PRIVATIZATION AND TECHNICAL EFFICIENCY: EVIDENCE FROM MALAWI MANUFACTURING

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Abstract: This study evaluates the impact of privatization on the technical efficiency of six privatized enterprises, three state-owned enterprises and six private enterprises competing in three oligopolistic manufacturing industries in which privatization took place between 1984 and 1991 using panel data between 1970 and 1997. In our empirical analysis, we employ the Data Envelopment Analysis (DEA) compute technical efficiency scores using the 'intertemporal frontier' approach with panel data. The statistical analysis of variance shows that privatization in Malawi is associated with high mean technical efficiency in privatized enterprises and competing state-owned enterprises and private enterprises. If we account for other sources of technical efficiency, in the full sample we find evidence that the competitive process is more important than privatization in increasing the technical efficiency of all enterprises competing in the same industries. However, the results of the subsample of privatized enterprises show that privatization significantly increases the technical efficiency of privatized enterprises, although we cannot ignore the role of domestic competition, capital intensity, multinationality and structural adjustment programs as sources of technical efficiency.

Key words: Privatization; Data Envelopment Analysis; Technical Efficiency; Malawi Manufacturing

JEL Classification:

1. Introduction

Many developing countries, and African countries have followed the path of privatization of the state-owned enterprises (Adam et al., 1992; Cook and Kirkpatrick, 1995; White and Bhatia, 1998). Although the pull and push factors leading to privatization differ across countries, in most African countries, privatization of state-owned enterprises (SOEs) has been associated with World Bank and International Monetary Fund (IMF) sponsored structural adjustment programs (Adam, 1994; White and Bhatia, 1998). In Malawi, the government has implemented privatization programs within the framework of expenditure-switching and expenditure-reducing structural adjustment programs of the World Bank and IMF following the poor performance of state enterprises in the early 1980s (Adam et al., 1992; Adam, 1994). The restructuring process of the SOE sector in Malawi began with the parastatal reform programme. The parastatal reform programme was initiated in 1981 and mainly targeted directly owned state enterprises. The establishment of the Department of Statutory Bodies, responsible for monitoring and improving control and resource management in state-owned enterprises marked the first step in enhancing the operational efficiency of SOEs. In view of this, the government reform strategies included review of corporate objectives, introduction of performance related incentives, increasing the

autonomy of management in recruitment and firing of employees (Malawi Government, 1987). All these strategies were in line with the overall policy objective of improving the efficiency and effectiveness of parastatal institutions including public departments responsible for reviewing, monitoring and regulating the parastatal sector. However, a review of parastatal activities in the 1990s suggests the continued existence of conflicts of objectives, the multiplicity of principals, limited managerial autonomy and low accountability levels (Lawson and Kaluwa, 1996).

The other component of the restructuring process is the privatization of state-owned enterprises, which has been implemented in two phases. The first phase of the privatization programme (1984 - 1992) began with asset swaps between two state holding corporations - the Agricultural Development and Marketing Corporation (ADMARC) and Malawi Development Corporation (MDC), and Press Corporations in 1984 (see Adam et al., 1992; Adam, 1994). This phase of privatization was supported under the first six structural adjustment loans that the World Bank provided to Malawi. Several estates, thirteen non-manufacturing enterprises and eleven manufacturing enterprises held by ADMARC and MDC were privatized by the end of 1992. The eleven privatized manufacturing enterprises were among the fifty-two state-owned enterprises in the manufacturing sector. The second phase is ongoing and began in 1996 under the seventh structural adjustment loan, the Fiscal Restructuring and Deregulation Programme. The scope of privatization in the second phase is much broader and the government identified more than one hundred and fifty state enterprises and assets in 1996 and more than fifteen major privatization activities have taken place between 1993 and 1998 (Privatization Commission, 1997, 1998).

Since privatization began in Malawi in 1984, no study has evaluated the performance of privatized enterprises more generally, and manufacturing enterprises in particular. Adam (1994: 142) notes that 'despite lying at the heart of the entire debate on privatization, the one area where our knowledge is weakest is the extent to which privatization has actually affected efficiency at enterprise level'. Two empirical problems have hampered progress in this area (see Adam, 1994; Martin and Parker, 1997). First, the problem of isolating the effects of other factors such as liberalisation and regulation on enterprise performance from the effects of privatization or ownership change. Secondly, most privatization activities are quite recent, such that one cannot embark on a meaningful comparison between the pre- and post-privatization enterprise level analysis. Thus it is quite possible for privatization to have an impact on performance with a

substantial lag, hence we probably cannot observe performance changes in the short or medium term.

This study is motivated by the existing empirical research gap on the effect of privatization on efficiency in small developing countries. We use enterprise level data in the manufacturing sector spanning the period 1970 to 1997, by selecting industries in which privatization took place during the 1984-91 period in Malawi, in which privatized enterprises have been under private ownership for at least five years. The study, therefore, contributes to the limited empirical evidence on the privatization-efficiency hypotheses, particularly in developing countries by taking into account oligopolistic interdependence and the impact of other liberalization measures. The next section reviews theoretical and empirical literature on the relationship between privatization and economic efficiency. Section 3 introduces the Data Envelopment Analysis (DEA) method of estimating technical efficiency. Section 4 describes the data, the sample of enterprises and the estimation methods. The empirical results are presented in section 5 and in section 6 we provide concluding remarks.

2. Privatization and Efficiency: Theoretical and Empirical Framework

The main economic justification for privatization is that it promotes the economic efficiency of privatized state-owned enterprises. Four alternative theories explain the superiority of private ownership over public ownership, and the economic efficiency gains that are likely to emerge from the transfer of ownership and control of assets from the public to private investors. First, the property rights theory explains differences in the performance of public and private enterprises in terms of marked differences in attenuation of property rights (Demsetz, 1966, 1967; Furubton and Pejovich, 1972; De Alessi, 1980; Davies, 1981). Property rights in public enterprises are attenuated partly because property rights cannot be easily transferable. The problem of transferability implies that the cost and rewards of economic activities do not accrue more directly to individuals responsible for the property rights. The link between the average public owner (the taxpayer) and the manager of the public firm is extremely long, weak and tenuous; making monitoring of public managers' behaviour difficult. The general conclusion from the property rights theory is that the more attenuated property rights are, the less

productively efficient will be the enterprise because attenuation weakens the rewards-penalties systems that are necessary for cost minimizing behaviour.

