that a firm engaging in CSR is indeed able to be free from decreases in both its bond and stock prices when adverse events occur. However, an insurance-like effect exists under the condition that firms are continuously involved in CSR, which lasts a long time. In other words, one should not expect that CSR engagement can benefit firms within a short time period, say, one or two years. Mullen (1997) and Yang (2015) find that CSR programs usually need to be in existence for 3-5 years in order to bring gains to the firms. Yang (2015) applies the slack-based DEA to investigate the effect of CSR on firms' efficiency and concludes that long-term CSR engagement not only benefits the efficiency of the firm itself, but also decreases the effect of competitors' long-term CSR by increasing its own long-term CSR engagement. It is noteworthy that there are few studies investigating the direct impact of CSR on a bank's efficiency in the context of SFA.

III. Methodology

A. The Cost Function

We employ the cost frontier to estimate the cost efficiency of the sample banks, due to the availability of the required variables, such as input prices and output quantities, from the BankScope of Bureau van Dijk. Cost efficiency may be a preferable measure for regulators and business

consultants who want to gauge the costs and benefits to society from distinct policies versus the conventional efficiency measure based on a production frontier (see, for example, Bauer et al. (1998)). It is known that a production function is suitable for a single output case without using information on input prices that are the key variables affecting the decisions on hiring of inputs and utilization of technology. Therefore, the application of cost frontiers is recommended and compatible with diversifying into financial products that banks provide. Different from previous studies, we apply SFA to investigate the relationship between cost efficiency and the CSR score, compiled from the EIRIS database, which is a leading socially responsible investment research supplier that studies 2,800 corporations around the world.

Unlike parametric methods, non-parametric DEA does not allow for a random error term in the model such that data noise is ignored, which tends to bias the efficiency estimates (O'Donnell and Coelli (2005)). Following Battese and Coelli (1995), we apply the parametric approach of SFA to assess cost efficiencies, as it allows for data noise and links cost inefficiency with a set of environmental factors under a so-called single-step approach. SFA assumes the existence of composed errors. One of them is a non-negative random variable, representing technical inefficiency. This one-sided error (u) is conventionally assumed to have one of the following four distributions: half-normal, truncated normal, exponential, and gamma distributions. The other is a two-sided error (v) with a normal distribution, i.e., $v \sim N(0, \sigma_v^2)$. Cost efficiency measures the distance between a bank's optimal costs and its actual costs for a given output mix. It is worth noting that environmental heterogeneity among countries plays an important role in the determination of efficiency level. Country-specific factors, such as economic development, can heavily influence the level of technical efficiency (Fries and Taci (2005)).

The translog cost frontier is thus expressed as:

$$
\begin{aligned}
ln(TC/W_1) &= lnTC^* \\
&= \alpha_0 + \sum_{j=1}^{3} \alpha_j \, lnY_{j+} \sum_{i=2}^{3} \beta_i ln\,(W_i/W_1) + \delta_1 t \\
&+ \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \delta_{jk} lnY_j lnY_k \\
&+ \frac{1}{2}\sum_{i=2}^{3}\sum_{m=2}^{3} \gamma_{im} ln(W_i/W_1) ln(W_m/W_1) + \frac{1}{2}\delta_2 t^2 \\
&+ \sum_{i=2}^{3}\sum_{j=1}^{3} \rho_{ij} ln(W_i/W_1) lnY_j \\
&+ \sum_{j=1}^{3} \theta_j lnY_j t + \sum_{i=2}^{3} \lambda_i ln(W_i/W_1) t + v + u \qquad (1)
\end{aligned}
$$

Here, $ln(TC/W_1)$ is the natural logarithm of the normalized actual expenditure by W_1, lnY_j and $ln\,(W_i/W_1)$ are the j^{th} logarithmic output quantity and the i^{th} logarithmic input price normalized by W_1, respectively, and t denotes the time trend that captures possible technical changes. Notation $v+u$ signifies the composed error term. Note that u is further expressed as:

$$u = \gamma' Z + w \geq 0, \qquad (2)$$

where Z is a vector of environmental variables affecting a bank's efficiency to be described later, and γ is the corresponding coefficients. Clearly, $-\gamma' Z \leq w \leq \infty$, and w is conventionally assumed to be $w \sim N(0, \sigma_w^2)$. We arbitrarily choose the first input as the numeraire and use its price, W_1, to normalize the above expenditure and input prices in order to impose the homogeneity property on the cost function. In addition, the symmetric conditions should also be satisfied, i.e., $\delta_{jk} = \delta_{kj}, \forall j,k$ and $\gamma_{im} = \gamma_{mi}, \ \forall j,k$.

B. CSR Hypothesis

As stated in Section II, the effect of CSR on corporate financial performance is controversial. The mixed result might be explained by the motives of a firm to conduct CSR. Baron (2001), Dam, Koetter, and Scholtens (2009), and Bénabou and Tirole (2010) claim that firms' engagement in CSR has three different motives: altruism, strategic choices,

and greenwashing. Those motives affect firms' financial performance in different directions. Here, we substitute cost efficiency for financial performance and propose three similar hypotheses.

Hypothesis 1:

For an altruistic CSR bank, CSR negatively affects efficiency.

The altruism motive indicates that banks conduct CSR initiatives for their own sake. This does not expect to bring any benefit, e.g., more revenue or outputs, to the banks. However, CSR engagement usually incurs an extra cost due to the fact that more resources are required for its deployment, forcing banks to deviate from their cost minimization objective. The result is a negative relationship between CSR and (input-oriented) cost efficiency.

