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Firm Growth and Technical Efficiency in Ethiopia: The Role of Firm Size and Finance

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Abstract

The performance of manufacturing firms can play a crucial rule in spurring economic growth and international competency. However, it has received little attention in developing countries particularly in Sub-Saharan Africa (SSA). Using firm level data from 2000 to 2008 survey, this paper empirically investigates the key determinants of growth and technical efficiency of Ethiopian manufacturing establishments focusing on the impact of size and finance. The empirical result using dynamic panel data estimation suggest that small and young firms grow more rapidly. Leverage ratio and cash flow are also main determinants of firm growth. However, they have heterogeneous effect. While, the availability of internal finance significantly affect the growth of smaller firms, leverage (borrowing) represent a binding constraint for growth of large firms. Firm's asset, labour quality, ownership and legal status are also binding constraints for growth of firm in Ethiopia. Moreover, a stochastic frontier analysis of the production function shows that there is significant difference in efficiency scores across firms. The result shows that efficiency score increases with firm size and cash flow but decrease with borrowing.

Keywords: firm growth, technical efficiency, panel data, system GMM, Ethiopia

1. Introduction

The performance of firms in manufacturing sector is an important policy objective as it has a direct impact on the productivity of all other sectors in the economy. Enterprises in this sector are vital in terms of modernization, job creation, technology advancement, and poverty reduction. Thus, understanding the nature and key determinants of firms' performance can provide insights to enhance their contribution in the economy through indications of effective programs design.

The literature on growth and efficiency of firms has been growing in recent years (Kumar, 1985; Hall, 1987; Evans & Jovanovic, 1989; Teal, 1999; Biesebroeck, 2005; Calvo, 2006; Bigsten & Gebreeyesus, 2007; Segarra & Teruel, 2014). Much has been learned, but a more comprehensive and dynamic analysis of firm growth and efficiency in developing countries remain to be explored. Ethiopia is one of the developing countries in transition that has improved in the performance of the manufacturing sector. The new government reforms in 1991, after two decades of centralized economic policy, were crucial turning point in the economic history of Ethiopia. The government undertakes extensive policy reforms including the permission of the establishment and development of private enterprises and financial institutions, trade opening and market deregulation. However, the sudden decline in business activities due to the Eritrean-Ethiopian war in 1998-2000, undermine business confidence, slackened production and suppress growth and efficiency of firms. It is widely agreed that the Ethiopian enterprises and financial sectors have grown rapidly ever since the end of the war. Therefore, I investigate in this paper what can be learnt on the performance of manufacturing firms in Ethiopia surveyed from period 2000 to 2009.

To the extent that firms in manufacturing sector are engines of development, it is important to identify how finance, size, and other key determinants affect firm growth and efficiency. Such analysis is particularly important for countries in Sub-Saharan Africa where performance of firms lags behind other regions. Due to lack of data, research on the determinants of firm growth and efficiency has focused on firms in developed countries (see for example Kumar, 1985; Hall, 1987; Calvo, 2006). The aim of this paper is two fold. First, to analyses key determinants of firm growth focusing on how firm size and financial constraints affect firms growth in Ethiopia. Second, to examine the presence of significant differences in efficiency across firms and identify the impact of

finance and size on efficiency.

This paper contributes on the existing literature of firm performance as least in three ways: first, unlike most previous studies, which focus on firms in developed countries, this paper uses sample of Ethiopian manufacturing firms to shed light in a developing economy setting as firm dynamics in poor countries are strikingly different to those of rich countries. Second, in contrast to other studies in Ethiopia and other developing countries, this paper exploits long census based panel data and use system GMM estimator to address issue of endogeneity. The previous studies in Ethiopia manufacturing firms most close to this paper are the papers by (Shiferaw, 2006; Soderbom et al., 2006; Bigsten & Gebreeyesus, 2007). While their focus is similar with this paper they use data during the Ethiopian-Ertirean war, a shock that may affect different firms differently, which made business unstable and high exit rate. Such shocks could potentially bias conclusions. Last, to the best of my knowledge, this is the first paper to examine the implication of key firm growth theories on technical efficiency in the Ethiopian Manufacturing firms.