Secondly, extending the property rights approach, the principal-agent theory focuses on differences in the monitoring mechanisms and incentives which public and private managers face as agents of shareholders given welfare maximization for the former and profit maximization for the latter (Vickers and Yarrow, 1988; Bös and Peters, 1991; Bös, 1991). The change in ownership from the public to the private sector has at least two effects: a change in the objective from a weighted welfare function to profit maximisation and a change in the incentive structure by linking reward to the level of performance under the private ownership. This shift towards profit maximisation may imply higher price, thus foregoing allocative efficiency, but there may be an increase in operational or productive efficiency.

Thirdly, the public choice theory takes the bureaucratic approach in which public enterprises are seen as an instrument of enhancing the utility functions of politicians such as maximization of votes and the budgets (Niskanen, 1972; Buchanan, 1972; Blankart, 1983; Boycko et al., 1996). Proponents of the public choice theory hold that government departments pursue objectives that do not maximize profits and usually pursue goals such as maximizing budget, risk aversion, employment and investment. Boycko et al. (1996) propose a model of privatization within the framework of public choice theory. The model shows that privatization will lead to effective restructuring of state-owned enterprises that are currently producing at inefficiently high levels to maximize employment, only if both cash flow rights and control rights pass from the government into private hands (particularly managers' hands). This will make it difficult for the government to bribe managers to produce at inefficient levels by offering them operating subsidies. Therefore, cutting the 'soft budget constraint' is vital to improving performance.

Finally, organizational theories emphasise the role of organizational characteristics in determining the performance of firms (Hartley and Parker, 1991; Dunsire, 1991; Bishop and Thompson, 1994; Martin and Parker, 1997). Proponents of organizational theories argue that differences in the performance of public and private firms are influenced by differences in management, goals, labour, communication and reporting systems, organisational structure, and the nature and location of business. In all the four theories of privatization, there is a consensus

that ownership matters and does affect the internal efficiency of firms (cost minimizing behaviour) and the allocative efficiency in the market place.

The controversy about the economic efficiency effects of privatization becomes apparent when we explicitly introduce issues of product market competition in form of either number and size distribution of firms or market contestability and regulation. It is generally agreed that without product market competition, privatization *per se* may not significantly alter the performance of the firm. Others argue that it is competition in the product market that provides the strongest incentives towards economic efficiency. Models of public enterprises in oligopolistic industries tend to shed more light on the uncertainty in the economic efficiency effects of privatization (see among others, Cremer et al., 1989; De Fraja and Delbono, 1989; Fershtman, 1990; De Fraja, 1991; George and La Manna, 1996; White, 1996; Pal, 1998). These models show that public ownership in imperfectly competitive markets can be an instrument of moderating private sector oligopolistic behaviour and the economic efficiency effects of privatization will depend on the trade off between productive efficiency gains and the allocative efficiency losses.

The empirical support for the impact of privatization on enterprise performance, on one hand, has mainly been motivated by a wide body of empirical evidence on the comparative performance of public and private ownership. The empirical results from comparative studies of private and public enterprises are mixed although largely supporting the propositions that emerge from the property rights and public choice theories that private enterprises are more efficient than state enterprises in achieving lower costs and higher productivity and profitability where firms operate in competitive environments.[1] In monopoly environments, especially where regulation exists, incentives for efficiency are eroded and most studies do not support the hypothesis that private enterprises are more efficient than SOEs except in health-related services and manufacturing sector where competition and absence of regulation may largely account for the superiority of private enterprises. Most studies in highly regulated utilities sector cast doubt on the private enterprise superiority over SOEs. Therefore, state regulation and limited competition may weaken management incentives to operate their firms efficiently irrespective

[1] See Martin and Parker (1997), Tittenbrun (1996), Domberger and Piggott (1994) and Boardman and Vining (1989) for a review of comparative public and private enterprise performance studies. Eckel et al. (1997), Boardman and Laurin (2000) provide evidence on share issued privatizations and industry effects of privatization.

of the form of ownership. Nonetheless, Vining and Boardman (1992) argue that it is in competitive markets that the superiority of private firms is unambiguous compared to the evidence in the uncompetitive and regulated markets, reflecting the complexity of the effects of market structure and regulatory policies.

The empirical analyses on the impact of privatization on economic performance within the pre- and post-privatization framework has mainly focused on profitability and productivity measures, and studies that use technical efficiency are limited (see Martin and Parker, 1997). Of the studies that use profitability and productivity measures Megginson et al (1994), Boubakri and Cosset (1999) and La Porta and Lopez-de-Silanes (1999) find significant improvements in returns on sales and labour productivity while the evidence in Martin and Parker (1997), Boubakri and Cosset (1998) and Villalonga (2000) is not significant. Notable studies that have used production frontier methods in evaluating the impact of privatization are Martin and Parker (1997) and Plane (1999). Martin and Parker (1997) find inconclusive evidence in the evaluation of the effect of ownership change in UK privatization on technical efficiency using Data Envelopment Analysis(DEA) in which each privatized firm's time series data represents a distinct decision making unit. Plane (1999) uses the stochastic frontier approach in the evaluation of the effect of privatization of the electricity company in Cote d'Ivoire using time series data for a single enterprise and find evidence that privatization improves technical efficiency.

3. Methodology

3.1 Estimating Technical Efficiency

Technical efficiency is a component of productive efficiency and is derived from the production function. Productive efficiency consists of technical efficiency and allocative or factor price efficiency. Productive efficiency represents the efficient resource input mix for any given output that minimizes the cost of producing that level of output or equivalently, the combination of inputs that for a given monetary outlay maximizes the level of production (Forsund et al., 1980). Technical efficiency reflects the ability of the firm to maximize output for a given set of resource inputs. Allocative efficiency reflects the ability of firm to use the inputs in optimal proportions, given their respective prices and the production technology. Developments in cost or production

frontier analysis are attempts to measure productive efficiency as proposed by Farrell (1957). The frontier defines the limit to a range of possible observed production (cost) levels and identifies the extent to which the firm lies below (above) the frontier. The deviation of the firm's observed cost and output from the frontiers measures the extent of productive and technical inefficiency, respectively.

The literature suggests several alternative approaches to measuring technical efficiency. In this study, we use Data Envelopment Analysis (DEA) to calculate technical efficiency scores. Data Envelopment Analysis is a deterministic and nonparametric approach to efficiency measurement that is mostly used in operational research and management science. This is a linear programming approach for measuring the efficiency of a multiple input and multiple output individual decision making unit (DMU) that does not require any prior assumptions about the form of the cost or production function. DEA defines the frontier of most efficient DMUs and measures how far the less efficient units are from the frontier. Charnes et al. (1978, 1981) proposed the DEA approach, and Fare and Lovell (1978) in related work, providing alternative measures of efficiency. Fare et al. (1985, 1994) decompose technical efficiency into several mutually exclusive and exhaustive components.[2]

The measures of efficiency are based on either the output set or the input set. Output-oriented measures of efficiency determine the extent to which output could be increased given inputs. On the other hand, input-oriented measures of efficiency identify the extent to which firms could proportionally reduce inputs to produce a given quantity of output. We follow the linear programs as presented in Fare et al. (1985, 1994) and focus on input-oriented measures of technical efficiency using constant returns to scale (CRSTE) model, variable returns to scale (VRSTE) model and scale efficiency (STE).[3]

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2 Fare et al. (1985, 1994) generate six measures of efficiency by relaxing assumptions and use of input price data. These measures include overall productive efficiency, allocative efficiency, overall technical efficiency, pure technical efficiency, congestion efficiency and scale efficiency. A review of some developments in DEA is found in Seiford and Thrall (1990).