Hypothesis 2:

For a strategic CSR bank, CSR positively affects efficiency.

Strategic CSR banks are inclined to pursue profit maximization and/or cost minimization by enhancing their reputation and brand names through activities such as environmental protection, charity behavior, integrity to customers, and maintaining the rights for employees. According to Bénabou and Tirole (2010), this perspective demonstrates a win-win vision of CSR, and they believe that strategic CSR involves taking a socially responsible position to strength the firm's market position to increase profit.

Hypothesis 3:

Greenwashing CSR exhibits no obvious effect on efficiency.

Frankental (2001) asserts that greenwashing attempts to improve a bank's image without considerably altering its business. Since the current paper focuses on the relation between CSR and cost efficiency, we construct Hypothesis 3, which differs from Dam, Koetter, and Scholtens (2009). Specifically, if there are no differences in cost efficiency between responsible and irresponsible banks, then those banks under study are simply greenwashing. Put differently, no relationship between CSR and cost

efficiency exists.

C. Economies of Scale (SE) and Scope (SC) and Cost Efficiency

After estimating the cost function, we can calculate scale and scope economies and cost efficiency for each sample bank. Following the recommendation of Berger, Hunter, and Timme (1993), we measure scale and scope economies using the estimated cost frontier. The existence of scale economies implies that firms can expand their production scale in order to decrease their long-run average costs. If the reverse is true, then shrinking a firm's operation scale can also lower down its long-run average costs. If SC prevails, then it is preferable for the sample banks to jointly manufacture a set of financial products.

The traditional definition of *SE* is:

$$SE=\frac{TC^*(Y,W)}{\sum_{j=1}^{3} Y_j TC_j^*(Y,W)} \tag{3}$$

Here, $TC^*(Y,W)$ is the translog cost function in (1), and $TC_j^*(Y,W)$ denotes the partial derivative of TC^* with respect to the j^{th} output.[6] $SE >$ (<) 1 means that the joint increase in all outputs by 1% raises total costs by less (more) than 1%, corresponding to increasing (decreasing) returns to scale. If SE=1, then constant returns to scale prevail, meaning that the bank's current production scale is already optimal. We define *SC* as:

$$SC = \frac{TC^*(Y_1-2\varepsilon_1,\varepsilon_2,\varepsilon_3)+TC^*(\varepsilon_1,Y_2-2\varepsilon_2,\varepsilon_3)+TC^*(\varepsilon_1,\varepsilon_2,Y_3-2\varepsilon_3)-TC^*(Y_1,Y_2,Y_3)}{TC^*(Y_1,Y_2,Y_3)} \tag{4}$$

Following Mester (1987), ε_j, j = 1, 2, 3, is substituted by 10% of the individual minimum output value, because the translog function is unable to take the natural logarithm with respect to zero. $SC >$ (<) 0 indicates that the joint production costs of $TC^*(Y_1,Y_2,Y_3)$ are less (greater) than the sum of specializing banks' production costs, supporting the existence of scope economies (diseconomies).

[6] SE can be reformulated as $1/(\frac{\sum_{j=1}^{3} Y_j TC_j^*(Y,W)}{TC^*(Y,W)})$, where the denominator measures the sum of the percentage changes in total costs when all outputs increase by 1%.

The i^{th} bank's cost efficiency (CE_i) is defined by the ratio of the optimal cost adjusted by statistical noise to its observed cost, i.e., $CE_i = E[exp(-u_i)|v_i + w_i]$, where u_i has been defined by (2). Note that the measure of CE_i must lie between 0 and 1 by construction.

IV. Data Description

A. Data Sources

We first explain how to construct the pivotal variable of the CSR score obtained from the EIRIS sustainability survey, spanning 2010-2014. The survey covers a wide range of corporate social responsibility issues collected by the questionnaire with the aim at investigating the involvement of CSR for different firms. In EIRIS, the questions are customized to measure the risks and performances of companies in 41 sectors on 38 ESG (Environment, Social, and Governance) criteria based on international standards, which are further divided into six domains of corporate social responsibility, including environment, human rights, human resources, community involvement, business behavior, and corporate governance. The response rate of the questionnaire differs across banks and years.

According to Brammer and Pavelin (2004) and Brammer, Brooks, and Pavelin (2006), this survey by EIRIS offers the largest and most sound multidimensional social performance coverage. In the questionnaire, there are many questions covering everything from the field of subsidiaries to the proportion of stocks owned by employees, etc. We use the criteria of Wu and Shen (2014) to categorize those questions. For qualitative questions, some are two-scale "yes" or "no", while some are three-scale (e.g., many, some, or none) and even four- to six-scale choices. The more complicated thing is that some positive replies favor CSR,[7] whereas others imply the opposite.[8]

[7] For example, the question "How clear is the company's commitment to community and charitable work?" has the following reply choices: Advanced, Good, Intermediate, Basic, Limited, and Little or no.

[8] For another example, the question "What is the level of potential exposure to bribery issues?" has the reply choices: High, Medium, and Low.

For convenience, we refer to these two kinds of questions as positive and negative attitude questions, respectively. The transformation of the text answer in the survey into a single aggregate value is simply done by adding all the transformed numbers. Appendix A shows the detailed conversion of CSR scores, where Panel A of Table AI shows negative attitude questions and Panel B shows positive attitude questions.

