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Interfaces with Other Disciplines

Adjustment costs in the technical efficiency: An application to global banking

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ABSTRACT

This paper proposes a new framework of measuring technical efficiency that takes into account adjustment costs in variable inputs associated with changes in efficiency. We look closely at the implicit assumption in any model of technical efficiency that inputs could freely adjust. Yet, the technical efficiency is determined from the allocation of inputs by the firm to production on the one hand and to efficiency on the other. We show that technical efficiency depends on adjustment costs in variable inputs. Estimating the proposed model has certain complexities that we overcome by employing a non-parametric Local Linear Maximum Likelihood (LLML). In the empirical section, we employ a comprehensive global banking sample and estimate bank alternative profit efficiency across a plethora of countries with strong variability in the underlying adjustment costs. Moreover, given the observed heterogeneity across countries evidence shows that adjustment costs due to personnel expenses are the highest among advanced countries. Emerging economies show strong potential in terms of efficiency post-financial crisis, mainly due to lower labor adjustment costs. Alas, our findings show some persistence in adjustment costs post the financial crisis.

1. Introduction

In this paper we argue that efficiency measurement should take into account the existence of adjustment costs related to changes variable inputs. This is of particular importance in the aftermath of the financial crisis due to dramatic changes in the underlying structural conditions of financial markets. Yet, the literature to this day in all models of technical efficiency remains agnostic regarding the dependency of technical efficiency to adjustment costs in variable inputs. The norm in the literature (Koutsomanoli-Filippaki & Mamatzakis, 2009; Lozano-Vivas & Pasiouras, 2010; Koutsomanoli-Filippaki & Mamatzakis, 2011; Tzeremes, 2015; Tsionas 2015; Galán, Veiga, & Wiper 2015) is to assume that adjustment costs in variable inputs are not significant. However, the technical efficiency is determined from the allocation of inputs by the bank to production on the one hand and to efficiency on the other. The process of this allocation is bound to generate adjustment costs, as variable inputs cannot instantaneously change without some loss in efficiency. In this paper, we propose a model that relaxes the assumption of no adjustment costs and as such we measure this adjustment process of technical efficiency.

Despite the importance of correctly measuring technical efficiency and its underlying adjustment costs there is limited evidence (Tsionas, 2006; Kien & Tsionas, 2016; Tsionas, 2016). There is, of course, an extensive literature on bank efficiency (Koutsomanoli-Filippaki & Mamatzakis, 2009; Lozano-Vivas & Pasiouras, 2010; Koutsomanoli-Filippaki & Mamatzakis, 2011; Galán et al., 2015) that this paper relates to. A common finding of the literature is the high level of cross-country heterogeneity in the global banking industry, (i.e. Altunbas et al., 2001; Lozano-Vivas & Pasiouras, 2010; Koutsomanoli-Filippaki & Mamatzakis, 2011; Galán et al., 2015).[1] Tsionas (2006) show that the variability in bank efficiency in US could be explained by adjustment costs. The author argues that efficiency levels across banks would not homogenously adjust in the short run, as there is some persistence due to

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[1] The literature on bank efficiency is quite vast. A starting point could be traced back to Berger and Mester (1997), that seemed to spark various studies thereafter (see for example for European banks, Koutsomanoli-Filippaki & Mamatzakis, 2009; Koutsomanoli-Filippaki & Mamatzakis, 2011; whereas for transition economies see Mamatzakis, (2009), Tsionas et al., (2015) and for the US banking see Tsionas (2015). It is evident that most of the empirical studies focus on advanced economies and it is not common examine bank efficiency at a global level. This paper fills this gap in the literature in the empirical application section.

heterogeneity in their adjustment costs. We follow Tsionas (2006) lead and herein we closely look at the underlying reasons for any persistence in efficiency by proposing a way to estimate adjustment costs in variable inputs at a global level that would reveal possible variability in efficiency. [2]

Moreover, the starting point of our model is the simple observation that the adjustment of technical efficiency for a firm indeed comes at a cost due to changes both in efficiency and in inputs. We provide a non-parametric model that measures such costs. Modeling adjustment costs in technical efficiency comes with some cumbersome estimations implications. To overcome such difficulties we propose to employ a non-parametric likelihood estimation method, opting for Local Linear Maximum Likelihood (LLML) in an initial conversion.[3] This LLML allows estimating all adjustment costs of technical efficiency for all banks in our global sample over time.

We employ a global banking sample as our new proposed methodology provides a way for taking into account adjustment costs in alternative profit efficiency, due to variable inputs, irrespectively of the intrinsic characteristics of financial markets. The coverage of the global bank sample is of importance as financial markets, and in particular the banking industry, have been through a remarkable restructuring process, partly because of the financial crisis in 2008 and partly because changes in their underlying productive structure so as to become more efficient. Undoubtedly, adjustment costs play an important role in the restructuring process of the banking industry. Yet, despite the restructuring steps observed in the banking industry, with some variability, across the world the underlying bank adjustment costs have not been quantified to date. Nevertheless, it is well documented (Mamatzakis, Tsionas, Kumbhakar, & Koutsomanoli-Filippaki, 2015; Galán et al., 2015) that banks, since the financial crisis, have targeted operating costs, for example cutting down personnel expenses, aiming to improve their operating performance.[4] The financial crisis has had a cataclysmic impact in rationalizing and scaling down operating expenses as it provided the opportunity step ahead restructuring efforts. In this paper, we argue that bank efficiency might have improved across the world since the crisis, and in particular in recent years, but as adjustment costs are also present such improvement is impeded. Moreover, results show that bank alternative profit efficiency has been subdued during the financial crisis in 2008 and 2009. But, there was a decline in bank alternative profit efficiency in advanced economies well before the financial crisis. Since the financial crisis, there has been a remarkable recovery of efficiency across the world, and in particular in emerging economies as they have managed to exceed their pro-crisis efficiency threshold. Therefore, the recovery in bank profit efficiency since the financial crisis across the world has not been homogenous. We show that adjustment costs in variable bank inputs, in particular the labor input, could explain the observed heterogeneity in bank profit efficiency across the world since the financial crisis.