3 We use these acronyms just for consistency with our presentation of empirical results.

First, we present the linear program for the constant returns to scale model. Charnes et al. (1978) proposed a model which had an input orientation and assumed constant returns to scale (C) and strong disposability of inputs (S).[4] The constant returns to scale DEA model does not impose restrictions on the sum of the weights used to construct a frontier, implying that the firm can be 'benchmarked' against firms which are substantially larger (sum of weights greater than one) or smaller (sum of weights less than one) than the reference firm. The linear program minimizes θ which determines the amount by which the firm can proportionally decrease inputs to produce given outputs efficiently. The linear program that we solve for firm *j* to obtain the input-oriented measure of technical efficiency (TE) under constant returns to scale and strong disposability, CRSTE model, is:

$$TE_{j_0}(y, x \mid C, S) = Min_{(\theta,w)}\ \theta \qquad (1)$$

$$\text{s.t} \quad \sum_{j=1}^{n} w_j y_{rj} \geq y_{rj_0}\ , \qquad \sum_{j=1}^{n} w_j x_{ij} \leq \theta x_{ij_0}\ , \qquad w_j \geq 0$$

where j_0 denotes the firm whose efficiency is estimated, y_{rj} denotes output r (r = 1,....,s) for the firm j, x_i denotes input i (i = 1,....,m) and w_j are the weights used to construct hypothetical firms on the frontier. The θ parameter is used to determine the amount by which firms can proportionally decrease observed inputs if they were to be used efficiently, such that (1 - θ) indicates the proportional decrease in inputs for the firm to produce a given level of output efficiently. If θ is equal to 1, then the firm j_0 is efficient, otherwise the firm is inefficient. The frontier is formed by the firms whose efficiency rating θ is equal to 1. The efficiency of the firm j_0 is measured relative to the input and output combination of peers that are technically efficient, identified by the positive values of w_j.

Secondly, we alter the constant returns to scale assumption and calculate technical efficiency under variable returns to scale. The constant returns to scale assumption is only appropriate when all firms are operating at an optimal scale. However, factors such as imperfect competition and financial constraints may lead a firm to operate at sub-optimal scale. Banker et al. (1984)

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[4] Strong or free disposability refers to the ability to stockpile or dispose of unwanted commodities. Strong disposability ensures that isoquant does not 'bend back' and displays input congestion.

proposed a model that relaxed the constant returns assumption by introducing the variable returns to scale (V) assumption by imposing a convexity restriction on the weights. This implies that the sum of the weights used to form the efficient frontier is equal to 1. This resulting linear program derives the input-oriented technical efficiency measure under variable returns to scale and strong disposability, VRSTE model:

$$TE_{j_0}(y, x \mid V, S) = Min_{(\theta,w)}\ \theta \qquad (2)$$

$$\text{s.t.} \quad \sum_{j=1}^{n} w_j y_{rj} \geq y_{rj_0} \ , \ \sum_{j=1}^{n} w_j x_{ij} \leq \theta x_{ij_0} \ , \quad w_j \geq 0, \qquad \sum_{j=1}^{n} w_j = 1$$

The convexity constraint that the sum of w_j is equal to one, implies that comparison of firms is by interpolation between firms of a similar size only, and preventing comparison with groups operating at a different scale to the firm j_0. Thus, the projected point of the firm on the frontier is a convex combination of observed firms - all firms are considered with reference to the linear combination of inputs and outputs. The frontier under variable returns to scale envelops the data points more tightly than the frontier under constant returns to scale, hence efficiency scores under variable returns to scale may be greater or equal to those obtained under constant returns to scale.

Finally, the assumptions of constant and variable returns to scale can lead into different estimates of the technical efficiency of the firm, particularly when the frontier from the CRSTE model does not coincide with that from the VRSTE model. The difference between two technical efficiency measures for the firm is due to scale inefficiency. Scale efficiency captures departure of a firm from constant returns to scale (optimal scale). The input-oriented scale efficiency measure is the ratio of technical efficiency under constant returns to technical efficiency under variable returns to scale (hence the STE model). If scale efficiency is equal to 1 then the firm is equally technically efficient relative to the (C,S) and (V,S) output set. Scale efficiency measures input loss due to operating at a sub-optimal or inefficient scale.

Technical efficiency scores using linear programs (1) and (2) are calculated using the panel data approach based on 'intertemporal frontiers' following Tulkens and Eeckaut (1995). The 'intertemporal' efficiency scores are obtained by applying the DEA on the pooled cross-section

and time-series sample. This assumes that the reference technology is time invariant. The pooling of cross-section and time-series data has the advantage of increases the number of observations especially in cases where the number of firms in the industry is small. The major advantage of data envelopment analysis is that it does not require a specified production function or the weights for different inputs and outputs used (Seiford and Thrall, 1990) and can also easily be extended to measure the efficiency of multi-product firms. However, the major disadvantage of the DEA approach is that we compute the frontier from sample observations and efficiency indices are sensitive to extreme observations, number of observations and measurement errors.

3.2 Factors Influencing Technical Efficiency

The literature suggests several factors that influence the allocation of scarce resources in the production process. However, there exists no compact theoretical model of determinants of technical efficiency, but strategies for identifying factors that determine inefficiency have been developed in sub-optimal organization and agency relationships within the firm, sub-optimal oligopoly bargains and related competitive factors within the industry, public policy (government intervention) and structural factors such as product differentiation (Caves, 1992a). Following Caves and Barton (1990) several hypotheses are formulated based on the usual structure-performance relation and other factors to explain the determinants of industrial (in)efficiency.

