Accepted Manuscript

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Please cite this article as: Chortareas, Georgios, Kapetanios, George, Ventouri, Alexia, Credit Market Freedom and Cost Efficiency in US state banking, *Journal of Empirical Finance* (2016), doi: 10.1016/j.jempfin.2016.03.002

Credit Market Freedom and Cost Efficiency in US state banking

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Abstract

This paper investigates the dynamics between the credit market freedom counterparts of the economic freedom index drawn from the Fraser institute database and bank cost efficiency levels across the U.S. states. We consider a sample of 3,809 commercial banks per year, on average, over the period 1987-2012. After estimating cost efficiency scores using the Data Envelopment Analysis (DEA), we develop a fractional regression model to test the implications of financial freedom for bank efficiency. Our results indicate that banks operating in states that enjoy a higher degree of economic freedom are more cost efficient. Greater independence in financial and banking markets from government controls can result in higher bank efficiency. This effect emerges in addition to the efficiency enhancing effects of interstate banking and intrastate branching deregulation.

1. Introduction

Over the recent decades the banking system in the United States (U.S.) went through many phases characterized by various levels or regulatory intensity. In the early 1980s financial intermediation took place in the presence of the Glass-Steagall Act, regulation Q, and restrictions on branching and interstate banking activities. A process of interstate banking deregulation was completed by mid 1990s, although adaptation to the Riegle-Neal act was slow.[1] The ensuing wave of consolidation increased the average bank size and allowed banks to expand into new markets by operating larger branch networks or bank holding companies. Moreover, by 1999 the Gramm–Leach–Bliley Act repealed key provisions of the Glass-Steagall Act regarding the affiliation between banks and securities firms. The financial and economic crisis of 2007-2008 was followed by financial regulatory reform spearheaded by the Dodd-Frank Act. Nevertheless banking regulation across the U.S. states remains highly fractionalized to date (Bernanke, 2015).

A growing literature exists assessing the effects of various forms of banking regulation (e.g., capital regulation, supervision, activity restrictions, etc.) on the efficiency of financial institutions.[2] As Barth et al. (2013) observe, however, the limited data availability on concrete measures of various bank regulations impedes the achievement of a comprehensive analysis on bank regulation and oversight. Various types of data exists attempting to measure the degree and tightness of restrictions on financial institutions' activities. La Porta et al. (1998; 2000), for example, consider financial liberalization, while Barth et al. (2006) and Barth et al. (2013) produce detailed data on bank regulation, supervision and monitoring for a large number of countries. A limited but developing literature uses the financial counterparts of the indices that measure economic freedom either as control variables in bank

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[1] See Berger and DeYoung (2001).
[2] See Barth et al. (2006) for a literature survey.

performance analyses (e.g., Demirguc-Kunt et al., 2004; Chortareas et al., 2011) or as key determinants of bank efficiency (Giannone et al., 2011). Recent empirical evidence by Chortareas et al. (2013) indicate that excessive government interference in the financial institutions activities, as reflected in low scores of the financial freedom indices, exert a negative impact on bank efficiency. Their results also suggest that banks operating in countries characterized by good governance and policies that promote financial freedom may result in a more efficient resource allocation process and a more effective management. The analysis is based on a sample of banks operating in 27 European Union (EU) countries from 2001 to 2009 (6,744 observations). Yet, the recent global financial crisis has put the discussion regarding governments' interference in the financial system on a new basis.

Abundant evidence exists on the efficiency of U.S. banks. Part of this literature analyses the effects of bank integration within the U.S. as well as of branching and intrastate banking deregulation on bank efficiency (e.g., Berger and DeYoung, 2001; Morgan et. al., 2004 Jeon and Miller, 2007; Zou et. al., 2011). To our knowledge, however, no evidence exists on how the degree of a state's financial freedom, typically measured by "freedom indices", may affect bank efficiency. This paper explicitly considers how the tightness of the regulatory environment, as captured by the financial freedom indices may affect bank performance. To proxy the regulatory environment we use the indices of freedom for the U.S. states, constructed by the Fraser Institute, focusing on the financial counterparts of the freedom indices. In particular, we consider the credit market freedom index, which measures the degree of financial and banking markets' independence from government control. Moreover, we account for the effects of other freedom indices, capturing related dimensions, whose effects may complement those of the credit market freedom index. In testing the above hypothesis we use bank specific, deregulation, and crises controls.

Key pieces of long-lasting banking regulation in the U.S. have been introduced in the mid-war period. The McFadden Act of 1927 imposed branching and geographic restrictions on nationally chartered banks to protect small banks from "destructive competition". National banks had to operate within their home state and also faced restrictions on their intrastate branching. The extent of state-wide branching allowed differed from state to state. The Glass-Steagall Act of 1933 in addition to separating commercial and investment banking and imposing interest rate regulations, amended the McFadden Act to further restrict interstate banking. Banks responded to the regulatory restrictions by creating bank-holding companies, "non-bank banks", and "non-bank-offices". The Bank Holding Company Act of 1956 made illegal the bank branching via bank acquisition by bank holding companies. Some restrictions were relaxed since the 1970s, a number of New England states allowed interstate branching in the 1980s, and in general a process of deregulation on a state-by-state basis occurred during this period. The most decisive step in terms of geographical restrictions removal was taken by the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) of 1994.[3]

The rationale for the hypothesized relationship between financial freedom measures and bank performance emanates from basic tenets of economic theory: the freer financial institutions are from various restrictions in pursuing their business the more efficiently they will organize their operations in order to minimize costs/maximize profits (Chortareas et. al., 2013). We focus on the concept of cost efficiency, which is typically the focus of efficiency analysis studies. Moreover, in the aftermath of the global financial crisis achieving high levels of efficiency on the cost side has become a critical factor for the ability of financial institutions to compete and survive.

