Efficiency and productivity of the cement industry: Pakistani experience of deregulation and privatisation ☆

Yaseen Ghulam, Shabbar Jaffry *

University of Portsmouth, Portsmouth Business School, Economics and Finance Subject Group, Richmond Building, Portland Street, Portsmouth PO1 3DE, UK

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ABSTRACT

This study evaluates the impact of privatisation on efficiency and productivity of the Pakistani cement industry. To address some of the serious concerns about the problem of dimension and outlier, we use a newly developed unconditional hyperbolic α-quantile estimator of Wheelock and Wilson to estimate efficiency (Wheelock DC, Wilson PW. Non-parametric, unconditional quantile estimation for efficiency analysis with an application to Federal Reserve check processing operations. Journal of Econometrics; 2008: 209–25). Subsequently, we use these efficiency estimates to calculate the Malmquist productivity growth and its components. The results show that deregulation and privatisation had the desired positive effect on productivity growth due to technological progress. We conclude that this improvement in the post reform period could be linked to political stability, improved economic conditions and a competitive industry.

1. Introduction

The privatisation wave of 1980s has encouraged research on testing the role of agency problems by comparing the performance of firms pre- and post change of ownership. A number of authors found that performance under private ownership was clearly superior. Others, however, suggested that performance was better under public sector management, or at least that public ownership did not impede efficiency. The two contrasting conclusions led to different policy recommendations in regard to the role of the state and management of public enterprises. There appear to be a number of reasons for this inconsistency. These include; the very short time spans and the small sample size used in these studies, lack of comparable firms and use of inappropriate methodologies.

This study evaluates the impact of deregulation and privatisation on the efficiency and productivity of the Pakistani cement industry. To address the issue of comparability of decision making units (firms), we use a firm-level data set comprising different ownership types such as public, private and privatised, the firms all producing a homogeneous product and operating in a relatively competitive environment[1]. The short time-span sample issue is addressed by collecting and using twenty six years of data (1986–2011). Based on available published literature, we argue that our study is the first using two decades of post reform manufacturing firms' data covering four to five business cycles. The results of this study should contribute significantly to the ongoing debate of the effect of reform on efficiency and productivity in developed countries as well as in the developing countries context.

Broadly speaking, studies of the impact of privatisation on the performance of firms have used two methods. First; financial ratios, and secondly; estimation of efficiency and productivity via the production and/or cost function. Studies using the first method include: Megginson et al. [55], Villalonga [88], Harper [44], Boubakri and Cosset [16], Jackson et al. [49], Wei et al. [89], Boubakri et al. [17], D'Souzaa et al. [32], Boubakri et al. [18], Chen et al. [24], Mathur and Banchuenvijit [52], Farinós et al. [41], Naceur et al. [57], Cook and Uchida [28], Huanga and Yao [46], Huang and Wang [47], and Zhang et al. [97][2]. The financial ratios methodology is simple, intuitive and easy to implement but is less preferred amongst some applied researchers. This is due to the non-parametric nature of the technique and being only a partial indicator of performance evaluation.

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* Corresponding author.
  E-mail address: shabbar.jaffry@port.ac.uk (S. Jaffry).

[1] Whilst, there have been allegations of foul play and the formation of cartels since 2000, investigations by the State run competition commission suggest no such arrangements existed between cement producers.

[2] Some commonly used financial ratios include: return on sales/investment, value of real output, investment as a % total assets, cash ratios and dividend payout. These ratios are considered as a good starting point, but are insufficient to paint a complete picture as well as having issues with different accounting standards across the globe which makes international comparison difficult.

The estimation of efficiency or productivity on the other hand, is considered a total indicator of performance evaluation[3]. Empirical research on the measurement of efficiency and productivity of a firm is expanding and increasingly becoming popular with governments, policy makers, management gurus and other key stakeholders. Some of the studies that use estimates of efficiency and/or productivity and compare firms performance in pre- and post-reform regimes include: Saal and Parker [68], Rossi [67], Sall and Parker [69,70], Chirwa [25], Estache et al. [38], Jones and Mygind [50], Resende and Faceanha [64], Cullinane and Song [30], Li and Xu [51], Chirwa [26],Tongzon and Heng [85], Cullinane et al. [31], Brown et al. [21], Okten and Arin [61], Amess and Roberts [5], Sall et al. [71], Al-Obaidan [4] and Asaftei et al. [7]. Despite the fact that the measurement of productivity and efficiency has become common practice, with significant methodological development in the last few years', debate on the appropriate estimator of efficiency and productivity is still inconclusive[4].

