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Financial distress drivers in Brazilian banks: A dynamic slacks approach

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ABSTRACT

This study applies the Dynamic Slacks Based Model (DSBM) developed by Tone and Tsutsui (2010) in order to assess the evolution of input saving/output increasing potentials in major Brazilian Banks from 1996 to 2011. We propose that these potentials or slacks can be used as proxies for an eventual financial distress situation in the future. The main research objective is to determine whether or not different characteristics of bank type – related to ownership, size, and merger and acquisition processes – are significantly related to inefficiency levels and, by extension, to an eventual financial distress situation, since higher inefficiency levels also imply lower input saving/output decreasing potentials. Based on a balanced panel model, secondary data from Economatica were collected and analyzed. Results indicate higher inefficiency levels and slacks in small public and national banks. Policy implications are also addressed.

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1. Introduction

This paper explores the use of the Data Envelopment Analysis (DEA), applying the Dynamic Slacks Based Model [DSBM] developed by Tone and Tsutsui (2010) to a data panel of major Brazilian banks, from 1996–2011, in order to assess the evolution of the input saving and output increasing potentials over the course of time. Differently from previous DEA models, the DSBM uses a non-radial slack-based measure, which allows a non-proportional changes of inputs and outputs. Moreover, the DSBM defines inter-temporal activities as carry-overs and allows their categorization into four types: desirable, undesirable, discretionary, and non-discretionary. These features can be particularly useful when analyzing credit risk and financial distress within the ambit of banking efficiency, as the limits of capital and equity of each institution typically vary over the course of time in different proportions, not observing a fixed one imposed by radial measures (Banker, Charnes, & Cooper, 1984; Varian, 1987).

Efficiency has been the focus of much recent research (Boussemart, Briec, Peypoch, & Tavéra, 2009; Briec & Lemaire, 1999; Briec & Liang, 2011; Camanho & Dyson, 2005) especially on banking (Arif & Can, 2009; Berger & Humphrey, 1992; Berger & Humphrey, 1997; De Borger, Ferrier, & Kerstens, 1998; DeYoung, 1998; Drake, Hall, & Simper, 2009; Epure, Kerstens, & Prior, 2011; Fukuyama & Weber 2009a, 2009b; Fukuyama & Weber 2010; Ray & Das, 2010; Sahoo & Tone, 2009). Deregulation and liberalization have placed Brazilian banks in a much more competitive environment and increased competition amongst them (Beccalli & Franz, 2009; Correa, 2009). As a result, Brazilian banks are now under pressure to upgrade their efficiency relative to their competitors. Benchmarking analysis is one of the ways to drive banks towards the frontier of best practices (Berger, Hasan, & Zhou, 2009).

The current research on banks' efficiency using non-parametric models such as DEA motivates and guides our research study. Recent empirical studies that focus on Brazilian banks includes Silva (2001), Ceretta and Niederauer (2001), Macedo, Santos, and Silva (2005), Ghilardi (2006) and Jorge and Wichmann (2006). All these papers have adopted traditional DEA models. The advantage of DEA is that it facilitates the computation of multiple input and output production correspondences.

This paper extends the current research on bank efficiency by assessing the role of productive slacks over the course of time as proxies of an eventual financial distress situation in the future. It

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also innovates in this context, by relating their respective inefficiency levels with several contextual variables associated to bank type: size, mergers and acquisition processes, and ownership. The major underlying hypothesis is that lower efficiency levels, which are linked to bank type, also imply higher slacks and, therefore, a greater chance for an eventual financial distress situation in the future.

The motivation of this paper are as follows: First, it aims to analyze efficiency in a representative emerging economy, Brazil. Although there is some research on Brazilian banks using DEA, the analysis of inter-temporal changes in productive slacks have not been taken so far into consideration. Therefore, this paper aims to contribute to the current theoretical research on bank efficiency using the innovative DBSM proposed by [Tone and Tsutsui \(2010\)](#). Second, the paper expands the existing literature especially due to its practical application that emulates the CAMELS rating systems and interprets its results linked to corporate governance characteristics ([Männasoo & Mayes, 2009](#)). Third, we analyze the aggregate carry-over slacks over the course of time, regressing them against different contextual variables. This is a significant contribution to the current research on efficiency in the bank sector in general. Fourth, our analysis covers the period from 1996 to 2011, which allows us to observe changes in banks' efficiency. Finally, our analysis is based on a representative sample of Brazilian banks.

The remainder of the paper is organized as follows: Section 2 presents the literature review. The theoretical model of banking profit model appears in Section 3. Section 4 presents the data and the model. The empirical results are presented and discussed in terms of policy implications in Section 5. Conclusions follow in Section 6.

2. Literature review

This section is subdivided into three smaller ones. The first section addresses the institutional setting of the Brazilian banking industry, recently depicted in [Barros and Wanke \(2014\)](#). The second one presents the body of literature on efficiency studies and financial distress. The last one, formalizes the major propositions of this research.