The results obtained from the static and dynamic growth model are strikingly different implying that the estimation strategies followed and the assumption made leads a different conclusion. While the result from simple OLS shows that most attribute does not affect growth, the preferred two step system GMM estimates indicate smaller and younger firms have higher growth. In addition, the result also reveals that while the growth of smaller firms is sensitive to internal finance, external sources of finance affect the growth of larger firms. The result from stochastic frontier analysis indicates that firm size and internal source of finance enhance production efficiency of Ethiopian manufacturing firms. It is also found that loan constrained firms are more efficient.

The reminder of the paper organized as follows. Section 2 report an overview of related literatures. Section 3 includes data and descriptive statistics, section 4 presents estimation procedure and discussion of our analysis. Robustness check and conclusion follows in section 5 and 6 respectively.

2. Literature Review

2.1 Growth and Efficiency Measures

Several indicators have been employed in the literature to measure firm growth. The most commonly used indicators are employment growth, sales growth and asset growth (Shiferaw, 2007; Bigsten & Gebreeyesus, 2007). Since both sales and asset growth are sensitive to inflation and change in exchange rate, I use growth rate of permanent employee between two consecutive periods as firm growth.

In his seminar paper,Aigner et al. (1977) states that the efficiency of firm consisted of two elements: technical efficiency, the ability of a firm to produce maximum possible output from a given set of inputs, and allocative efficiency, the ability of the firm to use these inputs in optimal proportions, given their respective price. Technical efficiency can be measured empirically using composed error terms in an econometric model. It is the deviation of individual firm's production from the maximum (frontier) output level (Aigner et al., 1977; Meeusen & Broeck, 1977).

2.2 Determinants of Firm Growth and Efficiency

2.2.1 Size and Age

Since Gibrat (1931) seminal publication, Gibrat's 'Law of Proportionate Effect' (LPE) has received a huge attention in the empirical firm growth literature. In his law of proportionate effect (LPE), Gibrat postulates that "the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry regardless of their size at the beginning of the period." Accordingly, Gibrat concludes that firm growth is independent of initial firm size and thus large firms are more important in the economy since they create more employment opportunities. However, empirical evidences about the prediction of Gibrat's LPE are rather mixed. Evidences from developed countries shows that small firms grow faster (see for instance Kumar, 1985; Hall, 1987). To the contrary, few evidences from Sub-Saharan countries indicates that large size firms grow more rapidly than small firms (Biesebroeck, 2005). Similarly, Teal (1999) finds that medium size firms have higher growth. There is also an empirical result which show no relationship between firm growth and size (Harding et al., 2004).

The failure to find support for Gibrat's LPE led to a farther development of growth theories. Jovanovic (1982) formulates a passive learning by doing (LBD) model. According to this model, small and young firms have no ex-ante knowledge of their own efficiency. When a firm gets older and larger, it grows more confident about its efficiency, and then the mean and variance of its growth decrease. Hence, the model predicts that smaller and younger firm has higher growth but lower efficiency. The absolute age of the firm in terms of operational years is also found to be one of the determinants of export performance. In order to test Jovanovic LBD model, Dunne et

al. (1989) analyses US establishments and concur with his model prediction of the negative impact of age on firm growth. The negative relationship between age and growth is consistent with a number of studies(see, e.g., Evans (1987); Evans and Jovanovic (1989); Jovanovic (1982); Biggs and Srivastava (1996); Gebreab (2006). However, as opposed to the above studies, the monotonous negative relationship is not always observed. Das (1995) examined the growth of firms in young industry in India and observed unusual results that growth increases with age.