After deleting incomplete data, we obtain 121 sample banks from 22 countries with 457 bank-year observations.[9] We next collect accounting statements for those banks from the Orbis Bank database, originally Bankscope. All dollar-valued variables are measured in millions of U.S. dollars and deflated by the consumer price indices, extracted from the World Bank, of individual countries with base year 2010. Tables I and II summarize the distribution of banks across countries and over time.

Table I
Bank Distribution across Countries and Over Time

Country	2010	2011	2012	2013	2014	Total
Australia	4	6	6	6	6	28
Austria	2	2	2	2	2	10
Belgium	0	0	0	1	0	1
Canada	0	6	6	6	5	23
Cyprus	0	1	1	0	0	2
Denmark	3	3	2	3	3	14
France	0	3	3	3	3	12
Greece	1	2	2	3	2	10
Hong kong	2	6	6	6	6	26
Israel	1	3	3	3	3	13
Japan	32	24	24	23	23	126
Netherlands	0	1	1	1	1	4
Norway	1	1	1	1	0	4
Portugal	1	0	0	1	1	3
Singapore	1	1	1	1	1	5
South Korea	1	3	4	4	4	16
Spain	5	3	0	3	3	14

[9] The EIRIS database provides CSR data on around 240 banks around the world, and almost all of their financial data can be found in the BankScope databank. If a bank group also runs a non-financial business, then the BankScope databank only offers consolidated financial data. We delete those banks so that all variables are measured under the same standard, because we compile relevant variables primarily from the unconsolidated accounting reports of all sample banks. The final sample contains 121 banks around the world.

Sweden	4	4	4	4	4	20
Switzerland	4	4	4	4	4	20
Ukraine	0	1	1	0	0	2
United Kingdom	1	2	2	2	0	7
United States	21	18	20	19	19	97
Total	84	94	93	96	90	457

Table II
Bank Distribution across Regions and Over Time

Region	2010	2011	2012	2013	2014	Total
Asia	36	34	35	34	34	173
Australia	4	6	6	6	6	28
British	1	2	2	2	0	7
Middle East	1	3	3	3	3	13
North America	21	24	26	25	24	120
North Europe	8	8	7	8	7	38
South Europe	7	5	2	7	6	27
West Europe	6	11	11	11	10	49
Other	0	1	1	0	0	2
Total	84	94	93	96	90	457

Based on the intermediation approach, a bank is regarded as a financial intermediary between depositors and borrowers, thus allowing us to identify three inputs and three outputs. The input categories are comprised of labor (X_1), physical capital (X_2), and borrowed funds (X_3). Since the item of number of employees is missing for many banks, we instead use total assets net of fixed assets as the proxy.[10] Total loans (Y_1) and investments (Y_2) are two traditional outputs. It is noteworthy that non-interest income (Y_3) is gradually growing in importance nowadays as it reveals a bank's degree of product diversification and also constitutes critical sources of revenue it generates from non-traditional activities. Spreading out risk and decreasing production cost through resource sharing are two advantages brought by non-interest income. Hence, we define non-interest income as a type of output. Table III shows all variable definitions.

[10] As data on the number of employees are either missing or unavailable for many sample banks, the price of labor is defined as the ratio of personnel expenses to total assets (net of fixed assets). In other words, the item of total assets (net of fixed assets) is used to proxy the number of employees. Altunbas et al. (2000) and Altunbas, Evans, and Molyneux (2001), Weill (2004), Fries and Taci (2005), and others utilize the same definition.

Table III

Variable Definitions

Variable	Description
Total loan (Y_1)	Short-term and long-term loans
Investments (Y_2)	Other earning assets, loans and advances to banks, reverse repos and cash collateral, all securities, investment in property and insurance assets
Non-Interest Income (Y_3)	Other operating income, total non-interest operating income equity-accounted profit/loss-operating
Labor (X_1)	Total assets net of total fixed assets
Physical Capital (X_2)	Total fixed assets (including property, plant a equipment)
Funds (X_3)	Deposits and short-term funding
Price of Labor (W_1)	Total personnel expenses/total assets
Price of Physical Capital (W_2)	Other operating expenses/total fixed assets
Price of Funds (W_3)	Total interest expenses/total funds
Total Cost (TC)	$W_1X_1+W_2X_2+W_3X_3$

B. Environmental Variables

As for the environmental variables, we consider those factors that affect the efficiency of a bank exogenously and are not traditional inputs. They are included to articulate the particular characteristics of each country's financial industry and macroeconomic and regulatory conditions, as well as to reflect each bank's traits. Unfortunately, there is no consensus on the selection of those variables, and there are few theories for us to refer to during the selection of environmental variables. Following Berger, Hancock, and Humphrey (1993), Mester (1993), Allen and Rai (1996), Lozano-Vivas, Pastor, and Hasan (2001), Lozano-Vivas, Pastor, and Pastor (2002), and Huang et al. (2011), we relate the inefficiency term to eight environmental variables to account for the impact of the exogenous discrepancy among countries and banks on cost inefficiency. As this study focuses the effect of *CSR* on cost efficiency, *CSR* and its squared term (CSR^2) are two of the environmental variables. The term of CSR^2 is considered to capture a possible non-linear relationship between *CSR* and inefficiency.

We summarize the remaining six environmental variables as follows.

