Bank efficiency and leasing in U.S.A. banking system

ANDRIAKOPOULOS, KONSTANTINOS and LADAS, AUGOUSTINOS and ANDRIAKOPOULOS, PANAGIOTIS

HELLENIC OPEN UNIVERSITY, UNIVERSITY OF PATRAS, HELLENIC OPEN UNIVERSITY

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Abstract

This paper contributes to the literature on leasing and bank efficiency by examining whether the cost efficiency of banks depends on the leasing that banks offer. Indeed, banks improve their situation when they offer products that might be close substitutes such as lease and loans. In addition, the presence of transaction costs offers more costumers to those banks that provide more products to their customers. Similarly, banks can create profit opportunities offering the asset of leasing in low price exploiting their negotiating power. Moreover, leasing can alleviate information asymmetries issues that arise during loan procedure. Using stochastic frontier analysis for a sample of commercial and savings banks in USA for the years 2010–2016, we find that leasing positively affects cost efficiency. Significant variations among type of bank appear to be present. By considering all CAMEL (Capital Adequacy, Asset Quality, Management, Earnings, and Liquidity) parameters we notice that banks' financial strength affects cost efficiency. Some policy implications are derived based on the empirical evidence supporting a more robust banking system can be created as banks offer leasing to their costumers instead bank loans reducing their credit risk that they face when they want to finance potential profitable investment projects.

JEL classifications: C33; G21; G30

Keywords: Leasing, Bank efficiency, Stochastic frontier analysis, Cost function

1. Introduction

Leasing[1] is a very important finance alternative to standard bank loans for many firms (Bowman, 1980; Ang and Peterson, 1984; Finucane, 1988; Krishnan and Moyer, 1994; Adedeji and Stapleton, 1996 ; Deloof et al., 2007). Recent national leasing statistics[2] for the year 2017 point out a potential substitution effect of leasing for SME bank lending as leasing and hire purchase activities rose in 26 out of 34 countries[3] at a median rate of 6.2%. Correspondingly to our data from SDI (Statistics on Depository Institutions) report of FDIC (Federal Deposit Insurance Corporation) this rising tendency of leasing is reflected by lease financing receivables of the average bank of our sample as the year 2014 notices the aforementioned increased tendency of lease financing receivables that continues for the coming two years of our research, 2015 and 2016.

[Insert Graph 1 here]

In addition, there are potential benefits of leasing from banks' perspective that make banks to provide leasing. In particular, financial institutions become less weak when they combine products that might be close substitutes under one roof in case that customers substitute one of these products for other ones (Boot, 2003).

Furthermore, banks which offer more services to their customers are more likely to be preferred for further services by their customers since the transaction costs of

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[1] Financial Accounting Standards Board (FASB) distinguishes two types of leases based on the lease terms, and this classification determines the lease's accounting treatment: (1) An operating lease is viewed as a rental for accounting purposes. Operating leases are disclosed in the footnotes of the lessee's financial statements and (2) A capital lease or finance lease is viewed as an acquisition for accounting purposes and in this case, the asset acquired is listed on the lessee's balance sheet (Berk and DeMarzo,2014)

[2] Leasing national statistics was extracted from OECD, complemented by information from Leaseurope

[3] Australia, Austria, Chile, Colombia, Estonia, Italy, Finland, France, Hungary, Indonesia, Korea, Latvia, Lithuania, Norway, Perou, Poland, Slovak Republic, Spain, Sweden, the Czech Republic, the Netherlands, the People's Republic of China, the Russian Federation, Turkey, UK, and Japan report increasing leasing and hire purchase activities. Contrary, Belgium, Denmark, Greece, Kazakhstan, Portugal, Slovenia, Switzerland, and USA report diminishing leasing and hire purchase activities.

switching become higher for the customer. Klemperer (1995) supports that switching cost gives firms a degree of market power over their existing customers and create the potential for monopoly profits. In a similar vein, lessor firms can achieve lower average prices and therefore to create profit opportunities negotiating appropriately with suppliers of assets as lessor firms buy assets in volume in contrast to the singly purchase by the lessee (Lewellen et al, 1976).

Moreover, a bank loan application is connected to credit risk as borrowers promise to lenders future uncertain payments which pay back the loan amount. However, borrowers are very likely to change their behavior when their bank loan applications are accepted by banks exploiting the liquidity nature of money. In other words, investments projects may be cancelled by borrowers consuming the loan amount and therefore undermining the repayment of the loan (Burkart and Ellingsen, 2002).

Especially, asymmetry in information exists between lenders and borrowers in loan markets. In particular, loan markets are characterized by adverse selection and moral hazard issues. Indeed, banks are not able to fully observe the creditworthiness of potential borrowers during a loan application procedure. In addition, banks do not control the behavior of borrowers when the latter have been obtained the loan (Jaffe and Russel, 1976; Keeton, 1979; Stiglitz and Weiss, 1981).

In other words, leasing can help banks to cope with customers who are vulnerable to information asymmetries, especially small and young firms, which make them riskier than large firms considered creditworthy and transparent firms. Krishnan and Moyer (1994) claim that leases should be used by riskier, less established firms. Since leasing can reduces monitoring cost to the lender through a reduction in potential risk taking behavior of the borrower (Stulz and Johnson, 1985) as leasing can be considered as a mechanism that can deal with issues related to agency cost of debt (Barro, 1976 ; Scott, 1977 ; Benjamin, 1978 ; Jackson and Kronman, 1979; and Smith and Warner, 1979) provided that capital leases impose consequences on a firm that are similar to secured debt financing (Krishnan and Moyer (1994).

In line with this argument Sharpe and Nguyen (1995) find strong support that firms likely to face high financial contracting costs have a significantly greater propensity to lease provided that lease obligations have higher priority and lower risk than even secured debt as bankruptcy protection does not cover assets which are financed via a true lease while in case of default these assets can be seized by the lessor who has additionally the option to release the asset recovering the full economic value easier than a lender would (Sharpe and Nguyen, 1995).

Furthermore, leasing the asset and the services as a bundle, lessor can exploit the lessee increasing the price of services provided that the value of the asset relies on additional services such as a truck with a driver. Thus, efficiency gains from specialization can be stemmed from lessors' policy to maintain or operate certain types of assets where lessors have efficiency advantage over lessees (Klein et al, 1978).