We obtain efficiency scores for banks operating in the U.S. using Data Envelopment Analysis (DEA) over the period 1987-2012, utilizing a large and unique sample of 99,032 commercial bank

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[3] For more details and the specific effects of the IBBEA on bank efficiency see Zou et al., (2011); and Jeon and Miller (2007).

observations. We then regress the efficiency estimates on the economic freedom indices and their financial counterparts employing the Papke and Wooldridge's (1996) 'fractional logit' estimator. Our analysis controls for bank-specific variables including capitalization, the relative size of the institutions, the quality of bank loans, and a proxy for off-balance-sheet (OBS) activities exposure. In addition, we consider other deregulator indicators and crises dummies to account for environmental changes and for robustness purposes. An extensive literature on bank efficiency exists.[4] The ability of financial institutions to remain efficient is vital for their very existence, the ability to deliver services to consumers, and the financial system's stability. The more efficient financial institutions are, the higher the level of expected profitability and service quality for consumers. In addition, if the efficiency savings are directed towards improving capital buffers that absorb risk one would expect a higher degree of safety and soundness for the financial system as a whole.

Our results indicate that there is a strong link between credit market freedom and bank cost efficiency. In particular, the higher the degree of a state's credit market freedom, the better the banks' performance is in terms cost efficiency. The evidence also suggests that the deregulation process that took place during the 80s and 90s has improved the efficient operation of banks, with the efficiency gains being more pronounced in states with freer market systems.

The remainder of the paper is organized as follows: Section 2 presents the data and empirical methodology, Section 3 discusses the empirical results, and Section 4 concludes.

2. Data and methodology

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[4] For comprehensive survey see Berger (2007); Goddard et al. (2010); Hughes and Mester (2010).

2.1. Data sources

To construct our data set we take balance sheet data of commercial banks from the quarterly *Consolidated Reports of Condition and Income* filed by commercial banks, known as "Call Repots". Call reports are prepared at the level of bank, with each commercial bank uniquely identified by the report item RSSD9001. We focus on commercial banks operating in the 48 states[5] of the U.S. over the period 1987-2012.[6] Given that the DEA efficiency measures can be sensitive to the presence of outliers and data errors, we run the data through a substantial screening and editing process as suggested by Berger and Mester (1997) in order to assure a high degree of credibility for the emerging efficiency indices ("super-efficient" observations). Implementing such screening methods, results in an unbalanced panel of 99,032 observations.

The time and size distributions of banks included in the estimation of the efficiency frontier are shown in Table 1. As illustrated in Table 1 an average of 3,809 U.S. bank observations per year is used for the frontier estimations. Although the asset size values have been seemingly risen on average during the period considered, after 2009 and again after the debt crisis in Europe in 2011, have declined dramatically, showing how the recent global financial crisis led to a noticeable fall in bank asset size.

<Insert Table 1 about here>

We use the economic freedom of North America indices by state as constructed by the Fraser Institute (2014) database. There exist two major attempts to measure economic freedom producing the

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[5] Arizona and Rhode Island states are excluded from our sample due to lack of data in the estimation of the frontier.
[6] Data on Call Reports after 2010 are obtained from FFIEC (*Federal Financial Institutions Examination Council*) Central Data Repository's Public Data Distribution web site.

corresponding indexes, namely the *Economic Freedom of North America* Annual Reports produced by

the Fraser Institute and the *Index of Economic Freedom* created by the Heritage Foundation and the

Wall Street Journal. Both indexes are highly credible and their results are compatible in general (e.g. De

Haan & Sturm, 2000; Chortareas et al., 2013). In this paper we use the *Economic Freedom of North*

America which is the only comprehensive economic freedom database that presents the ratings for U.S.

by state.[7] In particular, we focus on the "credit market regulation" component counterparts of the

economic freedom index, which captures the degree of regulatory tightness in finance. The variables of

economic freedom range from 0, for "no freedom", to 10 for "maximum freedom". In order to capture

the broader regulatory environment within which economic activity takes place, we also consider the

other two sub-components of the "regulation" counterpart of the freedom index, namely "labor

regulation" and "business regulation". We discuss these "regulation" variables and we provide detailed

information on the economic freedom variables used in our empirical analysis in Appendix B (Table B.1).

2.2. Estimating cost efficiency: the DEA approach

To examine the impact of economic and credit market freedom on bank efficiency, we use a

two-stage approach. The first stage consists in deriving DEA cost efficiency scores for the banks in our

sample. In the second stage we regress the cost efficiency scores against the available indices of

economic freedom, as well as on a set of bank specific and deregulation control variables.

DEA employs a linear programming framework and, by making some fairly general assumptions

about the underlying production technology, yields an estimate of the Farrell's (1957) efficiency

measure for each bank in the sample. This paper uses the input-oriented DEA with Variable Returns to

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[7] Another index of economic freedom across the US states is that provided by the *Mercatus Center* but the economic freedom counterpart of this index is a synthetic index of "fiscal policy" and "regulatory policy" where the last does not cover the financial sector.

Scale (VRS) which allows the production technology of banks in the sample to exhibit increasing, constant, or decreasing returns to scale.[8] This translates into the following cost-minimization model being solved n times; each time for a different bank in the sample:

$$Min \sum_{i=1}^{m} c_{i0} x_{i0}$$

$$st \qquad x_{i0} \geq \sum_{j=1}^{n} x_{ij} \lambda_j, (i = 1,...,m)$$

$$y_{r0} \leq \sum_{j=1}^{n} y_{rj} \lambda_j, (r = 1,...,s) \qquad (1a)$$

$$\sum_{j=1}^{n} \lambda_j = 1,$$

$$\lambda_j \geq 0, \forall j$$

where, λ is a $N \times 1$ vector of constraints, X and Y are the $m \times n$ input and $s \times n$ output matrices respectively, $j = 1,...n$ represents the number of banks, $i = 1,...,m$ are input volumes used by bank j, $r = 1,...,s$ measures the volume of output r, and c_{i0} is the unit cost of input i for $bank_0$ which is the benchmark projection that can be different from one bank to another. Based on the optimal solution of the above problem (x^*, λ^*), we define the cost efficiency of bank j as:

$$CE_j = \frac{c_j x^*}{c_j x_j} \qquad (1b)$$

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[8] The first version of DEA assumes Constant Returns to Scale (CRS), i.e. a change in inputs is followed by a change in the same proportion of the outputs (Charnes et al., 1978).

The relative cost efficiency measure CE_j emerges as a ratio of the estimated minimum cost bank *j* could potentially achieve to its realized cost, where $0 < CE_j \leq 1$ and equals unity when the bank is deemed cost-efficient.