We explain technical efficiency by factors that include privatization, competition, organizational characteristics and the policy environment using panel data regression models. Following other studies and our results from the survey, we specify an econometric model to test the hypotheses that privatization increases the technical efficiency of all firms in the privatized industries and increases the technical efficiency of privatized enterprises using the following specification:

$$TE_{jt} = \beta_0 + \beta_1 PRIV_{jt} + \sum_{k=1}^{m} \alpha_k X_{kt} + \varepsilon_{jt} \qquad (3)$$

where for firm *j* in industry *i* and at time *t*, TE is the technical efficiency score, PRIV is a dummy variable for privatization, **X** is the vector of competition variables, organizational characteristics and other policy variables, and ε is the error term. We estimate two models based on equation (3). The first model tests the hypothesis that privatization increases the technical efficiency of

all firms in the privatized industries (industry effect) using the full sample. Thus if the PRIV is significant in the full sample, then in general privatization affects the performance of the industry. The second model tests the hypothesis that privatization increases the technical efficiency of privatized enterprises and we use data of the sub-sample of privatized enterprises. If PRIV is insignificant in the full sample, but significant in the subsample, then privatization only affects privatized enterprises.

We group the sources of technical efficiency into ownership structure and privatization, competitive conditions and industry characteristics, organizational structure and firm characteristics and policy environment. The ownership structure and privatization variables include the proportion of state ownership in the enterprise at a given time (STATE) and a dummy variable for the period after privatization (PRIV) for the overall effect of privatization on all firms. If privatization enhances performance, we expect a positive and significant relationship between economic efficiency and the dummy variable PRIV. Theories of privatization predict a negative relationship between the share of state ownership and efficiency, hence we hypothesize that efficiency decreases with state ownership.

The role of competition and market structure in enterprise or industry performance has been an issue of considerable debate in both theoretical and empirical industrial economics, but there are no doubts that variations in market structure will lead to different performance results. Nickell (1996) notes that there are theoretical reasons to believe that competition improves corporate performance, and finds a positive relationship between competition and total factor productivity growth. We use two indicators of market power to capture the effect of competition on efficiency. The first measure is the Herfindahl-Hirschman index (HHI) as a measure to capture the extent of domestic competition. The HHI is the sum of squared market shares (sales) of all firms in the industry, measured at the four-digit industry level. The higher the monopoly power, high values of HHI, the weaker are incentives for efficient production. We expect the HHI to be negatively related to the measures of efficiency. Caves (1992a) and Mayes et al. (1994) note that there is no reason to believe that the relationship between concentration and efficiency is linear as opposed to curvilinear. Torii (1992: 77) argues that there is a level of concentration that maximizes efficiency, ‘when the number of firms in the market is relatively small, the efficiency level increases as the number of firms increases, which is mainly due to competition forcing

firms to produce more efficiently. When the number of firms is relatively large, the efficiency level decreases as the number of firms increases, and this is due to indivisible replacement investment.' The curvilinear relationship is modelled by including squared indices of market concentration, HHISQ, in the efficiency model.

The second measure of competition is import shares (IMPS) that capture the role of international competition. We calculate IMPS as the ratio of imports of manufactured products for the industry to total domestic supply of products in that industry, measured at the four-digit industry level. The inflows of imports exert competitive pressure on domestic firms that in turn should create incentives for domestic firms to operate efficiently. However, Mayes et al. (1994) note that high import ratios could actually indicate that the industry is inefficient relative to firms abroad, not that foreign competition drives out inefficient firms. The fact that there is excess market share which foreign firms are able to fill, points to the absolute inefficiency of production by domestic firms. We therefore expect either a positive or negative relationship between efficiency and import shares.

The role of organizational status or restructuring and firm-specific characteristics on economic performance are well recognized in the literature following Williamson's (1970) hierarchical organizational structures. Our specification includes two firm-specific variables. First, we include the capital intensity (KINT) of production calculated as the ratio of real capital stock to real wage bill. KINT captures the level of sunk costs that may inhibit changes and create barriers to entry and exit (Mayes et al., 1994). We expect a negative relationship between KINT and technical efficiency. However, we may obtain a positive relationship if capital intensive firms embody the most advanced technology. Secondly, due to the multinationality of enterprises in the three privatized industries, we include a dummy variable that takes a value of one if the enterprise in a given year is a subsidiary of a multinational corporation (MNC), otherwise it is equal to zero. MNC captures the superior performance of multinational enterprises over domestic firms due the former's advantages arising from firm-specific assets, access to a wider array of locational assets and their ability to reap economies of scale and scope at firm-level (Caves, 1996; UNCTAD, 1997) and due to concentrated ownership (Boardman et al., 1997).

Privatization in Malawi is just one of the many policy changes that the government introduced in the 1980s. Prior to structural adjustment programs, industrial policy was characterized by regulation of entry into the manufacturing sector, control of prices for selected industrial products, open trade policy with fixed exchange rate regime, control of agricultural input prices and control of interest rates and credit rationing. Under structural adjustment programs many policy changes were introduced as the government was attempting to liberalise the economy. Trade protection initially increased, but trade was subsequently liberalised in the 1990s and a more flexible exchange rate regime was introduced (Mulaga and Weiss, 1996). The programme of industrial price decontrol began in 1983 and by 1988 most of the prices in the industrial sector were liberalised (see Khan et al., 1989). In addition, monopoly rights were abolished in 1988 and entry into the manufacturing sector was liberalised in 1992 in which the government replaced the Industrial Development Act with the Industrial Licensing Act of 1992. Apparently, most of these measures were competition-enhancing in the manufacturing sector and their effects on technical efficiency cannot be ignored in the empirical analysis of privatization. We, therefore, control for changes in the general economic policy environment by including a dummy variable for the structural adjustment programs (SAPS) which takes a value of one after 1980, otherwise it is equal to zero. Since most adjustment policies were competition-enhancing, we expect SAPS to be positively related to technical efficiency. Ahsan et al. (1999) find evidence that total factor productivity growth was higher in the structural adjustment period compared with the performance before structural adjustment in the Malawi manufacturing sector.

4. Data and Estimation Methods

Government ownership of enterprises in the manufacturing sector was vested in two state holding corporations, the Agricultural Development and Marketing Corporation (ADMARC) and the Malawi Development Corporation (MDC). These two corporations had ownership in thirty-two manufacturing enterprises with an average share holding of 68.5 percent before structural adjustment programs in 1981. Most of these state-owned enterprises operate in mixed oligopolies. Privatization in Malawi has been implemented in two phases within the framework of structural adjustment programs. The first phase was between 1984 and 1991 and stated with asset swaps between ADMARC, MDC and Press Corporation in 1984 with subsequent privatization in 1987 and 1991. The focus in the first phase was on the privatization and

divestiture of subsidiaries and associate companies of ADMARC and MDC (see Adam et al., 1992). The second phase started in 1994 under the National Privatization Programme and is targeting more than 150 commercial state entities.

