



The random parameters stochastic frontier cost function and the effectiveness of public policy: Evidence from bank restructuring in Mexico



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ABSTRACT

We apply specifications of the random parameters stochastic frontier cost function model to estimate bank efficiency. This class of model appears to resolve the long standing problem of confounding inefficiency and heterogeneity. Mean cost efficiencies from random models are higher by as much as eleven percentage points compared to pooled OLS estimates. Whilst tests show efficiencies are not drawn from the same population, rank order efficiencies are strongly associated. In a second step, we employ the estimated efficiencies to determine the effect of foreign acquisitions on bank cost efficiency following legislative reforms made as part of Mexico's bank restructuring programme in 1995. Foreign bank acquisition does not significantly affect efficiency whereas consolidation of local banks yields significant long-term improvements in efficiency. We recommend random parameters stochastic frontier models since they better accommodate heterogeneity and produce more precise estimated efficiencies.

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1. Introduction

A recent strand of literature is debating the impact of government restructuring programmes on banking sector competition and risk-taking (Dam & Koetter, 2012; Gropp, Hakenes, & Schnabel, 2011; Hakenes & Schnabel, 2010). Restructuring programmes vary considerably between crisis episodes because their constituents must comply with government objectives. Ariff and Can (2009) identify that different restructuring measures yield different outcomes after examining bank performance in countries in receipt of IMF support following the 1997 Asian crisis. The lack of consensus as to which combination of restructuring policies constitute best practice is unsurprising given objectives vary from case-to-case (Laeven & Valencia, 2008, 2010).

This paper offers further insights by considering Mexico as a solitary case. Our objective is to determine the impact of a significant component of restructuring, namely the repeal of restrictions on foreign investment which facilitated one of the fastest acquisitions of market share by foreign banks on record, on the cost efficiencies

of banks. This study is one of the earliest to evaluate the effect of this landmark change in policy and it complements Haber (2005) who examines how foreign bank acquisitions affected lending, asset quality and profitability. Whilst the sale of Mexican banks to foreign banks is justifiable on grounds that the acquired banks would be better managed and more appropriately governed, which should yield performance gains (Caprio, Laeven, & Levine, 2007; Laeven & Levine, 2009), a lack of local resources to recapitalise the banks made the decision inevitable. Our results will interest policymakers concerned with evaluating the efficiency performance of domestic-owned and foreign-owned banks particularly as the empirical evidence is mixed or subject to caveats (Berger, DeYoung, Genay, & Udell, 2000). This study adds to a relatively sparse literature which examines the efficiency effects of cross-border consolidation (Berger, 2007). The results will also inform the bank privatisation literature which recommends letting foreign banks participate in auctions to buy domestic-owned banks because of associated improvements in the post-privatisation performance of privatised banks (Megginson, 2005).

Another objective of the paper is to consider alternative measures of bank efficiency proposed in the stochastic frontier literature. Firm-level inefficiency may be measured in terms of a unit's deviation from an estimated best practice frontier that represents the underlying production technology of an industry. Researchers estimate

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efficient frontiers using parametric and/or non-parametric methods: the most popular approaches are stochastic frontier analysis (Aigner, Lovell, & Schmidt, 1977; Meeusen & van den Broeck, 1977) and data envelopment analysis (Banker, Charnes, & Cooper, 1984; Farrell, 1957). Despite methodological advances in efficiency modelling, an outstanding anomaly is how to account for cross-firm heterogeneity. Standard panel data approaches confound inefficiency and heterogeneity which can “seriously distort” estimated inefficiencies (Greene, 2005a, p. 270; Mester, 1997; Orea & Kumbhakar, 2004). One solution to this problem is the random parameters stochastic frontier that relaxes the restrictive assumption of a common production technology across firms (Tsionas, 2002).

Applications of random parameters stochastic frontier models in banking are rare. Greene (2005a, 2005b) applies several specifications of a stochastic frontier cost function to a sample of 500 US banks in a seminal paper demonstrating statistical advances. He demonstrates that the precision of estimated efficiency is sensitive to model specification, which is a crucial point because estimated inefficiencies are commonly redeployed as the dependent variable in second stage regression analysis of the determinants of inefficiency. In support, Bos, Koetter, Kolari, and Kool (2009) find the efficiency ranks of German savings banks are sensitive to the treatment of heterogeneity. This implies the precision of estimated efficiency is vital if public policy is to be reliably informed by empirical evidence.

