

How Does Privatization Affect the Firm's Efficiency and Technology Choice? : Evidence from Turkey

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Abstract

This paper tests the effects of privatization on firm efficiency and technology choice by using a panel data set of 23 cement firms that were privatized between the years 1989 and 1998. Our results indicate that privatization reduces per unit costs and prices significantly and increases labor productivity and output substantially. We also find that privatized firm switches to a more capital-intensive technology as capital and capital labor ratio both increase. Since improvements in productive efficiency are likely to result from changes in technology, we develop a theoretical framework that explains how and why the technology choice of a public firm might differ than a private one. In this framework we endogenize the politician's choice of technology for the public firm by deriving this choice from an electoral process, which aggregates voters' preferences according to the majority rule. Our framework implies that state owned firms are likely to be under-capitalized and over-staffed in a labor abundant country, which is consistent with our empirical results.

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1 Introduction

In the last two decades, many countries launched extensive privatization programs. Despite this growing experience, we still lack empirical and theoretical knowledge of some critical issues. Does privatization result in more efficient firms? How does firm's technology change as ownership is transferred from public to private hands? In this paper, we address these questions as we empirically examine the effects of privatization on the firm's efficiency, input, output and investment choices with a panel data set of 23 Turkish cement firms which were privatized between 1989 and 1998. We find that both productive and allocational efficiency increase and firms switch to a more capital intensive technology as a result of privatization. Since change in technology is likely to be responsible for efficiency gains, we theoretically examine how and why the technology choice of the public firm may differ than a private one.

Privatization in Turkey started almost fifteen years ago, with the apparent reason to relieve the state from the burdens of inefficient state industries and to create revenue for the government. Since then, numerous state companies have been sold to private sector. We focus on cement firms for several reasons: First, the availability of a panel data set enables us to control for both firm and time specific effects, thereby allowing us to avoid problems with unobserved heterogeneity that has plagued earlier research. Second, the cement industry has some elements of a natural (regional) monopoly, and public ownership is considered to be one of the main solutions to the problems of market failure that arise in this type of market structure. Hence, if privatization increases productive efficiency without much translating into higher consumer prices in such a market, then we have all the more reason to be hopeful of its success elsewhere. Third, Turkey is the largest cement producer in Europe and eighth in the world.

There is a growing empirical literature analyzing the relationship between ownership and economic performance (See Megginson and Netter (2001) for an excellent survey). Unfortunately, this literature, either compares private and public firms at the same point in time- (Barberis et al. (1996), Cragg and Dyck (1999), Estrin and Rosevear (1999) or is gathered from studies of privatization or nationalization of the “before-after” variety which examine the averages of key variables before and after privatization and test for significant changes. (Megginson et al. (1994), Ecker et al. (1997), La-Porta and Lopez-De-Silanes (1997)). Cross-sectional studies cannot satisfactorily control for firm-specific effects, while “before-after” studies cannot satisfactorily control for period effects.

In this study, using a panel data set, we control for both firm-specific effects and period effects when testing for changes in economic performance after privatization. Because we have data on employment, capital, output, sales, investment, capacity, prices and profits, we are able to look at a more complete picture of privatization, unlike most studies that only analyze the effect of privatization on one variable such as employment. Previous studies are also susceptible to sample selection problems since firms they examine were selected for privatization while other firms in the same industry remained public. As our sample includes pre and post privatization data for all cement firms which were once state owned, we are able to avoid the problem of endogeneity associated with sample selection.

Our results show that privatization reduces per unit costs and prices significantly while labor productivity and output increase substantially indicating an improvement in both productive and allocational efficiency. We find evidence that technology becomes more capital intensive as both capital endowment and capital labor ratio increase. Increases in investment and capacity accompany these changes.

In this paper we focus on gains in productive efficiency and argue that

changes in technology choice are likely to be responsible for these improvements. We argue that public firm's technology choice depends on the politician's preferences which in turn reflect the preferences of the majority of the voters. In labor abundant countries like Turkey, the majority of voters would favor labor-intensive technologies, and hence such technologies will be adopted by public firms often at the expense of productive efficiency.

Does the firm change its technology from labor intensive to capital intensive after privatization? Our results on capital and employment utilization seem to say yes. We further investigate the answer to this question by estimating a Cobb-Douglas production function and allowing for structural changes in the contributions of capital and labor to the value of output when firms are privatized. Our results indicate that the contribution of capital to the value of output increases significantly while the contribution of labor decreases. These results have an important implication for the empirical literature on privatization. Many studies of privatization use rate of return on assets—defined as the ratio of sales to assets (capital)— as a measure of firm efficiency (Villalonga (2000)). If the privatized firm is increasing its capital as well as its sales as it switches to a more capital intensive technology, then this variable will not be an appropriate measure of firm efficiency in these studies.