The study focuses on privatization in the Malawian manufacturing sector and excludes privatization activities in other sectors of the economy due to data limitations in the latter.[5] Table 1 shows the major privatization activities in the manufacturing sector, including asset swaps to Press Corporation, between 1984 and 1998. Ownership of twelve enterprises in the first phase and eight enterprises in the second phase was transferred to the private sector through private/negotiated bids or competitive/negotiated bids. Eight of the privatization activities involved existing shareholders with pre-emptive rights while four attracted new foreign investors.

[Table 1 about here]

Our sample of privatized enterprises is drawn from eight privatization activities (excluding asset swaps). We eliminated three enterprises that were not covered in the survey either because they ceased operation or did make the data accessible or whose data were not consistent at the National Statistical Office. Each of the five privatized enterprises were grouped into three-digit industry classification level. We also obtained data for private enterprises and other state-owned enterprises competing in the same industry.[6] This enabled us to obtain panel data between 1970 and 1997 for fifteen large scale enterprises in three privatized manufacturing industries in Malawi. The privatized manufacturing industries are three-digit industries in which privatization occurred between 1984 and 1991. The three privatized manufacturing industries are food processing, manufacture of other chemical products and manufacture of transport equipment, and our sample include six privatized state-owned enterprises (PSOEs), three state-owned enterprises (SOEs) which have never been privatized and six private enterprises (PVTs) which have always been under state enterprise during the period of analysis.

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5 Data on enterprise level time series financial variables in other sectors of the economy are limited. For instance, most privatization activities occurred in the agricultural sector, particularly privatization of small agricultural estates in which ownership was transferred to individuals who do not keep consistent financial records.

6 One of the enterprises was privatized under the asset swaps, and is included as a privatized enterprise because it operates in the same industry as the selected privatized enterprises. The privatization year for the industry is determined by the sale of enterprises outside the share or asset swap.

The data were obtained from National Statistical Office based on unpublished data of the census of production. The census of production data is collected through a questionnaire, and with the permission of individual enterprises, we extracted the data from the questionnaire responses in each enterprise's file. We also administered a questionnaire to all the fifteen enterprises on organizational changes and changes in the competitive environments that have occurred following privatization. We do not report the results of the enterprise survey, but what was clear is that managers attributed changes more to the overall structural adjustment program, than to a specific policy such as privatization.

Technical efficiency scores were calculated using DEAP Version 2.1, a computer program written by Coelli (1996). DEAP computes technical efficiencies involving standard constant returns to scale (CRS) and variable returns to scale (VRS) models. We use the 'intertemporal' approach to derive efficiencies based on industry-specific frontiers by pooling cross-section and time-series data in each of the three privatized industries. The technical efficiency of the firm is measured relative to the frontier constructed from the firm's time series observations and those of competing firms. For each industry, we estimate constant returns to scale technical efficiency (CRSTE) model, variable returns to scale technical efficiency (VRSTE) model and scale technical efficiency (STE) model.

The estimation of technical efficiency requires data on output quantities and input quantities. We use the concept of one output produced by three inputs - capital, labour and raw materials. Sector-specific deflators were obtained as unpublished data from the National Statistical Office. For each sector, we obtained output, raw material, and plant and equipment price deflators and for each class of capital (land and buildings, transport equipment and office equipment) we obtained price deflators. Output is measured by sales at constant 1980 prices using the sector specific output price deflators. Capital is measured as real capital stock based on the perpetual inventory method and deflated by capital input price deflators. Labour is measured by the number of employees in the enterprise during the year. We measure raw materials at 1980 prices using sectoral input (raw material) price deflators.

The theoretical literature on privatization and economic efficiency suggests that privatization creates incentives for efficient resource use. We, therefore, test three hypotheses: privatization

enhances the technical efficiency of competing enterprises in privatized industries; privatization increases the technical efficiency of privatized enterprises, and the technical efficiency of enterprises is influenced by many other factors other than privatization alone. These hypotheses are tested in two ways. First, we use the statistical analysis of variance (ANOVA) to test the difference in the means before and after privatization. For each enterprise we code the value of zero as the period before and a value of one as the period after privatization in the industry. We obtain the F-test statistic under the null hypothesis of no relationship between technical efficiency and privatization. In addition, we establish the extent to which differences in the mean technical efficiency can be attributed to privatisation using eta-squared. ANOVA was carried out on SPSS version 8.0 (SPSS Inc, 1998).[7] The analysis is decomposed into three subsamples: privatized enterprises, SOEs and private enterprises. Secondly, we estimate equation (1) for the full sample of enterprises in privatized industries and for the subsample of privatized enterprises.

5. Empirical Results

5.1 Impact of Privatization on Technical Efficiency: Statistical Results

We report results from the analysis of variance and test the difference in mean technical efficiency before and after privatization. The statistic eta-squared, which we obtain from ANOVA, is the proportion of the variance in technical efficiency that we can attribute to privatization. Table 2 presents estimates of technical efficiency based on industry-specific 'intertemporal' frontiers by type of enterprise. Technical efficiency scores under variable returns to scale (VRSTE) are much higher than those under constant returns to scale (CRSTE), implying that the constant returns to scale assumption may not be appropriate for the firms in the study.

The results for the privatized state-owned enterprises support the hypothesis that privatization increases technical efficiency. All the three measures of technical efficiency show that technical efficiency improved following their privatization. The difference between the means before and after privatization are statistically significant at the 1 percent level with respect to the CRSTE

[7] See Bryman and Cramer (1999) for a detailed discussion and illustration of testing differences in means (comparing means) using analysis of variance.

and VRSTE models and at the 5 percent level in the STE model. The proportion of the variance that can be attributed to privatization is 27.4 percent in the CRSTE model and 31.6 percent in the VRSTE model, but only 3 percent with respect to scale efficiency. On the contrary, the changes in the performance of SOEs show decreases in resource use as reflected in constant returns to scale and scale technical efficiency scores, and the marginal increase in the variable returns to scale technical efficiency scores. The proportion of the variance attributed to privatization is also low ranging from 0.2 percent to 4.5 percent.

[Table 2 about here]

With respect to private enterprises competing with privatized enterprises and SOEs, technical efficiency scores increased under the CRSTE and STE models, but the difference in the means are only statistically significant in the latter. Technical efficiency scores under the variable returns to scale assumptions, however, declined following privatization, but the difference between the means is not statistically significant. The proportion of the variance that can be attributed to privatization among private enterprises is ranging from 0.3 percent to 5.4 percent, suggesting that privatization marginally affects the behaviour and performance of private enterprises.

Interesting, however, scale efficiency scores among privatized enterprises and private enterprises show that the use at the optimal scale significantly improved compared with the worsening performance among the SOEs. Overall, the results show that privatization affects directly the privatized enterprises than other competing firms in the same industry. These statistical results show that the industry effects of privatization are marginal. However, the analysis of variance assumes that changes in the performance are affected by privatization, ignoring the positive and negative effect of the many other factors that influence the firm's performance.

