Technical Efficiency of Enterprise Sector of Georgia

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Abstract

This thesis investigates the technical efficiency of the enterprise sector in Georgia over the 2000 – 2004 time period using an unbalanced panel data set, constructed from the enterprise surveys in Georgia. The mean value of the measure of technical efficiency based on the fixed effects from the 'within' estimation of the Cobb-Douglas production function is equal to 0.007. The regression results show that market power and skilled labor is beneficial for firm's technical efficiency. There is evidence that state firms are more technically inefficient than private firms and large and medium firms are doing better compared to their small counterparts. There are significant differences in technical efficiency between firms operating in different sectors. The findings suggest that after the decade of the transition process the enterprise sector of Georgia was operating at the low levels of technical efficiency and adequate microeconomic adjustment was still an urgent issue.

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Introduction

As many former Soviet Union countries, Georgia is experiencing the transition period from the central planning to the market economy. Although the country maintained stable inflation and growth after the decade of its transition process, the pace of the reforms was very slow and inefficient in restructuring the enterprise sector in order to improve its performance and increase firms' efficiency.

Measuring firms' technical efficiency has received much attention since Farrell's pioneered work in 1957. Great contribution was done by Afriat in 1972 and by .Aigner, Lovell and Schmidt (1977) and Meeusen and Broeck (1977) to development of different empirical techniques of measuring technical efficiency. Although significant research has been done in many developed and developing countries in this area, the empirical literature is lagging behind in many transition countries and particularly in former Soviet Union republics. Measuring the technical efficiency of firms is particularly important in the latter group of countries, since it is related to a very important policy question in enterprise restructuring and privatization. After estimating the technical efficiency of firms it becomes clearer whether transition measures, such as freeing of prices and trade, privatization and firm restructuring were effective in the country. It is also very important to determine the causes of technical inefficiency and incorporate these findings in design and implementation of effective economic policies in entrepreneurial sphere.

Under the planned system enterprises in Georgia, like in all the other socialist countries, were state owned and oriented to input-output plan rather than to the market and efficiency (Djunkov and Muller, 2002). Labor hoarding and undercapitalization were the main features

of the planned economy and efficiency considerations were secondary in determining labor force and capital in a firm.

During transition firms' efficiency is expected to increase, since macroeconomic adjustment and microeconomic restructuring occurs, the problems of excess labor and lack of capital are addressed, managerial incentives are improved and budget constraints are hardened. The transition in Georgia brought price and trade liberalization followed by the change in ownership through privatization, entry of new firms and policies to stimulate competition. Small scale privatization proceeded much faster during the first decade of transition, which led to 60% share of private sector in the economy by 1998 (Commander, Dutz and Stern, 1999). However, privatization process did not bring deep restructuring in the country. One of the main features of the Georgian enterprise sector was a large share of unofficial economy, which was highly detrimental for the private sector development. Entrepreneurs preferred not to register and hide all their output or operate officially and in order to survive and grow they may needed to misreport their sales and wages. By 1995 unofficial GDP as a percentage of total GDP was 62.6% (while in 1989 it was only 12%) and that number was the highest in the selected group of transition countries investigated by Johnson, et al (1997).

The effect of transition on technical efficiency of Georgian firms is unclear, because of limited research in this area. In the course of transition it is very important to know whether privatization brought more technically efficient firms, whether competition should be promoted or firms should be given some market power to increase their technical efficiency; or whether 'lack' of adjustment in firms was harmful for their technical efficiency. To make the conclusions about the technical efficiency of the Georgian enterprise sector and its possible determinants empirical investigation in needed.

Thus, the aim of this thesis is to measure the technical efficiency of the Georgian enterprise sector over the 2000-2004 time period and identify the sources of technical inefficiency. The paper tests whether privately owned firms are more efficient than state owned counterparts. It investigates the effect of market share of a firm on its technical efficiency. Further this paper identifies the role of human capital in firm's technical efficiency and addresses the question whether there is a variation in technical efficiency by size and sector of the firms.

The conducted empirical analyses are based on the unbalanced panel data set of the enterprise sector of Georgia. The relative measure of technical efficiency of the firms is based on the fixed effects from the within estimation of the Cobb-Douglas production function and takes values from (0, 1] interval. The results show that almost all enterprises in our sample operate below 0.5 technical efficiency levels and the distribution of firms is skewed to zero. The mean value of the technical efficiency is equal to 0.007 with standard error 0.019. The findings show that state ownership is detrimental, while the large market share and skilled workers are beneficial to firms' technical efficiency. The results suggest that large and medium firms are more technically efficient than small firms. The results show that firm technical efficiency varies across sectors, and Fishing is the most technically inefficient, while Construction is the most efficient one.

The structure of the paper is the following. Chapter 1 describes the development of the measures of technical efficiency and reviews some main findings about the sources of technical inefficiency, focusing mainly on transition economies. Chapter 2 presents the macroeconomic adjustment and microeconomic restructuring as a background for analyzing technical efficiency in the Georgian enterprise sector. Chapter 3 describes the data set and variables employed in the empirical analysis. Chapter 4 proposes the model and method for

production function estimation. Chapter 5 presents the estimation results of the production function. Based of the relative measure of firm technical efficiency, it describes the technical efficiency of the firms by different characteristics. Further, this section identifies the sources of technical inefficiency and interprets the findings. The final part concludes.

1. Empirical Literature on Technical Efficiency

This chapter of the thesis describes the development of the measures of technical efficiency and presents some main findings on the determinants of technical inefficiency. The main focus is made on technical inefficiency and its sources in transition countries, because of its importance to find the ways to raise efficiency. Almost all studies discussed below empirically measure the firm level technical efficiency by estimating the most widely used frontier production functions in practice and identify the following determinants of technical inefficiency: ownership structure, competition, managerial skills, firm size, profitability, export orientations, lack of input adjustment, etc. Unlike most of the developed and CEE countries, little research in this area has been devoted to former Soviet Union countries, including Georgia. The main reason for is absence of established systems of data collection by government agencies. There is no research about the technical efficiency of Georgian firms, but only general trends of privatization and restructuring have been studied. Some important findings about the enterprise sector of Georgia during the transition period are presented at the end of this section.

There has been a continuing development of the measures of technical efficiency over the past 50 years. For a long time, average productivity of labor was widely used by economists as a measure of efficiency. But according to Farrell this is an unsatisfactory measure as it ignores all other inputs and it might have misleading effect on economic policy making, such as overcapitalization. Labor productivity growth may simply account for a low initial level of efficiency (Djankov, 1999). There was an attempt to construct efficiency indices in which a weighted average of inputs is compared to output, but it failed, because this approach was faced by index number problems.

A great success was achieved by Farrel (1957) when he proposed a general measure of productive efficiency which takes into account all the inputs and avoids index number problems by separating allocative and technical efficiencies of firms. He defined the firm's overall efficiency as the product of its technical and allocative efficiency based on the assumption that the efficient production function (the best actually achieved standard as weighted average of all firms) is known. According to Farrell, the firms' technical efficiency is relative to the set of firms from which the efficient isoquant is estimated. Since factors used by firms are heterogeneous, which most of the time are not measurable, technical efficiency reflects differences in quality, which can not be separated from management of factors.

As mentioned by Winsten in the discussion of Farrell's paper, the most useful thing that was done by Farrell was the introduction of efficient production function, as compared to previously used average production function estimated by regression methods, which became the predecessor of the frontier functions originated by Afriat (1972). Although Farrell's work had some drawbacks[1], it made great contribution to measuring technical efficiency and stimulated further research.

The measures of technical efficiency obtained from frontier functions are different from Farrell's. The frontier production function specifies maximum output from given inputs, while Farrell's measure of technical efficiency is an input-based measure that is the ratio of the best practice input usage to actual usage, output held constant. The main advantage of the frontier functions is that they incorporate technical inefficiency in the production by

[1] Discussion on Mr. Farrell's Paper, Farrell (1957), The Measurement of Productive Efficiency, Journal of the Royal Statistical Society, Series A (General) Vol. 120, No. 3, pp: 282-290

assuming non-zero expectation of the error term. Average production function, on the other hand, assumes zero expectation of the disturbance term.

The most contemporary and widely used method to estimate firms' technical efficiency is stochastic frontier function estimation proposed simultaneously by Aigner, Lovell and Schmidt (1977) and Meeusen and Broeck (1977). They proposed an efficiency model with composite error which includes disturbance due to inefficiency and statistical disturbance due to randomness (reflects factors beyond the control of the firm, such as weather, machine performance, climate, etc) and to specification and measurement errors. The drawback of the measure of technical efficiency proposed by Afriat (1972), was that it did not take into account statistical error and led to lower estimates of technical efficiency compared to contemporary stochastic frontier function estimates.

Estimating the stochastic production function, there is a need for assumption on technical inefficiency in order to be able to measure firm technical efficiency. One of the possible ways is to assume some form of distribution on technical inefficiency term and estimate by Maximum Likelihood Estimation (MLE) method. Brada, King and Ying Ma (1997) assumed the half normal distribution of technical inefficiency term and determined the enterprise efficiency in Czechoslovakia and Hungary using cross section data from 1990 and 1991 respectively. They tested whether ownership structure, managerial effort (proxied by bonuses), firm size (proxied by value-added by firm in total industry value-added), export orientation and profitability effect technical efficiency of a firm. They did not find the significant role of ownership in enterprise efficiency. However they found that enterprise efficiency is positively related with firm size and negatively with managerial effort. Thus, firms with large market share were more technically efficient compared to their other

counterparts, supporting the disorganization effect of competition (Blanch and Kremer, 1997). The authors claim that in Czechoslovakia the negative relationship between efficiency and managerial skills suggests that managers who devoted greater efforts to lobbying and less to improving the technical efficiency of their firms were able to influence targets in a way that made it easier for them to meet these targets and thus pay higher bonuses than did managers who either failed to lobby effectively or devoted their efforts to improving efficiency. In Hungary there were no centrally-set targets, thus the results reflect the behavior of loss-making firms using up their cash reserves, liquidating assets, and delaying tax payments as well as payments to their suppliers, but continue to pay their managers and workers wages and bonuses that exceed what productivity or market forces would dictate. They further investigated the link between export orientation and profitability and technical efficiency. No significant effect of export orientation was found on technical efficiency, but in Hungary's more reformed economy efficient firms were more profitable, thus firm's financial results depended largely on its own efforts; while inverse relationship between efficiency and profitability in Czechoslovakia can be taken as evidence that by 1990 Czechoslovakia lagged behind Hungary in reforms and still had some features of the planned economy, such as profit redistribution (reallocation of profits from profitable to unprofitable firms by central authorities).