In the next section we review the empirical literature on the effects of *privatization* on firm efficiency and technology choice as well as the theoretical literature on the effects of *public ownership* on the same variables. In section 3, we develop a simple model, which endogenizes the politician's technology choice for the public firm by making this choice the outcome of an electoral process. In other words, on the basis of individual optimization, each individual determines her preferred technology choice for the public firm and these preferences are “aggregated” into a public sectorwide technology policy via the collective choice mechanism in place. Our results indicate that this model explains the

differences in employment and capital choices between state owned and privatized firms for Turkey's cement industry. Section 4, describes the privatization environment in Turkey and the data we use. Section 5 presents and discusses the results. Section 6 concludes.

2 Literature Review

2.1 Empirical Literature on Privatization

The Effects of Privatization on Firm Efficiency

The evidence presented by the empirical cross-sectional literature on whether privatized firms are more efficient is mixed. By using a survey of 452 Russian shops, Barberis et al. (1996) show that the existence of new owners and managers increases the chances of restructuring and renovation. Using data from U.K., Cragg and Dyck (1999) find that privatized firms with at least four years in the private sector, like established publicly traded firms, exhibit a significant negative relationship between improved performance and the probability of resignation whereas state owned firms show no such relationship. Contrary to these studies, using survey data from Ukraine, Estrin and Rosevear (1999) refute the hypothesis that private ownership per se is associated with improved performance as they find the private ownership dummy to be insignificant in regressions explaining sales, employment or profits.

The "before-after" studies seem to find a more robust positive relationship between privatization and increased efficiency. Eckel et al. (1997), find that stock prices of U.S. competitors and airfares in markets served by British Airways fell significantly upon privatization. Megginson et al. (1994) find that state owned firms' financial and operating performance increase moderately following privatization. La Porta and Lopes-De-Silanes (1997) find evidence of large increases in profitability of Mexican firms following privatization and at-

tribute most of the increases to gains in productivity, rather than to increases in product prices and transfers from laid-off workers to the privatized firms.

Three notable exceptions to studies with only cross-section or before-after dimension are by Ehrlich et al. (1994), Frydman et al. (1999) and Villalonga (2000). All three studies control for firm fixed effects and Frydman et al. also control for time effects with year dummies. Unfortunately, the results of these studies on privatization and firm efficiency are mixed. Ehrlich et al. use a sample of 23 comparable international airlines of different ownership categories over the period 1973-83 for which they are able to obtain good and comparable cost, output and ownership data. Their results suggest that private ownership leads to higher rates of productivity growth and declining costs in the long run, and these differences are not affected by the degree of market competition or regulation. Their estimates suggest that the short-run effects of changes from state to private ownership on productivity and costs are ambiguous.

Frydman et al., find that privatization to outsider owners has significant effects on revenue performance, but not on cost reduction using data from the Czech Republic, Hungary and Poland, on 218 state owned firms of which 128 were privatized during the 1990-1994 period. We should note that testing the effects of privatization on firm performance is even more difficult in transition economies than in non-transition economies as privatization in these countries occurs at the same time as and is part of, other massive economy-wide changes.

Villalonga (2000) examines 24 Spanish firms from different industries and find that privatization does not increase efficiency—defined as rate of return on assets. He argues that political factors such as the business cycle during which the firm is privatized and foreign ownership are important determinants of firm efficiency.

The Effects of Privatization on Firm Technology

Empirical studies on the effects of privatization do not directly examine the

changes in technology choice as a result of privatization. Rather, they report changes in employment and capital investment, which may suggest a change in technology. In their survey article, Megginson and Netter (2001) report that almost all of the 22 studies from non-transition economies that they review find that capital investment spending increases significantly as firms are privatized. Perhaps surprisingly, they report that these studies are far less unanimous regarding the impact of privatization on employment levels in privatized firms.

La Porta and Lopez-De-Silanes (1999), in their “before and after” type of study of 233 privatized Mexican firms, find that ratio of investment to sales and investment to fixed assets significantly increase after privatization while employment significantly decreases. Furthermore, they present results from a survey of 74 of these firms where their CEOs were asked to rate the importance of twelve factors—that are listed in the survey—as explanations for the gains in profitability. In that survey, half of the respondents assign the maximum score to the introduction of new production processes.

In a longitudinal study not covered in Megginson and Netter (2001), Bhaskar and Khan (1995) find that privatization has a large and significant negative effect on white-collar workers using employment data from Bangladesh, for 62 jute mills of which 31 were privatized in 1982 and controlling for firm fixed effects.

2.2 Theoretical Literature on Public Ownership

The economic theory of privatization is a subset of the vast literature on the economics of ownership and the role for government ownership of productive resources. There are two main branches in this literature: The Social View and the Agency View.

According to Social View (Shapiro and Willig (1990)), state owned enterprises are capable of curing market failures by implementing pricing policies

that take account of social marginal costs and benefits of production. A privately owned firm is expected to maximize profits whereas a state owned firm is expected to maximize social welfare, according to this view. For example, in a natural monopoly market structure, efficiency calls for a single firm to exist. But a profit maximizing monopoly will charge too high of a price and produce too low of a quantity. This potential inefficiency can be solved by state ownership.