5.2 Impact of Privatization on Technical Efficiency: Econometric Results

We investigate the impact of privatization on technical efficiency while controlling for several other factors that influence economic performance. These factors include the competitiveness of the industries, the organizational structure of firms and the policy environment, which we

consider in a multiple regression analysis. We present results for two models that test our hypotheses. The first model is based on the total sample observations and test the hypothesis that privatization increases technical efficiency of firms competing in the same industry (industry effects of privatization). The second model is based on a subsample of privatized enterprises and test the hypothesis that privatization increases the technical efficiency of privatized enterprises. Table 3 reports the econometric results on factors that influence the financial performance and operating efficiency based on a full sample while Table 4 reports results based on the subsample of privatized enterprises. All estimations were carried out on TSP version 4.4 using the PANEL command to obtain fixed effects and random effects models (Hall et al., 1995). We report results from the preferred models and report the Hausman specification test for the suitability of the random effect model that assumes that the individual effects are not correlated with explanatory variables.

a) Technical Efficiency in Privatized Industries (Industry Effects)

First, we focus on the results of the model on the industry effects of privatization presented in Table 3, with respect to technical efficiency under two assumptions - CRSTE in Model 1 and Model 2, and VRSTE in Model 3 and Model 4. Our results show that the share of state ownership (STATE) is consistently associated with lower levels of technical efficiency and the coefficient is statistically significant at the 1 percent level under both constant and variable returns to scale. The elasticity of technical efficiency with respect to state ownership is -0.13, suggesting that a 1 percent increase in the proportion of state ownership leads to a 0.13 percent decrease in technical efficiency. The results support the predictions of the traditional theories of privatization and the findings of Boardman and Vining (1989) that state-owned enterprises and mixed enterprises perform worse than private enterprises. The hypothesis that privatization leads to improvement in technical efficiency in the three privatized industries is not supported by the data. The coefficient for the privatization dummy variable (PRIV) is positive, but is statistically insignificant in all the models confirming our statistical results.

[Table 3 about here]

The effect of the monopoly power is statistically significant at the 1 percent level both under constant returns to scale and variable returns to scale. We reject the curvilinear relationships between technical efficiency and competition in Model 1, but we accept it in Model 3. The inclusion of HHISQ in the CRSTE model reduces the significance of HHI. Model 2 shows that firms that are more efficient operate in more competitive industries.[8] The computed elasticities at the means of technical efficiency with respect to monopoly power in Model 1 and Model 2 are -0.35 and -0.46, respectively. Mulaga (1995), Mulaga and Weiss (1996) similarly find a negative relationship between total factor productivity growth and monopoly power, although the relationship is statistically insignificant. Model 3 shows that firms operating in monopolistic industries have lower technical efficiency scores, but as monopoly power increases technical efficiency falls and technical efficiency reaches a minimum when HHI is 0.7649 under variable returns to scale and thereafter technical efficiency increases with domestic monopoly power. The average HHI for the full sample is 0.7693 and ranges between 0.5 and 1. However, technical efficiency is inelastic to monopoly power, suggesting that a 1 percent increase in HHI only increases technical efficiency by 0.02 percent. The curvilinear results are similar to those obtained in the other studies in the UK by Mayes et al. (1994) and Mayes and Green (1992) that find the U-shape relationship between monopoly power and technical efficiency, but our results are contrary to the inverted U-shape relationship in Caves (1992b). Import competition, however, does not significantly influence technical efficiency and the coefficient of IMPS is consistently negative in all the models. The negative relationship is consistent with the argument that the inflow of imports is an indication of inefficiency in domestic production.

We also find a positive and significant relationship between technical efficiency and capital intensity (KINT) under constant returns to scale model at the 1 percent level, but an insignificant relationship under variable returns to scale model. The computed elasticities of technical efficiency with respect to capital intensity at the means in Model 1 and Model 2 are equal to 0.05. The results suggest that technical efficiency is higher in capital intensive activities, which is contrary to the comparative advantage theory in the trade literature. The positive and significant relationship supports the argument that more capital intensive firms embody advanced

[8] This negative relationship between monopoly power and efficiency compare favourably with Nickell's (1996) results on the relationship between total factor productivity growth and concentration in UK manufacturing.

technology. The relationship between technical efficiency and multinationality (MNC) is consistently positive but is statistically significant at the 1 percent level in three of the four models. Technical efficiency scores in subsidiaries of multinational corporations are between 0.31 points and 0.41 points higher than in domestically owned enterprises.

The impact of structural adjustment programs, represented by a dummy variable SAPS, is sensitive to the returns to scale assumption and the specification of the model. The coefficient of SAPS is positive in three of the four models, but only statistically significant at the 5 percent level in the CRSTE models. We observe a negative but insignificant relationship in Model 3. The significant positive relationship supports the argument that structural adjustment programs that aim at correcting market rigidities provided incentives for efficient resource allocation in Malawi manufacturing. Technical efficiency scores under constant returns to scale are 0.05 points higher after structural adjustment programs than before adjustment programs.

b) Technical Efficiency in Privatized Enterprises

We turn to the results of a model of the impact of privatization on the technical efficiency of privatized enterprises. Table 4 presents results on sources of technical efficiency in privatized enterprises under two assumptions of measuring of technical efficiency - CRSTE in Model 1 and Model 2, and VRSTE in Model 3 and Model 4. Here, we test the hypothesis that privatization increases the technical efficiency of privatized firms, supporting the predictions of the property rights theory, the principal-agent theory, the public choice theory and our model of commercial SOEs. In contrast to the full sample results, we find no significant evidence that the proportion of state ownership is negatively related to technical efficiency. The relationship between technical efficiency and state ownership is positive but statistically insignificant in all the models.[9]

[Table 4 about here]

[9] STATE is included in the model of privatized SOEs to account for the government had majority holding in one enterprise and minority holding in another enterprise before privatization, and partial privatization occurred in two enterprises in which government had 100 percent share holding before privatization.

In contrast to the industry effects of privatization model, here we find overwhelming evidence that privatization increases the technical efficiency of privatized enterprises. The coefficient of the privatization dummy variable (PRIV) is consistently positive and statistically significant at the 1 percent level in all the models. The hypothesis that privatization increases the performance of privatized SOEs derived from the traditional theories of privatization is strongly supported by the data from privatized enterprises in three manufacturing industries. Technical efficiency scores are between 0.25 points and 0.33 points higher in the period after privatization than in the period before privatization.

