



Turkish bank efficiency: Bayesian estimation with undesirable outputs

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ABSTRACT

This paper analyzes the productivity and efficiency of Turkish banks from 2002 to 2010. We obtained estimates of efficiency, productivity growth and efficiency growth using a Bayesian stochastic frontier approach and focused on accounting for Non-Performing Loans (NPLs) for use in our model. Specifically, we introduce NPLs as a bad output in an input distance function, and estimate a system of non-linear equations subject to endogeneity. We confirm that the productivity growth of Turkish banks was positive over the period of this study, which was mainly due to the improvement in technology, while efficiency growth continued to be negative over the same period. Methodologically, we also prove that not accounting for NPLs in estimating the frontier model might seriously distort the efficiency and productivity results. The study also provides measures of shadow prices for NPL and discusses the results in terms of several interesting trends in Turkish banking. Finally, the paper provides efficiency and productivity comparisons between domestic and foreign banks.

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1. Introduction

The mixture of Turkey's turbulent economic development and ongoing discussion about EU membership has attracted research interest of the Turkish economy and banking system. Several studies of the efficiency and productivity analysis of Turkish banks have recently been published (Isik and Hassan, 2002, 2003; Demir et al., 2005; Ozkan-Gunay and Tektas, 2006; Aysan and Ceyhan, 2008; Fukuyama and Matousek, 2011, among others) driven by the major contributions of the banking sector to the Turkish economy and its major influence on other related economic sectors.

The recent focus on performance analysis of Turkish banks has also been predominantly motivated by the complex economic environment in which they operate. Poor macroeconomic conditions in the last two decades, combined with a fragile financial system, caused severe financial problems and brought the Turkish economy to a complete standstill. Despite several structural, legal and institutional reforms introduced by the Turkish government

and the International Monetary Fund (IMF), banks' balance sheets continue to be affected by a high percentage of Non-Performing Loans (NPLs) and continuing deflation. Internal management failings and flawed corporate governance have also continuously affected the performance of Turkish banks.

The present paper is motivated by all the above; we aim to extend the literature examining the productivity and efficiency analysis of Turkish banks, offering four important contributions. Firstly, we aim to account for both desirable and undesirable (NPLs) outputs in measuring and analyzing the efficiency and productivity of Turkish banks. We use an innovative methodology to account for undesirable outputs. Specifically, we adopt a Bayesian Limited Information Likelihood (LIL) and we allow undesirable outputs to enter as technology shifters in an input distance function (Atkinson and Dorfman, 2005). Secondly, we also estimate the input distance function in a Generalized Method of Moment (GMM) framework and compare the findings with the Bayesian results. Specifically, we estimate two GMM models, one that takes into account undesirable outputs and one that ignores undesirable outputs and test whether ignoring bad outputs affects efficiency results. Thirdly, we provide shadow price measures of the NPLs. This is an important contribution, as the discussion about the shadow price of NPLs has been rather neglected in literature and only a few studies have addressed the shadow price of NPLs in banking (Fukuyama and

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Weber, 2008). Shadow prices have important managerial implications as they show how much investments in inputs are needed to reduce the level of NPLs. Finally, the study also contributes to the banking literature on Turkey by using recent data and focusing on an interesting period. We investigate bank efficiency and productivity progress shortly after the bank restructuring and consolidation program. The sample analyzed covers the period from 2002 to 2010. We use a unique quarterly dataset that reduces the problem with window dressing balance sheets and income statements that is commonly experienced with annual data (Allen and Saunders, 1992; Evanoff and Segal, 1997). Further, we examine differences in bank efficiency and productivity between domestic and foreign banks. We also discuss and contrast the contribution of our results with other recent studies on Turkish bank efficiency.

This is the first time that a Bayesian methodology has been used to account for undesirable outputs in the banking literature. Most other studies have used non-parametric approaches, which despite their important merits, usually ignore the error of measurement in estimating efficiency. Previously, Feng and Serletis (2009) and Assaf et al. (2011) have used the Bayesian methodology to measure banks' productivity and efficiency. Turkish banks have historically suffered from a high percentage of NPLs. The literature clearly discusses that NPLs are an undesirable by-product that allows the aggregation of individual bank inefficiency (Park and Weber, 2006). From a methodological point of view, ignoring NPLs is also a major weakness and is likely to result in biased conclusions (Atkinson and Dorfman, 2005). For example, a bank that has high performance is not necessarily better than other banks, as it might be doing that at the expense of producing a high percentage of undesirable outputs. A production process must be clearly defined based on both desirable and undesirable outputs; using only desirable outputs will fail to credit a bank for its effort to reduce undesirable outputs (Fernandez et al., 2002).

