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TWO DECADES AFTER PRIVATIZATION: AN EVALUATION OF EFFICIENCY AND THE QUALITATIVE CHANGES OF PAKISTANI CEMENT INDUSTRY

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Abstract: *This study evaluates the long run impact of the combination of broader reforms before and after a change of ownerships on the operational performance of Pakistani cement industry. The empirical estimates of cost efficiency reveal that firms have been successful in their cost minimization efforts over longer time periods, as a result of qualitative and quantitative adjustments in firms' operational practices and market conditions. However, catching of best practice firm(s) in output maximization subject to given input use measured by the technical efficiency of the industry has not been achieved in the long run. Further,the study investigatesfirms' behavioral preference in cost minimization and conclude that this choice,alongside reforms, could be partially explained by the combination of operational changes, such as effective human resource management and modernization of production process resulting in higher operational days and better capacity utilization.*

JEL classification*: D24, L25, L33, L61*

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1. INTRODUCTION

An intuitive notion of efficiency refers to the achievement of maximum output from a given set of resources; the greater the output relative to input, the higher is the level of efficiency. Because an increase represents a kind of "manna from heaven", it is no surprise that the study of efficiency measurement has received huge attention in the last three decades, resulting in some significant methodological developments.Two methods are used in general to estimate a firm's efficiency. These include Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA). Both methods have merits and demerits. SFA provides the opportunity to perform statistical inferences but imposes strict priori assumptions on the distribution of residuals as well production/ cost function composition (such as Cobb-Douglas/translog or any other function). More specifically, SFA allows controlling for random unobserved heterogeneity among the firms. The inefficiency effect can be separated from statistical noise in this case. DEA avoids prior

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restrictions and is more flexible and is based on enveloping ofdata but with limited options to perform inferences. In particular, with DEA, any deviation of an observation from the frontier must be attributed to inefficiency, which makes the results very sensitive to outliers or measurement error.

The estimation of efficiency has been one of the popular tools used by researchers to evaluate the impact of broader reforms in manufacturing and financial sectors in a significant number of empirical studies. The numbers of these studies are on the rise since1980s when privatization and other broader reforms were introduced in the UK as well as in a number of other countries. The estimation of efficiency has also been complemented by a number of other indicators such as financial returns analysis, employment level analysis and productivity growth in pre and post reforms/privatization time periods. The increase in these studies has been in fact in response to a demand by policy makers, researchers, industry experts, newspapers and other stakeholders. Governments in different countries have also used the empirical efficiency estimates either to formulate more aggressive privatization and reforms program, or to curtail further demand for reforms.

Starting from themid-1990s, and similar to other countries, thePakistani government introduced a number of reforms in the industrial sector. These include price decontrol, selling off a certain percentage of shares of some publically owned firms through national stock exchange, recapitalization, and anoperational autonomy and so on. The main objective of these reforms was to put a lid on continual losses of these publically owned firms by making them operationally more efficient,and to help them survive after these firms became technically insolvent due to years of accumulated losses. These cosmetic changes were not sufficient and a more aggressive reforms agenda was introduced in the 1990s, which included selling of state-owned firms to private businesses and transfer of ownership and management. The aggressive privatization program since then has resulted in an almost complete transfer of ownership in a number of manufacturing industries such as cement, automobile, ceramics, cooking oil, and engineering, alongside significant progress in terms of full or partial sale of banks, telecommunication companies and other utility companies.

Interestingly, with the exception of few solid empirical studies, research on the impact of Pakistani privatization program on the industry in general and manufacturing sector in particular has not been forthcoming. With the exception of a few studies, a number of published studies that exist in the public domain lack rigor in terms of chosen methodology or coverage of the time period. This study fills this gap in this regard. The objective of this paper is to explore the evidence ofwhether privatization and other broader reforms in the early 1990s,especially in Pakistan,haveled to an improved efficiency of the cement industry. The secondary objective of the paper is to test the relative productive and cost efficiency of publically and privately owned firms compared to privatized firms. The motivation behind choosingthe cement industry as a case study is based on a number of factors such as data availability, as well as the significance of this industry in terms of economic growth, employment generation and contributions to national exchequer.

We use SFA as well as DEA methods to utilize the best feature of each one and estimate production and cost efficiency for the each cement producer firm during the period 1986 to

2011. The main reason of estimating both production and cost efficiency is to address the issue of often confused objective functions of the manager under public ownership. For example, does the manager maximize output or minimize cost? In estimating cost efficiency, we assume that producers are trying to minimize cost subject to output quantity and input prices. No such prior assumption is required in technical productive efficiency estimation where inputs are treated as exogenous. More specifically, technical productive efficiency part analyzes the producer efforts in maximizing revenues (output) whereas; cost efficiency analysis part evaluates producer efforts in minimizing cost of production or selecting cheaper combination of inputs. Cost efficiency measurement is necessary if the underlying behavioral objective of a firm is cost minimization rather than output maximization. Our sample of firms is comprised of those who were operating under public ownership and then had a change of ownership to become privatized (with private ownership) and those who were set-up under private ownership and remained private throughout the sample period. The combination of public/privatized/private compelled us to estimate both productive as well as cost efficiency.

Our study in fact supplements Ghulam and Jaffry (2015)'s study by not only calculating both technical and cost efficiencies, but also relates firms efficiency to a number of qualitative and quantitate changes as well as a due consideration to controlling for political and economic environment of the country during the sample period of the study. Our study period is long compared to many international studies in this area and thechosen methodology is comparatively advanced and robust. We believe that the findings of this study will be very helpful for policy makers, academics, industrialists and more importantly in contributing towards the debate of the impact of privatization and other broader reforms on the operational efficiency of the industry.

It is concluded that,on average, industry operated at 75% technical productive efficiency levels during the entire sample period and broadly speaking, all ownerships firms operated similarly. Contrary to expectation, the industry operated with 10-12% less efficiency after broader reforms including privatization. Our regression results after controlling firms, industry and economy specific variables confirmed that post reforms, technical efficiency did not improve. Interestingly, the decline in efficiency appeared to a whole industry feature. Our sensitivity analysis based on a non-parametric estimator broadly confirmed this. The empirical estimates for cost efficiency are however different compared to productive technical efficiency. We conclude that cost inefficiency in fact declined subsequent to broader reforms including privatization. Interestingly, a descriptive analysis of efficiency estimates reveal that smaller size firms were more cost efficient compared to medium or larger size firms, but regression results do not support this finding.The qualitative analysis of working patterns and adjustments made as a result of reforms and privatization show that firms achieved cost advantage due to a number of factors, such as adopting a modernization of production process, better human resource management, reducing the impact of labor union pressure, performing regular repairs and maintenance due to availability of higher working capital and purchasing of input at competitive prices. The findings of this study shall contribute significantly in the debate on the long run impact of privatization on firm's operational performance.

The rest of the paperis comprised ofseveral sections. *First*, we present a review of some of the literature on reforms and productive performance. *Second*, we measuretechnical and cost efficiency and interpret these estimates in the context of ownership, size and regional differentials. *Third*, we relate theefficiency estimates to quantitative and qualitative changes in the industry subsequent to broader reforms, including privatization to better understand the factors contributing towards better/worse performance post reforms/privatization. The last section summarizes the empirical findings in the form of conclusions.

2. REVIEW OF LITERATURE

Since the turn of the century, significant effort has been made to evaluate the performance of firms in pre- and post-privatization periods by using advanced parametric methods such as the stochastic production, cost function estimations, the subsequent derivation of production/cost efficiencies and productivity estimates. In contrast some authors have used non-parametric methods such as data envelopment analysis (DEA) to address the issues concerning parametric methods. In the following we present some broad conclusions from a selection of studies in chronological order that had addressed the issue of efficiency and productivity estimation under public and private ownerships.

Saal and Parker (2000) estimated multiple output cost functions for the period 1985-99 using the UK water and sewerage firm data. The study suggested that economic efficiency improved post privatization. They found that overall, better regulation promoted economic efficiency rather than privatization itself. Rossi (2001) estimated the post privatization performance of 8 Argentinean gas distribution companies. This paper uses the stochastic frontier method to estimate the efficiency in distribution of gas over 5 years. The study concluded that, as a consequence of a shift in the technological frontier and catching up, efficiency improved in the post privatization period for all firms in the sample. Subsequently,Sall and Parker (2001) estimated productivity growth using quality adjusted output indices for the period 1985-99 utilizing UK water and sewerage firm data. The study was unable to demonstrate any productivity improvement in the post privatization period, despite significant reductions in labor usageand growth in output prices. Chirwa (2001) used the DEA inter-temporal frontier to investigate Malawian firms for the period 1970-97. This paper uses sample of 6 firms, 3 each from the privatized and private categories of firms. The study found improved technical efficiency of privatized, state-owned and private ownership companies. The authors suggested that improvement to the competitive process is more effective than privatization in increasing technical efficiency.

Saygili and Taymaz (2001) used the stochastic production frontier to evaluate firms in the Turkish cement industry. Their study covered the period 1980-95, encompassing nine years of the pre privatization period. Their sample of firms included public, private and privatized and mixed ownership categories. The study found that privatization and change of ownership had no effect on technical efficiency. Estache *et al* (2002) estimated the total factor productivity of Argentinean and Brazilian railway companies for the period 1994-99. The authors calculated productivity of the operations before and after privatization. It concluded that improvements in productivity after privatization. Particularly the growth of TFP was primarily due to an

improvement in output rather than a reduction in input usage. Jones and Mygind (2002) evaluated the effect of privatization in Estonia. Using a large random sample of 666 Estonian firms for the period 1993-97, the authors estimated the fixed effect production function. Based on a number of different specifications, this study documented a positive effect of the change of ownership. Private firms were more efficient and productive compared to state-owned firms. The study also separated firms based on ownership type and concluded that employee owned and managed firms are more productive. Resende and Faceanha (2002) examined the efficiency of Brazilian telecommunication companies' using the DEA frontier. The study period covered only two data points July 1998 and December 1999. This study documented evidence of decreasing returns to scale and no improvement in efficiency in the post privatization period.