The Agency View of firm ownership presents a strong critique of this theory. There are two complementary strands of the literature differing on whether the agency conflict is with the manager or with the politician. Vickers and Yarrow (1988) argue that managers of state owned enterprises (SOEs) may lack high-powered incentives or proper monitoring. Shleifer and Vishny (1994) stress that political interference in the firm results in excessive employment, poor choices of product and location, lack of investments and ill-defined incentives for managers.

The main limitation of both the Social View and the Agency View models is that they simply posit objective functions for politicians/managers rather than deriving them from explicit models of the political process. While the Agency View is a relevant critique to the Social View, it assumes a very dismal political or managerial structure in order to make its case. For example, according to one version of the Agency View, the public is disorganized and politicians cater to interest groups, such as labor unions, rather than the median voter and this is the source of inefficiency (Shleifer and Vishny (1994)).

Even if we assume that politicians do cater to interest groups, it is not clear why labor unions should aim to induce excess employment. Unions protect the interests of insiders as opposed to outsiders. Strong unions can explain high wages, but why they should necessarily use their influence to increase employment in the state owned firm is far from clear unless we assume that there are competing unions each with the aim of increasing its market share by gaining more members. Furthermore, why should labor unions be the most

influential interest group? We could envision a model similar to Shleifer and Vishny's where businesses that provide capital inputs to the firm are the interest groups with influence over politicians. If that is the case, then we would expect that the state firm is over-capitalized rather than over-staffed. Hence predictions of these models change as we change the objective function imposed on the state owned firm.

The Social View, unequivocally predicts that the efficient technology will be chosen by the state owned firms. Models of Agency View on the other hand, while predicting that inefficient technologies will be chosen by politicians/managers, have ambiguous predictions for the direction of the distortion in the production process. They either predict that state owned firms will have low investment levels (Shleifer and Vishny (1994)) or will use excess capital as well as excess labor (Vickers and Yarrow (1988)). The over-capitalization argument stems from bureaucratic inefficiency models. The founder of this line of literature, Niskanen (1975), proposed that bureaucrats are inclined to maximize their total budget rather than the utility of their sponsors. In the context of a state-owned enterprise, this translates into over-investment and over-capitalization to justify perks and high salaries.

3 Technology Choice Under Public Ownership

In this section we endogenize the politician's technology choice for the public firm by making this choice the outcome of an electoral process which aggregates voters' preferences according to majority rule. We believe that this approach has advantages over making arbitrary assumptions about the politicians' objective function, as it will give us predictions for public sector's technology choices based on voter characteristics.

If the size of the public sector is significant then the input choices and hence

the technology choice of this sector will naturally be issues debated during elections. Megginson and Netter (2001) report that the public sector was indeed significant in many countries before massive privatization programs started to take place 25 years ago. More specifically, public sector formed 8.5 percent of GDP in high-income countries in 1984; in the low income countries, the average SOE share of national output was 16 percent at that time! Therefore, the public has a reason to be concerned in the choices of such a large sector. In case of Turkey, we observe a historically heavy reliance on SOEs which were established during the 1930s by the government to jump-start the economy that collapsed with the end of the Ottoman era in 1923. Over the years SOEs grew enormously, leaving the control of the economy to political parties that came to power. Each state owned enterprise belonged to the jurisdiction of individual government ministers, who were elected members of the parliament and SOE jobs were given to constituencies after elections (Ficici (2001)).

We propose that a politician who is seeking to maximize his votes can credibly promise to having a high level of employment in the public sector by committing this sector to a labor intensive technology. In a labor abundant country such as Turkey, if voters are to choose between labor-intensive versus capital-intensive technologies, majority of the voters are likely to favor a labor-intensive technology for the public sector even if this technology choice is inefficient.

3.1 A Simple Model

In this section, we propose a simple model where there are two types of technology available to the public firm and they differ according to their labor intensity. The voters who differ according to their labor and capital endowment, have preferences over these technologies and vote according to their preferences. The politician imposes the technology on the public firm which is preferred by the majority (the median voter) of the voters.

This model is rooted in models where individuals know their income when they choose a transfer scheme. Meltzer and Richard (1981) present a model of majority voting over simple income tax schedules meant to finance redistributive transfers. Their model illustrates some of the fundamental results on the connection between the characteristics of the income distribution and the nature of tax-transfer programs in the context of a simple model in which all individuals face the same linear tax rate and receive the same transfer. In our framework, individuals differ in their labor and capital endowment and transfers are in the form of employment opportunities in the public firm. If an inefficient labor-intensive technology is imposed on the public firm as a result of the electoral process, prices for the consumption goods produced by the public firm will be higher and these high prices are similar to a tax that voters have to pay to finance the public sector employees' wages.

The basic set up can be described as a two-stage game. In the first stage, voters choose which technology the state owned firm should use. In the second stage, the politician adopts the technology preferred by the majority of voters (the median voter) and sets price equal to marginal cost of production. We formalize this framework below.