The efficiency of Hungarian enterprise sector was further tested by Maurel (2001) and significant role of ownership was found for the later period of transition. He used a rich and unique Hungarian panel data set over 1993-1998 and estimated the two measures of efficiency: total factor productivity (TFP) gross of property structure by obtaining the residual from the standard production function which does not include property variables as explanatory variables and TFP net of the effect of corporate governance obtained from the

regression which includes property variable dummies. The results show that state owned firms are less efficient than private firms in the sample even after controlling for ownership structure. He concluded that privatization (change of ownership) should be complemented by the proper competition in order to enhance firm efficiency.

Jones, Klinedinst and Rock (1998) measured the productive efficiency of Bulgarian manufacturing firms during late communism and early transition (1989-1992) based on MLE of the stochastic frontier model and investigated the determinants of productive inefficiency. They found that efficiency of Bulgarian firms in early transition is unaffected by export, joint venture state (transfer of managerial expertise and technology), labor management relation and unionization, but it is enhanced by incentive compensation arrangements that provide profit-sharing and incentive pay systems. Bulgarian private firms, along with Czech and Hungarian counterparts (Brada, King and Ying Ma, 1997), did not show better performance attributable to persistent soft budget constraints in state firms. The disorganization hypothesis applies to Bulgarian firms as well in the beginning of the transition, suggesting that competition (proxied by firm's market share) worsened efficiency, because it was accompanied by loss of capital.

The empirical literature focuses not only on technical efficiency differentials in public and private firms, but also within private firms. Mathijs and Swinnen (2001) investigated whether de novo firms were more technically efficient than restructured former state owned firms in East German agricultural sector during 1991-1994. Assuming half-normal distribution of the technical inefficiency term and estimating the Cobb-Douglas specification of the frontier production function by MLE, the authors found that as a consequence of privatization accompanied by competition and factor adjustment, the gap in efficiency disappeared during

transition. They identified labor hoarding as the main source of technical inefficiency and stressed that labor adjustment led to improvements in technical efficiency.

Besides the distributional assumption, it is possible to construct technical inefficiency as a function of factors that may affect it. This approach was used by Blanchard, Paul and Sevestre (2002) in the study of two western European (France and UK) and three eastern European (Czech Republic, Bulgaria and Romania) countries for 1993-1998 time period. They estimated the Cobb-Douglas production function with the incorporated technical inefficiency term as a function of labor, capital and skill adjustment by Ordinary Least Squares (OLS) method. Their findings show that adjustment raises firm technical efficiency, but it is costly particularly in transition countries and partial adjustment might be more rational.

While labor hoarding was the main source of technical inefficiency in East German agricultural sector (Mathijs and Swinnen, 2001), lack of capital adjustment turned out to be more detrimental for firms' technical efficiency compared to lack of labor adjustment in the Hungarian enterprise sector. Korosi (2002) analyzed the effect of factor adjustment on the Hungarian firms' technical efficiency over the period 1992-'99 using the specification of technical efficiency term derived by Blanchard, Paul and Sevestre (2002). His findings support those by Blanchard, et al. (2002) that firms hoard labor and pay higher wages, but the main source of technical inefficiency in the Hungarian firms are inadequate capital and skill adjustments rather than adjustment of the level of employment.

The findings by Benaeek, Shemetilo and Petrov (1997) for the Czech textile and clothing industries (1990-1994) suggest that physical capital was significantly slowing the process of

restructuring and was the main cause of inefficiency. One of the most important determining factors of immobility of capital was its firm specificity, demand shocks and the lack of financial resources. Thus, enterprises in transition preferred to retain its capital, instead of scrapping, selling and replacing it with new more productive ones, which was a rational behavior. Labor hoarding is shown to be a lesser problem than capital hoarding in Czech firms. The authors additionally identified a disastrous effect of tunneling (stripping an enterprise of its assets by non-owners and the channeling of these assets into personal use as a result of the chaos in ownership and the dominant position of agents over principals) on firm's efficiency. They found the strong negative correlation between profits and technical inefficiency. Thus, negative relationship between profits and technical efficiency in 1990 found by Brada, King and Ying Ma (1997) reversed already by 1994 which is the evidence that the restructuring in textile and clothing manufacturing was over and these industries were approaching to market behavior and development. Thus, a competitive environment was created in the country.

Another possible identification assumption is time constancy of technical inefficiency term in panel data analysis. This approach was used by Seale (1990) who estimated the stochastic frontier production function for twenty five Egyptian small-scale floor tileries in 1982-1983 using unbalanced panel data. He constructed the technical inefficiency index based on fixed effects from within estimation of the Cobb-Douglas specification. He investigated whether entrepreneurial skills (proxied by an entrepreneur's age), firm size (proxied by total floor tile production measured in 1000 square meters), or market location (measure of competition proxied by distance in kilometers from an urban area) are associated with technical efficiency and found that entrepreneurial skills and firm size has positive and significant effect on technical efficiency, location effect is positive although not significant.

The estimation procedure of technical efficiency was based on even weaker assumptions conducted by Soderbom and Teal (2004) compared to that by Seale (1990). They employed 7-year (1991-'97) panel data from Ghana's manufacturing sector. They modeled stochastic frontier function as 'translog' specification and allowed not only the time constant technical inefficiency term but also statistical error to be correlated with the explanatory variables, exploited panel dimension of the data and used the IV approach (GMM estimator). They tried to detect whether there is a systematic variation in technical efficiency between different sectors, ownership structure, location (measure of competition) and managerial skills (measured by firm age). Their findings did not support efficiency differentials related with managerial skills found by Seale (1990) for Egyptian small-scale floor tileries, which can be explained by the different measures used. On the other hand their results are consistent that location has no significant effect on firms' technical efficiency. They found some variation in technical efficiency across sectors, but not by ownership type.

Thus, the empirical studies employ different approaches of measuring technical efficiency, such as non-parametric and standard production function estimations, but stochastic frontier production function has an advantage over them and it is the most widely used by the researchers. Employing different techniques to measure firm level technical efficiency, the existing literature identifies different factors that effect technical efficiency of firms. The results from transition countries suggest that private firms were not very different from state counterparts at the early stage of transition. However, significant differences between them were found during the later period, explained by the lack of competition. At the early stage of transition firms with large market share were more technically efficient than firms with small market share. The beginning of the transition was also characterized by negative relationship between managerial skills and profitability and technical efficiency. As the transition

proceeded, the relationship between the technical efficiency and the above motioned factors reversed. Capital, labor and skill adjustments are the determinants of technical inefficiency in all investigated countries. The same sources of technical inefficiency are identified in developed (Blanchard, Paul and Sevestre, 2002) and developing countries (Seale, (1990); Soderbom and Teal (2004)) as well.

Recognizing that privatization and restructuring are important for determining firms' technical efficiency in transition, I will discuss the findings about the Georgian enterprise sector, in order to create a background for further analysis. Djankov and Kreacic (1998) studied the restructuring decisions of Georgian firms and concluded that restructuring was only reactive, not deep. Djankov (1999) found that Georgian firms have restructured the least among the six newly independent states (Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Russia, and Ukraine) by 1997. They did not find a clear role of competition in restructuring process. Some changes appear to be promoted by more competition while other changes occur in the presence of market power. They found that competition from foreign producers is associated with employment cuts and with changes in suppliers (but reduce the likelihood of the disposal of assets, renovations and computerization). By contrast, firms with a larger market share were more likely to engage in computerization, renovations, and the establishment of a new marketing department and the disposal of assets. They found that the firms with smaller market share were managed by persons with lack of the necessary skill for operating in a competitive environment. Another finding by Djankov (1998) is that in Georgia restructuring is more rapid in enterprises bought-out by their managers as compared to enterprises privatized through voucher auctions where the control (direct or indirect) remains with their managers, suggesting that this may be due to the perception on the part of managers that ownership acquired through voucher privatization is a windfall gain.

2. Transition in Georgian Economy[2]

Having presented the empirical findings about the restructuring process during transition in Georgia, this chapter more extensively describes the macroeconomic and microeconomic adjustment in the country before conducting the empirical analysis. More attention is paid to the privatization of state ownership and restructuring within enterprises, generated by transition process.

2.1 Macroeconomic Environment

After the break up of the Soviet Union, Georgia experienced significant economic crises accompanied with political conflicts and the increased share of shadow economy. During the first years of independence the production process stopped in many enterprises and GDP fell by almost 70 per cent (Cukrowski and Kavelashvili, 2001). In 1994 government initiated the process of intensive system transformation based on a transition to a market economy, which involved economic liberalization, privatization of the state-owned sector, strengthening the budget, enforcing national currency stability, reducing inflation rate and ensuring economic growth. In the following years significant progress was achieved in establishing relative macroeconomic stability (real GDP growth reached to 10.7% in 1997), although characterized with significant fluctuations. In 1998 it was adversely affected by the Russian crisis. By 2000 the country overcame the hardship period and managed to maintain long term price stability, reflecting in its significantly low and not sharply fluctuating core inflation rate, and the real GDP growth 1.8%, in which shadow economy accounted for 50% by that time. The Georgian economy employed only a minimum level of available factors, primarily

[2] This section is based mainly on the information provided in Annual Reports by National Bank of Georgia; More statistics of the economy of Georgia can be found in Table 1 in the Appendix

caused by insufficient investments, corruption, noncompetitive environment and imperfect legislation.