Therefore, the main goal of this paper is the identification and estimation of the impact, if any, of leasing on banks' cost efficiency.

We expect that leasing affects positively cost efficiency of banks. Indeed, as we mentioned before, a lessor can enjoy efficiency gains from specialization while at the same time he deals with bankruptcy costs and moral hazard issues that involved in a loan procedure as the implementation of an investment project requires the necessary assets (property, plant and equipment) and when banks offer leasing instead of a bank loan then banks impel borrowers to invest so as to produce and finally repay the future lease payments(Klein et al, 1978 ; Stiglitz and Weiss, 1981 ; Sharpe and Nguyen, 1995; Berk and DeMarzo, 2014). Instead, when banks offer bank loans face moral hazard issues as borrowers may be involved in a fraud because of the liquidity nature of cash threatening the repayment of bank loan payments (Stiglitz and Weiss, 1981; Burkart and Ellingsen, 2002).

To investigate the above research question, this paper employs stochastic frontier analysis (SFA) examining the uncertain relationship between the extent of leasing and the cost efficiency of USA banks. Based on Battese and Coelli (1995), we implement the maximum likelihood estimation method to simultaneously estimate the stochastic function and the inefficient model. Moreover, examining the above hypothesis we shed light on an unexplored topic that reveals the relationship between two important financial issues cost efficiency and banks' leasing investments. Although, as we mentioned before, the theoretical foundation of this relationship can be relied on the alleviation of the moral hazard phenomenon we do not have so far any empirical evidence that can support the positive impact of leasing on bank efficiency thus this paper aims to fill this gap of bank efficiency literature offering empirical evidence on the aforementioned relationship.

The remainder of the paper is structured as follows. In the next section, we present the econometric methodology. Section 3 describes the data employed and the variables definition. Section 4 discusses the empirical results and Section 5 concludes.

2. Model Specification

In order to capture the cost inefficiency of a bank we rely on the notion of frontier efficiency or X-efficiency measurement, which measures inefficiency as the deviation from the efficient cost frontier where best -practice banks operate. Moreover, firms intend to minimize their costs so that to maximize their profits given their revenues, therefore cost inefficiency emerges when banks fail to opt appropriately the relevant output quantities given output prices or they are restricted to charge unideal output prices given quantities. (Sensarma,2005). In economic terms the inefficiencies or deviations from the frontier can be taken into account by one part of error terms for this reason we choose to proceed both in estimation of the cost function and inefficiency model that contains the potential determinants of efficiency using stochastic frontier analysis (SFA). Moreover, SFA is considered to be an optimal method to deal with problems that cause noise in our model because of data problems, loss or damages of resources as this method permits the cost frontier to be represented by a function while the inefficiency factors are considered by one part of the composite error term.

Therefore, the stochastic cost frontier may be specified[4] as (Kumbakhar and Lovell, 2000):

$$\ln tc_{it} = \ln f\left(\mathbf{y_{it}}, \mathbf{p_{it}}; \boldsymbol{\beta}\right) + v_{it} + u_{it}, \quad i = 1,..., I, \quad t = 1,..., T \tag{1}$$

so that a total cost $tc \geq 0$ can be emerged given an output vector $\left(y_1,..., y_N\right) \geq 0$ and an vector of input prices $\left(p_1,..., p_N\right) \geq 0$, where i indexes banks, t indexes time, $\ln f\left(\mathbf{y_{it}}, \mathbf{p_{it}}; \boldsymbol{\beta}\right)$ is the deterministic kernel of the stochastic cost frontier

[4] In Kounetas and Tsekouras's, paper (2010) following Kumbakhar and Lovell, (2000, p262) they specify the stochastic production frontier. In a similar vein, we also specify the stochastic cost frontier.

$\left[\ln f\left(y_{\mathbf{it}}, p_{\mathbf{it}}; \boldsymbol{\beta}\right) + v_{it}\right]$, $v_i \sim iid\ N\left(0, \sigma_v^2\right)$ captures the effect of random noise on the cost process, $u_i \sim N\left(0, \sigma_u^2\right)$ captures the effect of cost inefficiency and $\boldsymbol{\beta}$ is the parameter vector to be estimated. Hereafter the subscript t is suppressed and fixed effects panel data models are employed for simplicity reasons. Correspondingly, to our research, Battese and Coelli (1992) show that the best predictor of the cost efficiency of each producer is $TE_i = \exp(-\hat{u}_i)$, where $\hat{u}_i = E\left(u_i \left| \left(v_i + u_i\right)\right.\right)$. In the above described model, the so-called Error Component Model (ECM).

In addition, the inefficiency factors are represented by a vector of exogenous variables $(z_1, \ldots z_Q)$ in the spirit of the effect on the structure of the cost process by which output y that requires total cost tc given an vector of input prices p. The elements of $\mathbf{z}$ capture features of the environment in which the total cost takes place, and they are generally considered to be conditioning variables beyond the control of those who manage the total cost process. In this case, as Huang and Liu (1994) proposed, the stochastic cost frontier of equation (1) is accompanied by the cost inefficiency relationship:

$$u_i = g\left(\mathbf{z_i}; \boldsymbol{\delta}\right) + \varepsilon_i \tag{2}$$

where $\boldsymbol{\delta}$ is a vector of parameters which are associated to inefficiency factors, to be estimated. The requirement that $u_i = \left[g\left(\mathbf{z_i}; \boldsymbol{\delta}\right) + \varepsilon_i\right] \geq 0$ is met by truncating ε_i from below such that $\varepsilon_i \geq -g\left(\mathrm{z_i}; \delta\right)$, and by assigning a distribution to ε_i such that $\varepsilon_i \sim N\left(0, \sigma_\varepsilon^2\right)$. This allows $\varepsilon_i < 0$ but enforces $u_i > 0$. In the case in which the g function is a linear one, the above model is the so-called Technical Efficiency Effects Model (TEEM) which was introduced by Batesee and Coelli (1995). The cost efficiency of the $i-\text{th}$ bank is given by $TE = \exp\{-u_i\} = \exp\{-\boldsymbol{\delta}'\mathbf{z_i} - \varepsilon_i\}$. In this paper we test the hypothesis that the leasing may have the character of a z variable which we name it z_l, and thus relationship (3) becomes:

$$u_i = g\left(\mathbf{z_i}; \mathbf{z}_l; \boldsymbol{\delta}; \boldsymbol{\delta}_l\right) + \varepsilon_i \qquad (3)$$

where $\boldsymbol{\delta}_l$ are the additional parameters which must be estimated since the leasing has been included among the other inefficiency factors. According to equation (3) leasing influences the cost efficiency with which banks approach the cost frontier.