Assume that a country has a population of N people where N is an even number. Individuals differ in terms of their labor and capital endowments. We will assume that $\frac{N}{2} + 1$ of the individuals are endowed with labor hours (laborers) and $\frac{N}{2} - 1$ of them are endowed with capital (capitalists). The reason for this assumption is to have a set up where the majority of voters (the median voter) is interested in employment opportunities in the public sector. Utility of i for $i \in \{1, \dots, N\}$ is log linear in the consumption good and leisure and linear in the numeraire good,

$$U = a \ln y + \ln(T - l) + z \quad (1)$$

where y is the consumption good produced by the public firm, l is the hours worked, T is the total time endowment and z is the numeraire good. We assume that $a \geq 0$. Individual i 's budget constraint is given by

$$py + z = \begin{cases} wl + I & \text{if } i \text{ is a laborer} \\ rk + J & \text{if } i \text{ is a capitalist} \end{cases} \quad (2)$$

where p is the price of the consumption good, l is hours worked by the laborer, k is the amount of capital supplied by the capitalist, w is the wage rate, r is the rental rate of capital and I (J) is unearned income of the laborer (capitalist). We assume that there is a competitive world market for capital and capitalists have no market value for their labor. One motivation for the distinction between laborers and capitalists is that laborers are younger and hence are able to work while the capitalists are older and are not able to work but have accumulated capital.

Individual i maximizes his utility, equation 1 subject to his budget constraint, equation 2 by choosing his demand for the consumption good

$$y = \frac{a}{p} \quad (3)$$

and his supply of hours worked:

$$l^S = \begin{cases} T - \frac{1}{w} & \text{for } w > \frac{1}{T} \\ 0 & \text{for } w \leq \frac{1}{T} \end{cases} \quad (4)$$

where l^S is the amount of labor supply by a laborer at equilibrium wage rate and labor supply by the capitalist is 0.

We will assume that there are two technologies available to the public firm and the politician chooses the technology that is preferred by the majority of the voters. Hence, production technology that is adopted by the state firm is

given by

$$Y = \begin{cases} L & \text{if majority prefers technology 1} \\ K & \text{if majority prefers technology 2} \end{cases} \quad (5)$$

We will assume that the firm sets price equal to marginal cost for each technology choice.

$$p = \begin{cases} w & \text{if technology 1 is chosen} \\ r & \text{if technology 2 is chosen} \end{cases} \quad (6)$$

Hence, the indirect utility function of individual i is given by

$$\begin{aligned} a \ln \frac{a}{w} - \ln w + wT - 1 - a & \quad i \text{ is a laborer; technology 1 is chosen} \\ a \ln \frac{a}{r} + \ln T - a & \quad i \text{ is a laborer; technology 2 is chosen} \\ a \ln \frac{a}{p} + \ln T + rk - a & \quad i \text{ is a capitalist} \end{aligned} \quad (7)$$

We define social welfare as the sum of the utilities of individuals:

$$SocialWelfare = \sum_{i=1}^N U_i \quad (8)$$

After some algebra, we find that social welfare is higher under technology 2 than under technology 1 if

$$r < \frac{w}{\exp\left(\frac{1}{a} \frac{N+2}{2N} (wT - \ln wT - 1)\right)} \quad (9)$$

In this framework, we will assume that a technology is efficient if social welfare is maximized when that technology is adopted. Hence, equation 9 is the necessary condition for technology 2 to be efficient. Note that if we were only concerned about productive efficiency, $r < w$ would be sufficient for technology 2 to be efficient.

A laborer votes for technology 1 if her utility under technology 1 is higher than under technology 2

$$a \ln \frac{a}{w} - \ln w + wT - 1 - a > a \ln \frac{a}{r} + \ln T - a \quad (10)$$

This condition simplifies to

$$r > \frac{w}{\exp\left(\frac{1}{a}(wT - \ln wT - 1)\right)} \quad (11)$$

Since the laborer is the median voter in this example, his preferred technology will be voted for by the majority of the voters. Hence, the inefficient technology will be preferred by the majority of voters if equations 9 and 11 both hold.

Let L^D (L^S) represent total labor demand (supply) in this economy if technology 1 is chosen. At equilibrium,

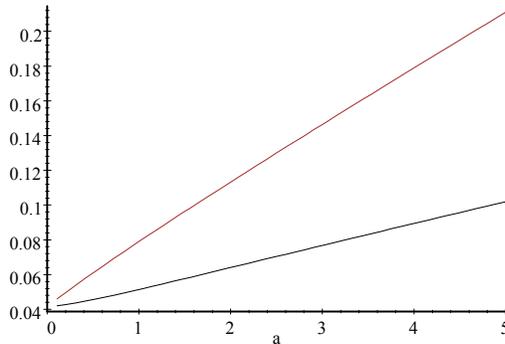
$$\begin{aligned} L^S &= L^D \\ \left(\frac{N}{2} + 1\right) \left(T - \frac{1}{w}\right) &= N \frac{a}{w} \end{aligned} \quad (12)$$

The equilibrium wage rate is

$$w = \frac{Na + \frac{N+2}{2}}{\frac{N+2}{2}T} \quad (13)$$

Note that at equilibrium, $wT - \ln wT - 1 > 0$, and hence, the upper bound for r in 9 is always higher than the lower bound in 11

Conditions 9 and 9 can further be illustrated in a graph by substituting for w from equation 13 and setting $N = 100$ and $T = 24$. In the graph below, the horizontal axis denotes a and the vertical axis denotes r . The upper line represents the upper bound and the lower line represents the lower bound that r can be such that the inefficient technology will be chosen as the electoral outcome.