Structural and institutional reforms in the country in 2004, along with rapid legalization of economic activity were evident in maintaining the macroeconomic stability at the transition stage and facilitation of economic growth. The real growth of the economy can be explained by putting production capacities gradually into operation and enlargement of the volume of investments in the fixed capital. As a result of large-scale legalization of the economy the share of the unobserved segment in the total output decreased to 28.8% by 2004.

Although increasing over time, in 2004 the Georgian economy showed lower real GDP growth compared to 2003. 2.7% drop was attributed to the reduction of agricultural (the leading sector of the economy) production due to unfavorable weather conditions; higher contribution of Baku-Tbilisi-Ceyhan oil pipeline and Baku-Tbilisi-Erzerum gas pipeline construction to growth in 2003 compared to 2004; legalization, which halted illegal economic activities and stopped the growth of the formation of value added. Additionally, in 2003, during the pre-election campaign GDP growth was temporarily increased as a result of increased spending. However, the growth rate in 2005 was 9.3%, indicating that the drop during the previous year was not induced by qualitative worsening of the economic conditions.

Among types of economic activities Financial intermediation represented one of the strongest sectors significantly influencing economic expansion. The growth rate of the sector was unprecedentedly high since 1999 and comprised 52%, indicating the sustainable and dynamic

development of the banking sector. All the other sectors in the country developed and grew, while Mining & quarrying and Public administration spheres continued the declining trend.

Despite the positive developments in the country's economy, the high level of unemployment still remained an acute problem even in 2004. Unemployment level growth continued at the expense of reorganization of state firms. Working places created in the private sector turned out to be insufficient for accommodating freed labor force caused by the scarcity of the stable and fulltime jobs. The unemployment level went up from 10.3% to 12.6% over 1996-2004 period and reached to 13.8% in 2005. According to the data of the State Department of Statistics of Georgia, almost 80% of the unemployed had no job for a year and more; the employment problem was especially acute among youth. The unemployment problem was severe also among low-skilled workers due to increased wages and salaries and thus increased demand for qualified labor force.

The actual unemployment level in the country is higher, because of high level of underemployment and hidden unemployment. Due to very low chances of finding a job through the employment agency, small amounts of unemployment benefits (11-14 Lari per month) the labor force was shrinking. More and more long-term unemployed give up hopes of finding a job, become discouraged workers and leave the labor force. Hidden unemployment is also rather high, especially in the government sector, where a large part of personnel can only formally be considered as employed. Therefore, the official statistics misrepresent reality and inaccurately reflect labor market conditions.

The number of employed decreased from 80.7% in 1996 to 65% in 2004, although self-employment mostly in agricultural sector in rural areas and employment in private sector

increased from 19.3% in 1996 to 34.8% in 2004. The decline took place in nearly all spheres except for trade and services, where self-employment is particularly prevalent. Due to a very limited number of jobs in the formal sector and a lack of qualified labor force, the major provider of employment is the shadow economy, which employed 750000 workers by 1997 estimates (Cukrowski and Kavelashvili, 2001), where retail and wholesale trade, as well as services - areas that do not require special knowledge and skills - account for a significant share. Income of this group of workers is low, while the job itself is often temporary or seasonal. The providers of the jobs were Agriculture (40%) and Services (40%), while industry accounted only 20% of employment in the country by 2004.

Thus, the positive effect of macroeconomic adjustment (overall price stability, stable national currency and developing financial system) was not fully reflected in the real sector due to negative impact of exogenous factors, serious problems in fiscal field, widespread corruption and large scales of the shadow economy.

2.2 Microeconomic Conditions

Pre-transition enterprises in the socialist countries, including Georgia, were state-owned overstaffed and undercapitalized firms, using outdated technologies, protected from competition, entrepreneurial skills and incentives were system specific, including lobbying for soft supports and the structure of production was driven by political objectives. Firms tended to be both larger and to possess more market power than in market economies (Djankov and Murrell, 2002). Transition policies aimed to adjust enterprise sector to market needs, thus change ownership, competition, soft budgets, managerial incentives and skills and institutions. According to Commander, Dutz and Stern (1999) transition requires the reallocation of resources across activities through closure of inefficient firms and the creation

of new firms. It also requires restructuring of existing firms where improvements in performance are feasible. The following paragraphs summarize the main elements of the reforms on the microeconomic side in order to set the scene for the subsequent analysis.

After fifteen years of transition Georgia still faces formidable challenges in its transition. Chubrik (2005) placed Georgia in the group of partial reformers in his study of transition countries. According to his findings the first stage reforms, such as price and trade liberalization, small-scale privatization were necessary, but not sufficient for sustained economic growth. Only comprehensive reforms, including enterprise restructuring, large-scale privatization and other measures, are growth enhancing.

As a result of privatization of state enterprises the share of private sector in GDP increased significantly. The primary method was voucher based mass privatization favoring incumbent managers (Djankov, 1998), while management and employee buy-outs (MBOs) and direct sales to outsiders (including foreign investors) had secondary importance. Georgia ended up with the following ownership structure by 1997: managerial ownership (53.6%), employee ownership (10.4%), state ownership (3.3%), outside local ownership (8.0%), outside foreign ownership (2.2%) and individual ownership (2.2%). Voucher based privatization hindered necessary restructuring of the enterprise sector, since the managers who gain ownership for free (through vouchers) had fewer incentives to restructure, as their income was not solely based on the success of the enterprise. Maintaining employment has remained a key objective of both firms and government, which can be explained by the absence of social benefits. Firms have adjusted employment only partially, preferring instead to vary working hours and impose wage arrears on workers. On the other hand management-bought firms restructured twice as fast as state-owned or voucher-privatized firms, as their fortunes were connected

entirely to the profits that the enterprise generates (Djankov, 1998). Georgia had the highest growth in labor productivity (19.2%) and the lowest asset sales (18.2%) and renovation (24.2%) among the six former Soviet Union countries investigated by Djankov (1999). The high measure of the first indicator of Georgian enterprises can be the result of ceased operations during the civil war in 1993-94, and the sales growth was coming from a low base. Low asset sales indicate management quality. They can use the proceeds from such sales to finance working capital and managers who refuse to sell assets in the hope of 'better times' will likely cease operations altogether.

Although there has been a large decline in explicit subsidies by 1997, the budget constraints has not been hardened enough. The budgetary subsidies reduced to 1.5% of GDP while in 1994 it was 13.4%, but these numbers are often misleading (Commander, Dutz and Stern, 1999). Soft supports remained as delayed payments, as well as through soft credits from the banking system.

Since Georgian privatization favored insiders, the lack of new investment and managerial skills remained substantial. Foreign direct investment (FDI) records, a source of management know-how, technology, and skills for enterprises, were very law relative to other transition countries of the region. FDI inflow as a share of GDP was 3.7% in 1999, which was about US$ 20 on per capita bases (Cukrowski and Kavelashvili, 2001). The explanation can be found in legal, economic and political environment. Although it maintained low inflation and real GDP growth, fiscal problems suggests that the macroeconomic environment in Georgia still cannot be considered as stable.

Although Georgia privatized a huge part of its economy and achieved significant private sector share by 2000, it failed to restructure successfully its enterprise sector and establish adequate corporate governance, competition and legal environment for market economy and lower the level of corruption in the country.

From 2003 the new government reoriented the Georgian economy toward large-scale privatization, free markets, reduced regulation, and control of corruption. The government privatized nine times the value of state-owned assets in 2005 as it did in 2000-2003. The privatization methods are mostly direct sales through auction and competition. The Georgian government expects to have privatized all of the large state-owned industries by the end of 2008, increasing revenues and removing a temptation toward corruption. The World Bank recognized Georgia as the world's fastest-reforming economy in its 2007 "Doing Business" report, ranking it as the world's 37th easiest place to do business. The World Bank's "Anti-Corruption in Transition 3" report places Georgia among the countries showing the most dramatic improvement in the struggle against corruption, due to implementation of a strong program of economic and institutional reform and reported reductions in the burden of bribes paid by firms. Georgia strengthened its orientation toward FDI, which is the most important source of physical and human capital for the country.

3. Data and Variable Description

The empirical analyses are based on the five year unbalanced panel data set covering 2000-2004 time period obtained from the Statistics Department of the Ministry of Economic Development of Georgia. The data covers registered economically active state and private enterprises by fourteen sectors, except Public administration, determined according to the National Classification of Georgia. It is representative of the enterprise sector of the whole country, since it covers the enterprises from thirteen regions of Georgia. It also covers all six organizational-legal types of enterprises defined by Law of Georgia 'On entrepreneurs'.

Since the sample contains only registered enterprises, the unofficial sector of business activity as well as business activity of legal and physical persons at markets and bazaars is not included, thus the data is missing the important part of the economy. The resulting panel contains 34129 observations after dropping all the firms whose nominal average wage per employee was below 20 GEL, which is the minimum salary by law (Annual Report 2000, NBG) and several large firms (outliers).

Aggregate Producer Price Indices[3] are used to deflate all the monetary variables. All references in the text and tables refer to deflated values of output, fixed assets and wages. I constructed the measure for human capital in a firm as its average monthly wage per employee divided by average monthly industry wage per employee. Another constructed variable is a measure of concentration defined as a share of each firm in total industrial output (the same measure was used by Jones, et al (1998) in the study of Bulgarian firms). Along with ownership (one) and industry (thirteen) dummies I additionally constructed the dummies for size (two) of the firms according to the gradation of enterprises which is in action since

[3] Web-site: nbg.gov.ge

2002, taking the annual average number of employees in a firm as the determinant of its size: small firm is a firm whose number of employees does not exceed 20, meduim firm - with number of employees below 100 and large firm - with number of employees more than 100.