Two estimators of efficiency measurement are common vis-à-vis parametric stochastic error term regression models based on Stochastic Frontier Analysis (SFA) and mathematical linear programming based non-parametric estimator such as Data Envelopment Analysis (DEA). Despite its statistical soundness, the SFA estimator is less straightforward when dealing with multiple outputs alongside assuming a priori functional forms (translog being the most flexible and commonly used[5]). In the case of DEA estimator, the common criticisms are first, it could produce unreliable inefficiency estimates due to extreme observations in the data, and second, the estimator suffers from the problem of dimensionality when using a small number of observations and a high number of inputs and outputs, resulting in more sample observations falling on the estimated frontier. In most empirical settings such as ours, the problem of dimensionality is serious issue which increases variance and produces larger confidence intervals. Hence, meaningful estimates would require researchers to use increasing amounts of data as the number of inputs is increased which are a typical feature of banking and manufacturing industries.

Despite criticism, the use of the DEA to estimate efficiency and productivity has been on the rise, and in fact OMEGA's volume 41 was dedicated to the discussion and the use of DEA in various settings. Subsequently, OMEGA alongside the European Journal of Operational Research remained at the forefront of publishing influential studies on the use of the DEA to estimate efficiency. These include Huang et al. [45] studying tourist hotels, Matthews [53] on banking, Hwang et al. [48] on the automobile industry, Rogge et al. [66] on solid waste collection and processing services, Tone and Tsutsui, [84] on US electric utilities, Collier et al. [27] on fisheries, Ray and Ghose [63] on agriculture farms, Doumpos and Cohen [37] on local government, Santos and Amado [72] on judicial systems, and Tüselmann et al. [87] on journal rankings.

Since the mid 1990s, there have been a number of developments in the examination of the properties of DEA estimator; for instance Simar and Wilson [76–83], Daraio and Simar [35], Daouia and Simar [34] and Wheelock and Wilson [89,90]. Wheelock and

Wilson [89,90] developed and used an unconditional α-quantile hyperbolic estimator to estimate efficiency and productivity. They concluded that their unconditional α-quantile hyperbolic estimator is robust, avoids the impact of an outlier, and produces reliable estimates even with fewer observations. Bruffaerts et al. [22] have also confirmed the robustness of the hyperbolic efficiency estimator. We have used this estimator to estimate efficiency and productivity and thus avoid the problem of the dimension and outlier effects typical of this type of study, mentioned above. We also use the other commonly used non-parametric estimators such as DEA, Free Disposal Hull (FDH) and order-m alongside the limitation of each; to facilitate the comparison and to highlight the importance of using an appropriate estimator in estimating efficiency and productivity[6].

We find, on average, that firms in the post reform period have become less efficient in using their key resources (inputs). Most of this decrease in efficiency is occurred during the 1996–2007 period. Efficiency did improve marginally between 2007 and 2011 but not sufficient enough to guarantee an overall improvement in the post reform period. Variations in the efficiency estimates across firms were high before reform was enacted, but relatively low in the post reform period since the late 1990s. The productivity story is equally interesting. Overall, firms experienced a productivity decline in the pre- reform period. This decline was largely due to a technological regress. For the post reform period, we find that firms experienced an improvement in productivity, mainly due to efficiency in the use of technology.

The structure of this paper is such that the next section presents an overview of the Pakistani cement industry as well as a review of the reforms in the early and late 1990s. Section three provides an overview of the empirical literature on the impact of reform on efficiency and productivity. Section four covers the conceptual framework and estimation techniques of efficiency and productivity. Data discussion, estimation results, analysis and conclusions are presented in sections five, six and seven respectively.

2. Developments in the Pakistani cement industry

Cement manufacturing is a well-established industry in Pakistan, accounting for about 5.5% of total industrial production, representing 1.4% of GDP and contributing 30 billion Pakistani Rupees annually to the National Exchequer. Cement manufacturing began in 1921 when Pakistan's first plant was set up with a capacity of 44,500 t per year (tpy). The industry grew steadily until independence in 1947. At this time, two companies with a total of four plants (all in the private sector) were in operation with a total capacity of 480,000 tpy. During the 1950s and 1960s, six more plants were set up, four in the private sector and two in the public sector by the Pakistan Industrial Development Corporation (PIDC). The industry maintained a growth rate of 9.7% per annum during the 1960s. By the end of 1971, the production capacity of cement had increased to 3.45 million tpy, with 58% in the public sector and 42% in the private sector, respectively. A socialist-leaning government nationalised the cement industry in January 1972 and all the cement plants were placed under the Board of Industrial Management (BOIM) and subsequently state run State Cement Corporation of Pakistan (SCCP).

The first clear indication of the reversal of the nationalisation policy came with the introduction of Martial Order in 1978 leading to the handing over of three cement manufacturing units to their

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[3] Composite measure of performance is generally calculated by estimating relationship between input quantities, expenditures, prices and outputs.

[4] See Wheelock and Wilson [88,89] on the shortcoming of different non-parametric estimators.

[5] Authors such as McAllister and McManus, [56]; and Wheelock and Wilson, [90] noted that the translog technology is likely to mis-specify the banks cost relationship. Incorrect specification of the model nonetheless is more of a common feature in most of the empirical studies and thus would lead to less satisfactory root-n consistency.

[6] See Section 3 for survey of literature and contrasting conclusions drawn from different estimators of efficiency.