As can be seen from the graph, the range of r that the inefficient technology will be chosen increases in a . In other words, as individuals value the consumption good more highly the probability of an inefficient outcome increases. The upper bound for r is there to ensure that the capital intensive technology is more efficient.

It is intuitive that this upper bound is relaxed—that it increases—as individuals value the consumption good more. In other words, r and hence the price of the consumption good does not have to be very low in order to ensure that social welfare is higher under the capital intensive technology when individuals have a high value for the consumption good.

The lower bound for r is there to ensure that the median voter—the laborer—will vote for the labor intensive technology. The lower bound tightens as a increases. This is also natural since the trade off that the laborer faces—higher price for y in exchange for labor income—increases as the laborer values the consumption good more. The lower bound, however increases at a slower rate than the upper bound since the upperbound incorporates the efficiency losses not only from the trade-off faced by the laborers but also the losses of the capitalists.

3.2 Model Implications

Our model implies that labor intensive technologies will be adopted in labor abundant countries where the median voter is likely to care about the employment opportunities in the public sector. We showed that when there is a choice between two types of linear technologies, the technology preferred by the median voter is not necessarily the efficient one.

In fact, if we assumed a Cobb-Douglas technology function and had voters choose from a continuum of technologies by choosing the labor intensity of the Cobb-Douglas specification, we would have found that the outcome of the polit-

ical economy equilibrium and the efficient technology would always be different. We do not present results with this technology since the model can not be solved analytically. Results which we get through comparison of first order equations are available upon request.

The reader may ask, if there is a more efficient technology available, why it is then not possible to adopt this technology and compensate the losing parties (in this case the laborers) from the efficiency gains of the capital intensive technology. There are two reasons why this move towards the efficient outcome may not be realized. First, it is difficult to credibly commit to such a scheme. In other words, it may be difficult to convince workers that they will receive transfers when they will no longer be necessary in the production process. A labor intensive technology choice which is not easily reversible, provides a credible commitment to the workers, whereas a promise that they shall be compensated if the public firm chooses the capital intensive technology may not be so credible. Second, holding out for a better deal, may stall the bargaining process that will lead to a decision on the terms of compensation for the laborers if they vote for the more efficient technology (Alesina and Drazen (1991)).

What should we expect as the public firm is privatized? If the technology of the public firm is distorted towards a labor intensive technology, then we expect the privatized firm to switch to a more capital intensive technology by decreasing its labor force and increasing its capital holdings. Labor productivity should increase. The firm to increase its investment in order to increase its capital. We expect the firm to become more efficient and decrease its per-unit costs. If the privatized firm operates in a sufficiently competitive market then we expect efficiency gains to be reflected in the form of reduced prices and output should increase.

However, the effect of privatization on rate of return on assets, which is the ratio of earnings (value of sales) to the value of assets (capital) is ambiguous.

This variable is often used as a measure of efficiency of the privatized firm, especially in cross-industry privatization studies (Villalonga (2000)). If the privatized firm is increasing the value of its assets (capital) as implied by our model, then this may not be a meaningful measure of efficiency for the privatized firm. Value of sales may be increasing as a result of privatization, but the assets might also be increasing if the firm is switching to a more capital intensive technology. Therefore rate of return on assets may go up or down depending on which effect will dominate.

4 Background and Data

Privatization in Turkey started almost 15 years ago, in order to relieve the state from the burdens of state industries, and generate revenue for the government. It is interesting to note that, privatization started under the first civil government after a military regime between 1980-1983. In the post military period, all of the former political parties and their leaders were banned from politics and the new conservative right of the center party, (Motherland Party) which was in power during this period, faced little political opposition in implementing its privatization programs. However, the privatization reforms have not been fully carried out as intended, due to a lack of legal framework and conflicting laws in the country's constitution with regard to privatization. Still numerous state companies have passed to private sector since then, including all the cement firms that were formerly owned by the state. The Privatization High Council is the ultimate decision-making body for privatization, under the chairmanship of the Prime Minister. Sales of these cement firms were realized through block sales to actual persons or entities.

Since, our sample includes all cement firms in Turkey which were formerly public we are able to look at a more complete picture of privatization and avoid

the problem endogeneity associated with sample selection. All the public cement establishments that ever existed were privatized between 1989 and 1998. Our data spans a period of 1981-1999 for many of the variables of interest, though the time series is shorter for some variables and the panel is not always balanced. Table 1 presents the time table of the privatizations of the cement establishments. Our data on output, employment, investment, capacity, and per unit costs are constructed from the official statistics of Privatization Administration of Turkey. Our data on capital and sales are constructed from Istanbul Chamber of Industry 500 largest firms of Turkey surveys. Table 2 describes the variables used in our regressions.