Cullinane and Song (2003) estimated a cross sectional production function frontier under different distribution assumptions, with a panel data structure, using the Korean container terminal industry for the period 1978-96. The study concluded that privatization improved container productive efficiency. The involvement of the private sector had a positive effect on efficiency. Li and Xu (2004) looked at the privatization and competition effects on the telecommunications sector internationally for the period 1990 to 2001. The study concluded that privatization and the effectiveness of competition had a positive effect on labor and total factor productivity. This study also explored the different effects of partial and full privatization on pricing and productivity and concluded that full privatization was significant in raising productivity levels. These conclusions were robust with alternative model specifications. Chirwa (2004) estimated the stochastic production frontier using Malawian public, private and privatized firms during the period 1970-97. This study reported high mean technical efficiency in privatized, competing state owned and private companies. It was found that international competition and the structural adjustment process was more valuable than privatization in increasing the technical efficiency.

Bartel and Harrison (2005) looked at Indonesian manufacturing companies during the period 1981–1995, including private and public companies. The authors aimed to determine whether reforms could replace full divestiture of public enterprises, and whether due to the presence of the agency problem, public sector manufacturing firms were less efficient. If in both ownership categories,firms were inefficient or efficient at a particular time, then the environment in which public firms operate could be a significant determinant of productivity and efficiency. The study concluded that public sector enterprises (PSEs) performed worse than their private-sector counterparts. PSEs receiving government subsidy or shielded from import competition or foreign ownership performed worse thantheir private sector counterparts. Tongzon and Heng (2005) using a stochastic frontier model looked at efficiency of25 container terminals.The study results suggested that private participation improved port operation efficiency and competitiveness. This study also accepted the premise that efficiency promotes competitiveness. Cullinane et al (2006) using DEA efficiency scores of the worlds' leading container ports examined the effect of private participation on the efficiency of port operations for the period 1992-99. This study rejected the proposition that greater private sector involvement in the container port sector irrevocably leads to improved efficiency.

Brown *et al.* (2006) carried out a study to determine the effect of privatization on the multifactor productivity of manufacturing firms in Romania, Hungry, Ukraine and Russia. The authors estimated the long-term effect of privatization by first introducing measures to control for the selection effect of privatization. This study found an immediate and long term positive impact of privatization on productivity in three countries (Romania, Hungary, and Ukraine), but a negative effect in Russia. Okten and Arin (2006) evaluated the productive and allocative efficiency of 22 Turkish privatized cement companies for the period 1983-99. It was found that ownership change affects labor productivity. However, allocative efficiency is dependent on changes in the competitive environment. All plants improved their labor productivity by reducing their work force. Whereas plants sold to overseas buyers also increase their capital and investment significantly.

Amess and Roberts (2007) evaluated the effectiveness of privatization on 2164 Polish producer cooperatives.They used the parametric approach to estimate total factor productivity change. Their sample comprisedof private and public enterprises over a 6 yeartime period. They concluded that firms improved their productivity in the first three years after privatization by a range of 3-20%. The figures were 9-36% for labor productivity and -16 to 6% for capital productivity. They concluded that competition had forced firms to restructure and operate more efficiently.Sall et al (2007) studied the effect of privatization on the privatized English and Welsh water and sewerage industry. This study used parametric stochastic frontier techniques to estimate total factor productivity, alongside its components (technological change, efficiency change and scale change) for the period 1985-2000. The study period covers four years of the pre privatization period and fourteen years post privatization. This study did not find any improvement in productivity due to an efficiency decline, but showed technical progress after privatization. The authors suggested that an expansion of scale and a loss inefficiencymight have contributed toward the decline in productivity. Asafteiet *al* (2008) looked at the effect of ownership change and business conditions on the productivity of Romanian manufacturing firms during 1995-2003. The study concluded that ownership change is not sufficient to guarantee better performance in terms of a productivity improvement. They found that competition plays a more crucial role in forcing firms to become efficient in running their business. Fully private firms did well in a highly competitive sector, but this cannot be said for the less competitive sector. Privatized firms did not perform any better than public enterprise. The study identified the role of institutional restructuring alongside privatization to boost productivity.

For the Pakistani privatization program, there is a serious dearth in the literature, and there are very few studies. Notable among these there is the study by Naqvi and Kemal (1997), which concluded that the effects of privatization on efficiency, output and the price level has so for been uncertain, and there is enough evidence to suggest that this policy may have lowered the economy's employment prospects, worsened the conditions of workers and has led to greater concentration of income and wealth". Aftab and Khan (1996) compared the pre- and post-privatization experience of five firms in three industry sectors, where employees themselves and private firms purchased the units. The study found that private sector firms are more successful than employee-led firms, and in general private ownership result in less labor

retrenchment. Ghulam and Jaffry (2015) have recently evaluated the productivity of the cement industry using advanced non-parametric methods, and concluded that reforms and privatization have helped the industry in achieving higher productivity growths compared to the pre reforms periods.

It could be concluded from reviewing the above mentioned studies that although there exists a substantial body of literature on public-private efficiency comparison and the effect of privatization, it lacks consistency in conclusions. Many influential studies such as Saal and Parker (2000), Rossi (2001), Chirwa (2001), Estache *et al* (2002), Jones and Mygind (2002), Cullinane and Song (2003), Li and Xu (2004), Chirwa (2004), Bartel and Harrison (2005), Tongzon and Heng (2005), Brown *et al.* (2006), Okten and Arin (2006) and Amess and Roberts (2007) suggested an improvement in efficiency/productivity. Whereas some authors i.e.Sall and Parker (2001), Saygili and Taymaz (2001), Resende and Faceanha (2002), Cullinane *et al.* (2006), Sall *et al.* (2007) and Asaftei et al (2008) suggested that change of ownership subsequent to privatization had no effect on the performance of the firms.

The contribution of this study to the debate is that first, we cover atleast five business cycles (26 years) of the Pakistani cement industry which has evolved over time and has become significant in term of a major export earner (Pakistan being the world's fifth largest cement exporter), and a significant contributor to the national exchequer (30 billion Rupees in tax). Second, studies that have addressed the issue of privatization/deregulation and firms performance since 2000 are limited to either developed countries or countries at the advanced stage of their economic development witha relatively stable political system, established property rights and an established industrial base. Whereas Pakistan being underdeveloped, having extremely low per capita income and a tax base facing consistent political instability (5 changes of government since the first phase of the privatization program) provides compelling and interestingly differentcase study when it comes to the analysis of the effects of change of ownership and other broader reforms on firms efficiency.

The contribution by the study of Ghulam and Jaffry (2015) is valuable but their findings could be less robust and subject to criticism due to heavy dependence on non-parametric data envelopment method. Whereas, to evaluate the impact of reforms on the efficiency of the industry, we use both (parametric and non-parametric)methods. Further, our non-parametric method addresses the common issues such as the effect of the influential observations on the construction of production frontiers. These methodological details are discussed in detail in our methodology section. But first, in the following, we discuss thePakistani cement industry background, institutional setup and reforms, sales and marketing arrangement, pricing and production technology.

3. INSTITUTIONAL AND REGULATORY REFORMS IN CEMENT INDUSTRY IN PAKISTAN

3.1. Firms Entry and Exit Reforms

Cement manufacturing is a well-established industry in Pakistan, accounting for about 5.5% of total industrial production, representing 1.4% of GDP of the country and contributing 30 billion

Rupees annually to the national exchequer. Cement manufacturing began in 1921 when Pakistan's first plant was installed with a capacity of 44,500 ton per year (tpy) and the industry grew steadily until independence, in 1947. At that time, two companies controlling four individual plants (all in the private sector) were in operation with combined capacity of 480,000 tpy. During the 1950's and 1960's, 6 more plants were established, 4 in the private sector and 2 (Zealpak and Maple Leaf) in the public sector by Pakistan Industrial Development Corporation (PIDC). The industry maintained a capacity growth rate of 9.7% per annum. By the end of 1971 overall cement production capacity had increased to 3.45 million tpy, with 58% in the public sector and 42% in the private sector.

In January 1972, the entire cement industry was nationalized and all plants were placed under the stewardship of the Board of Industrial Management (BOIM). The nationalization was formalized in 1973, when the State Cement Corporation of Pakistan Ltd. (SCCP) was constituted as a holding company under the control of the Ministry of Production (MOP). All major private shareholdings in cement companies were acquired by the Government of Pakistan (GOP). At the time of the formation of the SCCP, the company consisted of 9 Portland cement and one white cement plants, with overall production capacity of 3.42 million tons per year (tpy). These plants had been exporting a substantial amount of cement to Bangladesh, which ceased after mid-1971. Other markets were found after 1973 and exports reached a peak of 0.496 million tons in the financial year 1974-75. By 1975-76, substantial remittances of foreign exchange by Pakistani working in the Middle East resulted in an increase in the demand for cement. In 1976-77, the country had become a net importer and cement was being sold on the black market.

In an attempt to meet the demand, the SCCP plants were run at near capacity. Capacity utilization of the plants increased from 82.0% in the financial year 1972-73 to 96.4% in 1979-80. Total production capacity of SCCP increased to 4.125 million tons per year by 1981-82. However, capacity utilization decreased to 88.7% by 1981-82 as against a figure of 96.8% in 1980-81. In response to continuing shortages, the GOP lifted the ban on private investment in cement in 1978, announced an incentive package for private investors consisting of a guaranteed rate of return of 15-20%, a reduction in import duties on equipment and corporation tax exemptions depending on the location of the plant. Subsequently, SCCP increased capacity by 2.1 million tpy, through six projects comprising two expansions of existing plants and four new green-field plants. Whilst at the same time some two dozen private investors received approval to invest in the industry. By the beginning of 1987, four private plants, comprising about one quarter of sub-sector capacity, had commenced operation.