Banks' cost efficiencies are measured relative to a common frontier by pooling the data across states estimated separately for each year. This approach allows us to estimate efficiency differentials not only between commercial banks within a state but across states as well using the same benchmark. That is we adopt the "intermediation approach" (Berger and Humphrey, 1997) which views banks as intermediaries that employ labor, capital, and deposits to produce different types of loan accounts.In order to estimate cost efficiency, we need to compute input prices. The price of labor is obtained by dividing salaries and employee benefits by the number of employees. The cost of physical capital is calculated as expenses on premises and fixed assets divided by premises and fixed assets. The price of deposits is derived as interest expenses divided by total deposits. Finally, to construct the output series we specify two variables that capture the traditional lending (consumer loans) and non-lending activities of banks (business loans-all other loans), as well as their non-traditional activities (total securities). Capturing the non-traditional activities of banks is essential given the increased involvement of commercial banks in fee generating items. We present the descriptive statistics for outputs, inputs and their respective prices in Table 2.

<Insert Table 2 about here>

2.3. Regression framework

The second stage of our analysis, consists in uncovering, by means of regression methods, the underlying relationship between the estimated cost efficiency levels and the economic freedom indices while controlling for bank specific factors, deregulation and crises indicators. Specifically, we estimate the following equations:

$$EFF_{i,k} = \alpha + \beta_1 H_i + \beta_2 B_{i,k} + \beta_3 YEAR_t + \beta_4 REGION_i + \varepsilon_{i,k} \qquad (2a)$$

$$EFF_{i,k} = \alpha + \beta_1 CREDIT_i + \beta_2 B_{i,k} + \beta_3 YEAR_t + \beta_4 REGION_i + \beta_5 D_i + \beta_6 CRISES_i + \varepsilon_{i,k} \qquad (2b)$$

where i indexes state i, k indexes bank k. The dependent variable $EFF_{i,k}$ is the managerial cost efficiency measure, measuring how far the bank is from the estimated efficient frontier. In other words, this is a relative measure, which implies that the best-practice banks are by definition one hundred per cent efficient, while the others are characterized as inefficient relative to them. The vector H_i contains the indicators of economic freedom in state i, $B_{i,k}$ is a vector of bank-specific characteristics for each bank k in state i, and $YEAR_t$ is an annual dummy variable controlling inter alia for other macroeconomic and technical changes. $REGION_i$ is a regional dummy[9] controlling for systematic differences across states (Clark, 1998), and $\varepsilon_{i,k}$ is the error term.

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[9] Clark (1998) provides evidence that region-specific components are significant for the cyclical variation in the major regions of the U.S. The nine regions have been constructed based on the United States Census Bureau grouping which is the most commonly used classification system for large nations (such as the U.S.), with its diverse physical and cultural geography and its numerous State components. Appendix A, Table A.2 defines the nine census regions as described in the United States Census Bureau website.

Equation (2b) focuses more explicitly on the credit market freedom variable ($CREDIT_i$), which proxies for financial (banking) freedom, and introduces additional controls (D_i) capturing the years states entered an interstate banking compact (interstate banking deregulation) and the years they permitted intrastate branching (intrastate branching deregulation), as constructed by Morgan et al. (2004)[10]. By doing so, we want to prevent our credit market freedom variable from capturing the effects of these regional deregulation indicators. Finally, we consider the impact of the savings and loans crisis and the recent financial crisis by introducing the dummy $CRISES_i$.

To estimate equations (2a) and (2b) we employ Papke and Wooldridge's (1996) 'fractional logit' estimator. The reason for this choice is that DEA efficiency scores are not the outcome of a truncated process but rather the outcome of a fractional logit process and thus, not a latent variable (McDonald, 2009). Therefore, Papke and Wooldridge's (1996) quasi-likelihood estimator captures the nature of efficiency estimates which are generated by a fractional logit process. Since the DEA efficiency scores are bounded and typically lie between zero and one ($0 < CE_j \leq 1$), the fractional regression model appears more appropriate as it keeps the predicted values of the fractional response conditional mean in the unit interval.

The vector H_i of equation 2a contains the variables accounting for economic freedom from the Fraser Institute's (2014) database. Specifically, we define the vector H_i as follows:

$$H_i = (CREDIT_i, BUSINESS_i, LABOR_i, SIZE_i, PROPERTY_i, TRADE_i) \tag{3}$$

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[10] Appendix A, Table A.1 provides details for the interstate and intrastate deregulation dates by state.

where, $CREDIT_i$, is an indicator of credit regulation quality with larger values signifying more freedom. This variable incorporates considerations about ownership of banks, competition, extension of credit, and presence of interest rate controls. Other studies that use the international counterpart of this variable as a proxy of the regulatory quality in the finance industry include Giannone et. al. (2011) and Chortareas et, al. (2013). In order to control for all components of the regulatory quality, the vector H_i also includes the sub-components pertaining to "*business freedom*" ($BUSINESS_i$) and "*labor freedom*" ($LABOR_i$). The "*business freedom*" variable is a proxy of the ability to establish and run a business without interference from the government. Burdensome and redundant regulatory rules are the most common barriers to the free conduct of business activities. Higher values of the "*labor freedom*" index reflect a high degree of protection in the labor market with possible direct or indirect effects on the cost of labor inputs and therefore on the cost efficiency of the financial institutions.

To capture a state's broader environment within which economic activity takes place, the vector H_i also includes the following variables from the Fraser Institute: size of government, legal system and property rights, and freedom to trade internationally. The ($SIZE_i$) variable receives a lower score as government expenditure and involvement in the economy grows. Higher values of the variable $PROPERTY_i$ indicate a high degree of private property rights protection and the existence of a sound legal system. The Fraser Institute constructs a "world-adjusted" index that has each province's and state's score adjusted by data from the world index for the legal system and property rights. Finally, the freedom to trade internationally variable ($TRADE_i$), is an aggregate measure of the ability of individuals to engage in voluntary exchange, which increases wealth for both buyer and seller. The economic freedom indicators take values in a scale from 0 to 10, where higher values indicate an economic environment or set of policies that is most conducive to economic freedom.

