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## Bank efficiency and industry growth during financial crises

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## ABSTRACT

Financial crises pose many problems for growth, and in this time of increasing financial instability it is important to fully understand why this happens. Many papers have analyzed the relationship between growth and a country's level of financial development using private credit, which leads to several unexpected problems. However, very few have used bank efficiency to gauge the development of the financial sector. The aim of this paper is to analyze the effect of bank efficiency on value-added growth of industries that were most dependent on external financing during the financial crisis. Specifically, it uses the data envelopment analysis (DEA) method to measure the efficiency of the banking sector across countries, according to the empirical strategy offered by [Rajan and Zingales \(1998\)](#). Our main result shows that bank efficiency relaxed credit constraints and increased the growth rate for financially dependent industries during the crisis. This finding shows the great but overlooked importance of bank efficiency in mitigating the negative effects of financial crises on growth for industries that are most dependent on external financing.

## 1. Introduction

The subprime mortgage crisis of 2009 reminds us how the banking sector plays an important role in the real economy. Many papers have analyzed and identified a positive relation between a country's level of financial development and its growth rate. However, this extensive literature on finance and growth primarily uses private credit as a measure of a country's level of financial development. The use of this measure poses two problems. First, [Hasan et al. \(2009\)](#) showed that private credit measures only the quantity of funds of the financial sector and should not be used to measure the quality a country's level of financial development. Second, [Rousseau and Wachtel \(2011\)](#) found a weak relationship between the level of financial development measured by private credit and growth for developed economies.

In this paper, we investigate for the first time how bank efficiency alleviated the effects of financial friction on economic growth during the 2009 financial crisis. The paper uses the Data Envelopment Analysis (DEA) method to measure bank efficiency for a sample of 38 countries taken from [Barth et al. \(2013\)](#). These authors have shown that this non-parametric method has several advantages. First, it does not require a particular functional form, and does not impose a specific structure of the shape of the efficiency frontier. Second, [Banker and Natarajan \(2008\)](#) also showed that the DEA approach performs better than parametric methods when estimating individual decision-making unit productivity. We then study the effect of this measure on industrial growth for 36 industries that were dependent on external finance. More

specifically, we investigate the relationship between a country's bank efficiency and the extent of credit availability for these industries during the financial crisis. Growth is the annual growth rate in real value added across industries and countries during the period 2009, when the crisis spread from the U.S. to other countries. Financial dependence is computed at the industry level using data on U.S. industrial firms. Our first result shows that bank efficiency relaxed credit constraints, permitting externally dependent industries to grow faster during the crisis. Indeed, the reasoning behind this paper is as follows. More efficient banks do a better job of funneling available credit to more externally dependent industries. Thus, bank efficiency positively affects the supply of credit granted to firms, which in turn increases the growth rate in real value added for industries most dependent on external financing. Specifically, if we take an industry at the 75th percentile of external financial dependence and another industry at the 25th percentile of external financial dependence, we find that the difference in growth rate between these two industries is 2.41 percentage points higher in the former. This effect is quite large relative to mean annual industry value-added growth in our sample (−4.559%). In order to disentangle the impact of bank efficiency from other factors that might be correlated with this measure, we control for other interactions between external financial dependence with measures of financial development, bank concentration and competition, cross-border banking (international and local claims), domestic and international public debt, bank supervision, net interest margin, banking crisis measures, bank supervision, macroeconomic policies

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(trade, real GDP, monetary policy, exchange rate and inflation) and other government policy intervention measures put in place during the crisis. Our result continues to hold, and also remains robust to the use of several measures of external financial dependence, such as working capital needs and Tobin's Q. It is also robust to the use of several econometric methods, such as weighted least squares and the rank method.

Our paper is related to several strands in the existing literature on the topic. First, a few papers have previously investigated the link between bank efficiency and a number of economic outcomes. [Ramcharran \(2016\)](#) empirically estimated the efficiency of bank loans to small and medium enterprises (SME) in India during the period 1979–2013. He found that increasing the productivity of bank loans (i.e. efficiency) increases the performance of SME in India. This paper is different from ours in two main respects. First, he used a parametric production function, namely the log-quadratic production function, to determine the efficiency of the banking sector instead of the non-parametric DEA approach, as we do in this paper. Second, the study focuses on one country, whereas our paper includes 38 countries and uses industry growth as a measure of economic growth. In the same vein, [Wijesiri et al. \(2015\)](#) use a bootstrapped DEA method to measure the efficiency of microfinance institutions (MFIs) in Sri Lanka and find that these institutions are financially and socially inefficient. [Havranek et al. \(2016\)](#) investigate the link between bank efficiency and the pass-through channel of Czech loan and deposit products. They show that efficient banks smooth loan rates, but there is no relationship between bank efficiency and loan markups. Even though this paper uses the same method, namely the DEA approach to measure bank efficiency, it does not look at the link between a country's level of bank efficiency and its industry growth. The study conducted by [Belke et al. \(2016\)](#) is the one that is closest to our study. Specifically, they analyze the impact of bank efficiency and regional growth across Europe in normal and crisis times. They show that bank efficiency is positively and significantly related to regional growth in both periods. Despite these interesting results, they use a parametric production function to estimate banking sector efficiency across countries. This is problematic since [Barth et al. \(2013\)](#) show that parametric function forms impose a specific structure on the shape of the efficiency frontier. In addition, their sample only includes European countries, and does not use industry growth or external financial dependence to avoid the problems related to omitted variables and causality. Using a DEA-based meta-frontier, [Gulati and Kumar \(2016\)](#) assess the impact of finance on the Indian banking sector efficiency, finding that the global financial crisis decreased its efficiency. However, this paper focuses on only one country (India) and uses a different DEA-based meta-frontier approach to measure the bank efficiency. Finally, [Barth et al. \(2013\)](#) use the DEA method to measure bank efficiency and find that strict bank supervision negatively and significantly impacts bank efficiency for a sample of 72 countries during the period 1999–2007.