Thereby, this paper contributes to the existing literature in several ways. Firstly, from a methodological point of view, we propose a new model of bank efficiency that decomposes adjustment costs in variable inputs. Secondly, we focus on global bank alternative profit efficiency, aiming to examine cross-country variability in the underlying efficiency adjustment costs. Thirdly, we examine the underlying relationship between those adjustment costs prior and ex-post to the financial crisis. Overall, our results reveal striking variability in adjustment costs of alternative profit efficiency across countries, as well as over time. It is worth noticing that higher adjustment costs appear to persist in 2011 and 2012, that is well after the financial crisis, suggesting that improvements in bank efficiency worldwide is impended by such persistence.

The rest of the paper is structured as follows. Section 2 develops our new model of efficiency. Section 3 describes the global data set, whilst Section 4 discusses our results. Section 5 offers some conclusions.

2. A new model for bank efficiency

Following Tsionas (2006) who argues that there is persistence in efficiency for US banks, we propose a technical efficiency model that permits searching for underlying causes of such persistence. Moreover, the implicit assumption in any model of efficiency is that inputs could freely adjust. The standard assumption in the literature (see Koutsomanoli-Filippaki & Mamatzakis, 2009; Koutsomanoli-Filippaki & Mamatzakis, 2011; Galán et al. 2015; Tsionas, 2016; Tran & Tsionas, 2016) is that the efficiency is determined from the allocation of inputs by the firm to production on the one hand and efficiency on the other. This allocation implies that efficiency cannot be adjusted without adjustment cost and, therefore, any change in efficiency would require the use of resources. Therefore, the adjustment costs should be taken into account. Such adjustment costs we argue here depend on changes in variable inputs. This dependence is that, in the input-output space, the level of efficiency really depends on the use of inputs and the capacity to produce output(s).

2.1. The bank optimization problem: revisited

In detail, given a production function $y = f(x)e^{-u(x)}$, inefficiency is given by the function $u : \mathbb{R}_+^K \to \mathbb{R}_+$, which is assumed twice differentiable.[5] The cost minimization problem becomes:

$$C(w, y) = \min_{x \hat{I} R_+^k} : w'x, \quad s.t.\ y \le f(x)e^{-u(x;z)}. \tag{1}$$

The inefficiency function depends also on control variables $z \in R^m$ but we omit this dependence in what follows, for simplicity. The first order conditions to the problem are:

$$\frac{w_k}{w_1} = \frac{f_k(x) - f(x)u_k(x)}{f_1(x) - f(x)u_1(x)}, \quad k = 2, \ldots, K,$$
$$y = f(x)e^{-u(x)}, \tag{2}$$

where $f_k(x) = \frac{\partial f(x)}{\partial x_k}, u_k(x) = \frac{\partial u(x)}{\partial x_k}, k = 1, ..., K.$

In alternative form we have the conditions:

$$\frac{s_k}{s_1} = \frac{\frac{\partial \log f(x)}{\partial \log x_k} - u(x)\frac{\partial \log u(x)}{\partial \log x_k}}{\frac{\partial \log f(x)}{\partial \log x_1} - u(x)\frac{\partial \log u(x)}{\partial \log x_1}}, \quad k = 2, \ldots, K,$$
$$y = f(x)\, e^{-u(x)}, \tag{3}$$

where $s_k = \frac{w_k x_k}{C}, k = 1, ..., K$ are cost shares.

[2] Galán et al. (2015) argue that there are costs, for Colombian banks, associated with instant adjustment that would cause inefficiency. The authors extend Tsionas (2006) and report efficiency heterogeneity across Colombian banks based on size, ownership and corporate structure.

[3] Henderson and Parmeter (2009) provide a survey of regressions with references to the underlying constraints (see also Kumbhakar et al. 2007; Kumbhakar & Tsionas, 2010).

[4] In the aftermath of the crisis, questions emerged on what went wrong and how it could be corrected. Much of the attention has focused on the structural reforms needed to restore efficiency in the banking industry. Such voices of bank restructuring across operating costs, and in particular personnel expenses, have not been new as there were present well before the financial crisis (Koutsomanoli-Filippaki & Mamatzakis, 2009; Koutsomanoli-Filippaki & Mamatzakis, 2011). However, the crisis revealed that the warranted structural reforms were delayed, and certainly had not been carried out during good times (Mamatzakis et al. 2015; Galán et al., 2015). The outcome is higher adjustment costs in the aftermath of the crisis as we demonstrate.

[5] For simplifying the analysis we would refer to inefficiency.