2.2.2 Financial Constraints

Financial constraints including bank loan, working capital and other assets are found to be key determinant for growth and efficiency of firms. In a very prominent paper Stiglitz and Weiss (1981) proposes that imperfection in credit market has adverse consequences for a borrowing firm. First, the information asymmetry, adverse selection and moral hazard, between the firm and lenders impact both the cost and size of loan. And, second, the increase in the cost of loan can reduce firm's growth as it restricts its investment expansion. Evans and Jovanovic (1989) and Fazzari et al. (1988) shows that firm growth and productivity negatively affected by financial constraint.

2.2.3 Ownership Structure

According to Caves and Barton (1990), ownership is one of the major determinants of firm growth and technical efficiency. Mengistae (1996) finds that enterprises owned by the government are more efficient than private enterprises. On the other hand, Taymaz and Saatci (1997) find that privately owned firm is more efficient than public owned firms. Literature on differential growth of firms also documented that government-owned firms seems to grow more slowly (Beck et al., 2005).

2.2.4 Other Attributes

Apart from the above mentioned factors, a number of authors include other firm specific characteristics in a regression of production efficiency scores. Among others, these include the location of the firm (Caves & Barton, 1990; Fujita & Thisse, 2002; Aggrey & Joseph, 2010), firm type (Mengistae, 1996; Aggrey & Joseph, 2010), capital(Bigsten & Gebreeyesus, 2007) and labor quality (McPherson, 1996). The vast body of the literature examining the relationship between firm growth and its attributes varies on their findings. Some of the reasons for these mixed results includes the difference in country context, estimation techniques and model selection. In the earlier literature, attributes including size, labor quality and financial constraints are considered as exogenous variable result biased estimate (Kumar, 1985; Biggs & Srivastava, 1996; Gunning & Mengistae, 2001; Soderbom et al., 2006). However this association in these studies may not represent causality in the presence of endogeneity.

3. Data and Descriptive Statistics

3.1 Data

The paper uses a census based data over the period 2000-2008 for Ethiopian large and medium scale manufacturing firms collected by Central Statistics Authority (CSA) (Note 1). The census covers manufacturing establishments in the country which use power drive machines, produce at least partially marketable product and engage 10 or more workers , fixed location and customarily defined as a formal manufacturing sector. The dataset used in this paper is a balanced panel dataset comprises of only survived firms for nine years. Missing data, firm exit and exclusion of some observation regarded as outliers or coding error reduce the sample. Table 3 provides the summary on number of firms survive, enter and exit from the business during the surveyed years. Heckman (1979) two-step estimation method can correct for the potential sample selection problem bias. In this method, however, requires instrument variable that affect firm survival but does not influence firm growth to identify the selection correction term. Robustness checks are made to examine the consistence regression results.

3.2 Background and Descriptive Analysis

The new government reform in 1991, after 2 decades of centralized economic policy, was a crucial turning point in the economic history of Ethiopia. The government undertakes extensive policy reforms including the permission of the establishment and development of private enterprises, trade opening and market deregulation. However, the sudden decline in business activities due to the Eritrean-Ethiopian war in 1998-2000, undermine business confidence, slackened production and suppress growth and efficiency of firms. It is widely agreed that the Ethiopian enterprises have grown rapidly ever since the end of the war. But the number of officially registered firms and their contributions remain low.

Following the war, gross domestic product (GDP) grew on average by 8% per annum between 2000 and 2008

(Table 1). However, according to this report the contribution of the industrial sector remains 13% of GDP where the manufacturing sector contribute only 5%.

Table 1. GDP, share of manufacturing and other sectors in Ethiopia (between 2000 and 2008)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP growth	6	8	2	-2	14	12	11	12	11
GDP per capital growth	3	5	-2	-5	11	9	8	9	8
Manufacturing value added	6	6	6	6	6	5	5	5	5
Industry value added	12	13	14	14	14	13	12	12	12
Service Value added	40	41	44	46	43	42	42	42	40
Agriculture Value added	48	46	42	40	43	45	46	46	49

Source: World Bank Indicator, 2016.