Second, our paper adds to the empirical literature on the relationship between growth, banking crises and financial frictions ([Braun and Larrain, 2005](#); [Raddatz, 2006](#); [Kroszner et al., 2007](#); [Dell'Ariccia et al., 2008](#)). For example, [Braun and Larrain \(2005\)](#) find that industries that are more dependent on external financing are hit harder during recessions. For [Raddatz \(2006\)](#), larger liquidity needs create higher volatility, and financially underdeveloped countries experience deeper crises, a finding in line with our main result. [Kroszner et al. \(2007\)](#) use the same approach to investigate the growth impact of bank crises on industries and show that sectors that are highly dependent on external finance tend to experience a substantially greater contraction of value added during a banking crisis in countries with deeper financial systems than in countries with shallower financial systems. However, these papers all use private credit as a measure of the level of financial development. [Dell'Ariccia et al. \(2008\)](#) studied the effects of banking crises on growth in industrial sectors and found that in sectors more dependent on external finance, value added, capital formation, and the

number of establishments grew slower than in sectors less dependent on external finance. Recently, [Laeven and Valencia, \(2013a, 2013b\)](#) analyzed the impact of bank recapitalization on growth during the recent financial crisis. They found that the growth of firms dependent on external financing is disproportionately positively affected by bank capitalization policies. Our paper uses the same approach, but at the industry level, and adds bank efficiency as a measure of a country's level of financial development. Finally, [Cetorelli and Goldberg \(2011\)](#) show that cross-border banking operations were a driving factor behind the 2009 financial crisis. To test if our results are not affected by their finding, we use several measures of cross-border banking interacted with external financial dependence as controls. The remainder of the paper is organized as follows. [Section 2](#) outlines the basic methodology, [Section 3](#) presents the empirical investigation, and [Section 4](#) concludes.

## 2. Methodology

To study the relationship between bank efficiency, financial dependence and growth during the 2009 financial crisis, we first estimate the following econometric specification, following [Rajan and Zingales \(1998\)](#):

$$\begin{aligned} \text{Growth}_{j,k} = & \text{Constant} + \beta_1^* \text{Country Indicators}_k + \beta_2^* \text{Industry Indicators}_j \\ & + \beta_3^* \text{Size}_{j,k} + \beta_4^* \text{Financial dependence}_j \times \text{Efficiency Index}_k \\ & + \text{Controls}_{j,k} + \epsilon_{j,k} \end{aligned}$$

where  $j$  and  $k$  denote industry and country, respectively. Growth is the annual growth rate in real value added of industry  $j$  in country  $k$  during 2009. Financial dependence measures industry  $j$ 's dependence on external financing, and efficiency quantifies bank efficiency in country  $k$ . Size is measured by the logarithm of the total assets of industry  $j$ . The country and industry indicators are based on the IFS country classification code and the International Industry Classification Code, respectively.

[Rajan and Zingales \(1998\)](#) used data from U.S. firms to compute an industry's need for external financing as a benchmark, which allowed them to identify an industry's technological demand for external financing. They then used this measure to test whether the industries most dependent on external financing grow faster in countries with well developed financial markets. As argued by these authors, this method suggests that the cross-industry variance in financial dependence is similar across countries. For example, they stated that if “the pharmaceutical industry requires a large initial scale and has a higher gestation period before cashflows are harvested than the textile industry in the U.S., it also requires a large initial scale and has a higher gestation period in Korea.” However, several papers have questioned these assumptions. For example, [Claessens and Laeven \(2005\)](#) and [Fishman and Love \(2007\)](#) proposed to control for growth opportunities and Tobin's Q as controls. In the same vein, [Raddatz \(2006\)](#) argued that the results obtained using external financial dependence can be driven by a change in working capital financing. For this reason, we also introduce the interaction term between bank efficiency and capital needs in our estimations. Most importantly, [Laeven and Valencia, \(2013a, 2013b\)](#) indicate that an industry-level measure of a firm's growth opportunities should not be constructed using the U.S. as a benchmark. The reason for this is that growth opportunities vary across countries and industries. We also use the interaction term between bank efficiency and Tobin's Q, a proxy of an industry firm's growth opportunities. Thus, we include the Tobin's Q and capital needs as an extension of our baseline model. Finally, we re-estimate our econometric equation using regional sub-samples, i.e. European versus non-European countries, since 20 out of the 38 countries in our sample are European.

Another main advantage of this approach is that it treats for

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