1. Equity to Total Assets Ratio (*ETA*): The variable represents an indicator

of the regulatory condition of a country's banking industry. According to Hughes and Mester (1993), Mester (1996), Berger and Mester (1997), and Huang (2000), the variable is considered as fixed netput in either a cost or a profit function. Equity capital is also known as financial capital, which acts as a buffer against potential portfolio losses and as a substitute for deposits and borrowed money to fund loans. Risk-averse managers will try to mitigate the insolvency risk by enhancing the level of *ETA* at the expense of compelling the chosen level of equity to deviate from the one required by cost minimization. Compared to risk-averse managers, risk-neutral bank managers tend to run banks with a lower *ETA* ratio, leading to a higher loan to equity leverage and are willing to implement policies aimed at the promotion of production efficiency and financial performance. Since ETA can unveil the risk preferences of bank managers, which are correlated with production efficiency, we include it as one of the environmental variables, but its expected sign is uncertain.

2. Return on Assets (*ROA*): *ROA* is defined as the ratio of average return to total assets and is used as an indicator of profitability, which may relate to the competitiveness in each country. Previous works show that the predicted relationship between *ROA* and efficiency is positive in a competitive scenario, i.e., the higher the profits are, the higher the efficiency is (see, for example, Berger, Hancock and Humphrey (1993), Mester (1993), and Allen and Rai (1996)).
3. Net Interest Margin (*NIM*): Net interest margin measures the difference between interest received and interest paid, divided by the amount of interest-generating assets. Although *NIM* somehow gauges the profitability of a bank, its association with efficiency remains ambiguous. According to Lin et al. (2012), banks that are diversified can lower down the fluctuation in *NIM*; yet, the lower volatility of NIM does not guarantee higher income or higher efficiency. In contrast to Valverde and Fernández (2007), Lepetit et al. (2008) obtain a negative relationship between commissions and fees income and *NIM*, implying that the underpricing of credit risk, in order to attract new customers in an attempt to establish long-term customer relationships, aims at generating fees and commissions income afterwards. Thus, the effect of

NIM on efficiency is undetermined.

4. Loan to Total Assets Ratio: This variable enables us to assess a bank's strategy. The higher the ratio is, the more loans are lent out, and consequently the higher the financial risk will be. However, a higher loan to total assets ratio may contribute more profits to banks, if non-performing loans remain stable. The nexus between this and cost efficiency is thus vague.
5. Real GDP Growth Rate: This variable is used to reflect a country's economic conditions in business cycles. The expected correlation of this variable with a bank's cost efficiency is ambiguous since it influences both demand and supply factors of banking production activities (Perera, Skully, and Wickramanayake (2007)). An increase in the rate of real GDP growth corresponds to the expansionary stage of a business cycle, along with an increase in interest rates. This stimulates bank revenues, but is accompanied by an increase in production cost, incurred possibly by resource shortages.
6. (log)Real GDP per Capita: This is defined as the ratio of a nation's real GDP to its population, transformed by taking the natural logarithm. This macroeconomic indicator is proxy for overall economic conditions, under which both demand and supply sides of banking activities, including deposits and loans, operate and may impact banks' efficiency. When real GDP per capita increases, the demand for banking services rises as does the supply of loanable funds fueled by savings. This leads to higher profits and cost efficiency for banks. Thus, this variable is expected to be positively correlated with efficiency.

Table IV shows all sample statistics for the cost frontier, and Table V presents the distribution of the *CSR* score across countries in the sample period. Table VI shows that the mode of *CSR* scores is equal to 20 and that the mean of *CSR* is 43.4. This implies that the *CSR* index distribution is skewed to the right. The separate CSR indices for individual years are not shown for brevity, but they are available from the authors upon request.

Table IV

Sample Statistics for the Cost Frontier

[a] Measured in millions of real U.S. dollars with base year 2010. [b] Measured

in real US dollars with base year 2010.

Variable	Mean	Standard Deviation
Total Loans[a]	89249.2	1524642
Investments[a]	57773.5	372457
Non-Interest Income[a]	643.453	6295.93
Price of Labor	0.02126	0.16584
Price of Physical Capital	2.11774	13.3169
Price of Funds	0.06209	0.59206
Total Costs[a]	7186.17	132080
ETA	0.0911	0.1066
ROA	0.1120	0.2591
NIM	0.0175	0.0266
Loan/Total Assets	0.5597	0.1710
Real GDP Growth Rate	1.9198	1.9094
Real GDP per Capita[b]	48037.24	13608.04
Number of Observations	457	

Table V

Distribution of the *CSR* Score across Countries

CSR Score	1-11	11-21	21-31	31-41	41-51	51-61	61-71	71-81	81-91	91-101	101-111	Total
Asia	2	60	41	14	16	11	21	8	0	0	0	173
Australia	0	0	1	2	8	1	1	9	3	3	0	28
British	0	0	0	0	0	0	0	0	2	4	1	7
Middle East	0	3	1	1	2	2	2	2	0	0	0	13
North America	4	23	27	16	13	19	6	6	5	1	0	120
North Europe	9	0	0	0	6	13	8	2	0	0	0	38
South Europe	0	1	1	0	7	2	6	4	5	1	0	27
West Europe	0	5	4	6	7	4	1	1	16	5	0	49
Other	0	0	0	0	0	0	0	2	0	0	0	2
Total	15	92	75	39	59	52	45	34	31	14	1	457

Table VI

Description Statistic of the *CSR* Score

Mean	Standard Error	Median	Mode	Standard Deviation	Min	Max	Number of Observations
43.4092	1.1643	43	20	24.8906	1	102	457

V. Empirical Results

A. Parameter Estimates

Table VII shows the parameter estimates of the translog frontier. Eighteen out of 23 parameter estimates (excluding environmental variables), or 73.9% of the independent variables, achieve at least the 10% significance level. Except for the input prices and outputs, the eight environmental variables are all significant at least at the 5% level. The translog frontier appears to describe the data quite well. Using these parameter estimates, we can calculate the cost shares for the three inputs. More than 99% of the sample is found to have positive cost shares for the first (labor) and the third (funds) inputs, and around 82% of the sample points have positive shares for physical capital. The foregoing implies that the coefficient estimates are satisfactory.