In order to test the hypothesis that leasing affects the cost process through the inefficiency term, equations (1) and (3) should be combined and the following model arises:

$$\begin{aligned} \ln tc_i &= \ln f\left(y_{\mathbf{i}}, p_{\mathbf{i}}; y_l; \boldsymbol{\beta}; \boldsymbol{\beta}_l\right) + v_i + u_i \\ u_i &= g\left(\mathbf{z_i}; \mathbf{z}_l; \boldsymbol{\delta}; \boldsymbol{\delta}_l\right) + \varepsilon_i \end{aligned} \qquad (4)$$

Following Huang and Liu (1994) we let function $g\left(\mathbf{z_i}; \boldsymbol{\delta}\right)$ to comprise interactions between exogenous factors $\mathbf{z_i}$ and outputs $y_{\mathbf{i}}$ (Batesse and Broca, 1997). This approach allows us to incorporate the non-neutral effects of leasing in the cost performance as leasing is thought to be a cost efficiency factor. Thus, the $g\left(\mathbf{z_i}; \boldsymbol{\delta}\right)$ function for the $i-\text{th}$ bank can be written as:

$$\begin{aligned} g\left(\mathbf{z_i}, \mathbf{z_{li}}, p_{n\mathbf{i}}, y_{\mathbf{i}}; \boldsymbol{\delta}, \boldsymbol{\delta}_l\right) &= \sum_q^Q \delta_q z_{qi} + \delta_l z_l + \sum_q^Q \sum_n^N \delta_{qn} z_{qi} \ln y_{ni} \\ &+ \sum_q^Q \sum_n^N \delta_{qn} z_{qi} \ln p_i + \sum_m^M \delta_{ml} z_{li} \ln y_{mi} \end{aligned} \qquad (5)$$

Where the non-neutral effects of the leasing on the inefficiency terms when leasing is an inefficiency factor are represented by the last term of the right-hand part of the above equation. In more details, the sum of the second and fourth term of the right-hand part of the above equation show the total effect of leasing on the technical inefficiency of the $i-$th bank is the sum of the second and fourth term of the right-hand part of the above equation. Therefore, from equation (5) we can explore the case where non-neutral effects arise from leasing as an inefficiency factor.

The translog cost function for our study is presented by the below framework the following form:

$$\begin{aligned}\ln tc_i &= \beta_0 + \sum_m \beta_m \ln y_{mi} + \sum_n \beta_n \ln p_{ni} \\ &+ \frac{1}{2}\sum_m \sum_m \beta_{mm} \ln y_{mi} \ln y_{mi} + \frac{1}{2}\sum_n \sum_n \beta_{p_n} \ln p_{ni} \ln p_{ni} \\ &+ \frac{1}{2}\sum_m \sum_n \beta_{mp_n} \ln y_{mi} \ln p_{ni} + \beta_T T \\ &+ \frac{1}{2}\beta_{t^2} T^2 + \sum_m \beta_{tm} T \ln y_{mi} + \sum_n \beta_{tn} T \ln p_{ni} + u_i + v_i\end{aligned} \quad (6)$$

where m= L,I,N, and l denote loans, investments, non-interest income and leasing respectively while n=L, C and F denote price of labor, price of capital and price of funding respectively, tc_i represents the total cost of the i-th bank with subscript t suppressed, β_m , β_n, β_{mm}, β_{p_n}, β_{mp_n}, β_T, β_{t^2}, β_{tm}, β_{tn} are the parameters to be estimated. Cost and input prices are normalized by the price of labor before taking logarithms to impose linear input price homogeneity. This scaling implies an estimation of coefficients for p_C (price of capital) as well as p_F (price of funding) with the restriction that the sum of these coefficients is equal to one (see Kuenzle, 2005).A second order approximation translog cost function is often opted by scholars model to measure bank cost efficiency (Greene, 1980; Berger and Mester, 1997) therefore we follow this approach estimating equation cost frontier function and inefficiency model simultaneously trough maximum likelihood (Battese and Coelli, 1995 ; Coelli et all, 2005).

3. Data and Variables Definition

We obtain the data of our research using the SDI (Statistics on Depository Institutions) report created by FDIC[5] (Federal Deposit Insurance Corporation). This report provides banks' financial statements, ratios, types, ownership structure and information for USA banks. Therefore, it is the reference database for USA samples that offer data capturing the whole spectrum of banks loans and leases products. Moreover, we exclude the extreme values, decreasing the impact of outliers, as we eliminate 1 % of the extreme values for all variables employed in this research. Thus, our data set includes 806 banks covering the period 2010 -2016, so an unbalanced panel of 2,334 bank - year[6] observations is created. The option of factor input and output of banks assuming an intermediation approach (Berger and Humphrey, 1991; Ellinger and Neff, 1993; Altumbas et al., 2000; Rezvanian and Mehdian, 2002).

For our estimations, our dependent variable, a bank's total cost (tc) is the sum of labor cost, capital cost and funding cost, calculated as salaries and employee benefits, premises and equipment expense and total interest expense respectively. We specify as outputs, the total loans of banks (y_L), derived as total loans and leases minus lease financing receivables[7], the investments of banks (y_I), estimated as earning assets, and the non-interest income of banks (y_N) ,calculated as total non-interest income. In addition, we include in translog cost function the price of capital

[5] Our data are from the *Statistics on Depository Institutions* (https://www5.fdic.gov/sdi/download), which provides branch-level information.

[6] The data that support the findings of this study are available from the corresponding author upon reasonable request.

[7] Lease financing receivables is subtracted from the values of total loans and leases in order to avoid double measurement of the assets that are associated to the leasing investments.