The relationship between technical efficiency and monopoly power is negative in the models where HHI enters in the linear form, but we cannot reject the nonlinear specification of HHI in Model 1 and Model 3. Nonetheless, the curvilinear relationship is much flatter in the CRSTE model as monopoly power increases. Model 4 rejects the linear relationship between technical efficiency and HHI in favour of the nonlinear relationship in Model 3. The average monopoly power in industries in which privatized enterprises operate as measured by HHI is 0.6778 and ranges from 0.5 to 1. The results reveal that privatized enterprises operating in monopolistic industries perform worse than those in competitive industries, but the relationship between monopoly power and technical efficiency may be U-shaped. In the nonlinear cases, technical efficiency initially falls as competition decreases and technical efficiency reaches a minimum when HHI is 0.7957 in the CRSTE model and 0.8005 in the VRSTE model and thereafter technical efficiency increases with monopoly power. The computed elasticities of technical efficiency with respect to monopoly power in Model 1, Model 2 and Model 3 are respectively -2.70, -0.43 and -2.16, suggesting that technical efficiency is inelastic to monopoly power. Import competition is negatively associated with technical efficiency but the coefficient is statistically insignificant in all models, like in the full sample results. The negative relationship between technical efficiency and IMPS is in contrast to the impact of domestic competition. Nonetheless, World Bank (1989) and Mulaga (1995) note that effective protection in manufacturing industries has been high, suggesting that the high inflow of imports may be revealing the inefficiency of domestic firms resulting from trade protection.

Aspects of organizational structure and firm characteristics are also important sources of technical efficiency in privatized enterprises in the manufacturing sector. First, the results show

that enterprises with high capital intensity (KINT) are more efficient, and the relationship is statistically significant at the 1 percent level in all the four models. The computed elasticities of technical efficiency with respect to capital intensity 0.07 in the CRSTE model and 0.05 - 0.06 in the VRSTE model. The positive relationship between capital intensity and technical efficiency suggest that although capital is a scarce factor of production, increasing the labour content on the technologies reduces technical efficiency. These results support the argument that capital intensive firms embody the more advanced technology. Secondly, foreign ownership of privatized enterprises is positively associated with technical efficiency, with the coefficient of the multinationality variable (MNC) being statistically significant at the 1 percent level in all the four models. Technical efficiency scores among subsidiaries of multinational corporations are between 0.22 points and 0.33 points higher than in domestically owned firms.

The dummy variable, SAPS, representing the impact of structural adjustment programs is consistently positive in all the four models, but only statistically significant at the 10 percent level when we enter the competition variable in a linear form. The results suggest that structural adjustment policies capturing the effects of price decontrols, market deregulation and trade liberalization provided further incentives for efficient resource allocation among privatized enterprises, although the relationship is sensitive to specification. On average, technical efficiency scores are 0.06 points higher in the period after structural adjustment programs compared with the period before adjustment programs.

6. Conclusion

This study set out to test the relationship between privatization and efficiency based on technical efficiency scores derived from nonparametric production frontiers, and has investigated the sources of technical efficiency in Malawian privatized manufacturing industries. We computed technical efficiency scores for firms using Data Envelopment Analysis (DEA) based on industry-specific intertemporal frontiers at three-digit industry level. Overall, the statistical results show that technical efficiency improved among privatized state enterprises, state-owned enterprises and private enterprises. However, we have significant evidence that changes in technical efficiency are higher in privatized enterprises, and that the proportion of the variance in technical

efficiency attributed to privatization is also higher among privatized enterprises compared with that among state-owned enterprises and private enterprises.

Unlike many other studies of privatization, our approach in this study has been to study all firms competing in the same industry to discern the industry effects and to control for the many other sources of technical efficiency. The results from the econometric analysis, which accounts for other sources of technical efficiency show that improvements in technical efficiency cannot be attributed to privatization alone. The empirical results, particularly among privatized enterprises, show that after controlling for the many other sources of technical efficiency privatization improves technical efficiency and efficiency scores are at least 25 percent points higher in the period after privatization. The positive impact of privatization is also supported by the significant negative relationship between technical efficiency and state ownership in the industry effects model. These findings imply that the technical inefficiency associated with state ownership can be reduced by transferring their ownership to the private sector and partial privatization may not maximize efficiency. We also find that technical efficiency is higher in competitive industries, among firms with high capital intensity and among subsidiaries of multinational corporations. The latter implies that foreign participation in the privatization process in Malawi has positive implication on efficient domestic production. Structural adjustment programs by removing market rigidities enhance the role of the market mechanism and provided further incentives for input allocation to maximize output.

Overall, from a policy point of view, the findings show that the objective of promoting efficiency materialized in the first phase of privatization in Malawi even when we take into account the many other factors that influence technical efficiency. Nonetheless, the competitive environment which was partly reinforced by the sequential implementation of structural adjustment policies played a critical role in facilitating the positive impact of privatization.

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Table 1 Major Privatization Activities in the Manufacturing Sector, 1984-1998

Company	Sector	Year Privatized	Government Equity (%)		Purchaser
			Before Privatisation	After Privatization	
Enterprise Containers Limited	Plastic Products	1984	22	0	Press Corporation [a]
Carlsberg Limited	Beverages	1984	27	0	Press Corporation [a]
Malawi Distilleries Limited	Beverages	1984	41	0	Press Corporation [a]
Malawi Pharmacies Limited	Other Chemical Products	1984	100	0	Press Corporation [a]
Nzeru Radio Company	Radio Assembly	1984	60	0	Gateway Industries Limited
B&C Metal Products Limited	Fabricated Metals	1987	31	0	Brown and Clapperton
Advanx Limited	Rubber Products	1987	50	0	Advanx Limited [b]
Lever Brothers Limited	Other Chemical Products	1987	20	0	Lever Brothers (UK) [b]
PEW Limited	Transport Equipment	1987	87	0	Kamwai Corporation, NICO, Shire
National Oil Industries Limited	Food Processing	1991	77	23	Cargill Inc. (USA)
ADMARC Canning Limited	Food Processing	1991	100	0	Swan Industries Limited
Grain and Milling Limited	Food Processing	1991	75	25	Press Corporation & Namib Mills
Wood Industries Corporation	Wood and Wood Products	1993	100	0	Okhai Limited
Portland Cement Company	Non-Metallic Minerals	1996	51	49	Commonwealth Development Corp. (UK)
Packaging Industries Limited	Paper and Paper Products	1996	34	40	Transmar (SA) Ltd[b]
Encor Products Limited	Fabricated Metal Products	1996	23.3	0	Accord Trust[b]
Dwangwa Sugar Corporation	Food Processing	1996	14	51	Lonrho Sugar(UK)[b]
Sugar Corporation of Malawi	Food Processing	1996	4	40	Lonrho Sugar (UK)[b]
Dwangwa Sugar Corporation	Food Processing	1997	9	42	Lonrho Sugar (UK)[b]
Illovo Sugar Corporation	Food Processing	1997	14	30	Local Investors
Blantyre Dairy Limited	Food Processing	1998	60	40	Dairibord (Zimbabwe)
Optichem Malawi Limited	Industrial Chemicals	1998	23	0	Kynoch[b]

Source: ADMARC (various) **Annual Report and Accounts**, MDC (various) **Annual Report and Accounts**, Privatization Commission (various) **Annual Report and Accounts**, Privatization Commission (1998) **Privatization Newsletter** (various issues)

Notes: a Asset swaps with state holding corporations.
b The purchaser was a previous shareholder pre-emptive rights.