We can then compute the measure of SE on the basis of the parameter estimates. The average *SE* measure is equal to 1.48, but the measure decreases over time from 2.28 in 2011 to 0.94 in 2014. This indicates that our sample banks expand their production scale from increasing returns to scale technology towards the optimal size, i.e., adopting constant returns to scale technology, during the sample period. We finally calculate the average measure of scope economies, which is equal to 0.36.[11] This means that our sample banks enjoy product mix economies, i.e., it is advantageous for them to jointly produce the three outputs. The source of cost savings may be attributed to resource sharing.

B. Environmental Effects

As far as the environmental variables are concerned, the variable *ETA* is negatively related to the inefficiency term, implying that the higher *ETA* is, the more efficient a bank will be. The result is the same as Huang et al. (2011) who estimate the Fourier flexible cost function. As for *NIM*, the

[11] Unfortunately, the *SC* measure fluctuates substantially over time, such that its average values are positive in two of the five years, while negative in the remaining three years.

influential direction of inefficiency is opposite to *ETA*, meaning that an increase in *NIM* tends to lower bank efficiency. According to the finding by Lepetit et al. (2008), i.e., the relationship between commissions and fees and NIM is negative, our finding here suggests that it is advantageous for banks to diversify their financial products at the expense of lowering *NIM*. Diversification helps promote banks' cost efficiency.

The variable of total loans to assets ratio is found to have a negative effect on cost inefficiency, due possibly to the scale effect. When loans are granted to a certain level, banks can take advantage of their scale to hire more professional employees to scrutinize potential loan customers so as to earn more interest revenue and to minimize loan defaults. The coefficient of *ROA*, an indicator of profitability, is negative, implying that it is positively associated with efficiency, as expected.

The two macroeconomic variables, i.e., *DP* growth rate and real *DP* per capita, are found to have different impacts on efficiency. Similar to Perera, Skully, and Wickramanayake (2007), the *DP* growth rate is found to negatively affect cost efficiency. The reason might be that this rate signifies overall economic conditions and its increase may not induce people to have a higher demand for banking services; or the forces from the demand and supply sides are unequal or offset each other. However, real GDP per capita has a positive effect on efficiency. The increase in real GDP per capita raises the demand for an array of banking services and the supply of loanable funds fueled by savings. The effect of real GDP per capita is as expected and similar results are found by, e.g., Huang et al. (2011).

Table VII

Parameter Estimates of the Translog Cost Frontier

*, **, and *** denote significant at the 10%, 5%, and 1% levels, respectively. $\sigma^2 = \sigma_w^2 + \sigma_v^2$.

Variable	Parameter Estimate	Standard Error	Variable	Parameter Estimate	Standard Error
Constant	1.6032**	0.7209	$\ln(Y_3)\ln(W_3/W_1)$	0.0288*	0.0172
$\ln(Y_1)$	0.4553***	0.0880	t	-0.9165***	0.2434
$\ln(Y_2)$	0.1679	0.1186	$0.5t^2$	-0.0574	0.0469
$\ln(Y_3)$	0.2535**	0.1126	$t\ln(Y_1)$	0.1990***	0.0263
$0.5\ln(Y_1)\ln(Y_1)$	-8.3677E-04	0.0044	$t\ln(Y_2)$	0.0093	0.0199

$0.5\ln(Y_2)\ln(Y_2)$	-0.0249**	0.0121	$t\ln(Y_3)$	0.0082	0.0205
$0.5\ln(Y_3)\ln(Y_3)$	-0.0049	0.0118	$t\ln(W_2/W_1)$	-0.0481***	0.0172
$\ln(W_2/W_1)$	1.0474***	0.1066	$t\ln(W_3/W_1)$	-0.0344**	0.0161
$\ln(W_3/W_1)$	0.3057***	0.1003	Environmental		
$0.5\ln(W_2/W_1)\ln(W_2/W_1)$	-0.0140***	0.0024	Variables		
$0.5\ln(W_3/W_1)\ln(W_3/W_1)$	0.0004***	1.4306E-04	Constant	8.7691***	3.3512
$\ln(Y_1)\ln(W_2/W_1)$	-0.0832***	0.0110	*ETA*	-1.03980***	0.3978
$\ln(Y_1)\ln(W_3/W_1)$	0.0517***	0.0101	*NIM*	4.2731*	2.2361
$\ln(Y_2)\ln(W_2/W_1)$	0.0007	0.0164	*Loan/Asset*	-5.4579***	0.8271
$\ln(Y_2)\ln(W_3/W_1)$	-0.0385**	0.0157	*ROA*	-1.2323***	0.2070
$\ln(Y_3)\ln(W_2/W_1)$	-0.0525***	0.0185	*CSR*	0.0142**	0.0064
			CSR^2	-1.283E-04**	6.1129 E-05
σ^2	0.9000***	0.1650	GDP growth rate	0.2560***	0.0435
σ_w^2/σ^2	0.8995***	0.0337	ln(real GDP per capita)	-0.6706**	0.3032
Log-Likelihood	-3.32E+02				