The manufacturing industry is largely limited to simple agro-processing activities and production of basic consumer goods including textile, food and beverage. Industries including electronics, engineering and chemical processing that might facilitate technological progress and create dynamic inter-industry linkages are not operating and thus the technological level of firms are very small (World Bank, 2010).

Table 2 presents a summary statistics on employment, finance, number of firms by ownership, value of production, value of sale and other covariates for each survey year (Note 2). Overall the number of firms has increased from 739 in 2000 to 1734 in 2008 due to the high entry rate in the private sector. However, it has performed poorly minters of generating employment and production growth.

Table 2. Production, employment, finance and number of manufacturing firms

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Private	607	607	751	804	860	631	631	1,213	1,616
Public	129	107	124	128	129	126	123	118	110
Mean employment	108	103	94	89	89	78	89	85	66
Mean output value	10.7	10.8	8.9	9.17	10.9	15.2	12.3	14.4	12.7
Mean Sale	10.6	10.3	8.6	9.27	10.67	14.9	12.6	13.6	12.8
Mean Fixed Asset	7	7.8	7	7.2	6.5	8.5	6.2	5.7	4.9
Working capital	6.13	7.83	6.30	7.13	7.51	11.1	9.9	9.8	10.3
Cash flow	0.22	1.3	0.8	3.2	3	2	2.3	2	0.5
Bank Loan	15	14	13.3	15	15.9	19	18	16	20
Number of firms	739	722	883	939	997	763	1153	1339	1734

Table 3. Survivors, entry and confirmed exits

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Survivors	-	589	594	757	803	645	668	859	1219
New Entry	-	133	285	182	194	118	485	480	515
Confirmed Exits	-	150	128	126	136	352	95	294	120
Total Firms	739	722	883	939	997	763	1153	1339	1734

Table 4 and 5 provides a preliminary insight to the growth model. Table 4 presents the firm average growth rate when we breakdown the sample by size cohorts. A least two points are noted from Table 4. First, the average growth rate of the majority of small firms (87.30%) have experienced a positive growth rate. And, second, we observe that mean growth rate falls with firm size category. Only 58.78 % of medium size firms and 31.44 % of large firms have positive employment growth indicating that growth may negatively correlated with firm size.

Table 4. Proportion of firm with positive and negative growth rate

Firm size Categories	Negative (%)	Positive (%)
Small (10-19 employees)	12.7	87.3
Medium (20-99 employees)	40.22	58.78
Large 100 and above employees)	68.56	31.44
Total	40.98	59.02

Note. size catagories are based on World Bank, 2015.

Table 5. Proportion of firm with positive and negative growth rate

Firm Age Categories	Negative (%)	Positive (%)
Young (1-9 years old)	9.37	90.63
Mature (10-19 years old)	38.45	61.55
Old (20 years old and above)	69.23	30.77
Total	40.98	59.02

Note. Figures in parentheses are number of years since establishment.

Similarly, Table 5 compares the proportion of young, mature and old firms with positive and negative mean growth rate. It shows that the proportion of positive average growth rate is higher for young firms. One possible reason for the difference in proportion growth rate in the age cohorts can be attributed to the passive learning hypothesis.

Table 6 shows summary statistics of main variables when I split the sample into three size cohorts. It shows at least three noticeable points. First, we observe that mean growth rate falls when we move from small size cohort to large size cohorts. Second, cash flow ratio is high for small firm cohor. Third, leverage ratio is high for large firm cohort. This providing preliminary information that small firms are debt constrained than large firms which is consistent with he theory of asymmetric information and credit rationing.

This paper, therefore, analyse how the difference in initial size, access to bank loan, internal finance and other observed factors affect firm growth and efficiency in Ethiopia.