Table 1 – 5 present the descriptive statistics for the key variables for the aggregate sample, by ownership type, size and sector of the firms and by time period respectively[4]. Table 1 shows the summary statistics of the aggregate sample. The average output and fixed assets per firm are 3.507 and 4.684 thousand GEL respectively, although most of the firms operate below averages. 89% of the firms produce below average and 92% hold below average fixed assets in our sample. Average number of employees per firm is 32, while it ranges from 2 to 3960. Most of the firms are small or medium employ below average employment level (81%). Average relative wage is 0.71 and varies from 0.076 to 31.81, shows high wage inequality across firms. But 84% of the firms pay below average level thus most of them are low pay firms. Firms account for 0.2% of the market share on average. The largest firm in the sample occupies 69% of the market, but 99.75% of the firms have marker share less than 10%, and 87% has smaller market share than average firm in the sample. Thus there is no evidence of high market concentration.

Table 2 presents the summary statistics of the data by ownership type of the firms, containing four times more number of private enterprises than state counterparts. Although state firms produce more output, hold more fixed assets and employ more people than private firms on average, some private firms produce three times more than state firms. Variation in output, fixed assets and employment is higher in state firms compared to private ones as well.

[4] More about the data see Tables 2-4 provided in the Appendix

Table 1: Descriptive statistics (2000-2004)

Variables	Mean	Std Dev.	Min	Max
Output	3.507	29.675	0.001	1886.747
Fixed assets	4.684	63.104	0.001	3336.922
Employment	32.428	127.762	2	3960
Relative wage	0.706	0.971	0.076	31.810
Market share	0.002	0.0153	$2.45 \cdot 10^{-7}$	0.691
No of observations	34129	34129	34129	34129

Note: all the monetary variables are deflated by aggregate PPI, thousands GEL

In addition state firms are characterized by higher relative wage compared to private firms, although the variation is greater in the latter. The higher relative wage in state firms may stem from soft budget constraints and not from the better skilled workers. However 79% of state and 86% of private firms pay lower than average industry wage per employee. The mean value of market share is larger for the state firms than for the private counterparts, but 99% of both state and private enterprises operate at the market share less than 10%. Comparison of state and private enterprises to average firm in the sample (see Table 1) shows that private firms operate below sample averages in terms of output, fixed assets, employment and relative wage and are similar to average firm in terms of market share. Particularly the drastic difference is in employment levels: 89% of private firms employ less than 32 workers, while only 47% of state firms have such a low level of employment.

Table 2: Descriptive statistics by ownership type of firms (2000-2004)

	State				Private			
Variables	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	6.321	34.217	0.001	644.216	2.868	28.505	0.002	1886.747
Fixed assets	14.213	124.296	0.001	3336.922	2.520	36.786	0.001	2342.150
Employment	95.890	264.397	2	3960	18.016	55.088	2	2489
Relative wage	0.753	0.833	0.085	31.810	0.695	1.000	0.076	27.595
Market share	0.004	0.025	$2.50 \cdot 10^{-7}$	0.691	0.002	0.012	$2.45 \cdot 10^{-7}$	0.678
No of observations	6316	6316	6316	6316	27813	27813	27813	27813

Note: all the monetary variables are deflated by aggregate PPI, thousands GEL

Table 3 presents the summary statistics of the data by size of the firms. The largest share in the sample belongs to small and the smallest to large firms. But the large enterprises are

larger in terms of produced output and fixed assets than medium and small firms. Additionally average relative wage is higher in large than in medium and small counterparts, although some of the small firms pay the highest wages in the sample. Small firms have the lowest market share in their sector followed by medium and large firms on average and the variation across firms increases as the size of a firm increases. The 87%, 78% and 59% of the small, medium and large firms respectively pay lower wages compared to average industry wage. Additionally, almost all of the small and medium firms contribute less than 10% to the total industrial output, while 97% of large firms operate below 10% market share. Small firms account the largest share of the firms operating below sample averages in all variables, followed by medium and large firms. Small and medium firms stand closer to each other, while large firms stand apart.

Table 4 presents the summary statistics of the data by sector of the firms. The number of firms is distributed evenly across sectors. The largest share is accounted by the Trade & repair, Manufacturing and Transport & communications sectors, while the smallest share belongs to Fishing and Financial intermediation. The largest average level of output is produced in the Electricity, gas & water supply, Mining & quarrying and Transport & communications sectors following by Construction and Manufacturing. The highest levels of fixed assets are held by firms in the Mining & quarrying and Electricity, gas & water supply sectors. Mean employment level is the highest in the Electricity, gas and water supply, Health & social work, Transport & communications and Education sectors and largest firms in the sample are also presented in these sectors along with Manufacturing. Only small and medium firms operate in the Fishing and Financial intermediation sectors. All sectors except Fishing and Transport & communications, pay below average industry wage on average and Real estate, renting & business activity is characterized by the greatest variation.

Table 3: Descriptive statistics by size of firms (2000-2004)

Variables	Small				Medium				Large			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	0.643	2.481	0.001	129.524	3.773	13.491	0.002	432.187	38.661	114.822	0.027	1886.747
Fixed assets	0.574	4.694	0.001	536.235	3.774	18.526	0.001	834.947	59.946	253.504	0.004	3336.922
Employment	7.201	4.801	2	20	44.796	20.915	21	100	304.884	445.437	101	3960
Relative wage	0.633	0.923	0.076	31.810	0.834	1.033	0.084	20.609	1.154	1.143	0.090	15.043
Market share	0.0007	0.007	$2.45 \cdot 10^{-7}$	0.504	0.003	0.014	$6.30 \cdot 10^{-7}$	0.678	0.017	0.050	$1.99 \cdot 10^{-5}$	0.691
No of observations	24843	24843	24843	24843	7318	7318	7318	7318	1968	1968	1968	1968

Note: all the monetary variables are deflated by aggregate PPI, thousands GEL

Table 4: Descriptive statistics by sector of firm (2000-2004)

Variables	Agriculture, hunting & forestry				Fishing				Mining & quarrying			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	1.020	6.183	0.004	132.865	0.319	0.390	0.003	2.076	11.020	53.146	0.004	516.596
Fixed assets	3.344	23.977	0.001	536.235	1.403	2.246	0.005	7.626	9.457	37.426	0.002	289.310
Employment	23.428	37.436	2	607	12.512	10.722	2	48	95.02	402.486	2	3156
Relative wage	0.82	0.603	0.263	6.172	1.177	0.653	0.405	3.054	0.577	0.833	0.085	9.957
Market share	0.008	0.032	$3.60 \cdot 10^{-5}$	0.563	0.122	0.141	0.002	0.678	0.019	0.085	$6.16 \cdot 10^{-6}$	0.691
No of observations	608	608	608	608	41	41	41	41	270	270	270	270

Continues

Variables	Manufacturing				Electricity, gas & water supply				Construction			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	4.923	24.580	0.002	780.974	24.741	109.227	0.002	1530.680	5.125	15.251	0.002	382.576
Fixed assets	4.126	26.277	0.001	1347.907	69.171	341.569	0.004	3336.922	1.646	10.287	0.003	403.826
Employment	32.483	113.54	2	2931	139.825	447.448	2	3960	37.012	64.498	2	1442
Relative wage	0.624	0.74	0.12	16.17	0.675	0.89	0.092	12.17	0.732	0.71	0.08	8.773
Market share	0.0009	0.0043	$3.15 \cdot 10^{-7}$	0.106	0.006	0.027	$4.39 \cdot 10^{-7}$	0.359	0.002	0.0056	$1.14 \cdot 10^{-6}$	0.121
No of observations	5533	5533	5533	5533	802	802	802	802	2393	2393	2393	2393

Continues

Variables	Trade & repair				Hotels & restaurants				Transport & communications			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	0.747	3.691	0.001	106.235	1.256	10.670	0.006	203.647	10.370	65.156	0.002	1886.747
Fixed assets	0.578	4.106	0.001	166.739	4.132	45.871	0.002	926.839	12.387	90.263	0.002	3092.556
Employment	8.711	19.735	2	522	11.715	26.016	2	474	59.972	199.710	2	3925
Relative wage	0.813	0.164	21.74	0.342	0.465	0.1	10.06	0.747	1.444	0.076	21.75	0.813
Market share	0.0005	0.003	$8.20 \cdot 10^{-7}$	0.093	0.003	0.023	$8.96 \cdot 10^{-6}$	0.568	0.001	0.009	$2.45 \cdot 10^{-7}$	0.252
No of observations	9151	9151	9151	9151	1909	1909	1909	1909	3443	3443	3443	3443

Continues

Variables	Financial intermediation				Real estate, renting & business activity				Education			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	0.603	1.230	0.008	8.991	1.011	2.691	0.002	48.203	1.180	6.197	0.006	118.140
Fixed assets	0.199	0.314	0.003	1.725	1.969	17.537	0.001	834.947	0.403	1.530	0.001	20.264
Employment	7.119	7.014	2	38	14.670	24.867	2	289	50.309	203.233	2	3433
Relative wage	0.83	0.916	0.133	4.804	0.814	1.32	0.122	20.61	0.74	1.214	0.164	27.6
Market share	0.042	0.076	0.0005	0.504	0.001	0.003	$1.89 \cdot 10^{-6}$	0.041	0.004	0.021	$1.86 \cdot 10^{-5}$	0.325
No of observations	118	118	118	118	4337	4337	4337	4337	1215	1215	1215	1215

Continues

Variables	Health & Social work				Other kinds of activity			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	1.302	3.557	0.002	87.710	1.506	6.107	0.003	133.197
Fixed assets	1.456	5.825	0.001	230.760	2.739	11.491	0.002	206.115
Employment	68.579	98.634	2	1075	37.608	128.206	2	2366
Relative wage	0.934	0.947	0.232	31.81	0.601	0.697	0.146	13.89
Market share	0.002	0.004	$2.79 \cdot 10^{-6}$	0.085	0.004	0.013	$5.18 \cdot 10^{-6}$	0.282
No of observations	2895	2895	2895	2895	1414	1414	1414	1414

Note: all the monetary variables are deflated by aggregate PPI, thousands GEL

The mean value of market share is the largest for firms in the Fishing, Financial intermediation and Mining & quarrying sectors, while the smallest share belongs to firms in the Manufacturing, Transport & communications and Real estate, renting & business activities sectors. The largest firms in Real estate, renting & business activities and Health & social work account only 4% and 8.5% in the total industry output respectively, showing that they are the least concentrated sectors in the sample. Comparing the summary statistics by sector to the overall sample statistics (see Table 1) we can see that there is a great variation across sectors in all variables.