The regression specifications in equations (2a) and (2b) account for bank-specific control variables ($B_{i,k}$) while equation (2b) further includes state -specific deregulator control variables (D_i) as a robustness check. The corresponding vectors are defined as follows:

$$B_{i,k} = (EQAS_{i,k}, LNTA_{i,k}, LNTA_{i,k}^2, LQ_{i,k}, OBSTA_{i,k}) \tag{4}$$

$$D_i = (INTER_i, INTRA_i) \tag{5}$$

In particular the vector $B_{i,k}$, as specified in equation (4), includes a set of bank-specific factors that might influence the efficiency of a particular bank included in the second-stage regression model. We consider all the bank-specific variables, which one usually encounters in efficiency analyses, namely: (i) the equity over total assets ratio ($EQAS_{i,k}$), which proxies the level of capitalization; (ii) the bank size, defined as the logarithm of the bank's total assets ($LNTA_{i,k}$); (iii) the quadratic term ($LNTA^2_{i,k}$) as a check for non-linearity in the relationship between the logarithm of the bank's total assets and the bank's efficiency; (iv) the lending quality, captured by the non-performing loans to loans ratio ($LQ_{i,k}$), and finally, (v) the off-balance-sheet activities over total assets ($OBSTA_{i,k}$) to control for differences in the business mix.

The vector of dummy variables (D_i), in the efficiency equation (5) includes deregulation dummies to capture the changes in the regulatory environment and in particular the removal of restrictions on interstate banking and intrastate branching, which took place during the early part of our sample. Moreover, over the 26-years period covered by our sample two distinguishing crises took place,

namely the savings & loans associations crisis in the early period of our sample and the subprime mortgage and financial crisis in the late period of our sample. To capture the potential effects of these crisis we introduce the dummy $CRISES_i$, which takes the value of 1 during the crises periods and 0 otherwise.

The set of ($YEAR_i$) and ($REGION_i$) dummy variables in equations (2a) and (2b) control, inter alia, for other macroeconomic, technological and regional changes in the economy. Table 3 reports the descriptive statistics for the variables employed in the model. The average cost efficiency scores are about 73%, thus suggesting that banks have considerable scope for reducing wasted inputs while at the same time increasing desirable output.

<Insert Table 3 about here>

3. Results

3.1. Cost efficiency levels

We measure the banks' cost efficiency levels relative to a common frontier by pooling the data across states estimated separately for each year. This approach allows us to estimate efficiency differentials not only between commercial banks within a state but also across states using the same benchmark. The average estimated cost efficiencies relative to the whole sample are presented in Figure 1. Table 4 also reports the bank efficiency levels averaged for the whole period for each state in the sample.

<Insert Figure 1 and Table 4 about here>

Since the DEA results show relatively high cost inefficiency (levels of about 27%) there is still plenty of room for improvement in the way banks in the U.S. control their production costs (e.g. Berger and Mester, 1999). The mean efficiencies reported here are in accordance with previous studies in the U.S. area. In particular, cost efficiency scores display a decreasing trend between 1989 and 1993, possibly reflecting the major losses the U.S. banks have suffered due to the savings and loan associations (S&L) crisis. Following that, there is a peak in 2005 and then weakening over the following years. Overall, as it is apparent from figure 1, cost efficiency scores display a downward trend over the entire period considered.

3.2. Freedom and cost efficiency

In this second stage of the analysis, we look into the effects of economic and financial freedom on bank cost efficiency, while controlling for the effects of other relevant bank-specific and environmental factors. Following Papke and Wooldridge's (1996) quasi-likelihood estimation method,

we estimate Equations (2a) and (2b) using a fractional logit process with robust standard errors. The results from equation (2a) are provided in Table 5.

<Insert Table 5 about here>

The columns in Table 5 correspond to the results of different model specifications focusing on alternative economic freedom variables, while controlling for a selected set of relevant bank-specific variables frequently employed in banking studies. In particular, the first column in Table 5 reports the basic regression model that includes the credit market freedom variable and bank-specific control variables (model 1). The next five columns include alternative economic freedom control variables one at a time (models 2-6). To avoid problems of multicollinearity we include economic freedom variables one by one (models 1-6). All components of the financial freedom indices appear to have a positive and statistically significant effect on bank efficiency. In terms of magnitude this effect is more pronounced when the "credit freedom" and "business freedom" are considered. The variable capturing assessments of "labor freedom" has a limited effect as expected since its potential impact on efficiency can is transmitted indirectly. Thus, the evidence from the exploratory analysis corresponding to specification (2a) suggests that constraints on business and labor, as reflected on these sub-components of the "regulation" counterpart of the freedom index, may result in an inefficient resource allocation process. In particular, the coefficients of $BUSINESS_i$ and $LABOR_i$ are positive and statistically significant. This suggests that banks in states with less government bureaucracy, fewer difficulties in starting a new business, and fewer price controls and labor market restrictions tend to have higher cost efficiency levels.

The results also document a strong link between bank efficiency and government size, property rights and freedom to trade internationally. Excessive government spending often leads to inefficiency, possibly through the channels of bureaucracy, waste, and lower productivity. Moreover, banks in states where the overall environment is conducive to the protection of the private sector property rights and the financial system is characterized by relatively high levels of openness tend to have higher efficiency levels. Put it differently, all coefficient estimates for the Fraser institute variables describing the state's financial environment indicate a positive and statistically significant relationship at the 1% level. That is to say that economic freedom of different kinds is likely to have a favourable effect on cost efficiency possible because regulators and governments are engaged in more open policies, which in turn promotes the efficient allocation process resulting in a more efficient bank management. The findings are consistent with recent evidence from European data (Chortareas et al., 2013).

Focusing on the relationship between cost efficiency and credit market freedom, we estimate equation (2b). The "credit" counterpart of the economic freedom indices is the component of the economic freedom indices most directly related index to bank performance. The credit market freedom ($CREDIT_i$) coefficient is positive at the 1% level of statistical significance in all model specifications. These results are broadly in line with recent empirical international evidence considering the implications of financial freedom indices (e.g., Chortareas et al., 2013) and/or liberalization and reforms in the financial sector (Barrell et al., 2015).

Indeed, one would expect that a higher degree of restrictions and government controls in the financial and banking markets can have a significant role in reducing banks' cost efficiency scores. Banks in states with more open credit markets may be more likely to engage in competitive policies, thus achieving higher levels of cost efficiencies.