Ozmucur (1998) studied a panel of public and private cement establishments, using the results of Istanbul Chamber of Industry 500 largest firms of Turkey surveys. He estimated a separate equation for each firm to determine the year of structural change for employment and labor productivity for the 1981-1995 period and had at most 14 observations for each equation he estimated. He found that structural change coincided with time of privatization for public firms and reduction in employment which to a degree happened in all firms was significantly higher in the privatized firms.

5 Results and Discussion

Table 3 presents the comparison of the three year averages of the variables of interest before and after privatization. Results indicate that productivity, capital utilization, output and investment are significantly higher whereas employment, per-unit costs and prices are significantly lower in the post privatization period. Increase in capacity is not found to be significant. Fall in prices during this period may be due to an increase in competition among the cement firms and/or decrease in marginal costs of production.

Table 4 presents the results of the panel regressions for input and output choices of firms on the privatization dummy, which is equal to 1 for the post-privatization period of each firm and 0 otherwise. In this set of regressions we control for firm specific and period effects by adopting a firm fixed effect specification and employing year dummies as regressors. Results indicate that output, labor productivity, capital and capital labor ratio significantly increase while employment significantly decreases in the post privatization period.

Table 5 presents the same set of regressions as in Table 4 but this time firm effects are random. Random effects model is more efficient if it is consistent. We test the consistency of the random effects specification by using a Hausman Test. As shown in the table, for all regressions with the exception of employment output, we fail to reject that the random firm effects specification is consistent and therefore are able to estimate the coefficient on the privatization dummy efficiently and consistently. The significance and signs of the coefficients on the privatization dummy are the same as in the fixed effect specifications of Table 4.

Table 6 analyzes how privatization affects variables such as capacity choice, investment, per-unit costs and prices that are more likely to change in the longer-run. In fact, we find that our privatization dummy is positive but not significant for capacity and investment choices (columns 1 and 3). When we consider that these variables might not change immediately after privatization, and use a privatization dummy that is equal to one for the period one year after privatization takes place, we find this dummy to be positive and significant on the capacity and investment choices (columns 2 and 4).

Per-unit costs and prices appear to fall in the post privatization period. This implies that the productive efficiency gains do not come at the expense of consumers in the form of higher prices. Table 7 presents the same set of regressions as in Table 6 using firm random effects. Hausman test fails to reject that the

random effects specification is consistent for capacity and price regressions while it rejects this hypothesis for investment and per unit cost regressions. Hence the fixed effect specification should be used for these variables. The magnitudes of the coefficients are similar to that of the fixed effect regressions.

Our yearly dummies may not accurately capture the effects of the business cycle on firm efficiency. It would be interesting to see 1) How our firm efficiency measures move with the business cycle and 2) whether privatization effect will be still there when we control for the changes in the aggregate economy.

Hence we present results controlling for an industry production index constructed by Data Resources Incorporated (DRI) which measures the production level in total manufacturing industries (Table 8). We scale this variable by population of Turkey to get the per capita production level. In these regressions our dependent variables are labor productivity, log of sales over employment and per unit costs. We control for firm fixed effects as well as capacity of the firm to control for the firm size which changes over years and which may affect firm efficiency measures. We also include a time trend variable which is equal to 1, 15 years prior to privatization and equal to 26, 10 years after privatization.

As we would expect the log of the ratio of sales over employment co-moves with the business cycle: the industry production index has a positive and significant effect on this ratio. It is reassuring to observe that the privatization effect remains positive and significant in this regression (regression 2). Privatization effect remains positive and significant in the labor productivity and negative and significant in the per-unit costs regression, consistent with our earlier results. Capacity has a positive and significant effect on labor productivity and a negative, though not significant effect on per unit costs. This makes sense since we would expect the cement industry to experience considerable economies of scale.

Next, we estimate a Cobb-Douglas production function and allow for struc-

tural change in the coefficients of capital and labor due to privatization. The dependent variable is the natural logarithm of sales (earnings from the sale of output) in 1,000,000 and corrected for inflation. Our series on capital and sales do not have information on the post privatization periods of firms that were privatized after 1992. Hence we test for the possible structural changes in the production function for firms that were privatized in 1989 and 1992. Our explanatory variables are log of employment, log of capital, a dummy (P89) which is equal to 1 for the post-privatization period of firms that were privatized in 1989, another dummy (P92) which is equal to 1 for the post privatization period of firms that were privatized in 1992 and the interaction of these two dummy variables with log employment and log capital. We include yearly time dummies, and assume that observations are correlated for the same firm but independent across firms and estimate an OLS regression (Table 9).

This regression clearly indicates that a technological shift occurs as a result of privatization. Both of the privatization dummies are positive and significant indicating an increase in productivity as a result of privatization. Furthermore, the coefficients on the interaction terms for employment are negative and significant, and the interaction of P92 with log capital is positive and significant. These results indicate a significant increase in the contribution of capital and a significant decrease in the contribution of labor to the value of output due to privatization.