Table 5 presents the summary statistics of the data by time period from 2000 to 2004. The number of surveyed enterprises increases over time and reaches to 7649 firms by 2004. The average output shows the increased pattern over time and becomes more dispersed across firms. On the other hand number of employees decreases slightly and fixed assets remains almost constant after decline in 2000. The wages paid by firm approaches to industry average wage. Mean value of market share of firms is approximately constant in all periods and is equal to 0.2%.

Having presented the main descriptive statisitcs of the data I would like to mention some limitations of the given data set. The output and wage bill are distorted measure, because employers prefer to declare lower numbers than actual ones for tax invasion purposes. The measure of fixed assets is distorted as well, because of differences in depreciation methods used in practice. The average number of employees is not a satisfactory measure of labor input, since we can not distinguish between full and part time workers. Unfortunately, we can

not distinguish between domestic private and foreign owned firms, nor newly created and privatized former state owned ones. We can only distinguish between state owned enterprises and all the other forms of private firms.

Table 5: Descriptive statistics by time period

Variables	2000				2001				2002			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	3.256	21.752	0.002	644.216	3.294	24.456	0.001	752.070	3.380	28.174	0.002	1203.322
Fixed assets	5.129	67.146	0.001	3092.556	4.820	67.614	0.001	3336.922	4.801	63.526	0.002	3103.530
Employment	35.871	131.480	2	3925	33.547	124.150	2	3433	32.261	130.586	2	3938
Relative wage	0.81	1.064	0.122	21.75	0.753	1.016	0.112	19.88	0.713	0.923	0.109	16.81
Market share	0.002	0.015	$6.47 \cdot 10^{-7}$	0.568	0.002	0.014	$2.45 \cdot 10^{-7}$	0.623	0.002	0.015	$2.50 \cdot 10^{-7}$	0.624
No of observations	6050	6050	6050	6050	6675	6675	6675	6675	6892	6892	6892	6892

Continues

Variables	2003				2004			
	Mean	Std Dev.	Min	Max	Mean	Std Dev.	Min	Max
Output	3.764	34.230	0.002	1530.680	3.774	35.592	0.002	1886.747
Fixed assets	4.691	61.474	0.002	2994.938	4.101	56.453	0.002	2838.319
Employment	32.359	133.584	2	3960	28.938	119.656	2	3383
Relative wage	0.653	0.972	0.092	27.6	0.626	0.883	0.076	31.81
Market share	0.002	0.017	$3.15 \cdot 10^{-7}$	0.691	0.002	0.015	$4.62 \cdot 10^{-7}$	0.640
No of observations	6863	6863	6863	6863	7649	7649	7649	7649

Note: all the monetary variables are deflated by aggregate PPI, thousands GEL

4. Model and Method

This chapter presents the model for the production function estimation and makes necessary assumptions on technical inefficiency term. It discusses the methods employed in the empirical analysis and underlines the advantages and disadvantages of the different estimation procedures.

4.1 Model Specification

To measure the firm level technical efficiency I will estimate the "frontier" or "best practice" production function, which defines the maximum attainable output with given inputs and technology. For simplicity I will assume that the production is captured by the Cobb-Douglas production function given by the following general form:

$$Y_{it} = B\prod_{j=1}^{k} X_{ijt}^{\beta_j} e^{u_{it}} \text{, where}$$

Y_{it} - is output by firm i in period t

X_{ijt} - is input j used by firm i in period t

β_j - is the input elasticity for input j

$u_{it} = v_{it} - \mu_i$ - is a composed error term, where v_{it} is assumed to be identically and independently distributed with mean 0 and variance σ_v^2; it is a standard residual term, which includes different random factors out of firm control. $\mu_i \geq 0, \forall i$ - is a technical inefficiency for firm i and is assumed to be independent of v_{it}, Further, it is assumed to be approximately constant over time during which the firm is observed. Although time constancy of technical inefficiency is a strong assumption, it is realistic for transition countries, because firms are financially constrained and find it difficult to acquire superior technologies.

The logarithmic transformation of the production function is given by:

$$y_{it} = \beta_0 + \sum_{j=1}^{k} \beta_j x_{ijt} - \mu_i + v_{it}, \text{ where}$$

$y_{it} = \log Y_{it}, x_{ijt} = \log X_{ijt}, \beta_0 = \log B$.

Besides direct inputs, such as fixed assets and employment, quality of the labor plays important role in the production process. Usually to control for labor quality human capital variables, such as employees' years of education, tenure, age and age square are used as in 'Mincerian' earnings function (Soderbom and Teal, 2004). Since the data set does not provide any of these variables, I use a constructed human capital variable as a proxy for labor skills. Thus, I focus on the view that if firms pay higher wages they attract better pool of applicants (efficiency wage hypothesis) and as a consequence they are more productive. But there can be potentially unobserved labor quality (such as innate ability), but the assumption that it is time invariant seems reasonable.

Across to time-constant unobserved effects there can be time-varying unobservables effecting firm productivity and correlated with explanatory variables, resulting to simultaneity bias. To capture common time shocks, such as demand shocks and change in unemployment rate, I control for year dummied in the regression, which account for the yearly shift of the frontier production function. Along with state ownership dummy and thirteen sector dummies, I contorl for size dummies in the regression.

The final model is the following:

$$y_{it} = \beta_0 + \beta_1 FA_{it} + \beta_2 L_{it} + \beta_3 W_{it} + \bar{\beta} \sum D_{it} - \mu_i + \delta_t + v_{it}, \text{ where}$$

y_{it} - is log of output for firm i in period t

FA_{it} - is log of fixed assets for firm i in period t

L_{it} - is log of number of employees for firm i in period t

W_{it} - is a firm i's average monthly wage per employee divided by average monthly industry wage per employee in period t

D_{it} - is a dummy for ownership (size, sector) for firm i in period t

μ_i - is a technical inefficiency of a firm i

δ_t - is a dummy for period t

v_{it} - is a statistical error term

β s - are the parameters to be estimated

4.2 Estimation Procedure

I estimate the Cobb-Douglas production function by OLS and within estimation methods. The first, OLS estimation method is based on strong assumptions: the firm specific fixed effects μ_i (technical inefficiency), as well as statistical error term v_{it} is uncorrelated with explanatory variables. Although OLS estimation allows us to control for ownership, size and sector dummies in the regression, in reality it is most likely that technical inefficiency is correlated with production factors. Thus OLS estimators are biased and inconsistent, and we can not make the conclusions.

The second, within estimation method is the best solution when the firm fixed effects are correlated with the explanatory variables, but we can not control for the time constant regressors. Although ownership structure and size of the firm changes for some observations in the sample due to privatization and restructuring processes, the change is not sufficient. For consistent results we need the assumption that v_{it} is uncorrelated with the regressors. Using the within estimation method we solve the selection problem, which may bias the results if the missing observations in unbalanced data are endogenously determined. If this

effect is fixed for a given individual over all periods in which its dependent variable is observed, it is absorbed in the fixed effect and no consistency problems arise for the fixed effects estimator (Verbeek and Nijman, 1992).

5. Results and Discussion

This chapter presents the OLS and within estimations of the production function. After choosing the appropriate model, relative measures of firm technical efficiency are constructed and analyzed. Afterwards, OLS estimates of the technical efficiency equation parameters are reported and interpreted, in order to see whether different characteristics are the sources of technical inefficiency within firms. Additionally, it is investigated whether the results from the production function and technical efficiency equation are consistent with the results for the restricted samples.

5.1 Production Function Estimations

This section is devoted to the estimation results from the production function. Table 5 (see the Appendix) presents the OLS and within estimates for the Cobb-Douglas production function parameters. Both employment and fixed assets have positive and statistically significant effect on firm's output in both OLS and within regressions. The parameter estimate for employment is smaller for the within (0.784) than for OLS (1.066). The parameter estimate for fixed assets does not change much, however it is larger for within (0.995) than for OLS (0.076). There is no evidence that possible measurement error in fixed assets is further exacerbated by within estimation (c.f. Soderbom and Teal, 2004), but OLS estimate is downward biased due to unobserved productivity which may impact on the investment and exit decision simultaneously (Soderbom and Teal, 2004). Returns to scale is larger for OLS (1.142) than for the within (0.879), the latter indicating that the firms operate on the decreasing returns to scale. However, the results can be downward biased due to the fact that we estimate output production function rather than theoretically preferable value added and since the employed data set in the estimations does not contain the information

about raw material and indirect inputs, the only controlled inputs are fixed assets and employment.

Comparing OLS and within estimates of the Cobb-Douglas production function parameters, we can see that the within give more accurate results, indicating that within is better estimator than OLS for the data. Estimation of translog functional form by both OLS and within estimation methods show that square and interaction terms of inputs are individually as well as jointly statistically insignificant. Thus, simple Cobb-Douglas form better matches the data used in the estimations.

The human capital variable is positive and significant in both specifications. Thus, it confirms that workers skills are very important for determining firm's output. OLS coefficient for human capital variable is larger in magnitude which can be explained by unobserved labor skills, such as innate ability, which biases the result upward. After controlling for firm fixed effects it disappears if it is approximately constant over time in a firm.

As expected, the state dummy in OLS regression has a negative statistically significant effect on firm's output. State enterprises in the sample produce much less output than private counterparts. Firm size dummies show that medium enterprises are less productive in terms of output compared to small firms. Although the coefficient on dummy for large firms is negative, the size of the effect is smaller compared to coefficient on medium firms and it is not statistically significant. If we look at the sector dummies in the same regression we can see that Fishing, Education and Health & social work have lower output than Agriculture. The firms operating in all the other sectors produce more compared to firms in Agricultural sector, although coefficients for Trade & repair and Other kinds of activity is not statistically

significant. The most productive sectors are Construction, Mining & quarrying and Manufacturing.