(p_C) derived as the ratio of operating expenses to net fixed assts, the price of labor (p_L) calculated as the ratio of employ salary to total employees and the price of funding (p_F) determined as the ratio of interest payments to total liabilities. As far as the impact of leasing on the inefficiency model is tested, and thus leasing is regarded as an additional inefficiency factor, the values of $\tilde{y}_l$ are the ratios of lease financing receivables to total loans and leases.

Moreover, we rely on CAMEL model so as to opt the rest of the inefficiency factors. Correspondingly, these factors reflect the financial situation of the bank offering financial information for relevant bank characteristics such as the capital adequacy, asset quality, management capability, earnings and liquidity. Therefore, the variable $(CAPRAT)$ stands for bank's capital adequacy (Das and Ghose, 2006 ; Kumbhakar and Wang, 2007; Chortareas et al, 2012) and it is defined as the ratio of the sum of Tier 1 (core) capital plus Tier 2 Risk-based capital divided by bank's total assets. Also, the variable $(PROV)$, which is defined as the ratio of credit loss provision to net charge-offs to the bank's total assets, represents bank's asset quality (Berger, 1995). As far as the management capability the variable $(MANAG)$ defined as the ratio of net operating income to total not interest expenses (Hesse and Cihak, 2007; Liang et al 2017). Furthermore, bank's profitability is captured by the variable $(PROF)$, net income after taxes and extraordinary items (annualized) as a percent of average total assets, reflects banks' profitability (Pilloff and Rhoades, 2002 ; Liang et al 2017) while the variable (LIQ) reflects banks' liquidity Chortareas et al, 2012) and it is defined as the ratio of loans and lease financing receivables of the institution, including unearned income to total deposits. Moreover, county-specific factors that may affect cost efficiency are included in inefficiency model as inefficiency factors (Yildirim and Philippatos, 2007; Berger and Hannan, 1998; Manghetti, 2011). In this category we have also incorporated the Herfindahl index variable (HHI), as a proxy for the structural market conditions that prevails in each county while we use the variable ($RGDP$), which measures annual real GDP growth[8], capturing the evolution of economic cycle as a better access to new technologies can be observed in countries which are more prosperous and therefore banks' monitoring and screening cost can be diminished easier in prosperous countries than poor improving banks' cost efficiency (Lensink et al, 2008 ; Pasiouras et al, 2008). In addition, industry specific dummy variables (COM), and (SAV) are included in inefficiency model where (COM), variable takes the value of 1 for commercial banks and 0 for savings banks. Equally, (SAV), variable takes the value of 1 for savings banks and 0 for commercial banks. Finally, descriptive statistics for all variables employed in the estimation of the cost frontier and the inefficiency model are depicted in Table 1.

[Insert Table 1 here]

[8] GDP growth rate was extracted from Federal Reserve Bank of St. Louis

4. Results and Discussion

This study uses to carry out modeling estimation. Table 2 contains the result of Stochastic Frontier Estimation which is carried out using Frontier 4.1 software (Coelli, 1996). In addition, more than half of the variables are statistically significant. It should be noted that in our estimated model the relevant tests indicate that the null hypothesis of no cost inefficiency effects in the estimated cost frontier is not accepted[9]. Moreover the proposed inefficiency model is appropriate as the likelihood ratio test statistic[10] is 1184.8 (greater than $x^2_{0.01}$(14)=29.14), which soundly rejects H_0 at the significance level of 1%.

[Insert Table 2 here]

Most importantly, the estimates of the inefficiency model are summarized in Table 3. The null hypothesis that the coefficients of the inefficiency factors are jointly zero is not accepted**.** Surprisingly, banks' capital ratio variable (CAPRAT) influences negatively cost efficiency a relationship that does not confirm the argument that higher capitalization contributes to alleviate agency problems between managers and shareholders. Shareholders in this case have greater incentives to monitor

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[9] The likelihood ratio test is used to investigate the hypothesis γ=0. Kodde and Palm (1986) suggest the critical value for testing the aforementioned hypothesis while the relevant degrees of freedom is equal to the number of inefficiency variables included each time.

[10] The investigation of the inclusion of the inefficiency model in the stochastic frontier cost function demands the usage of the likelihood ratio (LR) test, thus we create the null hypothesis H_0:inefficiency model does not exist as well as the alternative hypothesis H_1:inefficiency model exists ; LR= -2$\left\{\ln\left[L\left(H_0\right)\right]-\ln\left[L\left(H_1\right)\right]\right\}$ .Here, $\ln\left[L\left(H_0\right)\right]$ is the translog cost function that does not include the inefficiency model, and $\ln\left[L\left(H_1\right)\right]$ is the translog cost function that includes the inefficiency model (Liang et al, 2017).

managements' performance and ensure that the banks are run efficiently (Eisenbeis et al., 1999).

In addition, the asset quality variable (PROV) influences negatively cost efficiency confirming the financial theory which suggests that the riskiness's of the banks overall portfolio may reduce cost efficiency since a high ratio of credit loss provision to net charge-offs to the bank's total assets could signal a poor quality of loans and therefore a higher risk of the loan portfolio as a deteriorated quality of loans increases the provisioning costs (Kosmidou, Tanna and Pasiouras, 2005).

Similarly, the cost to income ratio variable (MANAG) influences negatively cost efficiency implying that a poorer management's ability to control costs deteriorates cost efficiency implying that higher expenses normally mean higher cost and vice versa (Kosmidou et al, 2005). Moreover, cost efficiency is positively affected by banks' profitability variable (PROF). This result is in accordance to other relevant studies which argue that the higher banks' profits are, the more efficient their performance is (Pillof and Rhoades, 2002).

[Insert Table 3 here]

In a similar vein, the liquidity ratio affects negatively the cost efficiency indicating that banks' efficiency reduces as liquidity risk increases confirming the financial theory that suggests that banks are very likely to default when they are not able to fulfill short - term obligations (deposits), especially during times of economic stress, through current assets such as cash and quickly saleable securities (Golin, 2001).

In addition, commercial banks are revealed to be more efficient compared to savings banks as the relevant variable (COM) enters negatively and significantly in the inefficiency model suggesting that savings banks are related with credit risk more intensively compared to commercial banks provided that small enterprises and families, which are the prominent borrowers of savings banks, are thought to be opaque and less creditworthy by comparison to larges firms which borrow mainly by commercial banks (Manghetti and Chairman, 2011).