<Insert Table 6 about here>

The specification of estimation of equation (2b) and the corresponding results shown in Table 6 take explicitly into account the deregulation and crises indicators. In particular, we consider the credit market freedom, our proxy of financial and banking freedom, along with an index of interstate banking deregulation index ($INTER_i$) and an intrastate branching deregulation index ($INTRA_i$) based on the dates presented in Appendix A.1 (columns 1-2). The results of a specification that considers the S&L as well as the recent financial crisis appear in column 3. Finally, in column 4 we report results from a specification that consider all deregulation and crises indicators. The results broadly corroborate the key findings of the baseline model (equation 2a) in Table 5. The credit market freedom ($CREDIT_i$) coefficient remains positive at the 1% level of statistical significance in all models tested, suggesting that more deregulated systems are conducive to the more efficient operations of financial institutions. Both interstate and intrastate deregulation that took place in the 80s and 90s have a positive effect on the efficiency of financial institutions across U.S. states. Clearly the occurrences of crises in the financial industry impact negative on the efficient operation of banks.

Turning to the bank-specific control variables which appear in all specifications (Tables 5 and 6), we find that the equity over total assets ratio ($EQAS_{i,k}$) variable has a significantly positive sign suggesting that higher capital ratios are associated with more efficient bank operations. This finding is consistent with the argument that higher capitalization contributes to alleviating agency problems between managers and shareholders (Mester, 1996). As in most cases efficiency is positively related to bank size, which in our models is manifested by a positive and statistically significant sign for the coefficient of the quadratic term of ($LNTA_{i,k}$), implying a non-linear relationship between bank size

and efficiency. This finding is also consistent with the results of previous studies (Stavarek, 2004; Altunbas et al., 2007). The exposure to OBS activities is negatively related to cost efficiency suggesting that banks which are more focused on non-traditional banking business are on average less efficient. Finally, the lending quality variable display a positive relationship with bank efficiency but this link is weak since the relevant coefficient is not statistically significant.

Overall, it appears that economic freedom is a key element of the environment within which financial institutions operate. More credit market freedom seems to be associated with higher cost efficiency scores in U.S. banking. Furthermore, when controlling for deregulation our results reveal a strong link between the states deregulation and bank cost efficiency.

4. Conclusions

This paper contributes to the existing literature by focusing on the relationship between the credit market freedom counterparts of the economic freedom indices and bank cost efficiency across the U.S. states. Our analysis covers an exceptionally lengthy period as compared to the typical sample dimensions used in bank efficiency studies and covers periods characterized by different degrees of financial regulation intensity. The credit market freedom index proxies the tightness of the regulatory environment. Moreover, we consider the effects of other relevant dimension of economic freedom, as measured by the Fraser Institute, on the cost efficiency of financial institutions. Such measures include business freedom, labor market freedom, and proxies for the legal system and property rights. That is, we test the hypothesis that a higher degree of "market friendliness" and greater independence in financial markets from government control allow banks to perform in a more efficient manner. After producing DEA cost efficiency scores for banks operating in 48 U.S. states between 1987 and 2012 (99,032 observations), we use a robust fractional logit estimator procedure to account for the effects of

the economic freedom indices on the cost efficiency scores, while controlling for bank specific characteristics and deregulation indicators. In addition, we control for effects of the S&L crisis and the global financial crisis. The evidence produced show that a clear positive association between the credit market counterparts of the economic freedom indices and the bank cost efficiency measures exist. This suggests that excessive government interference in the financial institutions activities may adversely affect the efficient operation of banks.

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Figure 1

Cost efficiency estimates for U.S. commercial banks

Bank balance sheet and income statement data are from

Consolidated Reports of Conditions and Income ("Call Reports").
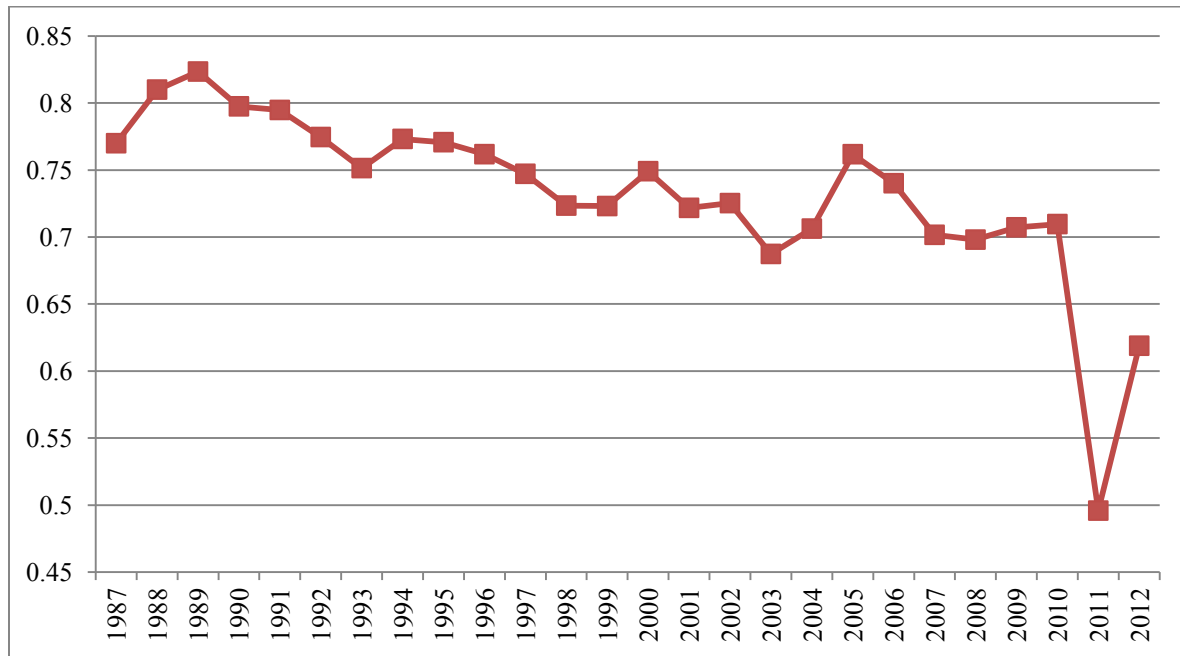
Table 1

Time and size distribution of banks included in the estimation of the efficiency frontier

Bank balance sheet and income statement data are from *Consolidated Reports of Conditions and Income (*"Call Reports"). Asset size values are expressed in terms of thousands of dollars.