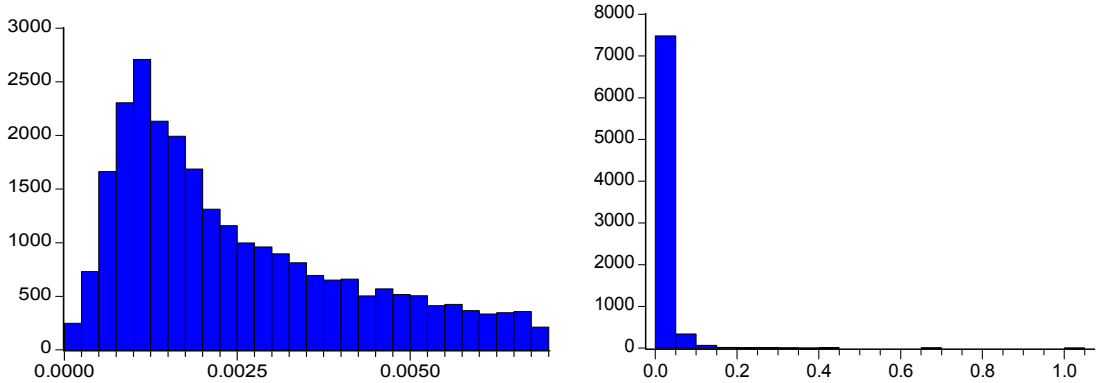
Having estimated the production function equations for the whole sample, it is important to know whether results vary from sector to sector. Table 6 (see the Appendix) presents OLS and within estimates of the Cobb Douglas production function by sector. The estimations of the translog functional forms do not prove that translog form better captures the production than Cobb-Douglas in some sectors. The estimation results for each sector support the findings for the whole sample, but there are some differences. Although the within estimators of employment are positive and statistically significant for all sectors, the estimators for fixed assets are not always statistically significant. For some sectors coefficient on fixed assets is negative although statistically insignificant, which is the evidence of the measurement error in this control variable. Returns to scale is decreasing in majority of the sectors, but we can not make conclusions about the returns to scale for the Fishing, Mining & quarrying, Construction and Financial intermediation sectors, because of the misleading size of the effect of the input variables. As expected, the estimates for relative wage are positive and for state dummies are negative, but they are not statistically significant for all sectors. The main difference is that small firms are not more productive than large and medium counterparts in all sectors. The results suggest that small firms are more productive in Trade & repair sector, while large firms perform better in Electricity, gas & water supply sector.

5.2 Technical Efficiency and Its Determinants

Since the within estimation is more appropriate method for the model, I construct the technical efficiency measure of a firm i as following: $TE_i = e^{-(\hat{\mu}_{\max} - \hat{\mu}_i)}$ (Seale, 1990), where $\hat{\mu}_{\max}$ - is the sample maximum of the fixed effects and $\hat{\mu}_i$ - is the fixed effect for firm i obtained from within estimation of the Cob-Douglas specification. Thus, technical efficiency measure for a firm is relative to the most efficient firm in the sample; it is inversely related to the inefficiency measure and takes values from (0, 1] interval. Firm is technically efficient if its technical efficiency index is equal to 1 and technically inefficient if its index is below 1.

Technical efficiency measures show that average technical efficiency is equal to 0.007 with standard deviation 0.019 for the whole sample. Graph 1 shows the distribution of technical efficiency below (a) and above (b) the average technical efficiency level for visualization purposes, where 77% of the firms operate below the sample average.

Graph 1: Distribution of technical efficiency



(a) (b)

Table 7 (see the Appendix) presents the firm distribution of technical efficiency by sector, ownership type, market share and relative wage. The distribution of firms over technical efficiency intervals shows that most of the firms operate at very low levels of technical

efficiency. 46.72% operates in the 0-0.0025 interval and only 0.375% operates in 0.1-0.5 range. The same picture emerges if we look at the distribution of firms by sector, ownership type, size, market share and relative wage.

The given statistics show that Health & social work accounts the largest share of firms (66.74%) in the lowest interval of technical efficiency and on the other hand Construction accounts the lowest (0.164%) share in the same interval. Only 3 firms (0.021%) operate above the 0.5 technical efficiency levels, which belongs to Manufacturing, Electricity, gas & water supply and Education sectors. 60.12% of state firms operate in the 0-0.0025 interval, while only 43.68% of private firms fall in the same range. At the 0.1-0.5 technical efficiency levels the percentage of private firms is equal to 0.414 while the state firms account only half of it. The size distribution of technical efficiency shows that large firms are doing better in terms of technical efficiency compared to small and medium counterparts. Only 41.69% of large firms operate below 0.0025 technical efficiency levels, while small and medium firms account for 46.97% and 47.24% respectively. Firms operating at the higher levels of technical efficiency are mostly large firms, suggesting that small firms are more technically inefficient. The firms with less than 10% market share and firms which pay below the average industry wage operate at the lower technical efficiency levels compared to their other counterparts.

Although the statistics presented above gives a general idea about the technical efficiency of firms with different characteristics, the regression analysis are necessary in order to identify the determinants of the technical inefficiency in the Georgian enterprise sector. I will estimate the specification where dependent variable is the estimated fixed effects from the within (column 2, Table 5). The explanatory variables are market share of the firms (representing competition in the product market) and relative wage (representing human capital).

Additionally the dummies for sector, ownership and size of firms are included in the estimated equation to account for differences between ownership structure, firm size and sectors. Table 8 (see the Appendix) presents the OLS estimation of the technical efficiency equation.

The positive and statistically significant coefficient on market share suggests that firms with larger market share are more technically efficient than firms with smaller market share. This supports the findings by Djankov and Kreacic (1998) about Georgian firms that more powerful firms were engaged in deeper restructuring (disposal of assets, renovation and computerization), because their managers had better skills and had more access to financial assets, while managers of less powerful firms did not have the right human capital for the many restructuring tasks that needed to be undertaken simultaneously and thus, were not able to manage firms in the competitive environment.

The positive and significant coefficient on human capital measure suggests that the firms paid wages which were dictated by workers' productivity. The firms which paid higher wages compared to other firms in their sector attracted more skilled labor and increased their technical efficiency.

The coefficient on state ownership has negative and statistically significant effect on firm's technical efficiency. The result suggests that state firms are more technically inefficient than their private counterparts, which can be explained by insufficient capital investment, poor managerial incentives and skills to restructure the firms in the state sector. This finding shows that private firms, including de novo and privatized former state owned ones, restructured

more than their state owned counterparts which led to increased technical efficiency in the former.

The coefficients on size dummies are positive and statistically significant, showing that medium and particularly large enterprises are more technically efficient than their small counterparts. This result suggests that by the sample period labor adjustment, which was facilitated by the increased competition from foreign producers (Djankov and Kreacic, 1998), had already taken place in the firms, which increased their technical efficiency. As a result of voucher based privatization, small firms were acquired by insiders for free; who did not have right incentives to restructure and improve firm's performance. Further, unfair taxation slowed the growth of newly created small firms (Blanchard and Kremer, 1997) and left them at the low levels of technical efficiency.

The results suggest great variation across sectors in terms of their technical efficiency. Fishing is the most technically inefficient sector, while Construction is the most efficient one. Although positive, the coefficient on the Financial intermediation, Education and Health sectors are not statistically significant, thus we can not make conclusions whether firms in these sectors are more technically efficient than those in Agriculture. The R-squared of the regression indicates that the control variables explain only 8% of the variation in the fixed effects.

The estimation results from the technical efficient equations by sector, presented in Table 9 (see the Appendix), are consistent with the results for the whole sample presented above. The market share and relative wage has positive effect on firm's technical efficiency, although not statistically significant for all sectors. State firms are more technically

inefficient than private firms in most of the sectors. Although the coefficients are positive for Agriculture and Fishing, they are statistically insignificant. Relying on the variation of signs on size dummies across sectors, we can not make clear conclusions, since they are not statistically significant. The only significant finding is that large firms are more technically efficient in the Electricity, gas & water supply, Transport & communications and Other kinds of economic activity sectors than small counterparts.

Further, technical efficiency equations were estimated separately for different ownership structure, size, market share and relative wage and there is no evidence of significant differences due to different firm characteristics. Thus, the results are not driven by sectoral, ownership, size, market power and human capital differences in the firms. I additionally restricted the sample for different technical efficiency intervals and estimated the technical efficiency equations separately and the results show the same statistical effects for each explanatory variable.

Conclusion

In this thesis I have used an unbalanced panel data set of enterprise sector of Georgia to investigate the technical efficiency of the firms. I measured technical efficiency based on the fixed effects from the within estimation of the Cobb-Douglas production function. The resulting average technical efficiency is equal to 0.007 for our sample, where the maximum attainable level is 1.

I investigated the possible sources of technical inefficiency by estimating the technical efficiency equation by OLS. The results show that private and large firms with larger market share are more technically efficient than their state and small counterparts with smaller market share. The coefficient on the control variable for human capital suggests that firms which pay higher wages employ more skilled workers and are more technically efficient. The technical efficiency of firms significantly varies across sectors.

Relying on the findings I conclude that the enterprise sector in Georgia remained technically inefficient even by 2004, although a large part of it was privately owned containing either newly created or privatized former state owned firms. The failure of transition measures to increase firms' technical efficiency can be explained, following Djankov (1998), by the subsidies, lack of new investments and absence of suitable managerial incentives and skills to restructure in state owned firm and small enterprises managed by incumbent managers. On the other hand de novo firms remained small and mainly operating in shadow economy, since they were financially constrained and preferred to stay underground to avoid the unfair tax burden.

However, high technical inefficiency does not constrain the firm to be productively efficient due to high allocative efficiency, this is be able to choose the best set of inputs given prices. The data is too limited to measure the allocative efficiency of Georgian firms, which is left for the future research. The bottom line is that after fifteen years of transition the enterprise sector in Georgia necessarily needed deeper restructuring. The policies in early transitional Georgia have been accompanied by losses by Georgian firms. It seems likely that the reforms initiated by the new government from 2003 will lead to successful large-scale privatization, creation of competitive markets and a well functioning legal system, which will enhance restructuring within enterprises. Further, orientation to FDI is an important step for a long run development of the county, which will bring necessary technologies and knowledge to facilitate the transition to the market economy.