Regarding the impact of leasing on the banks' cost performance we notice that leasing increases cost efficiency as the relevant leasing variable (y_l) appear a negative sign in the inefficiency model implying that a decrease in operations cost of banks can be accomplished by banks which prefer to extend leasing to their borrowers trough the reduction of banks' credit risk as borrowing firms that have received leasing by banks are not able to change the lease for loss – making goals. Thus, a reliable obligation can be created between banks which extend leasing especially to those firms considered less creditworthy when financial circumstances are tough and financial markets are tight (Burkart and Ellingsen, 2002).

Moreover, we can identify the negative influence of large lending on the cost efficiency, when they are combined with total loans output, as the relevant interaction variable ($y_l \ln y_L$) shows a positive coefficient, confirming the financial theory that support that bank loan is positively connected with credit risk in the spirit that borrowers promise to lenders future uncertain payments which pay back the loan amount. Moreover, this kind of risk can be higher if we take into account that asymmetries information prevail during a loan procedure as borrowers may change behavior when they finally received the loan exploiting the opportunity of liquidity of a loan and finally they use the loan for consumption threatening the repayment of loan amount (Burkart and Ellingsen, 2002).

In contrast, we observe the positive influence of leasing on the cost efficiency, when they are combined with the variable that represents banks' non-interest income, ($y_l \ln y_I$). Thus, we can argue that expectedly non-interest income do not change the efficiency increasing effect of leasing, as the relevant interaction variable ($y_l \ln y_I$) has a negative coefficient, confirming at the same time the beneficial role that non-interest income has on banks' total cost level as banks achieve to diversify their portfolio reducing the credit risk that they face (Engle et al, 2014).

Concerning, the interaction of leasing with the price of funding, the identified negative influence on the cost efficiency is rather expected and it is reflected by the positive sign of the relevant interaction variable $y_l \ln\left(p_F / p_L \right)$, since an increase of price of funding variable reflects the increase of credit risk that banks may face when grant loans especially at high interest rate which worse the pool of potential borrowers increasing banks' credit risk, provided the positive relationship between lending interest rate and deposit interest rate (Irequi et al 2001) and naturally increase the cost of granting leasing (Stiglitz and Weiss, 1981). Furthermore, the above relationship changes when leasing variable interacts with the price of capital, as the negative sign of the corresponding interaction variable $y_l \ln\left(p_C / p_L \right)$ implies that revenues increases can be observed for those banks that can notice the expected inflation rate adjusting appropriately their interest rates gaining and dealing with the price of risk (Revell, 1979; Perry 1992).

5. Conclusions

Information asymmetries between lenders and borrowers are more severe when banks need to lend SMEs which are considered to be more opaque compared to large firms which offer audited financial statement so that banks assess credit risk using financial and accounting data (Berger and Udell, 1998 ; Wingborg and Landstrom, 2000 ; Howorth, 2001; Cassar, 2004). Since SMEs are more vulnerable to adverse selection and moral hazard issues banks are more likely to ration the credit (Stiglitz and Weiss, 1981) hampering the positive effect on economic growth and social cohesion that SMEs can create when they undertake investment projects, financed by bank credit, that promote also economic growth and social stability (Carter and Jones-Evans, 2006).

In addition, a number of scholars have highlighted the role of credit guarantee scheme to alleviate information asymmetries as in case of a loan default credit guarantee system can absorb market failures such as credit risk diminishing the financial loss faced by banks when borrowers are not able to repay the loan amount (Levitsky, 1997 ; Llisteri, 1997; Craig et al 2008; Liang et al, 2017). Although credit guarantee scheme deals appropriately with adverse selection issues as it rises the expected returns derived from lending and diminishes the expected loss created from bad loans, this financial tool may not so effective to face moral hazard issues since the minimum acceptable interest rate required by the credit guarantee schemes suppress the interest rate at some extent (Liang et al, 2017).

Alternatively, banks can deal with moral hazard issues lending firms via leasing controlling the behavior of borrowers as they push borrowers to invest using the assets that they have lend to them and finally repay the future lease payments dealing effectively with moral hazard issues which threaten the payment of loan increasing the likelihood of loan default (Jaffe and Russel, 1976; Keeton, 1979; Stiglitz and Weiss, 1981).

Our analysis employed financial and accounting data for USA banks obtained from SDI (Statistics on Depository Institutions) report constructed by FDIC (Federal Deposit Insurance Corporation), which explicitly allows the identification of cost performance for USA banks. Exploiting this valuable feature of the data, we focused on modeling the determinants of the cost efficiency of a bank. Cost efficiency measures the cost performance of a banking firm relative to the best-practice (least - cost) bank that produces the same output under the same exogenous conditions (Sensarma, 2005).

According to our results the higher leasing ratio increases banks' cost efficiency. Therefore, our empirical results explain the reason that banks provide leasing as they can reduce the asymmetries information issues that arise during bank loan procedure as well as they can exploit profit opportunities that leasing offers to them. As far as bank-specific characteristics are concerned, our results indicated that the cost efficiency is significantly reduced for commercial firms, for firms with higher management capability, higher profits, and lower loan loss provisions. In contrast, capital adequacy affects negatively cost efficiency while cost efficiency is significantly reduced for banks with lower liquidity. Finally, we do not document market construction effects as the coefficient for the Herfindahl index enters insignificantly in our specification. Equally, the macroeconomics conditions seem to not affect cost efficiency since the relevant macroeconomic factor is not significant in inefficiency model.