As mentioned, the study also estimates the input distance function using the GMM framework. A formal comparison of Bayesian and GMM is necessary in order to check whether GMM results are accurate in the specific sample that we use. Regarding GMM it should be mentioned that its known properties are only asymptotic. The Bayesian version based on Limited Information Likelihood (LIL) is exact for the sample at hand and therefore we hope to obtain more accurate results. A comparison of results between Bayesian LIL and classical GMM helps to validate GMM itself and its assumptions, including the validity of instruments, etc. For example, if the sample size is too small to justify GMM inferences, that should turn up in important differences compared to Bayesian LIL or other Bayesian versions of GMM. In fact, since we rely in our model on parameter estimation for inefficiency, the issue is even more important. The differences between classical GMM and Bayesian techniques are well documented in the literature and it is also well known that GMM may behave quite badly in finite samples; apparently we wish to know whether we are in this kind of situation.¹ Moreover, we consider as another benchmark of comparison the Battese and Coelli (1995) model with systematically time-varying technical inefficiency. The model has been used for quite some time in the literature. It has also been used extensively in the distance function formulation that we use here. In this formulation, or version, maximum likelihood (ML) is used without taking into account the endogeneity of inputs that are used in the right-

hand-side of the input distance function. A quite unexpected result is that in the aggregate but also for specific banks, inefficiency distributions (and distributions of other functions of interest like productivity change, etc.) are quite similar for GMM and the Battese and Coelli (1995) model but both are quite different from the Bayesian LIL approach. This indicates that the Bayesian LIL approach can be profitably employed in small or finite-sample situations to draw more accurate inferences about the economically important functions of interest.

The remaining parts of this paper are organized as follows: Section 2 provides an overview of the Turkish banking industry, highlighting all the recent trends and challenges. Section 3 provides an overview of the literature, focusing on all the current gaps and reinforcing the contributions of this study. Section 4 describes the model and method of estimation. Section 5 describes the data. Section 6 discusses the empirical results, and Section 7 summarizes our findings and concludes.

2. A brief overview of the Turkish banking sector

In the early 1990s, the banking sector struggled with the uncontrolled liberalization of the financial market, which later led to a severe currency and banking crisis. The government sought to prevent runs on banks by introducing the full deposit insurance scheme. However, this action caused moral hazard problems of as banks correctly assumed that the government's financial support and further bailout would be provided in the near future. A number of banks then reported a deterioration in asset quality in order to receive bailouts or capital injections from the government. This situation almost paralyzed the activities of the financial sector. The authorities tried to respond by introducing a stabilization program.²

However, the implementation of the proposed reforms, which aimed to restore fiscal and monetary discipline, was delayed, leaving the market in complete instability. Inevitably, the banking sector experienced a systemic crisis that reached its peak in November 2000, particularly due to the high volume of NPLs. The crisis also caused a severe contraction in economic activities and the government, with IMF support, announced a comprehensive program in May 2000 that was intended to reduce both inflation and public sector debt and restructure the banking system.

The bank restructuring program proved to be the vital part of the overall program. It was designed to restructure state-owned commercial banks and to prompt resolution of those banks that were taken over by the Savings Deposit Insurance Fund. The total bank restructuring costs reached 53.6 billion USD (34% of GDP), of which some 47 billion had to be assumed by the government. A complementary corporate debt restructuring scheme, called the "Istanbul approach," was also launched on a voluntary basis. Some 6 billion USD corporate debts were restructured between 2002 and 2005. The proportion of NPLs gradually decreased from its peak of 29.6% in 2001 to 11.5% by the end of 2003 following the restructuring program.

Around this time, the banking sector underwent a strict restructuring and consolidation process particularly in the state-owned commercial banking segment. Most banks closed on average about 33% of their branches and reduced their staff by 50%. In addition, public sector banks reduced the number of employees by 27%. At the same time, the authorities consolidated large state-owned banks. Banks' heavy duty losses and huge overnight liabilities were

¹ We do not wish to go to the other extreme and claim that Bayesian LIL is always a good solution-after all it depends on a set of moment conditions which may not be valid. But if the moment conditions are not valid then this should turn up in large differences between GMM and Bayesian LIL. In that way, when the two approaches agree we have enough evidence to conclude that the use of reasonable distributional assumptions in LIL can lead to important efficiency gains relative to GMM without introducing biases from wrong moment conditions, particularly in finite samples or samples with other problems.

² The Turkish banking sector has a number of commonalities with transition economies. However, the number of studies that investigate the Turkish banking sector is still rather limited compared with the extensive research on banking in transition economies (e.g. Fries and Taci, 2005; Staikouras et al. 2008; Matousek and Sarantis, 2009, among others).

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