At the beginning of the financial year 1986-87, the Pakistan cement industry consisted of 17 operating plants, with a total nominal installed capacity of 7.7 million tpy. Thirteen of the plants, comprising about 6.0 million tpy (78% of total capacity) belong to SCCP[1] and 4 private plants[2] with installed capacity of 1.63 million tons. At the end of 1996, the total number of cement companies increased to 23, with 6 new private sector firms entering the market during the period 1988-96. Since then, some other new firms have entered the market and a number of older firms had been acquired by competitors. The Government of Pakistan successfully implemented a privatization policy and by 2003, all public sector companies were privatized.

In order to enhance their production capacity, a majority of existing units have expanded their production capacity. After the commissioning of new units, and mergers, the number of cement manufacturing plants in the country in 2011 was 21, and the production capacity had increased to 45 million ton per year (tpy). Of those new units, some are located in the Punjab and rest in the Khyber Pakhtunkhwa (KPK) province. Two of the new units in Punjab had production capacity of 0.990 million tons each, while, Pioneer Cement and Lilla Cement had annual of 0.660 and 1.5 million tons respectively.

3.2. Pricing Policy and Reforms in the Distribution Channels

Prior to 1985, SCCP established the price of cement for each plant, including the wholesale and retail prices. This was done through a system of average cost pricing, coupled with cross-subsidization schemes at plant and regional market levels. A "retention" price (SCCP wholesale price less taxes and duties) was established for SCCP cement as a whole, on the basis of average production costs, including an overall rate of return on fixed assets of approximately 15%. At the plant level, the price paid to each plant was the retention price plus a development subsidy in the case of high-cost producers, or a negative subsidy in the case of low-cost producers. It assured each factory, more or less a 15% rate of return on equity. Retail prices in each locality were arrived at by adding to the wholesale price an allowance for transport costs (to avoid disparities in cement prices in different areas). SCCP established the dealer margin for major consumption areas whereas elsewhere, government administrators such as Deputy District Commissioners (DC) set the margins.

In June 1985, the government of Pakistan abandoned the long-standing cement price controls and freight equalization. Subsequently, SCCP introduced a number of changes in its pricing procedures. First, the freight equalization scheme was abolished and dealers were responsible for making their own transport arrangements. There were no basic changes in the system of cross-subsidization of production at the plant level, but SCCP plant managers were allowed to vary the ex-plant price. Only two plants took advantage of this more flexible pricing policy, one southern plant selling below SCCP's standard ex-factory price and a northern plant selling above it. Plant managers however, were expected to become increasingly responsive as competitive pressure from the private sector increased. After the privatization of public sector plants, SCCP lost its control over the cement sector and the All Pakistan Cement Manufacturer Association (APCMA) now represents more than 80% of cement manufacturers and sets an agreed consensus price for all its members.

3.3. Privatization Programme

The first clear indication of the reversal of the nationalization policy came with the introduction of a Martial Law Order in 1978 and lead to the handing over of three industrial units to their former owners. Another Martial Law Order similar to the previous one was promulgated in 1979 to protect against any further nationalization. The Pakistan People Party (PPP) who came to power in 1988 was no longer committed to state enterprise as an engine of growth, but no serious attempt was made during the PPP regime (1988-90) to transfer the ownership of public sector companies to the private sector. In 1990, the Muslim League government headed by an

industrialist who was committed to a free market economy came to power. At the same time, a surging budget deficit and pressure from donor agencies provided the impetus for wide spread privatization of state industrial units. Raising revenues through the sale of state-owned enterprise was an easy option available to the government in order to cope with the mounting budget deficit.

The Nawaz Shariff government sold off 66 industrial units and commercial banks to the private sector in the financial year 1991-92. The Benazir Bhutto government subsequently privatized more industrial units. The government however was unsuccessful in selling public utilities in infrastructure (Pakistan Telecommunication Company Limited (PTCL), Water and Power Development Authority (WAPDA), Karachi Electric Supply Corporation (KESC)) as well as the larger nationalized commercial banks and development financial institutions (DFI's). The major achievements of the Bhutto government remained limited to privatization of a power sector unit and a 13.2% equity stake of PTCL. The Military government led by General Musharraf sold off the remaining two government owned cement industrial units in 1999 and 2003. The privatization program was controversial partially due to the mixed financial performance of privatized industrial units. Nonetheless, successive governments tried to sell bigger companies such as the national rail network and airline without success and are likely to make further attempts in the future.

Privatization of cement industry started in1984, when the first attempt was made by SCCP to sell part of its shareholdings in Zeal Pak and Gharibwal Cement through the enterprise mutual fund of the Investment Corporation of Pakistan (ICP). Shares worth Rs.30 million were sold by SCCP to the ICP at the market price, which subsequently sold them on without any difficulty as part of a mutual fund to the public. In 1992, cement companies like Dandot Cement, D.G.Khan Cement, Kohat Cement, Mapple Leaf Cement, Gharibwal Cement, White Cement and Zealpak Cement were privatized. Out of 8 units privatized in the financial year 1991-92, 6 were sold to establish industrial groups, with experience of managing industrial units in Pakistan[3] and remaining 2 units were sold to group comprising of employees and management.

At the time of privatization of these units, total numbers of employees working in different fields in these units was 5520. The Government on the eve of privatization, implemented a golden handshake scheme for workers. The response by workers was encouraging with some 20-30% of workers opting for the scheme. The Government restricted payment at the time of transfer of ownership to of 40% of bid value. The amount of money received at the time of transfer was 2297.19 million, with a further 2860 million received later. The privatization of Thatta Cement and Mustehkam Cement was also completed at that time although payment was delayed, and finalized later following legal action. The privatization of Associated Cement, Rohri and Wah and General Refractors were completed in 1996 and Javadan Cement in 2003.

3.4. Market Structure Reforms

The market for cement in Pakistan has been relatively unsophisticated and narrowly focused in the past, with little effort made to promote demand for cement, other than Ordinary Portland Cement (OPC)[4]. Before 1981 when the private sector was first allowed to import and market cement, the government through the SCCP, controlled all sales and distribution of cement in

Pakistan. SCCP determined regional quotas, arranged for transportation of cement and established allocations for public sector agencies. The cement market in Pakistan has undergone both quantitative as well as qualitative change after the liberalization and privatization process of 1992. The market is, no longer a "sellers' market" and prices have responded to market forces following a series of events such as the commissioning of several private cement plants, the government's decision to abandon cost-plus pricing, and control of market prices with the elimination of the freight subsidy and the general competitive market environment following deregulation and privatization.

The cement market in Pakistan is divided into two geographical zones i.e. north and south. The former covers KPK, Azad Jammu and Kashmir and part of Punjab (North of Rahim Yar Khan district), whereas the latter covers Sindh, Balochistan and the rest of the Punjab. The north zone is served by a total of nineteen companies, while, the south is served by a total of five companies. At present, out of the total production capacity of clinker about 83% is in the north and the balance 17% in the south. The higher ratio of capacity located in the north region is mainly due to the availability of raw material and the proximity to two large export markets (India and Afghanistan).

5. METHODOLOGY

The study aims to evaluate the changes in firms' operational changes as a result of broader reforms including privatization. These operational changes could include new practices and process, management of cash and working capital, response to economic and industry environment including competition alongside alteration and utilization of inputs to their full potential. Hence, for such comprehensive analysis, we divide our analysis into two parts. Thefirst part comprises of a quantitative analysis of firm efforts in utilization of inputs to maximize output and allocation of inputs by considering their prices. For this, first, we estimate productive efficiency using parametric stochastic frontier production function framework. By utilizing parametric production function estimates, we also estimate and discuss elasticities of inputs and returns to scale. Since, stochastic parametric production method is subject to serious debate due toprior assumptions imposed on the distribution of inefficiency; hence subsequently, we also estimated production technical efficiencies by using the Data Envelopment Analysis (DEA) techniques and compared the efficiencies across these two methods.

Second, we estimate parametric cost function and derive cost inefficiencies by assuming that both technical and allocative efficiencies are present during pre-reforms years and reforms are aimed to reduce these inefficiencies. The second part deals with qualitative and quantitative changes introduced by the industry generally privatized firms in particular and their impact on firm's performance by controlling for political and macroeconomic environment. In the following, we present and discuss our production and cost frontiers methodology in greater detail.

4.1. Production technical efficiency estimation

To measureproductive technical efficiency, we use the parametric stochastic frontier production function model for unbalanced panel data proposed by Battese and Coelli (1992).This model could be expressed as:

$$Y_{it} = X_{it}\,\beta + (V_{it} - U_{it}),$$
$$i = 1, 2, 3, \ldots\ldots, N \quad t = 1, 2, 3, \ldots., T \tag{1}$$

Where, Y_{it} is the value of output of the i[th] firm in the t[th] period; X_{it} is a k×1 vector of (transformation of the) inputs quantities (values) of the i[th] firm in the t[th]time period; β is a vector of unknown parameters; V_{it} is a random variable which is assumed to be iid. $N(0, \sigma^2_v)$, and independent of the error term U_{it} which is anon-negative random variable assuming to account for technical inefficiency in production and is assumed to be iid. $|N(0, \sigma^2_u)|$ distributed.Two specific forms of the production frontier function are commonly used in applied researchof production function estimation. These are the Cobb-Douglas type and the more flexible form of translog production function. These two types of production function are also used in our study.