Tables

Table 1. Descriptive statistics of cost frontier variables												
	tc	y_L	y_I	y_N	*CAPRAT*	*PROV*	*MANAG*	*PROF*	*LIQ*	*HHI*	*RGDP*	*COM*
Mean	17,593	487,494	672,032	7,272	0.107	2.502	5.610	3.841	0.764	0.026	2.142	0.094
Std.Dev	29,274.54	890,186.1	1,188,366	15,612	0.022	0.002	23.483	0.588	0.164	0.030	0.506	0.219
Min	379	5490	16,684	47	0.057	1.361	0.432	1.386	0.179	0.005	1.5	0
Max	238,367	7,234,990	8,746,207	203,291	0.371	0.025	883.125	6.120	1.390	0.343	2.9	1
Number of observations	2,334	2,334	2,334	2,334	2,334	2,334	2,334	2,334	2,334	2,334	2,334	2,334

Table 2: Empirical results of the stochastic cost frontier model[a]		
Coef-ficient	Variable	Model
β_0	Constant	- 1.787** (-1.760)
β_L	$\ln(y_L)$	-4.823 (-1.288)
β_I	$\ln(y_I)$	1.682*** (4.074)
β_N	$\ln(y_N)$	-2.662 (-0.225)
β_{p_C}	$\ln(p_C/p_L)$	-3.555*** (-2.828)
β_{p_F}	$\ln(p_F/p_L)$	1.100*** (6.496)
β_{L^2}	$(\ln y_L)^2$	-2.128*** (-2.669)
β_{I^2}	$(\ln y_I)^2$	-1.816*** (-2.069)
β_{N^2}	$(\ln y_N)^2$	6.679*** (6.993)
$\beta_{p_C 2}$	$(\ln p_C/p_L)^2$	-6.381*** (-6.164)
$\beta_{p_F{}^2}$	$(\ln p_F/p_L)^2$	1.710*** (9.021)
β_{LI}	$(\ln y_L)(\ln y_I)$	2.331*** (3.020)
β_{LN}	$(\ln y_L)(\ln y_N)$	-2.875 (-1.143)
β_{IN}	$(\ln y_I)(\ln y_N)$	-3.716 (-1.385)

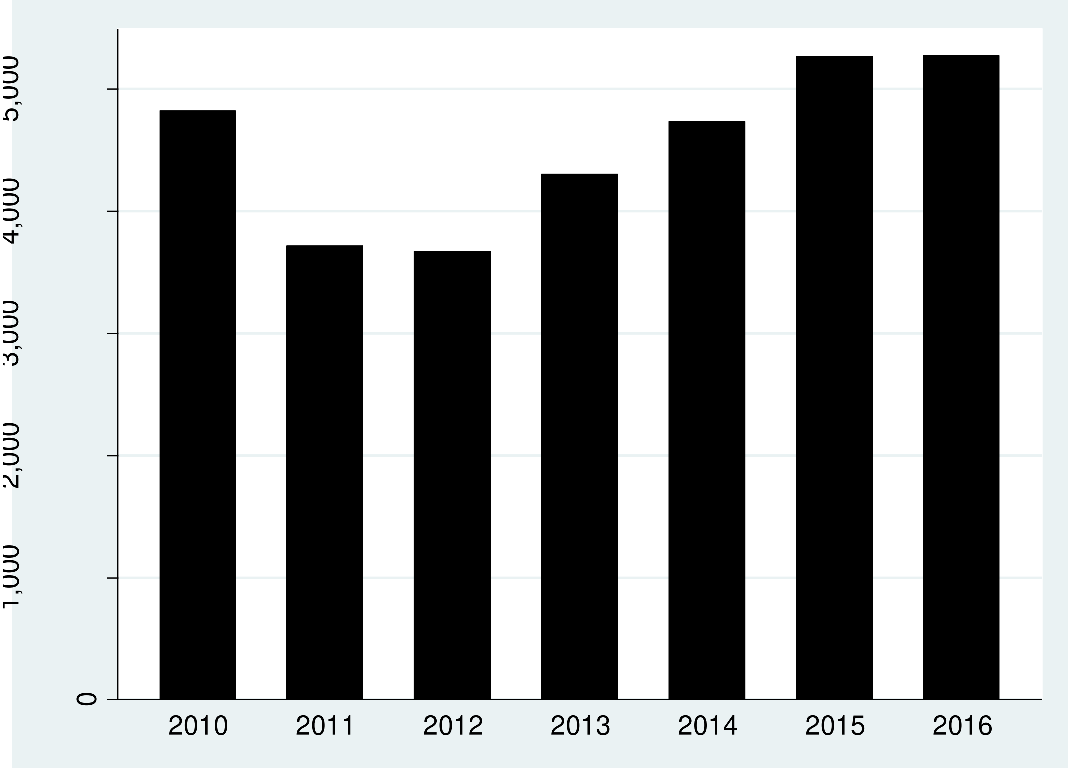
$\beta_{p_C p_F}$	$\ln(p_C/p_L)\ln(p_F/p_L)$	-4.559 (-0.371)
β_{Lp_C}	$\ln(y_L)\ln(p_C/p_L)$	-3.578 (-1.330)
β_{Lp_F}	$\ln(y_L)\ln(p_F/p_L)$	-1.437 (-0.411)
β_{Ip_C}	$\ln(y_I)\ln(p_C/p_L)$	3.844 (1.436)
β_{Ip_F}	$\ln(y_I)\ln(p_F/p_L)$	1.147*** (3.064)
β_{Np_C}	$\ln(y_N)\ln(p_C/p_L)$	1.022 (0.124)
β_{Np_F}	$\ln(y_N)\ln(p_F/p_L)$	-6.327*** (-5.817)
β_t	T	-4.096 (-0.658)
β_{t^2}	T^2	-1.140*** (-3.548)
β_{tL}	$T \ln y_L$	9.518 (0.007)
β_{tI}	$T \ln y_I$	1.033 (0.762)
β_{tN}	$T \ln y_N$	-6.835* (-1.668)
β_{tp_C}	$T\ln(p_C/p_L)$	1.592 (0.389)
β_{tp_F}	$T\ln(p_F/p_L)$	-3.659 (-0.570)
$LogL$	-	1138.114

σ^2	-	2.587*** (18.076)
γ	-	5.109*** (7.401)
Notes: (a) Numbers in parentheses are the ratios of estimated coefficients to their standard errors ***Represent statistical significance at the 1% levels **Represent statistical significance at the 5% levels *Represent statistical significance at the 10% levels, respectively		