We extend the number of applications of the random parameters stochastic frontier cost function of the banking sector to establish if this class of model suitably disentangles heterogeneity and inefficiency to improve the precision of estimated efficiency. Greene (2005b) applies the fixed and random effects framework to a stochastic frontier setting which he terms true effects models. The latter is nested within a random parameters model (RPM) which accommodates cross-firm heterogeneity through a random constant term. In what follows, we apply the true random effects model to a sample of Mexican banks, to proxy emerging market firms, and check the robustness of the findings for US banks. We contribute to the efficiency literature by applying three RPM stochastic frontier models to identify if bank efficiencies are sensitive to model specifications that better accommodate heterogeneity. Bank output is heterogeneous in the first RPM whereas heterogeneity enters the means of the random parameters and is dependent upon an observed variable, selected as average total assets to proxy bank size in the second. Lastly, a random parameter which we define as size enters the variance of the inefficiency term. To facilitate comparison with standard panel data methods, we estimate efficiency using pooled ordinary least squares.

We source quarterly data for 43 banks from the National Banking and Securities Commission (known by its Spanish acronym CNBV¹) to estimate bank cost efficiencies between March 1998 and December 2006.² Bank efficiency studies commonly report the results of second stage estimations of the determinants of inefficiency. We use the estimated inefficiencies from the non-random and random models as dependent variables in separate regressions. We select covariates to proxy policies associated with the restructuring programme to resolve the Tequila crisis of 1995 to determine the impact of ownership changes resulting from foreign penetration and domestic M&A activity on bank efficiency. Also, we investigate the relationship between inefficiency and diversification (the Financial Groups Law of 1990 permits universal banking), and between inefficiency and asset quality (from 1996 to 1997 new accounting rules advocate

more stringent treatment of non-performing loans and generally attempt to raise local standards to international level). For robustness, we compare coefficients from a two-step model with estimates from the one-step technical inefficiency effects model (Battese & Coelli, 1995).

In preview, foreign acquisition does not significantly affect bank cost efficiency. Whilst it is plausible to suggest that foreign ownership has put a brake on inefficient management practices at acquired banks, the result is consistent with arguments that there are forces in Mexico which prevent foreign banks from generating efficiency gains. In contrast, consolidation involving domestic-owned banks secures long term efficiency gains suggesting local banks did react to the threat of foreign banks. The results reveal diversification is an important predictor of bank efficiency. The random parameters stochastic frontier cost function estimates of efficiency demonstrate that failing to model heterogeneity confounds estimated inefficiencies. Our evidence shows mean cost efficiency is higher when estimated using models that explicitly accommodate heterogeneity. The findings from emerging market banks concur with evidence from the US and Germany (Bos et al., 2009; Greene, 2005a).

The paper is organised as follows. Section 2 presents a synopsis of developments in Mexico's banking sector and theoretical exposition of the random parameters stochastic frontier model. Section 3 shows the cost function and data. Sections 4 and 5 present results on the cost function estimations and policy evaluation exercise. Section 6 concludes.

2. Background and theory

Recent history illustrates the role of government in resolving banking crises. Gelos and Roldós (2004) note government intervention to restructure banking systems is particularly important in emerging market nations. For instance, the response of the Mexican authorities to the 1982 Debt Crisis involved nationalising the banking sector by amending Articles 28 and 123 of the Constitution to prohibit the private ownership of banks and to retrench boards of bank directors (Gruben, Welch, & Gunther, 1994). Under government ownership a consolidation process saw the number of banks fall from 58 to 18. Across the 1980s banks recapitalised balance sheets because of high profits accruing from wide interest rate spreads and high commissions (Montes-Negret & Landa, 2001). Political objectives changed in the late 1980s to promote competition in banking (and other industries) through interest rate deregulation (in 1989) and privatisation. The Credit Institutions Law of July 1990 legislated for the bank privatisation programme from June 1991 to July 1992, whilst the Financial Groups Law defined universal banking as the main organisational structure of the financial sector (Barnes, 1992). Early moves towards a universal banking model had begun in the 1950s motivated by prospective gains from mergers and economies of scale. In the 1990s several commercial banks remained independent of financial groups whereas some groups did not contain a commercial bank.

Ultimately, the bank privatisation programme failed because of the Tequila crisis which created enormous banking sector pressures in 1995. Studies document how the privatised banks were sold at inflated prices to entrepreneurial groups (some with banking sector experience and some without), which distorted incentives and created an environment of excessive risk-taking under conditions of weaknesses in regulation and supervision and poor upholding of property rights (Haber, 2005; Hoshino, 1996; Montes-Negret & Landa, 2001). The problems were compounded by a mistaken belief by the new bank owners that they were acquiring secure oligopolies and that competition would not increase because the government had forbidden foreigners from entering the auctions to buy banks (Haber, 2005).

¹ Comisión Nacional Bancaria y de Valores.

² The period from 1998 to 2006 covers the third of three phases of foreign bank entry into Mexico's banking sector (Haber & Musacchio, 2005). By 1998 the restructuring programme was largely complete pending the sale of restructured banks. Foreign bank ownership of banking assets accelerates from 1998 and peaks around 82% from 2002–3 (Haber, 2005). The chosen period captures the efficiency dynamics associated with this process. Also, other important reforms took place either before or during the period.

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