			USA		
	Number			Asset size	
Year	of obs.	Mean	St.Dev.	Minimum	Maximum
1987	3,708	103,818	842,272	2,365	41,362,913
1988	3,726	109,725	891,279	2,061	43,732,080
1989	3,728	114,760	890,699	2,158	45,555,858
1990	3,716	126,967	1,029,863	2,175	53,823,569
1991	3,785	155,100	1,279,200	2,111	51,747,459
1992	3,749	165,250	1,345,911	2,270	50,833,179
1993	3,750	160,469	1,234,237	2,164	50,924,650
1994	3,750	171,061	1,314,150	1,924	52,215,794
1995	3,756	157,816	1,150,814	2,523	49,091,757
1996	3,728	208,725	2,117,564	2,374	99,165,167
1997	3,712	248,234	2,439,246	2,045	89,155,929
1998	3,725	327,402	5,558,105	1,972	317,127,000
1999	3,736	430,412	9,660,782	2,306	571,732,000
2000	3,688	590,652	11,940,707	2,333	584,284,000
2001	3,666	685,775	12,605,433	2,497	551,691,000
2002	3,686	776,198	13,469,504	2,488	565,382,000
2003	3,698	866,629	15,251,193	3,209	617,962,335
2004	3,708	989,570	18,676,842	3,152	771,618,758
2005	3,704	1,146,496	22,910,650	4,905	1,082,250,290
2006	3,731	1,313,308	27,235,048	4,523	1,196,123,794

2007	3,764	1,164,282	22,819,241	4,484	1,251,715,000
2008	3,768	1,629,478	33,240,075	3,063	1,470,276,918
2009	3,747	1,065,664	20,520,737	4,541	1,161,361,000
2010	3,746	1,465,334	27,533,225	4,592	1,154,293,000
2011	4,985	1,681,284	33,269,349	4,001	1,459,157,302
2012	4,572	496,578	2,147,294	3,533	85,810,000
Average	3,809	-	-	-	-
Total	99,032				

Table 2

Descriptive statistics of bank inputs and outputs (state averages 1987-2012) included in the estimation of the efficiency frontier

Bank balance sheet and income statement data are from *Consolidated Reports of Conditions and Income* ("Call Reports"). All values are expressed in terms of thousands of dollars.

State	Consumer Loans	Business Loans	Securities	Labor	Physical Capital	Total Deposits	Labor Prices	Physical Capital Prices	Total Deposits Prices
1987	11,469	40,933	49,812	60.55	1,604	87,793	24.19	0.42	0.05
1988	11,879	45,057	51,195	60.51	1,610	92,875	25.22	0.42	0.05
1989	12,722	48,682	51,631	61.43	1,737	97,539	26.36	0.42	0.06
1990	13,572	55,794	55,700	65.01	1,919	107,215	27.51	0.40	0.06
1991	14,706	66,439	71,598	73.95	2,357	129,298	29.11	0.40	0.05
1992	15,465	69,532	77,742	77.95	2,531	137,065	30.17	0.40	0.04
1993	15,987	67,927	74,048	75.29	2,520	131,482	31.37	0.38	0.03
1994	18,045	75,369	74,947	78.05	2,708	137,616	32.25	0.39	0.03
1995	15,127	70,369	69,769	72.87	2,569	129,850	33.41	0.38	0.04
1996	20,807	94,284	90,172	88.71	3,489	165,442	34.51	0.38	0.04
1997	25,433	117,722	101,053	99.53	4,058	192,154	35.64	0.38	0.04
1998	27,420	150,174	144,819	119.79	5,043	239,316	36.88	0.36	0.04
1999	31,129	217,074	175,924	146.14	6,362	310,956	38.48	0.35	0.04
2000	48,721	284,062	249,880	180.87	8,106	428,849	39.95	0.33	0.04
2001	56,647	318,335	302,051	199.85	8,742	490,193	41.54	0.32	0.04
2002	72,874	360,423	333,593	216.98	9,464	550,921	43.58	0.32	0.02
2003	85,773	386,562	384,404	227.65	10,062	614,954	45.54	0.33	0.02
2004	92,690	440,105	446,136	251.37	10,838	706,431	47.16	0.32	0.02
2005	92,420	523,596	518,593	271.44	12,123	814,704	48.81	0.31	0.02
2006	94,079	640,326	565,620	286.05	13,549	923,068	50.63	0.31	0.03
2007	98,665	574,079	478,867	256.24	13,106	803,430	52.43	0.32	0.03

2008	112,956	756,261	744,432	299.08	16,509	1,100,174	54.31	0.34	0.02
2009	74,836	504,147	473,938	211.64	12,932	786,822	55.57	0.33	0.02
2010	97,802	669,264	682,859	292.78	16,014	1,108,861	57.15	0.33	0.01
2011	173,882	730,315	759,976	299.33	17,376	1,260,383	60.50	0.35	0.01
2012	29,756	245,580	178,157	100.40	7,762	371,959	65.09	0.39	0.01
Total	1,364,860	7,552,411	7,206,915	4,173	195,088	11,919,349	1,067	9.37	0.85

Table 3

Variables Names, Definitions, Summary Statistics and Sources for 1987-2012

Statistics are calculated over 48 states over 1987-2012.