2.1. Background on the Brazilian banking industry

Brazil banking sector is large with a high number of banks. The bigger banks are bank Bradesco, Caixa Econômica Federal, HSBC bank; Banco J. Safra, SA.; Bank Itaú; Banco do Estado do Rio Grande do Sul; Banco PanAmericano SA; Banco Santander; banco do Brazil and Citibank. This list reveals openness of the Brazilian bank market but also the representativeness of national big banks ([Tecles & Tabak, 2010](#)). The market revealed in the financial crises of 1997 and 1998 some weakness of systems for monitoring the credit risk. To answer to this weaknesses, the Brazilian National Monetary Council (CMN) issued Resolution 2099 of 1994 ratified the Basel Accord as the minimum requirement for opening operation of financial institutions.

However this kind of risk regulation resulted that from 2008 to 2012 – also as consequence of the economic crisis, several banks were seized by the Central bank Banco of Brasil: Bank BVA SA, Bank Rural, Bank Cruzeiro do Sul, and a smaller lender Bank Prosper, the biggest collapse of a financial institution since Bank Santos was shuttered in 2005. Bank PanAmericano was shuttered in November 2010 and Bank Morada, a small lender, followed suit a few months later. This intervention resulted when the controlling shareholders failed to deposit the funds the bank needed to shore up the bank's capital base, and this represents an example of the strain facing the

nation's small-sized lenders following years of fast credit-fueled growth. As it will be discussed later, this list of seized and shuttered banks is useful to analyze the predictive capabilities of the DBSM in terms of financial distress (Section 5.2).

2.2. Efficiency studies and financial distress in the banking industry

Banks play a very important role in the society, presenting a pivotal position in the process of promoting economic growth. As a result, bank performance evaluation has received great attention over the past several years for both theoretical and practical purposes. These studies are often grouped into two main approaches; parametric and nonparametric ([Berger & Humphrey, 1997](#); [Brandouy, Bricc, Kerstens, & Van de Woestyne, 2010](#); [Bricc & Liang, 2011](#); [Brissimis, Delis, & Tsionas, 2010](#); [De Borger et al., 1998](#); [Kerstens, Mounir, & Van de Woestyne, 2011](#); [Lampe & Hilgers, 2014](#)). The most popular parametric method is known as the stochastic frontier approach (SFA), whereas, the most popular nonparametric method DEA.

Although applying these methods could determine the efficiency levels they do not give details of the determinants related to inefficiency. In this sense, several studies proposed a combination of measuring and explaining bank efficiency scores ([Fethi & Pasiouras, 2010](#)) using DEA or SFA in the first stage to determine the efficiency scores and some regression model in the second stage to explain their drivers. [Casu and Molyneux \(2003\)](#), [Ariff and Can \(2008\)](#), and [San, Theng, and Heng \(2011\)](#) employed Tobit regression in particular, to explain bank performance. More recently, [Barros and Wanke \(2014\)](#) used a Bayesian dynamic frontier model so as to provide a more structural (i.e., one-stage) explanation for the variation in bank inefficiency than has been presented in the previously cited two-stage models. It is important to mention that, although focusing on the efficiency drivers by means of parametric and non-parametric techniques in a dynamic environment, a further step is still missing in the current body of literature: how efficiency drivers translate into several capital and equity slacks so that financial distress situations can be examined, and why it is important to do so.

Since these efficiency measurement techniques return efficiency scores, it is fundamental to establish the linkages between financial (in)efficiency or (inferior) superior performance and financial distress. More precisely, these techniques should be capable of indicating how effective a financial institution is in minimizing variables related to increasing financial distress and maximizing the other ones related increasing financial health. In DEA, this fine tuning between efficiency scores and decision making is often accomplished not only by choosing the proper set of input and output variables, but also by looking at their slacks.

There is a number of variables that are thought to be associated with financial distress. Predicting failure using firm-specific characteristics together with financial structures is originally attributed to the seminal works of [Altman \(1968\)](#) and [Altman, Haldeman, and Narayanan \(1977\)](#), which employed discriminant analysis on financial ratios to derive the Z-score approach. More recently, [Männasoo and Mayes \(2009\)](#) presented a comprehensive literature review on this subject. According to these authors, although there is no universal set of indicators used across previous studies, the CAMELS factors appear to have significant role in detecting distress.

The CAMELS acronym stands for capital adequacy (C), asset quality (A), management efficiency (M), earnings (E), liquidity (L) and sensitivity to market risk (S). Along the past decades, several studies reported the use of such related-variables in risk measurement and monitoring. Some examples can be found in [Cole and Gunther \(1995\)](#), [DeYoung \(1998\)](#), [Oshinsky and Olin \(2006\)](#), [Kumar and Ravi \(2007\)](#), [Poghosyan and Cihák \(2011\)](#) and

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