Table 2 Technical Efficiency Scores in Privatized Manufacturing Industries

Type of Enterprise and Efficiency	Mean before Privatisation	Mean after Privatisation	Mean change [p-value]	η^2
Privatised Enterprises	*(108)*	*(48)*		
CRSTE	0.4579	0.7518	0.2939 [0.000]	0.274
VRSTE	0.5667	0.8596	0.2929 [0.000]	0.316
STE	0.7786	0.8781	0.0994 [0.030]	0.030
State-Owned Enterprises	*(62)*	*(22)*		
CRSTE	0.5253	0.4565	-0.0689 [0.132]	0.027
VRSTE	0.6757	0.6960	0.0203 [0.664]	0.002
STE	0.7875	0.6829	-0.1046 [0.052]	0.045
Private Enterprises	*(102)*	*(56)*		
CRSTE	0.5673	0.6142	0.0468 [0.107]	0.017
VRSTE	0.8090	0.7929	-0.0162 [0.511]	0.003
STE	0.6990	0.7817	0.0826 [0.003]	0.054

Notes: The number in parentheses and italics is the number of observations in each period and the figure in brackets is the *F*-test probability of rejecting the null hypothesis of no difference in performance before and after privatization. η^2 is the proportion of the variance in the performance measure that we can attribute to privatization.

Table 3 Regression Estimates of Sources of Technical Efficiency in Privatized Manufacturing Industries

Independent Variables	CRSTE		VRSTE	
	Model 1	*Model 2*	*Model 3*	*Model 4*
STATE	**-0.1952** [a]	**-0.2006** [a]	**-0.2422** [a]	**-0.2293** [a]
	(-4.153)	*(-4.304)*	*(-6.324)*	*(-4.963)*
PRIV	0.0166	0.0207	0.0195	0.0221
	(0.788)	*(0.971)*	*(0.882)*	*(0.999)*
HHI	**-2.0412** [c]	**-0.3301** [a]	**-3.4098** [a]	-0.1097
	(-1.693)	*(-2.927)*	*(-4.381)*	*(-0.886)*
HHISQ	1.1631	-	**2.2290** [a]	-
	(1.490)		*(4.279)*	
IMPS	-0.0334	-0.0531	-0.0177	-0.0328
	(-0.263)	*(-0.419)*	*(-0.289)*	*(-0.285)*
KINT	**0.0052** [a]	**0.0052** [a]	0.0008	0.0010
	(4.189)	*(4.182)*	*(0.999)*	*(0.877)*
MNC	**0.3809** [a]	**0.4080** [a]	0.0575	**0.3053** [a]
	(4.160)	*(4.544)*	*(1.264)*	*(4.216)*
SAPS	**0.0470** [b]	**0.0498** [b]	-0.0022	0.0033
	(2.116)	*(2.234)*	*(-0.114)*	*(0.151)*
Intercept	-	-	**1.9996** [a]	-
			(7.123)	
Firm Effects?	*Yes*	*Yes*	*No*	*Yes*
Adjusted R^2	0.4795	0.4767	0.2608	0.4674
Hausman test [*p*-value]	10.941 [0.027]	57.651 [0.000]	4.7237 [0.580]	330.91 [0.000]
N	398	398	398	398

Notes: The figure in parentheses and italics are t-statistics based on heteroscedastic-consistent standard errors. Subscripts *a, b* and *c* indicate that the parameter is statistically significant at the 1%, 5% and 10% level, respectively. *Yes* to 'firm effects' imply that the model is the fixed effects model with firm-specific constants and *No* implies a random effect model.

Table 4 Regression Estimates of Sources of Technical Efficiency in Privatized Enterprises

Independent Variables	CRSTE		VRSTE	
	Model 1	*Model 2*	*Model 3*	*Model 4*
STATE	0.0550	0.1115	0.1056	0.1063
	(0.574)	*(1.136)*	*(1.146)*	*(1.114)*
PRIV	**0.2512** [a]	**0.3046** [a]	**0.3012** [a]	**0.3281** [a]
	(3.270)	*(3.925)*	*(4.142)*	*(4.344)*
HHI	**-3.7977** [a]	**-0.3474** [a]	**-3.6254** [a]	-0.1739
	(-3.336)	*(-2.621)*	*(-2.843)*	*(-1.350)*
HHISQ	**2.3864** [a]	-	**2.2645** [a]	-
	(3.063)		*(2.695)*	
IMPS	-0.0831	-0.0664	-0.0150	-0.0860
	(-0.815)	*(-0.605)*	*(-0.097)*	*(-0.809)*
KINT	**0.0071** [a]	**0.0066** [a]	**0.0077** [a]	**0.0061** [a]
	(3.237)	*(2.939)*	*(2.912)*	*(2.810)*
MNC	**0.2990** [a]	**0.3286** [a]	**0.2206** [a]	**0.2044** [a]
	(3.994)	*(4.217)*	*(2.863)*	*(2.697)*
SAPS	0.0555	**0.0624** [c]	0.0473	**0.0623** [c]
	(1.574)	*(1.736)*	*(1.217)*	*(1.779)*
Intercept	**1.7464** [a]	**0.5129** [a]	-	**0.5467** [a]
	(4.129)	*(3.702)*		*(4.058)*
Firm Effects?	*No*	*No*	*Yes*	*No*
Adjusted R^2	0.4031	0.3303	0.5433	0.2130
Hausman test	2.1146	1.8094	433.87	4.8826
[*p*-value]	[0.715]	[0.771]	[0.000]	[0.181]
N	156	156	156	156

Notes: The figure in parentheses and italics are t-statistics based on heteroscedastic-consistent standard errors. Subscripts *a, b* and *c* indicate that the parameter is statistically significant at the 1%, 5% and 10% level, respectively. *Yes* to 'firm effects' imply that the model is the fixed effects model with firm-specific constants and *No* implies a random effect model.