The stochastic Cobb-Douglas for the cement industry may be defined as:

$$ln\ Y_{it} = \beta_0 + \beta\ ln\ X_{it} + \tau\ T + e_{it} \tag{2}$$

Where $ln\ Y_{it}$ represents the log of the real value of production (in millions of rupees) of the i[th]firm in the t[th]period; and $ln\ X_{it}$ represents the vector of inputs (in logs). We use labour (L), fixed capital (K); real fuel and energy expenditures (F) and real expenditures on raw material (M). The inclusion of a time trend as an independent variable is to separate time invariant efficiency.Labor and fixed assets (capital) are two very important factors of production used in almost all studies conducted on efficiency and productivity estimation. Our labor variable is the actual number of workers. It includes all workers including those engaged in both production and non-production activities. This is because we were unable to obtain reliable detailed numbers for each category.

Fixed capital is a proxy of capital stock. The use of this proxy is common in empirical literature and we use this measure in our study as well. The inclusion of fuel and raw material (called the intermediate inputs) is extremely important given the fact that fuel represents almost 60% of the total cost of cement production. Exclusion of these costs would compromise the approximation of total cost estimation. Because of the fact that we were not able to obtain data on the physical quantities of these inputs, we use expenditures on these inputs.

The Cobb-Douglas production function is based on the assumption of constant return to scale. A more flexible form of production function that is the translog production function of above equation 2 can be defined as:

$$\begin{aligned} ln\,Y_{it} = {} & \beta_0 + \beta_l\, lnL_{it} + \beta_f lnF_{it} + \beta_k lnK_{it} + \beta_m lnM_{it} + \tau_t\, T + \beta_{ll} lnL^2{}_{it} \\ & + \beta_{ff} lnF^2{}_{it} + \beta_{kk} lnK^2{}_{it} + \beta_{mm} lnM^2{}_{it} + \tau_{tt} T^2 + \beta_{lf}\, lnL_{it}\, lnF_{it} \\ & + \beta_{lk}\, lnL_{it}\, lnK_{it} + + \beta_{lm}\, lnL_{it}\, lnM_{it} + \beta_{lt}\, lnL_{it}\, T + \beta_{fk}\, lnF_{it}\, lnK_{it} \\ & + \beta_{fm}\, lnF_{it}\, lnM_{it} + \beta_{ft}\, lnF_{it}\, T + \beta_{km}\, lnK_{it}\, lnM_{it} + \beta_{ft}\, lnK_{it}\, T \\ & + \beta_{ft}\, lnM_{it}\, T + \varepsilon_{it} \end{aligned} \tag{3}$$

4.2. Sensitivity analysis of productive technical efficiency - non-parametric order-m efficiency estimation

The technical efficiency estimates derived from the above translog production function with strong assumptions about the technology of production and a-priori functional form could be subject to discussion and issues. One of the serious criticisms of the parametric approaches of efficiency and productivity estimation methods is that these techniques are based on some rigid assumptions. Violations of these assumptions can lead to unreliable and less efficient estimates, and consequently conclusions. Recently, a substantial body of literature has appeared using alternative methods which are not based on aprior assumption. These techniques are data driven and are based on the belief that the "data speaks itself".

One such technique that had been utilized successfully is DEA. DEA technique involves the analysis of the rate at which firms convert a given quantity of inputs into a quantity of outputs. From this analysis, it is possible to estimate the most efficient feasible output/input combinations so as to construct an efficiency frontier. A comparison can then be made between each individual firm's input and output quantities and the efficiency frontier, so as to generate an (in) efficiency rating specific to each particular firm in the sample across time periods. The farther the distance from the frontier (e.g. less output produced by each firm, for a given the level of input), the less efficient the firm. Tracing the distance from the frontier reveals the amount by which each firm could maximize outputs subject to given inputs.

As we do not have complete information, but rely upon a finite data sample for the estimation of the frontier, it is likely that the estimated efficiency frontier will not be representative of the true frontier, but might however be a very close approximation. Taking this into account, we construct a measure of efficiency in the same way as Wheelock and Wilson (2004). We divide the quantity of output produced by each firm by a given level of input and compare this firm with a firm operating on the efficiency frontier producing maximum output by using least inputs. Intuitively, this measure will be equal to 1 if the firm is itself on the frontier. The more output produced by the firm relative to the frontier, the higher this measure will be.

The estimated frontier is subject to the same standard assumptions outlined in Wheelock and Wilson (2004), namely that the frontier itself is smooth, convex and closed, that production requires the use of some positive quantity of disposable inputs in order to produce a disposable output, that the observations used in the calculation of relative efficiency levels are representative of a probability density function (which is strictly positive at all points) with bounded support over the production set, and that the density is continuous as you move toward the interior from any point along the frontier.

We employ an expected maximum output frontier (order-m) as proposed by Cazals et al (2002). This methodology has certain benefits over the use of simple DEA alone – for example, a reduced dependence on individual observations (lessening the impact of extreme observations on the nature of the frontier) as well as the relaxation of the assumption that the efficiency frontier is convex. More importantly, the inclusion of a noise effect is possible under this methodology. This noise effect has an expected value of zero, and allows us to differentiate between genuine and persistent inefficient operation and random shocks that are not indicative

of a long term problem with each respective firm, but could otherwise cause an inefficient estimation of the efficiency frontier.

The order refers to the method by which this measure of efficiency is calculated. Effectively, this refers to the k drawings of (m) firms from a pool of those producing the same level of output. The firm among this sample of (m) which produces maximum output by using lowest quantity of inputs is used in the computation of a mean from the (k) repetitions of the drawing of the (m) firms. The estimated efficiency frontier is then composed from the series of mean values generated from different input output levels. It is expected that the estimated frontier will be below the true frontier due to the finite sample used to compute the mean values for each output level. Relative inefficiencies for each firm can then be calculated by observing the distance of the firm's input/output combination from the order-m frontier.

In order to calculate this empirically, output quantity is divided by the input quantity that would be required if operating on the estimated order-m efficiency frontier. From this ratio, we can calculate the amount of extra output this firm could have achieved if operating at or near the frontier. Empirically, this ratio of output to input should be <1. Any firm achieving maximum output and operating near to full potential is likely to achieve score near to 1. We estimate the output distance function for each year for the population of our cement firms. Because of the fact that we estimated efficiency by using each specific year output/input ratio rather than pooling the data hence in effect we estimated the frontier for each year.

4.3. Cost efficiency estimation

Although the stochastic production frontier is a useful construct, there are some serious limitations in the information it contains. A firm could be inefficient in many ways; only one of which can be detected by an estimated production frontier of above equations 1-3. It can be technically inefficient in the sense that it fails to produce maximum output from given inputs. It can also be inefficient in the sense that marginal revenue product might not be equal to the marginal cost of that input, generally called allocative inefficiency. It occurs as a result of using inputs in the wrong proportions, given inputs prices. Since estimation of the production frontier is carried out with observations of output and inputs only, such an exercise cannot provide evidence on the matter of allocative inefficiency, and hence cannot be used to draw inferences about total economic efficiency.

One of the main objectives of privatization and broader reforms was to encourage (force) managers of former public sector firms to not only operate near or at the productive efficiency frontier by attaining maximum output given inputs usage but also to allocate resources in best proportions given output/inputs prices. In the presence of allocative inefficiency assumption, we could specify and estimate a stochastic cost frontier and could interpret the fall in the estimated cost inefficiency as an evidence of firms allocating inputs more wisely over time if technical efficiency has fallen during that time period.

By using duality theorem of the cost function and following Schmidt and Lovell (1979) and Coelli (1996) with allocative inefficiency present, the stochastic cost function frontier analogues of the above stochastic production frontiercould be specified as:

$$C_{it} = X_{it}\,\beta + (V_{it} + U_{it}),$$
$$i = 1, 2, 3, \ldots., N \quad t = 1, 2, 3, \ldots., T \tag{4}$$

Where C_{it} is the cost of production of the i[th]firm in the t[th] period; X_{it} is a k×1 vector of (transformation of the) input prices and output; β is a vector of unknown parameters; V_{it} are random variables, which are assumed to be iid. $N(0, \sigma^2_v)$, and independent of U_{it} which are non-negative random variables and assumed to account for cost of inefficiency (technical and allocative) of production process and distributed as $N(0, \sigma^2_u)$. U_{it} in fact shows how the firm is operating above the industry frontier. By following our stochastic translog production strategyabove, we estimate the following translog cost frontier function:

$$\begin{aligned} lnC_{it} = {} & c_0 + \alpha_y lnY_{it} + \alpha_{w_1} lnW_{1it} + \alpha_{w_2} lnW_{2it} + \alpha_{w_{3it}} lnW_{3it} + \alpha_t T + \alpha_{yy} lnY^2{}_{it} \\ & + \alpha_{yw_1} lnY_{it} lnW_{1it} + \alpha_{yw_2} lnY_{it} lnW_{2it} + \alpha_{yw_3} lnY_{it} lnW_{3it} + \alpha_{yt} lnY_{it} T \\ & + \alpha_{w_{11}} lnW^2{}_{11it} + \alpha_{w_{22}} lnW^2{}_{2it} + \alpha_{w_{33}} lnW^2{}_{3it} + \alpha_{w_{12}} lnW_{1it} lnW_{2it} \\ & + \alpha_{w_{13}} lnW_{1it} lnW_{3it} + \alpha_{w_{23}} lnW_{2it} lnW_{3it} + \alpha_{w1t} lnW_{1it} T + \alpha_{w2t} lnW_{2it} T \\ & + \alpha_{w3t} lnW_{3it} T + \alpha_{tt} T^2 + \epsilon \end{aligned} \tag{5}$$

Where lnC_{it} is cost of production, lnW_1, lnW_2, lnW_3 are prices of labour, fuel and capital (in logs), lnY is real value of output and T is time trend variable. The cost of raw material (limestone) is used to normalize other input prices and to impose the homogeneity assumption.