Although the relative measures of firm technical efficiency were obtained and different causes of technical inefficiency of the Georgian enterprise sector were identified, improvements are necessary. There is a possibility that the measured technical inefficiency may simply reflect how imperfect the measures of inputs are rather than how poorly managers transform inputs into outputs (Tybout, 2000). The better measure for competition can be location of a firm, rather than its market share, and entrepreneur's age can be a better measure for managerial skills rather than relative wage (Seale, 1990). The profit and export orientation of a firm can also be a possible source of technical inefficiency (Brada, King and Ying Ma, 1997). There is a need for better data to further investigate these issues and make clear conclusions about the determinants of firms' technical inefficiency in Georgia.

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Appendix

Table 1: Real Sector of the economy of Georgia

	Unit value	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Nominal Gross Domestic Product	Mln GEL		3870.6	4667.6	5063.0	5709.2	6043.1	6674	7456	8564.1	9824.1	11591.9
GDP per capita	GEL	-	-	-	-	-	1298.6	1445	1625.9	1880	2166.1	2563.7
Growth Rate in Real GDP	%	-	-	110.7	102.9	103.0	101.8	104.8	105.5	111.1	108.4	109.3
Inflation (CPI)	%	157.4	113.5	107.6	110.7	110.9	104.6	103.4	105.4	107	107.5	106.2
Employment	Thousand employees	1730.1	2036.0	2233.0	2283.2	2079.0	1840.7	1877.7	1839.5	1814.5	1783.3	1744.6
Registered unemployed	Thousand employees	61.0	57.7	142.0	98.7	103.9	329.8	354.6	303.0	45.9	46.9	29.8
Unemployment rate	%	3.4	2.8	6.0	4.1	4.8	10.3	11.1	12.3	11.5	12.6	13.8
Nominal wages	GEL	13.6	29.0	42.5	55.4	67.5	72.3	94.6	113.5	125.9	156.8	204.3
Growth of nominal wages	%	219.4	213.2	149.7	127.6	121.8	107.1	130.8	120.0	110.9	124.4	126.7
Growth of real wages	%	139.4	152.9	139.8	123.2	102.2	122.6	125.0	113.6	105.8	117.7	116.7

Source: Annual Reports, National Bank of Georgia
CPI for each year is rebased to December of previous year

Data Statistics

Table 2: Number of Enterprises[5], unit

	2000	2001	2002	2003	2004
By sector					
Agriculture, hunting & forestry	103	134	136	122	113
Fishing	8	5	9	7	12
Mining & quarrying	46	49	54	53	68
Manufacturing	1051	1093	1106	1056	1227
Electricity, gas & water supply	175	154	156	156	161
Construction	428	478	473	480	534
Trade; repair of vehicles, personal & household goods	1742	1798	1803	1736	2072
Hotels & restaurants	331	344	387	394	453
Transport & communications	545	679	761	780	678
Financial intermediation	24	30	21	22	21
Real estate, renting & business activity	721	834	838	903	1041
Education	196	247	235	259	278
Health & social work	437	568	626	607	657
Other kinds of activity	243	262	287	288	334
By ownership type					
State	1227	1342	1350	1275	1122
Private	4823	5333	5542	5588	6527
By size					
Small	4246	4787	5041	5036	5733
Medium	1380	1468	1452	1458	1560
Large	424	420	399	369	356
Total	6050	6675	6892	6863	7649

Table 3: Number of enterprises by size in 2004, unit

	Small	Medium	Large
By sector			
Agriculture, hunting & forestry	74	34	5
Fishing	11	1	-
Mining & quarrying	44	19	5
Manufacturing	912	253	62
Electricity, gas & water supply	59	76	26
Construction	298	201	35
Trade; repair of vehicles, personal & household goods	1913	143	16
Hotels & restaurants	407	40	6
Transport & communications	493	145	40
Financial intermediation	18	3	-
Real estate, renting & business activity	873	153	15
Education	140	125	13
Health & social work	252	295	110
Other kinds of activity	239	72	23
By ownership type			
State	421	503	198
Private	5312	1057	158
Total	5733	1560	356

[5] **An enterprise** is an economic entity, which produces goods or renders services, independently makes economic decisions on distribution of own resources (possesses a certain degree of freedom on decision-making). An enterprise carries out activity of one or several kinds in one or several places. An enterprise can be individual (physical) or legal person (Statistics Department of the Ministry of Economic Development of Georgia)

Table 4: Structure of output[6] by size of enterprises in 2004, percent

	Small	Medium	Large	Total
By sector				
Agriculture, hunting & forestry	0.42	0.65	0.97	0.82
Fishing	0.06	0.001	-	0.01
Mining & quarrying	1.51	1.28	3.64	2.80
Manufacturing	28.91	35.66	21.13	25.58
Electricity, gas & water supply	0.97	3.28	20.28	13.66
Construction	10.95	14.46	9.70	10.98
Trade; repair of vehicles, personal & household goods	21.22	11.96	2.35	7.20
Hotels & restaurants	3.77	1.38	2.32	2.31
Transport & communications	14.44	14.63	32.60	25.91
Financial intermediation	0.24	0.186	-	0.08
Real estate, renting & business activity	12.29	8.134	0.78	4.08
Education	0.62	1.72	1.23	1.26
Health & social work	1.52	4.57	3.74	3.62
Other kinds of activity	3.08	2.09	1.27	1.71
By ownership type				
State	3.55	10.72	29.99	21.85
Private	96.45	89.28	70.01	78.15
Total	13.93	23.13	62.94	100

[6] **Output** determines quantity of production made by an economic entity, and volume of realized output including goods or services bought for resale and changes in stocks of finished goods. Output is defined as follows: **Turnover** - Purchase of goods and services for as-is-resale +/- Changes in stocks of finished goods and work-in-progress +/- Changes in stocks of goods bought for resale + Capitalized output (Statistics Department of the Ministry of Economic Development of Georgia)

Estimation Results

Table 5: Cobb Douglas production function estimations

Variables	OLS	Within
Inputs		
Log employment	1.066	0.784
	(70.310)	(43.323)
Log fixed assets	0.076	0.095
	(12.179)	(10.346)
Human capital		
Relative wage	0.501	0.260
	(18.780)	(9.939)
Ownership dummy		
State	-0.783	
	(-29.245)	
Size dummies		
Medium	-0.182	
	(-5.700)	
Large	-0.081	
	(-1.426)	
Sector dummies		
Fishing	-0.416	
	(-2.153)	
Mining & quarrying	0.904	
	(7.522)	
Manufacturing	0.803	
	(12.547)	
Electricity, gas & water supply	0.696	
	(7.832)	
Construction	1.181	
	(17.994)	
Trade; repair of vehicles, personal & household goods	0.075	
	(1.220)	
Hotels & restaurants	0.562	
	(8.571)	
Transport & communications	0.669	
	(9.949)	
Financial intermediation	0.686	
	(5.015)	
Real estate, renting & business activity	0.355	
	(5.652)	
Education	-0.422	
	(-6.12)	
Health & social work	-0.270	
	(-4.36)	
Other kinds of activity	0.093	
	(1.301)	
Constant	2.133	3.120
	(30.908)	(47.513)
R-squared	0.684	0.943
No of observations	34101	34111

Note: a) t-statistics based on White period standard errors are reported in the parenthesis; b) omitted categories: for ownership type - private, for size – small, for sector – Agriculture, hunting & forestry; d) time dummies are included in both regressions

Table 6: Cobb Douglas production function estimations by sector

		Log employment	Log fixed assets	Relative wage	State	Medium	Large	Constant	R-squared	No of observations
Agriculture, hunting & forestry	OLS	1.041	-0.024	0.658	-0.586	-0.226	-0.055	2.403	0.608	608
		(11.394)	(-0.758)	(7.962)	(-5.121)	(-1.274)	(-0.146)	(9.261)		
	Within	0.729	0.102	0.582				2.297	0.938	608
		(9.575)	(1.509)	(7.374)				(4.791)		
Fishing	OLS	0.625	0.202	0.457	-0.016	-0.115	-	2.443	0.532	41
		(3.302)	(3.513)	(3.484)	(-0.039)	(0.184)		(3.263)		
	Within	1.109	2.342	0.768				-12.172	0.896	41
		(3.754)	(2.228)	(2.620)				(-1.862)		
Mining & quarrying	OLS	1.250	-0.116	0.588	-0.867	0.121	0.032	3.501	0.675	270
		(7.132)	(-1.787)	(2.823)	(-3.610)	(0.455)	(0.053)	(9.117)		
	Within	1.215	-0.037	1.135				2.725	0.930	270
		(4.255)	(-0.433)	(3.902)				(3.259)		
Manufacturing	OLS	1.126	0.040	0.589	-1.148	-0.176	-0.227	2.952	0.602	5533
		(27.200)	(2.382)	(10.187)	(-14.134)	(-1.948)	(-1.480)	(32.479)		
	Within	0.830	0.094	0.325				3.477	0.932	5533
		(19.007)	(4.184)	(5.538)				(21.259)		
Electricity, gas & water supply	OLS	0.871	0.133	0.743	-0.550	0.132	1.107	2.522	0.780	789
		(9.360)	(2.404)	(4.522)	(-3.751)	(0.802)	(3.777)	(9.618)		
	Within	0.833	0.020	0.226				3.700	0.947	789
		(6.579)	(0.316)	(1.288)				(5.364)		
Construction	OLS	0.990	0.028	0.751	-0.509	-0.135	0.075	3.511	0.662	2393
		(20.130)	(1.423)	(13.464)	(-8.162)	(-1.851)	(0.471)	(24.632)		
	Within	1.013	0.010	0.716				3.403	0.916	2393
		(22.144)	(.379)	(10.071)				(20.657)		
Trade; repair of vehicles, personal & household goods	OLS	1.261	0.033	0.585	-0.689	-0.373	-0.828	2.001	0.557	9151
		(40.862)	(2.395)	(9.960)	(-10.293)	(-4.070)	(-4.160)	(31.239)		
	Within	0.703	0.114	0.261				2.885	0.929	9151
		(18.631)	(6.280)	(5.489)				(27.118)		
Hotels & restaurants	OLS	1.099	-0.019	0.665	-0.697	0.139	-0.252	3.039	0.656	1909
		(21.461)	(-1.0002)	(3.362)	(-5.792)	(1.102)	(-0.766)	(30.119)		
	Within	0.626	0.040	0.464				3.764	0.922	1909
		(8.802)	(1.204)	(2.560)				(18.279)		
Transport & communications	OLS	0.983	0.162	0.454	-1.301	-0.158	0.277	2.720	0.687	3438
		(17.406)	(7.406)	(8.211)	(-14.918)	(-1.435)	(1.522)	(24.234)		
	Within	0.698	0.128	0.137				3.625	0.960	3438
		(13.497)	(4.885)	(4.297)				(17.662)		