Variables	Definition	Mean	St.Dev.	Median	Source
Efficiency measure:					
EFF	Cost Efficiency	0.73	0.11	0.73	Bank balance sheets and income statements. "Call Reports" from the Federal Reserve Board. Authors' calculations.
Economic freedom variables:					
CREDIT	Credit market freedom	9.07	0.91	9.50	
BUSINESS	Business freedom	7.49	0.52	7.90	
LABOR	Labor market freedom	6.53	0.83	6.60	
SIZE	Size of government	6.98	0.92	7.10	Economic freedom of North America. Fraser Institute.
PROPERTY	Legal system and property rights	8.06	0.65	8.30	
TRADE	Freedom to trade internationally	8.45	0.41	8.70	
Bank specific control variables:					
EQAS	Total equity/total assets	0.10	0.03	0.10	
LNTA	Logarithm of total assets	11.35	1.23	11.23	
LQ	Non-performing loans/total loans	0.01	0.02	0.01	
OBSTA	Off-balance-sheet/total assets	0.01	0.01	0.01	

Deregulation and crises indicators (0/1)

INTER	Interstate banking deregulation (switches on after deregulation)	0.96	0.19	1.00	
INTRA	Intrastate branching deregulation (switches on after deregulation)	0.95	0.22	1.00	Dates in Appendix A. (Table A.1). Authors' calculations.
CRISES	(switches on after S&L and the recent financial crises)	0.25	0.43	0.00	Authors' calculations.

Table 4

Cost efficiency estimates

Statistics are calculated over 48 states over 1987-2012.

States	Mean	St.Dev.	Median
Alabama	0.733	0.118	0.738
Alaska	0.703	0.154	0.674
Arkansas	0.708	0.107	0.709
California	0.766	0.139	0.750
Colorado	0.699	0.108	0.699
Connecticut	0.725	0.115	0.732
Delaware	0.798	0.146	0.799
Florida	0.720	0.124	0.717
Georgia	0.716	0.107	0.719
Hawaii	0.806	0.116	0.819
Idaho	0.681	0.098	0.699
Illinois	0.728	0.107	0.730
Indiana	0.737	0.109	0.741
Iowa	0.736	0.104	0.734
Kansas	0.745	0.109	0.746
Kentucky	0.739	0.109	0.746
Louisiana	0.691	0.105	0.692
Maine	0.770	0.140	0.785
Maryland	0.756	0.115	0.754
Massachusetts	0.710	0.138	0.711
Michigan	0.722	0.114	0.729
Minnesota	0.730	0.101	0.730

Mississippi	0.716	0.102	0.723
Missouri	0.721	0.109	0.722
Montana	0.723	0.100	0.722
Nebraska	0.764	0.112	0.765
Nevada	0.714	0.138	0.686
New Hampshire	0.717	0.153	0.707
New Jersey	0.717	0.128	0.694
New Mexico	0.692	0.110	0.690
New York	0.737	0.125	0.727
North Carolina	0.740	0.123	0.739
North Dakota	0.723	0.099	0.728
Ohio	0.754	0.121	0.751
Oklahoma	0.720	0.109	0.721
Oregon	0.705	0.118	0.712
Pennsylvania	0.748	0.112	0.753
South Carolina	0.713	0.102	0.712
South Dakota	0.741	0.107	0.736
Tennessee	0.714	0.113	0.715
Texas	0.709	0.108	0.709
Utah	0.732	0.131	0.725
Vermont	0.735	0.126	0.739
Virginia	0.737	0.114	0.741
Washington	0.708	0.119	0.710
West Virginia	0.735	0.119	0.734
Wisconsin	0.741	0.110	0.741
Wyoming	0.699	0.113	0.688

Table 5

QMLE analysis using equation (1a)

48 states over 1987-2012

Dep.Var.: EFF	(1)	(2)	(3)	(4)	(5)	(6)
Economic freedom variables						
CREDIT	0.306***	-	-	-	-	-
	(0.028)					
BUSINESS	-	0.451***	-	-	-	-
		(0.052)				
LABOR	-	-	0.009**	-	-	-
			(0.003)			
SIZE	-	-	-	0.010***	-	-
				(0.002)		
PROPERTY	-	-	-	-	0.404***	-
					(0.042)	
TRADE	-	-	-	-	-	0.830***
						(0.061)
Bank Specific variables						
EQAS	4.563***	4.537***	4.528***	4.530***	4.536***	4.544***
	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)	(0.054)
LnTA	-1.644***	-1.643***	-1.645***	-1.643***	-1.644***	-1.164***
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
LnTA^2	0.070***	0.070***	0.071***	0.070***	0.071***	0.070***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LQ	0.135	0.115	0.132	0.120	0.126	0.122
	(0.137)	(0.138)	(0.137)	(0.138)	(0.137)	(0.137)

OBSTA	-0.250	-0.250	-0.269	-0.267	-0.252	-0.245
	(0.364)	(0.365)	(0.365)	(0.365)	(0.365)	(0.365)
Constant	7.302***	6.629***	10.114***	10.093***	6.844***	2.877***
	(0.294)	(0.430)	(0.124)	(0.124)	(0.367)	(0.559)
YEAR	YES	YES	YES	YES	YES	YES
REGION	YES	YES	YES	YES	YES	YES
Observations	99032	99032	99032	99032	99032	99032

Note: CREDIT= Credit market regulation, BUSINESS= Business regulations, LABOR= Labor market regulation, SIZE= Size of government, PROPERTY= Legal system and property rights, TRADE= Freedom to trade internationally, EQAS= Equity/Assets, LnTA= Logarithm of Total Assets; LnTA² = Quadratic term of Total Assets, LQ= Non-performing loans/Total loans, OBSTA= Off balance sheet items/total assets, Constant= constant term.

Estimated using Papke and Wooldridge (1996) Quasi-Likelihood estimation method.

Robust standard errors in parentheses. P-Values are derived using robust standard errors

*Significant at 10%; **Significant at 5%; ***Significant at 1%.