4.4. Identifying the factors that could have affected productive and cost efficiency

Estimation of the magnitude of efficiencies by using above formulations and then subsequently tabulation/analysis of efficiencies over different time periods (i.e. pre and post reforms) has been a standard practice in a number of studies mentioned above in our literature review section. In our effort to better understand the factors that might have an impact on inefficiency term U_{it}, similar to other studies, and in particular widely cited paper of Battese and Coelli (1995), we use a two stage method, and regress a number of factors that might have a role to play in determining productive and cost inefficiencies. These include firm and industry specific factors, macro economy and international trade and the role of monetary and fiscal policy over longer time periods. More specifically,firm specific characteristics include ownership type (privatized, private), production technology (old wet or semi advanced such as semi dry or dry), size (small, medium or large), capacity utilization rates, debt level (leverage), and profitability.Industry environment in terms of competition conditions measured by Herfindhal index (based on production capacity/actual produced quantities or gross sales). The role of macro economy is determined by GDP growth, base interest rate,volume of commercial banks loans to the construction industry and the volume of international trade measured by the sum of export and import. The trade volume in particular is included to accommodate the role of cement and related products exports in the later part of our sample period.

By following Battese and Coelli (1995), the above formulation in equations 1& 4 is restated where all other variables and related parameters are similar to equation 1 above excepts $U_{it}s$ that are non-negative random variables representing technical inefficiency of production assumed to be independently distributed. The U_{it} is obtained by truncation at zero of the normal distribution with mean, $z_{it}\delta$ and the variance σ^2. z_{it} in this formulation is $(1\times m)$ vector of a number of factors discussed in above paragraphthat could affect technical inefficiency of production process, and δ is an $(m\times 1)$ vector of unknown coefficients to be estimated. See Battese and Coelli (1995), for further explanation of the estimation of parameters and related assumptions. To accommodate panel nature of the data, we also include firm and time dummies in our list of z_{it} variables.

5. DATA

For the estimation of technical and cost efficiency, most of the data has been collected from the following sources: annual reports of previously Expert Advisory Cell, Government of Pakistan (GOP); annual audited accounts of the respective companies (various issues); annual un-audited accounts of the public sector companies (various issues); annual report of the State Bank of Pakistan (various issues); Economic Surveys, Ministry of Finance, GOP (various issues);Census of Manufacturing Industries (CMI), GOP [various issues);Cement Directory (1991); National Development Finance Corporation, GOP; and Fifty years of Pakistan Statistics. All of the monetary value of inputs and output variables were deflated by the appropriate prices indices to convert these into real values. Further, to reduce the impact of noise in the data, all inputs and out data was mean deflated prior to estimation of the above mentioned models.

6. EMPIRICAL RESULTS

6.1. Production Functions Estimation and Technical Efficiency Estimates

In our presentation of the estimates of the parameters of the Cobb-Douglas and translog production functions, we considered three models; one for the Cobb-Douglas and two for translog production function (Table 1). Liu and Liu (1996) pointed out that results derived from the efficiency parameters and predicted efficiencies of this type of production function are highly sensitive to the selection of the model and related parameters. We carried out a test on the adequacy of the models before choosing the final model. Based on the Log Likelihood Ratio (LLR) test, our preferred model is the translog time varying production function model. The hypothesis that all translog variables are equal to zero is rejected by the LLR test. The next step involved the choice between the translog time invariant model which assumes that the persistence of inefficiencies are time invariant across firms is not justified based on the fact that the privatization policy was adopted to address these persistent inefficiencies, and we would expect that as a result of the change of ownership, firms would have changed their input/output mix and would have become more efficient over time.

Furthermore, one could also test the validity of this claim by testing the statistical significance of parameters which are estimated alongside translog variables parameters. Three of these extra parameters are mu, eta and gama. The maximum likelihood estimates for the

parameter mu (μ) is associated with the distribution of in-efficiency effects during the last period of the panel data and is indicative of the possibility that somewhat less in-efficiency that would be indicated by a half normal distribution. The maximum likelihood estimate eta (h) shows the time-varying inefficiency effects. The most significant and important parameter is gama (γ) which measures the variances in in-efficiency effects across the firms.

The maximum likelihood estimates of the Cobb-Douglas and translog production functions for the overall industry represented by different ownership categories are presented in Table 1. The statistical significance and negative sign of eta in our preferred model indicates that for the firms in our sample, the degree of inefficiency has increased over time. It is based on the last period level of inefficiency and other periods are compared against this last base period of inefficiency. The maximum likelihood estimates of γ, which shows the variation in efficiency across the firms is very high, showing greater level of variations in efficiency among different firms. The significance of the γ parameter suggests that the traditional response function with no inefficiency is not an adequate representation of the data.

Table 1
Maximum Likelihood Estimates for the Parameters of Stochastic Production Frontier

Variable	*Cobb-Douglas*	*Translog time-invariant*	*Translog Time-varying decay*
α_l	0.08288**	0.11243	0.05004
α_f	0.57453***	0.40303***	0.46215***
α_k	0.08112***	0.12818***	0.11217***
αm	0.34811***	0.35512***	0.34457***
α_t	0.42713***	-0.07546	-0.06235
α_{ll}		-0.01193	0.02219
α_{ff}		0.048	0.04158
α_{kk}		0.02651*	0.01452*
α_{mm}		-0.09789*	-0.09056*
α_{lf}		-0.13737	-0.12228
α_{lk}		0.04727	0.03865
α_{lm}		0.21604**	0.13566
α_{fk}		-0.10994**	-0.08658**
α_{fm}		0.00552	0.02568
α_{km}		0.05196	0.04643
α_{lt}		-0.02532	0.03364
α_{ft}		0.15912*	0.09787*
α_{kt}		-0.0381	-0.03415
α_{mt}		-0.04438	-0.05505
α_{tt}		0.24116***	0.35506***
constant	-0.30549***	-0.02135	-0.15296*
mu	0.22774*	0.29773	0.54751*
eta	-0.01629		-0.05469**
gamma	0.297	0.23044	0.61023
N	407	407	407

Notes: legend: * p<0.05; ** p<0.01; *** p<0.001. Elasticities evaluated at mean values are labour=.0577831, fuel=.5975482, capital=.0636295, material= .2727655

Elasticity estimates derived from the translog production function could reveal the extent of the role played by each input in the production of output. By calculating these estimates of the elasticities at mean input, we get the impression that fuel cost plays an extremely important role in the variations of production and sale of cement. Our interaction with the Cement Manufacture Association confirms this and rising fuel cost was highlighted as one of the major impediments to industry revenues, profits and competitiveness. The industry has seen a lot of change in term of the fuel mix in the last few years where coal is being substituted for furnace oil. But it could take few years before this has any statistically significant effect on production function.

Table 2 reports average production efficiency levels in each year predicted by the coefficients of the translog production function presented in Table 1 by industry as well as by ownerships. Some interesting conclusions can be derived;average efficiency levels for the industry are 75% over the entire sample period. These figures are 76% for public sector firms, 73% for privatized and 74% for private firms. This suggests that private and privatized firms were operating almost homogenously. In a way it is difficult to differentiate between these two types and this is what hypothetically would happen after the change of ownership, privatized firms would behave similar to private firms.When firms are grouped by their size, large size firms are more efficient (77%) compare to small size firms (71%). The small size firm group consists of firms using the semi-dry or wet process, which have little room for improvement due to technological drawbacks even in the case of relatively stable economic conditions. Medium size firms though have very similar efficiency ratings to large size firms.

All those firms operating in the north region are on average 5% more efficient compared to firms operating in the south region. The lower efficiency of forms operating in the south region during the sample period could be due to the fact that the group consists of firms located either in Karachi or nearby areas of the Karachi industrial zone. The city has been badly affected bydeteriorating law & order conditions during the sample period, causing the loss of working days and delays in deliveries. Firms located in north have a natural advantage of easy excess to raw material and easier export access to the adjacent Indian and Afghani export markets. This translates into lower cost of raw material i.e. limestone, gypsum and clay etc. The energy efficient dry process technology produces a more efficient operation. Firms using semi dry process are more efficient than those using the wet process. The marginal efficiency increment of moving from the wet to dry process is 5%.In terms of temporal pattern of efficiency estimates, the industry as a whole operated at roughly 10-12% lower efficiency levels than during the pre-reform period. These figures are consistent across different ownership categories. Further, decline seems to be industry wide rather than with only few individual firms.

6.1.1. Sensitivity Analysis of ProductiveEfficiency Estimates

Table 3 displays the output orientated efficiency estimates for cement firms using an order-m efficiency frontier, where order of the m is 5. These efficiency scores are provided as median values for each individual year between 1986 and 2011. The results are also provided as averages over different time periods so that comparisons can be made between overall efficiency in both pre and post reform periods. Comparisons are therefore drawn between the before and after

Table 2
Median Technical Efficiency Estimates Derived from Translog Production Frontier

	1986-91	*1988-91*	*1993-96*	*1993-95*	*1997-2006*	*2007-2011*	*1992-2011*	*1986-2011*
Industry	0.830	0.821	0.769	0.771	0.706	0.605	0.706	0.741
Public	0.825	0.816	0.766	0.771	0.690		0.724	0.760
Privatized			0.798	0.808	0.729	0.594	0.729	0.729
Private	0.834	0.826	0.773	0.774	0.710	0.615	0.710	0.738
Small	0.824	0.815	0.751	0.757	0.663	0.539	0.663	0.706
Medium	0.839	0.831	0.794	0.798	0.708	0.615	0.708	0.745
Large	0.825	0.816	0.766	0.771	0.734	0.648	0.734	0.749
Very Large	0.863	0.856	0.815	0.820	0.736	0.630	0.736	0.772
North	0.858	0.851	0.809	0.814	0.726	0.616	0.726	0.765
South	0.823	0.814	0.755	0.766	0.671	0.564	0.671	0.711
Wet	0.819	0.810	0.758	0.764	0.655	0.520	0.655	0.704
Dry	0.844	0.836	0.784	0.785	0.720	0.616	0.720	0.752
Semi-dry	0.844	0.836	0.790	0.795	0.712	0.605	0.712	0.746

1992 (representing the major privatization activity). The figures displayed are an indication of the actual output given the technology of production as compared to the expected maximum output amount dictated by the order-m frontier.