Continues

	OLS	1.074	0.176	0.265	-0.697	-0.159	-	2.612	0.621	118
Financial intermediation		(3.844)	(1.395)	(1.316)	(-1.821)	(-0.447)		(8.051)		
	Within	1.037	-0.379	0.514				4.870	0.893	118
		(2.823)	(-1.567)	(2.386)				(5.889)		
	OLS	0.908	0.121	0.382	-0.620	0.0007	0.007	2.693	0.572	4337
Real estate, renting & business activity		(25.845)	(8.720)	(10.336)	(-10.257)	(0.009)	(0.042)	(31.465)		
	Within	0.656	0.101	0.231				3.390	0.933	4337
		(12.337)	(3.702)	(4.535)				(18.585)		
	OLS	0.826	0.210	0.315	-0.276	0.106	0.245	2.005	0.784	1215
Education		(5.769)	(7.518)	(3.421)	(-2.925)	(1.347)	(1.431)	(13.881)		
	Within	0.513	0.117	0.167				3.456	0.965	1215
		(8.204)	(4.375)	(4.133)				(16.550)		
	OLS	0.911	0.121	0.393	-0.423	-0.061	-0.071	1.929	0.759	2895
Health & social work		(24.072)	(6.960)	(3.692)	(-7.660)	(-0.815)	(-0.594)	(15.917)		
	Within	0.658	0.063	0.159				3.029	0.935	2895
		(9.651)	(3.137)	(2.547)				(10.857)		
	OLS	0.986	0.094	0.624	-0.821	0.036	0.145	2.112	0.700	1414
Other kinds of activity		(15.677)	(3.876)	(4.566)	(-8.419)	(0.277)	(0.623)	(13.741)		
	Within	0.714	0.032	0.475				3.081	0.961	1414
		(10.274)	(1.079)	(5.281)				(11.291)		

Note: a) t-statistics based on White period standard errors are reported in the parenthesis; b) omitted categories: for ownership type - private, for size – small, for sector – Agriculture, hunting & forestry; d) time dummies are included in all regressions

Table 7: Firm distribution of technical efficiency

	0-0.0025	0.0025-0.005	0.005-0.01	0.01-0.05	0.05-0.1	0.1-0.5	> 0.5
Sector							
Agriculture, hunting & forestry	63.98	20.07	9.375	6.414	0.164	-	-
Fishing	60.98	21.95	12.2	4.878	-	-	-
Mining & quarrying	32.96	20.74	21.48	22.96	1.481	0.37	-
Manufacturing	38.17	20.46	18.27	21.47	1.193	0.416	0.018
Electricity, gas & water supply	44.36	15.84	18.38	18.76	0.887	1.648	0.127
Construction	27.16	20.89	22.15	27.29	2.006	0.501	
Trade; repair of vehicles, personal & household goods	52.69	19.63	14.2	12.23	0.841	0.415	-
Hotels & restaurants	41.75	28.39	18.23	10.9	0.576	0.157	-
Transport & communications	43.25	18	17.04	19.08	1.92	0.698	-
Financial intermediation	33.9	27.97	30.51	7.627	-	-	-
Real estate, renting & business activity	44.34	25.73	15.84	13.33	0.507	0.254	-
Education	52.92	25.76	10.86	8.395	1.564	0.082	0.412
Health & social work	66.74	18.31	8.014	6.598	0.345	-	-
Other kinds of economic activity	48.02	25.81	15.35	10.11	0.566	0.141	-
Type of Ownership							
State	60.12	19.12	12.26	8.07	0.206	0.206	0.016
private	43.68	21.77	16.44	16.5	1.172	0.414	0.022
Size							
Small	46.97	21.57	15.47	14.61	0.938	0.419	0.02
Medium	47.23	20.46	15.56	15.39	1.148	0.191	0.027
Large	41.69	20.62	18.46	17.59	1.128	0.513	-
Market share							
Below 10%	46.77	21.29	15.65	14.92	0.993	0.361	0.021
Above 10%	27.03	17.57	21.62	25.68	1.351	6.757	-
Relative wage							
Below unity	49.01	21.28	14.98	13.51	0.924	0.268	0.021
Above unity	34.38	21.24	19.33	22.71	1.368	0.955	0.019
Total	46.72	21.28	15.66	14.95	0.994	0.375	0.021

Note: technical efficiency is measured as $e^{-(\hat{\mu}_{\max}-\hat{\mu}_i)}$ based on fixed effects from column 2 (Table 5)

Table 8: OLS estimation of technical efficiency equation

Variables	OLS
Marker share	4.734
	(5.117)
Human capital	0.123
	(8.433)
Ownership dummy	
State	-0.477
	(-14.602)
Size dummies	
	0.079
Medium	(2.734)
	0.261
Large	(4.805)
Sector dummies	
	-0.568
Fishing	(-2.398)
	0.677
Mining & quarrying	(4.701)
	0.554
Manufacturing	(6.616)
	0.622
Electricity, gas & water supply	(5.116)
	0.838
Construction	(9.370)
Trade; repair of vehicles, personal & household	0.181
goods	(2.226)
	0.366
Hotels & restaurants	(4.095)
	0.591
Transport & communications	(6.783)
	0.237
Financial intermediation	(1.660)
	0.327
Real estate, renting & business activity	(3.933)
	0.134
Education	(1.369)
	0.075
Health & social work	(0.876)
	0.269
Other kinds of activity	(2.958)
Constant	2.683
	(33.757)
R-squared	0.080
No of observations	34101

Note: a) dependent variable is the fixed effects obtained from the within estimation of the Cobb-Douglas specification reported in column 2 (Table 5); b) t-statistics based on white period standard errors are reported in the parenthesis; c) omitted categories: for ownership type – private, for size – small, for sector – Agriculture, hunting & forestry

Table 9: OLS estimations of technical efficiency equations by sector

	Market share	Human capital	State	Medium	Large	Constant	R-squared	No of observations
Agriculture, hunting & forestry	2.962	0.181	0.001	0.170	-0.803	2.426	0.033	608
	(1.897)	(2.028)	(0.010)	(1.161)	(-1.921)	(20.297)		
Fishing	3.095	0.295	0.194	-1.255		2.258	0.240	41
	(2.425)	(1.390)	(0.591)	(-1.802)	-	(7.370)		
Mining & quarrying	4.931	0.018	0.196	-0.386	-0.723	3.578	0.111	270
	(5.333)	(0.264)	(-0.691)	(-1.394)	(-1.783)	(24.803)		
Manufacturing	13.030	0.090	-0.544	0.097	0.080	3.262	0.025	5533
	(0.990)	(1.980)	(-5.606)	(1.397)	(0.525)	(81.240)		
Electricity, gas & water supply	13.368	0.127	-0.448	0.101	1.020	3.103	0.168	789
	(2.371)	(1.004)	(-2.356)	(0.534)	(3.571)	(16.733)		
Construction	30.866	0.066	-0.357	-0.158	-0.090	3.601	0.046	2393
	(3.776)	(1.336)	(-3.575)	(-1.932)	(-0.442)	(60.813)		
Trade; repair of vehicles, personal & household goods	36.883	0.098	-0.368	0.097	-0.025	2.861	0.023	9151
	(1.796)	(3.393)	(-3.708)	(1.134)	(-0.081)	(100.44)		
Hotels & restaurants	3.012	0.241	-0.367	0.216	-0.256	3.001	0.029	1909
	(3.068)	(3.152)	(-1.867)	(1.469)	(-1.196)	(60.416)		
Transport & communications	12.378	0.127	-0.808	0.184	0.409	3.309	0.103	3438
	(1.186)	(2.991)	(-7.875)	(1.850)	(2.828)	(60.239)		
Financial intermediation	1.976	0.021	-0.607	0.169		3.124	0.063	118
	(1.466)	(0.254)	(-3.102)	(0.343)	-	(20.987)		
Real estate, renting & business activity	67.079	0.036	-0.379	0.020	-0.286	3.013	0.059	4337
	(4.222)	(1.708)	(-5.257)	(0.262)	(-1.808)	(82.567)		
Education	5.945	0.128	-0.161	-0.059	0.064	2.836	0.040	1215
	(2.776)	(1.924)	(-1.154)	(-0.599)	(0.310)	(30.584)		
Health & social work	26.744	0.053	-0.456	0.068	0.078	2.809	0.068	2895
	(2.917)	(1.584)	(-5.916)	(0.952)	(0.740)	(35.949)		
Other kinds of activity	5.520	0.231	-0.545	0.266	0.413	2.852	0.097	1414
	(0.845)	(3.674)	(-5.158)	(2.201)	(2.115)	(44.170)		

Note: a) dependent variable is the fixed effects obtained from the within estimation of the Cobb-Douglas specification reported in column 2 (Table 5); b) t-statistics based on white period standard errors are reported in the parenthesis; c) omitted categories: for ownership type – private, for size – small, for sector – Agriculture, hunting & forestry