Table 6

QMLE analysis using equation (1b)

48 states over 1987-2012

Dep.Var.: EFF	(1)	(2)	(3)	(4)
Economic freedom variables				
CREDIT	0.729***	0.822***	0.429***	0.429***
	(0.009)	(0.103)	(0.007)	(0.007)
Bank Specific variables				
EQAS	4.547***	4.546***	4.546***	4.548***
	(0.054)	(0.054)	(0.054)	(0.054)
LnTA	-1.645***	-1.643***	-1.642***	-1.645***
	(0.022)	(0.021)	(0.021)	(0.021)
LnTA²	0.070***	0.071***	0.070***	0.071***
	(0.001)	(0.001)	(0.001)	(0.001)
LQ	0.132	0.095	0.122	0.113
	(0.137)	(0.139)	(0.137)	(0.138)
OBSTA	-0.247	-0.233	-0.244	-0.237
	(0.364)	(0.365)	(0.364)	(0.365)
Deregulator variables				
INTER	0.017**	-	-	0.035***
	(0.008)			(0.008)
INTRA	-	0.059***	-	0.066***
		(0.007)		(0.007)
CRISES	-	-	-0.359***	-0.406***
			(0.013)	(0.010)

Constant	2.612***	2.325***	6.069***	6.044***
	(0.156)	(0.160)	(0.139)	(0.139)
YEAR	YES	YES	YES	YES
REGION	YES	YES	YES	YES
Observations	99032	99032	99032	99032

Note: CREDIT= Credit market regulation, INTER= Interstate banking deregulation, INTRA= Intrastate branching deregulation, CRISES= S&L and Financial crises, EQAS= Equity/Assets, LnTA= Logarithm of Total Assets; LnTA² = Quadratic term of Total Assets, LQ= Non-performing loans/Total loans, OBSTA= Off balance sheet items/total assets, Constant= constant term.

Estimated using Papke and Wooldridge (1996) Quasi-Likelihood estimation method.

Robust standard errors in parentheses. P-Values are derived using robust standard errors

*Significant at 10%; **Significant at 5%; ***Significant at 1%.

Appendix A:

Table A.1

States, by the year out-of-state bank entry and intrastate branching permitted

States	Interstate Banking	Intrastate Branching
Alabama	1987	1981
Alaska	1982	*
Arizona	1986	*
Arkansas	1989	1994
California	1987	*
Colorado	1988	1991
Connecticut	1983	1980
District of Columbia	1985	*
Delaware	1988	*
Florida	1985	1988
Georgia	1985	1983
Hawaii	1999	1986
Idaho	1985	*
Illinois	1986	1988
Indiana	1986	1989
Iowa	1991	*
Kansas	1992	1987
Kentucky	1984	1990
Louisiana	1987	1988

Maine	1978	1975
Maryland	1985	*
Massachusetts	1983	1984
Michigan	1986	1987
Minnesota	1986	1993
Mississippi	1988	1986
Missouri	1986	1990
Montana	1993	1990
Nebraska	1990	1985
Nevada	1985	*
New Hampshire	1987	1987
New Jersey	1986	1977
New Mexico	1989	1991
New York	1982	1976
North Carolina	1985	*
North Dakota	1991	1987
Ohio	1985	1979
Oklahoma	1987	1988
Oregon	1986	1985
Pennsylvania	1986	1982
Rhode Island	1984	*
South Carolina	1986	*
South Dakota	1988	*
Tennessee	1985	1985
Texas	1987	1988

Utah	1984	1981
Vermont	1988	1970
Virginia	1985	1978
Washington	1987	1985
West Virginia	1988	1987
Wisconsin	1987	1990
Wyoming	1987	1988

Branching date reflects when states permitted branching via merger and acquisition (usually before de novo branching permitted).

Source: Morgan et al. (2004) and updates by authors.

*pre-1970

Table A.2

Regions

Regions	States
New England	Connecticut, Maine, Massachusetts, New Hampshire and Vermont
Middle Atlantic	New York, New Jersey, and Pennsylvania
South Atlantic	Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia
East South Central	Alabama, Kentucky, Mississippi, and Tennessee
West South Central	Arkansas, Louisiana, Oklahoma, and Texas
East North Central	Illinois, Indiana, Michigan, Ohio, and Wisconsin
West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota
Mountain	Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming
Pacific	Alaska, California, Hawaii, Oregon, Washington

Source: Clark (1997) and updates by authors.

Appendix B:

Table B.1

Details on the Economic Freedom variables included in the empirical analysis

Variable	Category	Description
CREDIT	Credit market freedom	
		This variable takes values between 0 and 10, with higher values indicating greater independence in financial and banking markets from government control. This includes ownership of banks (percentage of deposits held in privately owned banks), competition (the extent to which domestic banks face competition from foreign banks), extension of credit (percentage of credit extended to the private sector), and presence of interest rate controls. A score of 10 indicates repressive government interference, whereas a score of 0 a negligible one.
BUSINESS	Business freedom	This is a quantitative measure of the ability to start and operate a new business that represents the overall burden of bureaucracy as well as the efficiency of government in the regulatory process. This variable includes price controls, administrative conditions for new businesses, government bureaucracy, difficulties in starting a new business, irregular, additional payments connected with import and export permits, business licenses, exchange controls, tax assessments, police protection, or loan applications. The business freedom score ranges between 0 and 10, with 10 equalling the freest business environment.
LABOR	Labor market freedom	This variable measures the extent to which labour market rigidities are present. It considers the impact of minimum wage regulation, the government employment as a percentage of total state employment, and the ability to form and join unions and its relation to public policy. This variable takes values between 0 and 10, with higher values indicating a freer labor market.

SIZE   Size of government

This variable indicates the extent to which states rely on the political process to allocate resources, goods and services. When government spending increases relative to spending to individuals, households and businesses, government decision-making is substituted for personal choice and economic freedom is reduced. This variable is constructed using the following areas: General consumption expenditures by government as a percentage of GDP; Transfers and subsidies as a percentage of GDP; Social security payments as a percentage of GDP; and Government enterprises and investment. Higher values indicate excessive government spending.

PROPERTY

Legal system and
property rights

This variable measures the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state. It considers the following components: Judicial independence; Impartial courts; Protection of property rights; Military interference in rule of law and politics; Integrity of the legal system; Legal enforcement of contracts; Regulatory restrictions on the sale of real property; Reliability of police; and Business costs of crime. This variable takes values between 0 and 10, with higher values indicating more certain legal protection of property.

TRADE

Freedom to trade
internationally

This variable takes values between 0 and 10 with higher values indicating low tariffs, less regulatory trade barriers, few controls on the movement of capital and people and efficient administration of customs. This variable is constructed using the following areas: Tariffs; Regulatory trade barriers; Black-market exchange rates; and Controls of the movement of capital and people.

Highlights

►We investigate the relationship between market freedom and bank efficiency. ►We estimate cost efficiency scores using the Data Envelopment Analysis. ►We develop a fractional regression model to test our hypotheses. ►Strong link between credit market freedom and cost efficiency. ►Freer market systems can improve efficiency levels for US states.