The privatization effects we find are quite robust, driven neither by a few well-performing privatized firms nor by a few poorly performing state firms and they remain virtually unchanged when the data is trimmed at the fifth and ninety-fifth percentiles. These regressions though not presented are available upon request.

6 Conclusion

In this paper, we find that privatized firms change their choice of technology as they increase their capital, investment and output while decreasing employment. Contribution of capital to the value of output increases while the contribution of labor to the value of output decreases as firms are privatized. The new technology choice is efficient since the per-unit cost of production is reduced significantly while prices are not increased to consumers. Hence evidence strongly suggests that privatized firm improves both allocational and internal efficiency.

Evidence we presented in this paper is consistent with the technology choice view that we developed. If the public sector is significant in a country then the employment choices of this sector will be of direct interest to the voters. Our model shows that a labor intensive technology is likely to be chosen as the outcome of an electoral process and this technology need not be efficient. Results of empirical literature on privatization also finds that capital spending increases significantly after privatization (Megginson and Netter (2001)) consistent with our model implications.

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Table 1: The privatized cement factories in Turkey:

Year Privatized	Privatized Firms
1989	Afyon, Ankara, Balikesir, Soke, Pinarhisar
1992	Corum, Denizli, Gaziantep, Iskenderun, Nigde, Sivas, Trabzon.
1993	Askale, Bartin, Ladik, Sanliurfa,
1995	Adiyaman
1996	Elazig, Kars, Lalapasa, Van.
1997	Ergani
1998	Kurtalan

Table 2: Description of Variables

Variable	Description
Capacity	The Minimum Efficient Scale of the firm, measured in tons scaled by 1000.
Capital	Assets measured in Turkish Liras, deflated by the Wholesale Price Index of Central Bank of Turkey, 1987=100 and scaled by 1,000,000.
Capital/Labor Ratio	Capital divided by number of workers
Employment	The number of workers employed by the firm
Labor productivity	Per capita cement production, measured in tons
Investment	The Investment Expenditures of the firm, measured in Turkish Liras, deflated by the Wholesale Price Index and scaled by 1,000,000
Output	Output sold by the Firm, measured in tons scaled by 1000.
Log Sales	Natural logarithm of sales measured in Turkish Liras, deflated by the Price Index and scaled by 1,000,000.
Profit	The net profit of the firm (net of operating costs and investment), measured in Turkish Liras, and deflated by the Wholesale Price Index and scaled by 1,000,000.
Prices	The sale price per ton, deflated by Wholesale Price index and scaled by 1,000,000
Per Unit Cost	Calculated by subtracting profits and investment expenditures from revenues and dividing this operating cost by the output sold (in TL scaled by 1,000,000).

Table 3: Comparison of Means Three Years Before and After Privatization[†]

VARIABLE	NUMBER OF OBSERVATIONS	BEFORE PRIVATIZATION MEAN	AFTER PRIVATIZATION MEAN	T-VALUE	PR > T
Optimum Capacity	23	510.58	567.03	1.37	0.1720
Log Employment	23	5.7089	5.2012	-11.47***	0.000
Investment	23	847.64	2137.7	2.98***	0.0034
Price	23	34319	30667	-2.80***	0.0062
Per Unit Cost	23	0.0317	0.027	-2.41**	0.0176
Capital/Labor Ratio	23	0.8716	1.8821	4.36***	0.000
Output	23	367.91	427.84	2.49**	0.014
Production per Capita	23	1.2252	2.4377	7.53***	0.001
Capital	23	285.28	362.97	1.76*	0.08

***Significant at 1%

**Significant at 5%

*Significant at 10%

[†]Data from the three years before and after the year of privatization are included in the before privatization and after privatization data sets respectively. If data was missing for one or two of these years for a given firm in the pre (post) privatization period, we also excluded the symmetric year in the post (pre) privatization period to ensure that the comparison is symmetric.

Table 4: The Effect of Privatization on Input and Output: Firm Fixed Effects

Dependent Variable	Employment (Log)	Output	Productivity	Capital Labor Ratio	Capital
Privatization Effect	-0.3013*** (-8.00)	42.2018* (2.29)	0.8468*** (7.75)	37.942*** (3.23)	6300.65*** (2.76)
Year Dummies†	Yes	Yes	Yes	Yes	Yes
F Statistic	67.39	6.31	40.19	8.49	4.67
Overall R ²	0.71	0.10	0.71	0.35	0.19
Test Statistics for the Equality of Firm Effects	F=10.31	F=21.47	F=15.24	F=6.48	F=9.52
No of Obs	364	279	279	239	240

t-statistics are in parenthesis.

***Significant at 1%

**Significant at 5%

*Significant at 10%

†Dummy variables are used for each year in the 1982-1999 period, for employment and for each year in the 1985-1998 period for output and labor productivity regressions. For capital and capital-labor ratio and capita, year dummies are used for each year in the period of 1982-1997.