Table 3: Empirical results of inefficiency model[a]		
Coef-ficient	Variable	Model
δ_0	Constant	2.236*** (19.991)
δ_{prov}	*PROV*	4.036*** (5.933)
δ_{caprat}	*CAPRAT*	6.119** (2.253)
δ_{manag}	*MANAG*	2.254*** (15.689)
δ_{prof}	*PROF*	-7.587*** (-16.284)
δ_{liq}	*LIQ*	4.022*** (6.709)
δ_{hhi}	*HHI*	1.330 (1.541)
δ_{rgdp}	*RGDP*	-5.537 (-0.197)
δ_{com}	*COM*	-1.135*** (-5.474)
δ_l	y_l	-1.733*** (-4.200)
δ_{lL}	$y_l \ln y_L$	4.012*** (3.140)
δ_{lI}	$y_l \ln y_I$	-1.527 (-1.132)
δ_{lN}	$y_l \ln y_N$	-1.321*** (-4.558)
δ_{lp_C}	$y_l \ln(p_C / p_L)$	-1.395*** (-4.267)

δ_{lp_F}	$y_l \ln\left({p_F}/{p_L} \right)$	9.598*** (3.215)
Notes: (a) Numbers in parentheses are the ratios of estimated coefficients to their standard errors ***Represent statistical significance at the 1% levels **Represent statistical significance at the 5% levels *Represent statistical significance at the 10% levels, respectively		

Graph 1. Lease financing receivables by year



Source: the SDI (Statistics on Depository Institutions) report of FDIC (Federal Deposit Insurance Corporation)

References

Adedeji, Abimbola, and Richard C. Stapleton. 1996. Leases, debt and taxable capacity. Applied Financial Economics 6.1, 71-83.

Aigner, D., Lovell, C. K., and Schmidt, P., 1977. Formulation and estimation of stochastic frontier production function models. Journal of econometrics, 6(1), 21-37.

Allen,J., Rai, A., 1996. Operational efficiency in banking: an international comparison. Journal of Banking and Finance, 20, 665-672.

Altunbas,Y.,Liu, M.H.,Molyneux, P.,and Seth, R., 2000. Efficiency and risk in Japanese banking. Journal of Banking and Finnace. 24(10), 1605-1628.

Ang, J., Peterson, P., 1984. The leasing puzzle. Journal of Finance 39 (4), 1055–65.

Barro, R. J., 1976. The loan market, collateral, and rates of interest. Journal of money, Credit and banking, 8(4), 439-456

Battese, G.E., and Broca, S.S., 1997. Functional forms of stochastic frontier production functions and models for technical inefficiency effects: a comparative study for wheat farmers in Pakistan. Journal of Productivity Analysis 8, 395-414.

Battese, G.E. and Coelli, T., 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Economics 20, 325-32.

Battese, G. E., and Coelli, T. J., 1992. Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India. Journal of productivity analysis, 3(1-2), 153-169.

Benjamin, D. K., 1978. The use of collateral to enforce debt contracts. Economic Inquiry, 16(3), 333-359.

Berger, A. N., 1995. Problem loans and cost efficiency in commercial banks (Vol. 95, No. 5). Office of the Comptroller of the Currency.

Berger, Allen N., and Timothy H. Hannan. 1998. The efficiency cost of market power in the banking industry: A test of the "quiet life" and related hypotheses. Review of Economics and Statistics 80.3, 454-465.

Berger, Allen N., and David B. Humphrey. 1991. The dominance of inefficiencies over scale and product mix economies in banking. Journal of Monetary Economics 28.1 , 117-148.

Berger, A. N., and Mester, L. J., 1997. Inside the black box: What explains differences in the efficiencies of financial institutions?. Board of Governors of the Federal Reserve System working paper, (1997-10).

Berger, A.N., and G.F. Udell., 1998. The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle, Journal of Banking and Finance, 22,(6-8), 613-673.

Berk, J. and DeMarzo, P., 2014. "Corporate Finance", Global Edition.

Boot, Arnoud WA., 2003. Restructuring in the banking industry with implications for Europe. EIB papers 8.1, 109-129.

Bowman, Robert G., 1980.The debt equivalence of leases: An empirical investigation. Accounting Review, 237-253.

Burkart, Mike, and Tore Ellingsen., 2002. In-kind finance. Financial Markets Group, London School of Economics, Discussion Paper 421.

Carter, S. and Jones-Evans, D. (Eds.), 2006. Enterprise and small business:Principles, practice and policy. Pearson Education.

Cassar, G., 2004. The financing of business start-ups. Journal of Business enturing, 19(2), 261-283.

Chortareas, Georgios E., Claudia Girardone, and Alexia Ventouri., 2012. Bank supervision, regulation, and efficiency: Evidence from the European Union. Journal of Financial Stability 8.4, 292-302.

Coelli, Tim J., 1996. A Guide to FRONTIER Version 4.1: A Computer Program for Stochastic Frontier Production and Cost Function Estimation. Armidale, NSW, Australia: Department of Econometrics, University of New England.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., and Battese, G. E., 2005. An introduction to efficiency and productivity analysis. Springer Science & Business Media.

Craig, B. R., Jackson, W. E., & Thomson, J. B., 2008. Credit market failure intervention: Do government sponsored small business credit programs enrich poorer areas?. Small Business Economics, 30(4), 345-360.

Das, A., and Ghosh, S., 2006. Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period. Review of Financial Economics, 15(3), 193-221.

Deloof, Marc, Istvan Lagaert, and Ilse Verschueren., 2007. Leases and debt: complements or substitutes? Evidence from Belgian SMEs. Journal of Small Business Management 45.4: 491-500.

Eisenbeis, Robert Eisenbeis, Gary D. Ferrier, and Simon H. Kwan., 1999. "The informativeness of stochastic frontier and programming frontier efficiency scores: Cost efficiency and other measures of bank holding company performance.

Ellinger, P.N., and Neff, D.L., 1993. Issues and approaches in efficiency analysis of agricultural banks.Agric. Finance Rev. 53, 82-99.

Engle, R. F., Moshirian, F., Sahgal, S., and Zhang, B., 2014. Banks non-interest income and global financial stability. CIFR Paper, (015)

Farrell, M.J., 1957. The Measurement of Productive Efficiency. Journal of the Royal Statistical Society Series A, 1957, 120, 253-90.

Finucane, Thomas J., 1988. Some empirical evidence on the use of financial leases. Journal of Financial Research 11.4, 321-333.

Gilligan, Michael J., 2004. Is there a broader-deeper trade-off in international multilateral agreements?. International Organization 58.3, 459-484.