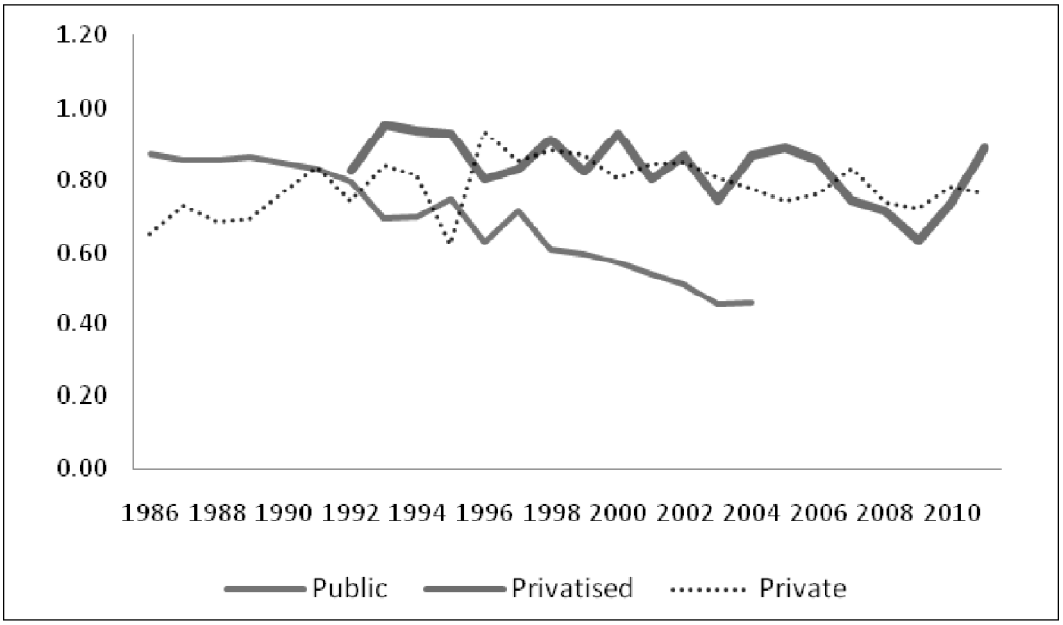

Figure 1: Order m Technical Efficiency Estimates by Ownership

In terms of a comparison between the time periods, it would appear that the separation around 1992 reveals an interesting fact that immediately after privatization, efficiently levels

marginally improved to 86% from 82% in the pre reform period for the overall industry. But subsequently, efficiency levels started declining and on average, we are unable to detect any notable difference in the pre and post reform periods for the overall industry. There are some major decreases in efficiency levels for some particular years but overall efficiency scores are nearer to 0.8 (implying firms are using their resources 80% efficiently). Hence, reforms do not appear to have had any significant effect, indicating a seemingly neutral effect of the 1992 deregulation/privatization upon efficiency.

Table 3 and Figure 1 show order-m efficiency estimates for three categories of ownerships: public, private and privatized. The immediate observable trend here is that it is difficult to see any significant difference in efficiency between private and privatized firms, although, private firms did catch up in post reforms period. For all those firms which were not privatized during the first round of privatization, their efficiency levels were consistently lower, until the time they were subsequently privatized. When firms are grouped according to different sizes, small size firms did improved their efficiency in the post reform period by almost 8-10% but, for all other size firms, no significant difference is noticed with some variations across the sample years. There seems to be an increasing level of efficiency as the firm size increases. Larger size firms are roughly 35-40% more efficient compared to very small size firms. The difference is 10-12% between medium and large size firms.

Table 3
DEA Order-m Efficiency Estimates

	1986-91	*1988-91*	*1993-96*	*1993-95*	*1997-2006*	*2007-2011*	*1992-2011*
Industry	0.820	0.834	0.800	0.800	0.808	0.752	0.798
Public	0.856	0.852	0.697	0.698	0.556		0.609
Privatized		0.932	0.937	0.862	0.734	0.844	
Private	0.711	0.728	0.826	0.811	0.824	0.759	0.804
Small	0.516	0.516	0.544	0.531	0.631	0.741	0.619
Medium	0.765	0.792	0.766	0.754	0.818	0.673	0.772
Large	0.866	0.866	0.876	0.898	0.896	0.812	0.861
Very Large	0.985	0.989	0.945	0.954	0.874	0.951	0.907
North	0.817	0.827	0.811	0.778	0.888	0.799	0.851
South	0.860	0.836	0.785	0.885	0.692	0.684	0.689
Wet	0.832	0.832	0.846	0.839	0.837	0.609	0.829
Dry	0.766	0.788	0.784	0.768	0.818	0.759	0.784
Semi-dry	0.953	0.940	0.852	0.853	0.672	0.819	0.754

Firms operating in north region appear to be more efficient compared to thesouth region. This is expected given the fact that they are nearer to their export markets in India and Afghanistan as discussed before. Firms operating in the south region though have one clear advantage in term of their close proximity to the ports (Karachi and Gwadar). The technology of production (wet, dry and semi dry) does not appear to have any significant effect with the exception of differences for only few years. This is also expected as the majority of the firms since 1992 had gradually moved to the dry production process.

On balance, it would appear that the 1992 reforms have had some positive impact, atleast in the initial years but this effect gradually disappeared. We have also offered a comparison of order-m efficiency levels between three types of firm ownership and find that privatized and private firms operated almost homogeneously while public firms operated below the maximum amount they could have produced given input usage. Firm size does matter and large size firms appear to be more efficient compared to small size firms.

6.2. Cost Function Estimation and Efficiency Estimates

The translog cost function with four input prices and a single output is estimated by using the Maximum Likelihood method. The results of these estimates are shown in Table 4. Similar to the production function, we estimated three models. The first model is a simple Cobb-Douglas specification model with three input prices and an output. The input prices are normalized by a fourth input price to impose a homogeneity restriction on input prices which is normal in empirical studies such as this one. The next two models are translog models, one with time invariant cost

Table 4
Maximum Likelihood Estimates for the Parameters of the Stochastic Costs Frontier

Variables	*Cobb-Douglas*	*Translog time-invariant*	*Translog Time-varying decay*
αy	0.74391***	0.76257***	0.76039***
αw1	0.24175***	0.05939	0.0842
αw2	0.35256***	0.57955	0.56957
αw3	0.11829***	0.36463***	0.36516***
αt	-0.09965*	0.87740**	0.89854**
αyy		0.02458**	0.02381*
αyw1		-0.19126***	-0.18598***
αyw2		0.15824**	0.15691**
αyw3		0.08581***	0.08572***
αyt		0.10384	0.10574
αw11		0.13184*	0.13832*
αw22		0.13603	0.13234
αw33		-0.03433***	-0.03422***
αw12		-0.41377**	-0.40679**
αw13		-0.08011	-0.08521
αw23		0.24757***	0.24816***
αw1t		-0.06597	-0.09357
αw2t		0.28301	0.29151
αw3t		-0.30625***	-0.30612***
αtt		-0.71327***	-0.71506***
constant	-0.2917	0.02752	0.0033
mu	0.55926	0.06721	0.0698*
eta			0.01212*
gamma	0.32539	0.24171	0.18592
N	407	407	407

Notes: * p<0.05; ** p<0.01; *** p<0.001. Costelasticities with respect to labour = 0.123, fuel = 0.5645, capital = 0.1155, output = 0.8715

inefficiency imposed and the other with a time decay inefficiency effect. The validity of the translog model against the Cobb-Douglas model was tested using the LLR test. We conclude that translog terms are needed in the cost function to reflect the nature of the data and the technology of production. We also tested for the presence of some other functional form (not reported here) but again the results favored the translog cost function. Elasticities (given below) of costs with respect to inputs and output are in accordance with theory. Again, similar to the production function, elasticity of cost with respect to fuel is the highest. Labor and capital elasticities combined are less than half that of the fuel elasticity. The value of gama indicates some variations in the cost function across different firms. This value is though less than the production function value. Overall,the models' fit is reasonable and the predicted inefficiencies based on this model are representative of the underlying production process.

The predicted cost efficiencies are reported in table 5. By looking at these estimates it is clear that the empirical findings related to cost efficiencies appear to be different compared to productive technical efficiency as mentioned above. The descriptive analysis of efficiencies stratified by three ownerships, four firm sizes (4), three technologies of production and two locations for different time periods covering pre and post reformsperiods reveal that efficiency did not improve significantly subsequent to reforms. A minor increase in efficiency during the first few years after privatization disappeared shortly and remained almost similar to pre reforms period. Nonetheless, efficiency although did not improve but contrary to technical production efficiency not decreased either. Interestingly, descriptive analysis of cost efficiency estimates reveal that smaller size firms were comparatively more cost efficient compared to medium or larger size firms. The difference does not appear to be large enough though. Lastly, no significant differences in efficiency estimates were observed for firms using different technologies. Similar could be said of firms operating in two distinct locations (north and south) during pre and post reforms and privatization time periods. This is a surprising finding given the fact that firms operating in the north region has a clear advantage in sourcing raw material as well as plant proximity to two export markets (India and Afghanistan) resulting in low transportation cost.