C. Hypothesis testing

Both coefficients of *CSR* and CSR^2 are significantly estimated at the 5% level, indicating that the relationship between *CSR* and cost inefficiency is not linear, which is similar to Barnett and Salomon (2006) who find a curvilinear relationship between *CSR* and financial performance. Mullen (1997) and Yang (2015) suggest that we should expect *CSR* to show benefits over a long-term period than a short-term period. We now emphasize the effect of *CSR* in Table VIII. As stated in Section IV, the mode of the *CSR* score is equal to 20. Table VIII displays that the majority of efficiency scores range from 0.6 to 0.8, where the corresponding sample banks have *CSR* indices between 11 and 31. Taking the partial derivative of the cost inefficiency with respect to *CSR*, we obtain the turning point at around 55. If the *CSR* score is below 55, then the efficiency measure is decreasing with an increase in *CSR*, while the reverse is true when the CSR score surpasses 55, i.e., the efficiency score is increasing when *CSR* grows in excess of 55. The above finding enlightens us that in terms of *CSR*, a bank should engage itself at greater than 55 such that the beneficiary effect on efficiency sets in. A higher value of *CSR* usually takes more time to achieve, implying that the positive effect of *CSR* on efficiency tends to be long-term instead of short-

term (Mullen (1997) and Yang (2015)).[12]

Recall that the greenwashing hypothesis predicts no association between the *CSR* score and cost (in)efficiency. This hypothesis is decisively rejected since both coefficients of *CSR* and CSR^2 are significantly estimated. Instead, our parameter estimates partially support the altruistic and strategic hypotheses. According to the coefficient estimates, cost inefficiency (efficiency) first rises (declines) with *CSR* until the turning point of *CSR*=55. This stage supports the altruistic hypothesis, because there is a negative relation between *CSR* and efficiency. The relationship between CSR and efficiency becomes positive after the turning point of *CSR*=55. This stage supports the strategic hypothesis, due to the presence of a positive relation between *CSR* and efficiency. In other words, a bank is said to be altruistic if it engages in *CSR* activities with a score less than 55 (possibly in the short-term), while a bank is said to be strategic if it actively conducts *CSR* with a score above 55 (possibly in the long-term).

We look to deal with the possible endogeneity problem of *CSR* using the instrumental variables (IV) approach. The main difficulty in using IV comes from the collection of instrumental variables, which must be uncorrelated with the error term, but at the same time be correlated with *CSR*. We choose two macroeconomic variables, i.e., real *DP* growth rate and (log)real *DP* per capita and their squared terms, as the instrumental variables to obtain the fitted values of *CSR* and CSR^2. Those two fitted values are then treated as environmental variables, together with ETA, NIM, loan to total assets ratio, and *ROA*.

Appendix B shows the parameter estimates for the first- and second-stage regression results. Most of the first-stage parameter estimates are significant at least at the 5% level, implying that the chosen four instrumental variables tend to be valid. With regard to the second-stage results, the signs of those environmental variables are the same as those in Table VII. Here the coefficient of the fitted value of *CSR* is now insignificantly estimated, but its sign is the same as that of *CSR* in Table VII, and the fitted CSR^2 is significantly estimated. The insignificance of the

[12] Mullen (1997) claims that for a firm to benefit from its CSR program the program should last at least 3-5 years.

coefficient of fitted *CSR* may be attributed to the fact that the substitution of the fitted *CSR* for observed *CSR* tends to incur an extra estimation error, such that the variance of the new disturbance term in the second-stage enlarges. This expands the standard errors of the coefficient estimates and consequently reduces the *t*-test statistics. Although the replacement of *CSR* and CSR^2 by their fitted values adversely affects the significance of the coefficient of the fitted *CSR*, the main results change little.[13]

We estimate the same model as Appendix B, but preclude the variables of loan to total assets ratio and *ROA*, because they are likely to be choice variables. The coefficient estimates of the four remaining environmental variables, i.e., *ETA*, *NIM*, fitted *CSR*, and fitted CSR^2, are all insignificant; moreover, merely four out of 31 parameter estimates attain at least the 10% level of significance. We therefore recommend that environmental variables include the variables of loan to total assets ratio and *ROA*.

An interesting question worth figuring out is where the benefits come from after banks are involved in *CSR* at greater than 55. Because *CSR* investments lead to higher levels of credibility (Lin et al. (2011)), improved image or reputation (Tewari (2011)), higher employee retention (Kim and Park (2011)), and close customer relationships (Peloza and Shang (2011), Matute-Vallejo, Bravo, and Pina (2011), and Brown and Dacin (1997)), we think the benefits may come from the above four sources. Once banks engage in *CSR* at more than an index level of 55, they have built up a reputation. Customers are thus more willing to pay a higher price to get the services, and at the same time banks are able to hire more qualified workers to enhance their production efficiency. The improvement in production efficiency comes from either banks hiring fewer inputs to produce the same amount of output and reducing production costs (improving cost efficiency), or banks producing more outputs using a given input mix and raising total revenue or profit (enhancing revenue or profit efficiency). This paper focuses on cost efficiency and leaves the link of revenue or profit efficiency

[13] We use the likelihood ratio test to test for the null hypothesis that *CSR* and CSR^2 are uncorrelated with the error term. We estimate two cost frontiers. One of them is shown in Appendix B, where the fitted values of *CSR* and CSR^2 are a part of the environmental variables. The other replaces those fitted values by their observed counterparts. The corresponding log-likelihood values are -370.21 and -341.67, respectively. The test statistic is equal to 57.08 with the degrees of freedom equaling 33, which is significant at least at the 5% level. The hypothesis is then rejected.

with CSR activities as a future research topic.