Table 5: The Effect of Privatization on Input and Output Choices: Firm Random Effects

Dependent Variable	Employment (Log)	Output	Productivity	Capital Labor Ratio	Capital
Privatization Effect	-0.299*** (-8.28)	55.014*** (2.96)	0.911*** (8.45)	42.439*** (3.95)	6310.858*** (2.91)
Year Dummies†	Yes	Yes	Yes	Yes	Yes
Wald Statistic	1276.67	89.09	591.65	147.01	77.45
Overall R ²	0.71	0.11	0.50	0.36	0.20
Number of Observations	364	279	279	239	240
Hausman test (p-value)	N/A	N/A	0.76	1.00	1.00

t-statistics are in parenthesis.

***Significant at 1%

**Significant at 5%

*Significant at 10%

†Dummy variables are used for each year in the period of 1982-1999 for employment and for each year in the 1985-1998 period, for output and labor productivity regressions. For capital-labor ratio and capital regressions, year dummies are used for each year in the period of 1982-1997.

**Table 6: The Effects of Privatization on Capacity, Investment, Costs and Prices:
Firm Fixed Effects**

Dependent Variable	Capacity	Capacity	Investment	Investment	Per Unit Costs	Price
Privatization Effect	19.442 (0.82)	48.916** (2.02)	1640.506 (1.58)	2797.802*** (2.64)	-.005** (-2.06)	-0.003*** (-3.86)
Year Dummies†	Yes	Yes	Yes	Yes	Yes	Yes
F-Statistic	6.00	6.31	1.01	1.33	3.28	39.71
Overall R ²	0.05	0.07	0.05	0.07	0.09	0.62
Test Statistics for the Equality of Firm Effects	43.74	43.90	2.46	2.41	3.67	5.05
No of Observations	279	279	279	279	203	203

t-statistics are in parenthesis.

***Significant at 1%

**Significant at 5%

*Significant at 10%

†Dummy variables are used for each year in the period of 1985-1998, for capacity and investment regressions. For per-unit cost and price variables, year dummies are used for years 1988, 1989, 1990, 1992, 1993, 1994, 1995, 1996, 1997, 1998.

**Table 7: The Effects of Privatization on Capacity, Investment, Costs and Prices:
Firm Random Effects**

Dependent Variable	Capacity	Capacity	Investment	Investment	Per Unit Costs	Price
Privatization Effect	22.37 (0.96)	51.708** (2.16)	2482.974*** (2.74)	3278.30*** (3.63)	-.004* (-1.95)	-0.002*** (-3.07)
Year Dummies†	Yes	Yes	Yes	Yes	Yes	Yes
Wald Statistic	90.66	95.81	16.23	22.18	29.32	436.08
Overall R ²	0.06	0.07	0.06	0.08	0.09	0.63
Number of Observations	279	279	279	279	203	203
Hausman test (p-value)	1.000	1.000	0.000	0.0002	N/A	0.3714

t-statistics are in parenthesis.

***Significant at 1%

**Significant at 5%

*Significant at 10%

†Dummy variables are used for each year in the period of 1985-1998, for capacity and investment regressions. For per-unit cost and price variables, year dummies are used for years 1988, 1989, 1990, 1992, 1993, 1994, 1995, 1996, 1997 and 1998.

Table 8: The Effects of Privatization on Firm Efficiency controlling for the Business Cycle: Firm Fixed Effects

Dependent Variable	Productivity	Log (Sales/Employment)	Per Unit Costs
Privatization Effect	0.461** (4.01)	0.308** (4.30)	-0.004* (-1.93)
Time trend	0.157** (6.16)	0.03 -1.74	-0.001* (-2.21)
Firm Capacity	0.001** (3.28)	0 (1.08)	0 (-1.14)
Industry Production Index	-22.728 (-0.47)	85.44* (2.54)	0.828 (0.87)
Constant	-1.038* (-2.02)	2.048** (6.28)	0.043** (3.97)
Test Statistics for the Equality of Firm Effects	F=5.14	F=3.27	F=2
Observations	274	162	203
Number of firm	23	21	23
R-squared	0.73	0.7	0.19

t statistics in parentheses

* significant at 5%; ** significant at 1%

Table 9 Effects of Privatization on the Production Function**Dependent Variable: Log Sales**

Estimation Method: OLS

	Coefficient		t-statistic
Log Capital	0.256	** *	4.07
Log Employment	0.837	** *	3.79
Log Capital*Private after 1989	0.054		0.53
Log Capital*Private after 1992	0.235	** *	3.03
Log Employment*Private after 1989	-0.544	** *	-2.70
Log Employment*Private after 1992	-0.738	** *	-3.05
Private after 1989 (=1)	2.908	** *	2.29
Private after 1992 (=1)	2.105		1.31
Year dummies	yes		
R-squared	0.648		
Number of observations	243.000		

Log Sales and Log Capital are corrected for inflation and in 1,000,000 TL
Observations are assumed independent across firms but not within firms.