Table 5
Predicted Cost Efficiency Estimates

Years	*1986-91*	*1988-91*	*1993-96*	*1993-95*	*1997-2006*	*2007-2011*	*1992-2011*
Industry	0.897	0.898	0.917	0.918	0.897	0.904	0.900
Public	0.882	0.885	0.902	0.909	0.918		0.913
Privatized			0.885	0.885	0.897	0.919	0.899
Private	0.938	0.939	0.951	0.952	0.894	0.902	0.901
Small	0.950	0.949	0.962	0.962	0.956	0.960	0.958
Medium	0.948	0.948	0.951	0.951	0.897	0.902	0.900
Large	0.882	0.883	0.890	0.889	0.912	0.932	0.912
Very Large	0.861	0.863	0.870	0.870	0.857	0.865	0.862
North	0.880	0.885	0.890	0.885	0.898	0.951	0.902
South	0.919	0.917	0.924	0.926	0.893	0.901	0.897
Wet	0.893	0.893	0.898	0.901	0.882	0.902	0.893
Dry	0.925	0.926	0.942	0.943	0.908	0.917	0.913
Semi-dry	0.875	0.877	0.883	0.885	0.891	0.899	0.891

If we assume that in the pre-privatization period these firms were both allocatively and technically inefficient, then the marginal improvement in cost efficiency for some firms may be the result of significant decrease in allocative inefficiency and that could have translated into higher productivity. However, in the case of technical efficiency,the estimates of efficiency had been declining. If the assumption of allocative inefficiency is assumed [see Toda (1976)], then this leads to the conclusion that firms became allocative efficient during the post reforms period.

6.3. Determinants of Technical and Cost Inefficiencies

In the following discussion, we try to identify the causation between a decline in firms' productive efficiencycompared tocost efficiency and the adjustments made by firmssubsequent to the change of ownership and broader reforms in post reforms years. We attempt to relate firms' performance to the prevailing economicand international trade conditions generally and firms and industry specific variables particularly. Table 6 contains the regression estimates of the variables deemed having an impact on productive technical and cost inefficiency of cement producer firms in our sample.

The estimates contained in the table show that for both technical and cost inefficiency, our regression results do not agree with the line of thinking that firms under public ownership always perform inferior compared to firms operating under private ownership (as regression coefficient for private and privatized ownerships are statistically insignificant). Similarly, our regression results also do not support the fact that decline in productive technical inefficiency or improvement in cost inefficiency was as a result of firms using older (wet) technology. Contrary to expectations, regression results show that smaller size firms (size1) are less cost and technical inefficient compared to larger size firms. This is perhaps due to larger firms on average being unable to operate at full production capacity during our sample period due to a variety of reasons and thus being not able to realize economies of scale.

Table 6 also shows the impact of economic and industrial conditions on firms' productive inefficiency levels. Industry competition measured by the Herfindhal index (lhhi)using actual cement production (acpr) quantity, gross sale (grsa) or production capacity (prca) has no significant impact on technical inefficiency. We experimented by computing this index using production capacity and revenues, and the broad conclusions are same. This could be due to very small or insignificant variations in the index. However, for cost efficiency, a small change in the index would have a significant impact as shown by the statistically significant positive coefficient of this variable. The implication of this finding is that a small decrease in competition would lead to a significant decrease in cost efficiency. This perhaps could be explained by the fact that in a struggling economy and lower capacity utilization environment, a minor increase in competition could further squeeze the profit margins. Hence, probably this was the reason that our sample firms reacted to a minor change in a competitive environment more proactively.

The increase in export sale (expsal) receipts reduces firm inefficiencies probably due to learning from international experience. But, it could be a case of reverse causation that more efficient firms are likely to export more and hence earn more external market revenues. Similarly, an increase in indirect taxes measured by the excise duty (etax) and sales tax (stax) divided by

Table 6: Determinants of Productive and Cost Efficiency

Variables	*Production efficiency*					*Cost efficiency*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
privatized	0.4248					0.7190	0.6967	0.7163	0.5661	0.5647
	(0.7073)					(0.7564)	(0.7574)	(0.5462)	(0.5709)	(0.5704)
private	1.2144					-0.0557	-0.0751			
	(1.2110)					(1.0976)	(1.0977)			
wet	0.1769					0.6074	0.5914			
	(1.1432)					(1.0110)	(1.0108)			
size1	-1.1991***	-1.1576***	-1.1352***	-1.1352***	-1.1353***	-1.9615**	-1.9545**	-1.9843*	-1.9308***	-1.9306***
	(0.4257)	(0.4067)	(0.4101)	(0.4101)	(0.4101)	(0.9414)	(0.9450)	(1.1001)	(0.6220)	(0.6199)
lhhi_acpr	-1.4534	-1.2917	-2.5261			17.8269***		17.2928***	21.1559***	
	(4.4357)	(4.4929)	(4.4917)			(3.2036)		(5.6836)	(7.4168)	
lhhi_grsa					-2.5474		16.8784***			
					(4.5289)		(3.2371)			
lhhi_prca				-4.5572						35.7131***
				(8.1031)						(12.3269)
expsal	-0.2492	-0.2633				-0.1144	-0.1218	-0.1159		
	(0.2020)	(0.1988)				(0.2406)	(0.2403)	(0.2342)		
stax	-0.1841	-0.1440				-0.1244	-0.1273	-0.1836		
	(0.1765)	(0.1561)				(0.2333)	(0.2340)	(0.2081)		
etax	-0.1806	-0.2094				0.0152	0.0114	-0.0099		
	(0.1739)	(0.1724)				(0.2208)	(0.2205)	(0.2125)		
llever	0.3596***	0.3426***	0.3652***	0.3652***	0.3651***	0.1394	0.1376	0.1385	0.1840	0.1835
	(0.1326)	(0.1303)	(0.1327)	(0.1327)	(0.1327)	(0.1589)	(0.1579)	(0.1611)	(0.1663)	(0.1660)
lros	-0.8407**	-0.8043*	-1.0388**	-1.0388**	-1.0388**	-0.8438*	-0.8351*	-0.8536*	-0.9203**	-0.9198**
	(0.4250)	(0.4239)	(0.4126)	(0.4126)	(0.4126)	(0.4597)	(0.4588)	(0.4739)	(0.4368)	(0.4362)
ldiscr	-8.3504**	-8.2894**	-8.9175***	-9.1724***	-8.8215***	26.6028***	24.1136***	26.6505***	31.8598**	48.8839***
	(3.4089)	(3.3695)	(3.4166)	(3.5105)	(3.3961)	(1.4538)	(1.4703)	(4.1436)	(12.7535)	(17.9956)
lcaput	-2.6420***	-2.4840***	-2.6522***	-2.6522***	-2.6523***	-1.7751***	-1.7630***	-1.8148**	-1.9203***	-1.9194***
	(0.4951)	(0.4583)	(0.4545)	(0.4545)	(0.4545)	(0.6801)	(0.6789)	(0.7928)	(0.5526)	(0.5509)
lloancons	9.5564**	9.6799**	10.0508**	8.4102***	9.8381**					
	(4.1796)	(4.2166)	(4.2517)	(2.7368)	(3.9680)					
lconsrgr	9.5564**	9.6799**	10.0508**	8.4102***	9.8381**	-14.2320***	-12.8198***	-14.1042***	-17.0508**	-28.3137**
	(4.1796)	(4.2166)	(4.2517)	(2.7368)	(3.9680)	(0.5569)	(0.5685)	(2.5184)	(7.5395)	(11.0312)
lgdpgr	-1.8703	-1.9491	-1.7061	-0.4396	-1.9335	39.6486***	35.6904***	39.3017***	47.5817**	74.2907***
	(2.3074)	(2.2868)	(2.3046)	(2.5911)	(2.4765)	(0.8959)	(0.9266)	(7.0793)	(20.1980)	(28.4605)
ltrade	-7.2985**	-7.3148**	-7.8644**	-6.5092***	-7.7637**					
	(3.1548)	(3.1906)	(3.2109)	(2.0335)	(3.0745)					
d9203						-5.1845***	-4.5421***	-5.0531***	-6.0274**	-9.0272**
						(1.0084)	(1.0246)	(1.2752)	(2.8065)	(3.6398)
d0411						-35.1772***	-31.3658***	-34.7874***	-42.1329**	-65.7818**
						(2.1590)	(2.2062)	(6.2188)	(18.7405)	(25.9229)
d9296	2.0956	2.2617	1.9790	0.4911	1.9815					
	(2.2620)	(2.1672)	(2.2415)	(2.9818)	(2.2422)					
d9701	9.0700***	9.0971***	9.4874***	9.3418***	9.1003***					
	(2.9199)	(2.9255)	(2.8600)	(2.8832)	(2.9713)					
d0211	10.0146**	10.2601**	10.2893**	7.3471*	9.9934**					
	(4.3984)	(4.4080)	(4.4145)	(4.2246)	(4.1049)					
Constant	29.2136**	28.6576**	30.7438**	23.1325	31.4164**	-47.4861***	-40.9053***	-48.1445	-57.8618**	-79.9483**
	(13.1307)	(12.9691)	(13.1711)	(23.4969)	(12.5540)	(8.4976)	(8.7793)	(0.0000)	(29.4511)	(35.1735)
Observations	406	406	406	406	406	406	406	406	406	406

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

total generated revenues wouldalso force firms to put an extra effort in best utilization of inputs in maximizing output and reducing cost. Interestingly, in both case (indirect taxes and export sale), regression coefficients are not statistically significant.

The disciplinary impact of debt is contrary to expectations in case of technical inefficiency. The increase in deb measured by firm leverage ratio (llever) also increases inefficiency. This is perhaps due to the fact that rising cost of debt would leave fewer funds for plants routine and regular repair and maintenance which reduces the potential of achieving maximum industry compatible output subject to given input use. Interestingly, for cost efficiency, the impact is statistically insignificant. Higher profitability would allow firms to spend money on regular maintenance. This could also indicate better demand conditions and resultantly operating at optimal scale as well as being able to charge higher prices to cover marginal cost. These observations are confirmed by the negative coefficient attached to returns on sale (lros) variable. The estimate confirms that more profitable firms are likely to be less inefficient (both productive as well as cost).