Table VIII

CSR Score Cluster with Efficiency Score

Efficiency Score	*CSR* Score Range											Total
	1-11	11-21	21-31	31-41	41-51	51-61	61-71	71-81	81-91	91-101	101-111	
0.006-0.106		1		1	1							3
0.106-0.206		5	2	3	1	1	3	3	3	2		23
0.206-0.306		5	3	3	6	5	4	2	1			29
0.306-0.406		4	5		6	4	3	5	1	1		29
0.406-0.506	1	**6**	6	1	1	3	2	1	2	1		24
0.506-0.606	1	14	**15**	4	6	7	6	3	4	2		62
0.606-0.706	2	15	12	9	**17**	11	6	2	6	3	1	84
0.706-0.806	9	**31**	20	9	13	12	13	12	8	3		130
0.806-0.906	2	10	**12**	9	7	9	8	6	6			69
0.906-1.000		1			1					2		4
Total	15	92	75	39	59	52	45	34	31	14	1	457

The average efficiency scores vary over time and across distinct regions, as shown in Table IX. The table unveils that the most stable average efficiency is found in Asia, primarily Japan, while the most volatile average efficiency occurs in North Europe. The average efficiency peaks in 2011 and then decreases over time. We apply the method of variance analysis to test for the null hypothesis that the average efficiency measures of the five regions are equal. The *F*-statistic is equal to 22.65. The null hypothesis is decisively rejected, and we conclude that the managerial abilities of the sample banks differ across the five regions.

Table IX

Average Cost Efficiency across Different Regions

Region	2010	2011	2012	2013	2014	Mean (2010-2014)	Standard Deviation
Asia	0.6116	0.6456	0.6141	0.62925	0.6285	0.6258	0.0122
North America	0.6151	0.5690	0.5947	0.6263	0.5933	0.5997	0.0198
North Europe	n.a.	0.7708	0.6872	0.4688	0.6171	0.6360	0.1108
West Europe	0.6761	0.6247	0.5706	0.6041	0.5133	0.5978	0.0544
South Europe	0.6356	0.7126	0.7461	0.6119	n.a.	0.6766	0.0548
Total	0.6346	0.6646	0.6425	0.5881	0.5881	0.6189	

VI. Conclusion

This paper mainly examines the effect of *CSR* engagement on efficiency in the context of the translog cost frontier versus most existing research works that examine the effect of *CSR* on financial performance. We apply the stochastic frontier approach to estimate a cost frontier in order to verify whether the relationship between *CSR* and cost efficiency exists in banking industries across countries. Several interesting empirical results are worth mentioning. First, *CSR* is not linearly correlated with efficiency; rather, its curvilinear relation to the efficiency score prevails, since its squared term significantly impacts cost inefficiency. We further find that banks benefit from the involvement of *CSR* only when their *CSR* scores exceed 55. Since the engagement of *CSR* takes time to achieve a higher score, our finding recommends that long-term engagement of *CSR* is able to boost cost efficiency. This finding is similar to, e.g., Mullen (1997) and Barnett and Salomon (2006), who confirm positive effects of *CSR* on financial performance.

Second, akin to Wu and Shen (2014), our results fail to support the greenwashing hypothesis, but partially support the altruistic and strategic hypotheses. In particular, a bank is altruistic if it engages in *CSR* activities with a score less than 55, while a bank is strategic if it actively conducts *CSR* with a score above 55. While this paper sheds light on the determinants of cost efficiencies, it overlooks the effect of *CSR* on profit efficiency, which may be regarded as a future research direction. Third and finally, microeconomic and macroeconomic factors play important roles in the determination of cost efficiency.

Appendix A

Table AI

	Answer				Score Given
- Between 25% and 50%	Over 50%				- - 1 2
- Civilian	General	Strategic			- - - 1 2 3
- Dual use military goods/services	General or civilian goods/services	Military specific goods/services	Significant parts of weapons	Weapons systems or platforms	- - - - - 1 2 3 4 5
- Has not addressed allegations	Assessment pending on allegations	Has addressed allegations			0 -1 - 2
- Low	Medium	High			- - - 1 2 3
- Minor nuclear area	Conventional area	Major nuclear area			- - - 1 2 3
- no					1
- No convictions	Fines in lower half	Fines in second quartile	Fines in top quartile		0 -1 - - 2 3
- Non strategic parts for	Strategic parts for	Whole			0 -1 - 2
- Services	Large	GRS(Global Resource Sector)			- - - 1 2 3
- Smaller	Large				- - 1 2
- Some evidence	Clear evidence				- - 1 2
- Some exports	Major exports				- - 1 2
- Under 1,000 cubic metres	1,000 - 10,000 cubic metres	10,000 - 100,000 cubic metres	100,000 - 1 million cubic metres	Over 1 million cubic metres	- - - - - 1 2 3 4 5
- Up to 5%	Between 5% and 10%	Between 10% and 33%	Over 33%		- - - - 1 2 3 4
- Yes					- 1
+ 0 points	1-4 points	5-8 points	9-12 points	13-16 points	0 1 2 3 4
+ 10% - 25%	25% - 50%	50% - 75%	75% - 90%	Over 90%	1 2 3 4 5