Golin, J., 2001. The Bank Credit Analysis Handbook: A Guide for Analysts, Bankers and Investors, John Wiley & Sons (Asia) Pre Ltd.

Greene, W., 1980. Maximum likelihood estimation of econometric frontier functions. J. Econometrics, 13: 27-56.

Hesse, H., and Cihak, M., 2007. Cooperative banks and financial stability. International Monetary Fund.

Howorth, C. A., 2001. Small firms' demand for finance: A research note. International Small Business Journal, 19(4), 78-86.

Huang, C.J.and Liu, J.T., 1994. Estimation of a non neutral stochastic frontier function, Journal of Productivity Analysis 15, 171-180.

Iregui, A. M., Milas, C., and Otero, J., 2002. On the dynamics of lending and deposit interest rates in emerging markets: A non-linear approach. Studies in Nonlinear Dynamics & Econometrics, 6(3).

Jackson, T. H., and Kronman, A. T., 1979. Secured financing and priorities among creditors. The Yale Law Journal, 88(6), 1143-1182.

Jaffe, D. and Russel, T., 1976. Imperfect information, uncertainty, and credit rationing, Quarterly Journal of Economics 90 (4), 651-666.

Keeton, W.R., 1979. Equilibrium credit rationing. New York and London:Garland.

Klein, Benjamin, Robert G. Crawford, and Armen A. Alchian., 1978. Vertical integration, appropriable rents, and the competitive contracting process. The Journal of Law and Economics 21.2, 297-326.

Klemperer, Paul., 1995. Competition when consumers have switching costs: An overview with applications to industrial organization, macroeconomics, and international trade. The Review of Economic Studies 62.4, 515-539.

Kodde, D. A., and Palm, F. C., 1986. Wald criteria for jointly testing equality and inequality restrictions. Econometrica: Journal of the Econometric Society, 1243-1248.

Kosmidou, Kyriaki, Sailesh Tanna, and Fotios Pasiouras., 2005. Determinants of profitability of domestic UK commercial banks: panel evidence from the period 1995-2002. Money Macro and Finance (MMF) Research Group Conference. Vol. 45.

Kounetas, K., & Tsekouras, K., 2008. The energy efficiency paradox revisited through a partial observability approach. Energy Economics, 30(5), 2517-2536.

Krishnan, V. Sivarama, and R. Charles Moyer., 1994. Bankruptcy costs and the financial leasing decision. Financial Management, 31-42.

Kuenzle, M., 2005. Cost Efficiency in Network Industries: Application of Stochastic Frontier Analysis. Universität Zurich.

Kumbhakar S. C., and Knox Lovell,C. A., 2000. Stochastic Frontier Analysis, Cambridge University Press.

Lensink, R., Meesters, A., and Naaborg, I., 2008. Bank efficiency and foreign ownership: Do good institutions matter?. Journal of Banking & Finance, 32(5), 834-844.

Levitsky, J. (1997). Credit guarantee schemes for SMEs–an international review. Small Enterprise Development, 8(2), 4-17.

Lewellen, Wilbur G., Michael S. Long, and John J. McConnell., 1976. Asset leasing in competitive capital markets. The Journal of Finance 31.3, 787-798.

Liang, L. W., Huang, B. Y., Liao, C. F., and Gao, Y. T., 2017. The impact of SMEs' lending and credit guarantee on bank efficiency in South Korea. Review of Development Finance, 7(2), 134-141.

Llisteri, J.J., 1997. Credit guarantee schemes: preliminary conclusions.Financier 4, 95–112.

Manghetti, G., and Chairman, C. D. R. D. V. I., 2011. Do savings banks differ from traditional commercial banks?.

Matoušek, R., and Taci, A., 2004. Efficiency in banking: Empirical evidence from the Czech Republic. Economics of Planning, 37(3-4), 225-244.

Meeusen, W., and van Den Broeck, J., 1977. Efficiency estimation from Cobb-Douglas production functions with composed error. International Economic Review, 435-444.

Neff, David L., et al., 1993. Measuring Inefficiencies of Individual Agricultural Banks. No. 1280-2016-102136.

Pasiouras, F., Liadaki, A., and Zopounidis, C., 2008. Bank efficiency and share performance: Evidence from Greece. Applied Financial Economics, 18(14), 1121-1130.

Perry, P., 1992. Do banks gain or lose from inflation?. Journal of Retail Banking, 14(2), 25-31.

Pilloff, Steven J., and Stephen A. Rhoades., 2002. Structure and profitability in banking markets. Review of Industrial Organization 20.1, 81-98.

Revell, J., 1979. Inflation & Financial Institutions. Financial Times Limited.

Rezvanian, Rasoul, and Seyed Mehdian., 2002. An examination of cost structure and production performance of commercial banks in Singapore. Journal of Banking & Finance 26.1, 79-98.

Sensarma, R., 2005. Cost and profit efficiency of Indian banks during 1986-2003: a stochastic frontier analysis. Economic and Political Weekly, 1198-1209.

Semih Yildirim, H., and George C. Philippatos., 2007. Efficiency of banks: Recent evidence from the transition economies of Europe, 1993–2000. European Journal of Finance 13.2, 123-143.

Scott Jr, J. H., 1977. Bankruptcy, secured debt, and optimal capital structure. The Journal of Finance, 32(1), 1-19.

Sharpe, Steven A., and Hien H. Nguyen., 1995. Capital market imperfections and the incentive to lease. Journal of Financial Economics 39.2-3, 271-294.

Smith, C. W., and Warner, J. B., 1979. Bankruptcy, secured debt, and optimal capital structure: Comment. The Journal of Finance, 34(1), 247-251.

Stulz, RenéM, and Herb Johnson., 1985. An analysis of secured debt. Journal of Financial Economics 14.4, 501-521.

Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. The American Economic Review, 71(3), 393-410.

Wang, H. J., and Schmidt, P., 2002. One-step and two-step estimation of the effects of exogenous variables on technical efficiency levels. journal of Productivity Analysis, 18(2), 129-144.

Wingborg, J. and Landstrom, H., 2000. Financial bootstrapping in small business: examining small business managers' resource acquisition behaviour. Journal of Business Venturing, 16(1), 235-254.