In line with existing literature, increases in base interest rates measured by central bank discount rate (ldiscr) forces firms to utilize their resources wisely and hence reduces technical inefficiency. However, increasing interest rates and resulting debt cost makes it difficult to achieve reduction in cost of operation. This is shown by the statistically significant coefficient of base interest rate in our cost inefficiency estimates. The chances of bankruptcy are multiplied by depressed demand and stagnant or lower economic activity when interest rates are rising. Threats of bankruptcy could be a powerful challenge for the industry generally and the new management of privatized firms particularly after the elimination of subsidies. D.G. Khan Cement director's report to shareholders stated: "At present the cement industry as a whole is moving toward decline in earnings growth as competition increased with the advent of extra capacity. This means that we are heading toward the survival of the fittest, that is, the most efficient plant will survive in the high competitive environment".In the backdrop of these conditions, industry would opt for the improvement in technical efficiency a top priority.

In an effort to control for macroeconomic and market demand environment, we introduce a number of variables which are beyond the control of firm's management. These include firm's capacity utilization rates, construction sector growthand loans to construction sector which directly affects the demand for cement, international economic activity measured by country's total volume of external trade, and GDP growth rate. The coefficients contained in Table 6 show that higher capacity utilization (lcaput) reduces inefficiency (both productive as well as cost) perhaps due to helping firms to operate at optimum scale of production and achieve economies of scale. Higher loans to construction sector (lloanscons) would result in higher demand for construction related material such as cement resulting in an increases in productive technical inefficiency due to scale economies. Higher construction sector growth (lconsgr) increases productive inefficiency but reduces cost inefficiency. This could be due to the fact that an increase in demand for cement would let firms increase output price leaving little incentive for the management to put in extra efforts. Similar could be said of higher GDP growth rates (lgdpgr) too. Lastly, higher external economic activity measured by sum of exports and imports divided by GDP (ltrade) reduces productive inefficiency perhaps again this would

increase the demand for cement export and provide incentive to reduce effort level on the part of top management in particular.

Based on different specifications of regression models, the results contained in Table 6, show that after controlling for firms specific factors and industry and economic conditions mentioned above, since 1997 onward, firms' productive inefficiency have increased. The immediate negative impact of privatization and broader reforms on productive inefficiency was not statistically significant though. Post reforms dummy variables however, do confirm that dissimilar to technical inefficiency, the longer time impact on cost has been positive for the industry whereby, cost inefficiency have declined significantly since 1992 onward. After conducting a thorough analysis of the firm's director reports and interviews with APCMA, we summarize the main qualitative adjustments that could have led to an improvement in cost efficiency.

First, immediately after privatization, the new managements took extra measures to curtail their wage bill. All the additional benefits which new management considered illegal such as backhanders and bribes and as well as those that were above the legal minimum were withdrawn. Employees who obtained the "early retirement option and received severance payment to individuals for loss of their job have been re-employed on a contract basis, in which they are employed at a much lower wage rate than earlier, and have no additional benefits such as, leave of absence, medical facilities, holidays, pensions etc. This strategy played a dual role in lowering costs and employing the most efficient workers among the persons who opted for golden handshake.

Second, similar to world-wide trends, public sector firms operated with excessive and unnecessary pressure from labor unions. The effect was less operating days and lower working hours resulting in higher average cost per unit produced. However, after privatization, labor union pressure was minimalized due to less job security under private sector ownership. Our interviews with the new management of firms from the privatized group reveal that the new management paid greater attention to increasing operating days by carrying out effective repair and maintenance programs, creating a better working environment as well as offering monetary incentives and perks to permanent staff. With the exception of Zealpak and Dandot, where labor-management disputes forced plant shut-downs for a short while, overall management-labor relations were fairly stable. Production targets were more rigid, employee holidays were curtailed to the legal maximum and the extra holidays negotiated by the unions with the previous public sector management were no longer honored and non-pecuniary benefits were also curtailed.

The result was more working days and longer working hours. An example, in this context, is D. G. Khan Cement, where a record-breaking number of operating days were observed. Interestingly, all those few firms who were not privatized in the first round of privatization, with the exception of Mustahkam Cement, operated as usual and in some cases with an even lower number of operating days than historically normal. Further, during pre-reforms period, the poor law & order condition of the country affected firms (both private and public) badly, but impact on public sector firms was greater because of union pressure and job security. Privatized and private sector firm's employees were reluctant to take days off due to poor law

& order conditions due to the fear that they would not be paid because the union pressure had been nullified.

Third, a company can produce more output from their existing plant by keeping it in a good working condition, so that it can be used at close to 100% capacity. The years of neglect in repair and maintenance services during the public sector ownership regime resulted in low capacity utilization, loss of operating days and the delays in committed supplies. Once the cement industry was privatized, the monopoly power of the SCCP gradually weakened. The resultant price war between private and state-run companies led to an urgent need to replace the relatively older kilns, replacing these with new, better, modern, cost efficient and computerized dry process plants. Elimination of the fixed price formula and rising prices of output provided the impetus for the new managements to opt for Building, Modernization and Rehabilitation (BMR) of existing operating fixed assets. Dandot and D.G. Khan Cement companies implemented this plan immediately after the transfer of ownership and the remaining privatized firms with the exception of Gharibwal Cement implemented BMR during the period 1993-95. The results show that under BMR programs companies achieved cost efficiency improvements.

Fourth, the indirect effects of privatization such as, better access to and mobilization of resources, and enough input-output inventory stocks for windfall gains in a period of uncertain demand are numerous. Shaikh (1985) estimated a 6.5% improvement in technical efficiency of working capital in the case of the private ownership period for the ghee (cooking oil) industry during 1970-71. The building of sufficient stock of working capital is important because of the fact that in the case of public ownership if the firm defaults on payment, then the state usually intervenes and rescues the firm from bankruptcy/closure. Private sector firms do not enjoy such protection. The stock of working capital of the privatized firms improved immediately after privatization. This ensured that the new management could achieve more competitive input prices by shopping around for cheaper suppliers, whereas the state-run firms had been locked into supply contracts with other state-owned institutions and corporations such as the Water and Power Development Authority (WAPDA) for electricity, Sui Northern and Southern Gas for gas and Pakistan State Oil (PSO) for furnace oil purchases.

7. CONCLUSIONS

Pakistan followed the reforms agenda in mid 1980s initially and more aggressively since 1990s. The studyis an attempt to estimate technical production and cost efficiency by utilizing the whole industry data covering the period 1986 to 2011. We utilize a parametric estimator to estimate firm level efficiency but subsequently test the stability and validity of our efficiency estimate by more advanced non-paratactic estimator. On average, industry operated at 75% technical efficiency levels during the entire sample period and broadly speaking, our estimates for different ownership firms are almost similar. All those firms operating at larger scale, north region and advanced technology were more efficient compared to smaller size, south region operating and older technology firms. In terms of the impact of reforms on efficiency, industry operated at 10-12% less efficiency during post reforms period compared to the pre reforms period. The decline in efficiency is similar for both private and privatized firms. Subsequently

our sensitivity analysis exercise where we utilized a relatively new efficiency estimator (order-m), and broadly confirm the findings derived from parametric efficiency estimator. Our regression results where we introduced a number of firm, industry and economy specific control variables confirmed that post reforms, technical efficiency did not improve.

The empirical findings and estimates for cost efficiency are different compared to productive technical efficiency. The descriptive analysis of the cost efficiency estimates reveal that efficiency did not improve subsequent to reforms. A minor increase in efficiency during the first few years after privatization disappeared shortly and remained almost similar to pre reforms period. But in the subsequent analysis where we introduced a number of control variables which are beyond the control of management, we concluded that cost inefficiency in fact declined subsequent to broader reforms including privatization. Interestingly, descriptive analysis of efficiency estimates reveal that smaller size firms were more cost efficient compared to medium or larger size firms but regression results do not support this finding. Lastly, no significant differences in efficiency estimates were observed for different technology and regions of operating firms during pre and post reforms and privatization time periods. Regression results also confirmed these findings.

The qualitative analysis of working conditions and significant adjustments made as a result of reforms and privatization shows that firms introduced a number of initiatives which helped firms in achieving cost efficiencies. These include adoption of modernization of production process such as moving from old wet technology to dry or semi dry production process, better human resource management by cutting wage bills and unnecessary holidays and resultant improvement in working days, significantly reducing the labor union pressure, carrying out routine repairs and maintenance of production plants due to greater availability of working capital from a number of new sources such as capital market and more importantly sourcing of inputs at a market competitive prices due to better availability of cash.

The findings of this study have a significant implications and contributions towards debate on the impact of reforms and privatization on firm's operational efficiency. Our findings for the technical efficiency improving initially confirms a number of earlier influential empirical studies reporting positive impact of reforms and privatization. But our long run analysis does not support such findings for technical productive efficiency. Hence studies using a short time period after privatization could have attributed some other factors to the pure impact of privatization. The positive long run impact on cost efficiency however does confirm that firms could achieve a long lasting improvements in cost structure after reforms if they introduce a number of initiatives like cement producers in Pakistan did immediately after transfer of ownership. The study also confirms the fact that any empirical study that does not look into other factors which are not under control of the management could conclude differently and inappropriately.

Notes

1. Nine plants produced only ordinary port land cement (OPC), two produced both OPC and slag cement, one produced OPC and sulphur resistant cement and one produced OPC and white cement.

2. The private companies in operation at that time were Pakland, Cherat, Dadabhoy, and Attock Cement.
3. D.G. Khan Cement was sold to Mansha and Saigal group. Dandot Cement was initially sold to an Employee-led group, but was later sold on to the Chakwal Group of Industries. Mapple Leaf was sold to the Saigol Group of Industries. Similarly Kohat Cement was also sold to Palace Enterprises, another industrial group.
4. In 1985-86, OPC comprised approximately 95% of sub-sector output, with slag cement and sulpher resistant cement comprising about 2% each of the market and white cement the remainder.

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