+	Advanced	Good	Intermediate	Basic	Limited	Little or no	No evidence of	5 4 3 2 1 0
+	Advanced overall policy/system	Intermediate overall policy/system	Basic overall policy/system	Little or no overall policy/system				3 2 1 0
+	All	Some	One	None				3 2 1 0
+	Clearly communicates policy	Has adopted policy	Little or no evidence of policy					2 1 0
+	Exceptional	Good	Moderate	Weak	Inadequate			3 2 1 0 -1
+	Final	Minimum	Does not meet minimum					2 1 0
+	Five or more	Four or more	One or more	No indication of				3 2 1 0
+	Good policy	Moderate policy	Basic policy	No policy				3 2 1 0
+	In top 100	In top 50	In top 10					1 2 3
+	Less than 33%	More than 33%						1 2
+	Major improvement	Significant improvement	Minor improvement	No improvement	No data or inadequate data			3 2 1 0 0
+	Very clear	Clear	Some	Little or no evidence of				3 2 1 0
+	Yes1							1
+	Good	Moderate	Basic	Limited	Little or no			4 3 2 1 0
+	Clear evidence	Some evidence	Little or no evidence					2 1 0
+	Has clear policy and procedures	Has adopted a policy	No policy disclosed					2 1 0
+	Has identified	Has not identified						1 0
+	Best practice	Meets	Low impact for	Does not meet				3 2 1 0

Appendix B. Parameter Estimates from the IV Approach

Table BI

Parameter Estimates of the First-Stage Regression with the Dependent Variable of *CSR*

, and * denote significant at the 5% and 1% levels, respectively.

Variable	Parameter Estimate	Standard Error
Constant	1341.51***	336.73
GDP growth rate	-1.5276**	0.6561
Square of *GDP* growth rate	-0.0150	0.0889
ln(real *GDP* per capita)	-248.51***	64.7438
Square of ln(real *GDP* per capita)	11.9010***	3.1170
R^2	0.045	
Number of Observations	457	

Table BII

Parameter Estimates of the Second-Stage Regression for the Cost Frontier

*, **, and *** denote significant at the 10%, 5%, and 1% levels, respectively. $\sigma^2 = \sigma_w^2 + \sigma_v^2$.

Variable	Parameter Estimate	Standard Error	Variable	Parameter Estimate	Standard Error
Constant	0.5649	0.9442	$\ln(Y_3)\ln(W_3/W_1)$	0.0509**	0.0200
$\ln(Y_1)$	0.5459***	0.0984	t	-0.3891	0.2956
$\ln(Y_2)$	0.1728	0.1429	$0.5t^2$	-0.0658	0.0558
$\ln(Y_3)$	0.2208*	0.1328	$t\ln(Y_1)$	0.1035***	0.0278
$0.5\ln(Y_1)\ln(Y_1)$	0.0015	0.0051	$t\ln(Y_2)$	-0.0079	0.0234
$0.5\ln(Y_2)\ln(Y_2)$	-0.0048	0.0135	$t\ln(Y_3)$	0.0705***	0.0240
$0.5\ln(Y_3)\ln(Y_3)$	0.0122	0.0136	$t\ln(W_2/W_1)$	-0.0372*	0.0193
$\ln(W_2/W_1)$	1.1395***	0.1322	$t\ln(W_3/W_1)$	-0.0305*	0.0184
$\ln(W_3/W_1)$	0.2982**	0.1164	Environmental		
$0.5\ln(W_2/W_1)\ln(W_2/W_1)$	-0.0124***	0.0029	Variables		
$0.5\ln(W_3/W_1)\ln(W_3/W_1)$	0.0004***	0.0001	Constant	1.2808*	0.6770
$\ln(Y_1)\ln(W_2/W_1)$	-0.0854***	0.0113	*ETA*	-1.3398***	0.3392
$\ln(Y_1)\ln(W_3/W_1)$	0.0486***	0.0116	*NIM*	0.2405	0.2941
$\ln(Y_2)\ln(W_2/W_1)$	-0.008	0.0199	*Loan/Asset*	-0.8076***	0.1097
$\ln(Y_2)\ln(W_3/W_1)$	-0.0361*	0.0187	*ROA*	-0.2393*	0.1325
$\ln(Y_3)\ln(W_2/W_1)$	-0.0736***	0.0212	Fitted *CSR*	0.0118	0.0226
σ^2	0.3735***	0.0091	Fitted CSR^2	-0.0004**	0.0002

σ_w^2/σ^2	0.0052	0.0042
Log-Likelohood	-370.2090	

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在隨機成本架構下銀行從事 CSR 會否影響其效率?

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摘要

本文探討銀行從事企業社會責任 (CSR)，對其成本效率產生何種影響？利用 EIRIS 資料庫收集跨國銀行業的CSR資料，轉換成標準化分數，視為環境變數之一，進行實證分析。析結果不支持漂綠假說，部分支持利他與策略動機。因為銀行CSR分數需經過一段時間的累積，故在短期間CSR分數低於55分時，支持利他動機；高於55分的長期，則支持策略動機。

關鍵詞: CSR 分數、隨機成本邊界、環境變數、利他動機、策略動機

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