Table 6. Comparison of means: small, medium and large firms

	small	medium	large	difference
Growth	0.051	0.036	0.006	
Bank loan	1,075 298	2,040 019	3,694 505	***
Leverage ratio	0.59	0.63	0.64	
Cash flow ratio	0.63	0.49	0.39	**
Asset	2,443 829	8,294 418	32,600 000	***
Age	19	20	29	***
Wage	298069	1111974	4222197	***
Ownership	0.92	0.75	0.41	***
Location	0.79	0.69	0.46	
No. of observations	2826	206	1702	

Note. Standard errors are in parentheses.

***, **, *: Significance level at 1%, 5%, and 10%, respectively.

4. Estimation Procedure and Results

4.1 Firm Growth

The analysis of firm growth is performed using a dynamic growth model. Several indicators have been employed in the literature to measure firm growth. The most commonly used indicators are employment growth, sales growth and asset growth. Since sales growth and asset growth are sensitive to inflation and exchange rate Shiferaw (2007); Bigsten and Gebreeyesus (2007), the growth rate of permanent employee between two consecutive periods is preferred in this study. Following Oliveira and Fortunato (2006), The model is specified as:

$$\ln g_{it} = \rho g_{it-1} + \beta_1 \ln s_{it} + \beta_2 \ln(CF_{it} / A_{it}) + \beta_4 \ln leverage_{it} + \beta_k(X_{it}) + \delta_i + \upsilon_{it} \quad (1)$$

where g_{it} denotes annual growth rate of firm i at time t, s is total number of permanent employee, CF/A is a ratio of cash flow (net revenue) to asset, $leverage$ is a ratio of bank loan to total asset and x is additional firm growth attributes such as age, asset, labor quality, ownership status, legal form and location, δ_i captures unobserved firm fixed effect and vit is statistical noise term. The model allows to test gibrat's LPE ($\beta 1 = 0$ and $\rho=0$) and Jovanovic LBD theory predictions ($\beta 1 < 0$). It also allows to examine the relationship between growth and financial constraints.

4.1.1 Estimation Issues

There are some common estimation concerns that could be relevant to this paper.

Unobserved firm and industry fixed effect: The relationship between firm growth and some of the explanatory variable can be confounded by firm and Industry fixed effects. These factors may includes rules and policies which can not be controlled in the model. To address these issues fixed effects are included in the model.

Reverse causality and simultaneity: The associations between firm characteristics and growth are insufficient in establishing the direction of causality. it rather results endogeniety problem and biased conclusions. For example, bank loan may cause firm growth but growing firms may get bank loan. it is true that finance and some other attributes are not exogenous to growth. For example, poor institution may lead insufficient loan availability and reduce growth. To account such problems, I use Gmm type instrument estimation for the growth equation.

Multicollinearity: some of the explanatory variables may tend to correlate and result implausible sign. I transform the highly correlated variables, for example loan and asset, into a ratio to address the issue of multicollinearity.

Selection: the sample selection problem related to firm survival or exit could be a potentially important source of bias. Heckman's (1973) two-step estimation method has been widely employed to correct for sample selection problem bias. In this method, one should have a variable that identify the selection correction term to solve the selection bias. However, in this paper, I do not have such a variable which affect firm survival but does not influence firm growth. Empirically, it is well established that small firms tend to have less probability of survival. Therefore, I re-estimated the growth equation for small, medium and large firms separately to check whether the results are different.

4.1.2 Results

Benchmark results obtained from the OLS and FE estimations are reported in Table 7. The results indicate that most of the determinants are statistically insignificant with some unexpected signs. However, given the potential endogeneity issues in the model, OLS and FE results biased and does not show the true causal relationship. The problem of endogeneity in growth model arises reverse causality such that firms with higher growth may have higher size and lower financial constraints. In this cause, the direction of causality is not clearly known. In addition there can be omitting unobserved and firm specific characteristics that cause possible bias. Hence, system GMM is used in this paper to address the endogeneity of size, cash flow, leverage and other endogenous attributes using lag of the endogenous variables as instruments.

The system GMM regression is based on the works of Blundell and Bond (1998) that combines a system of two equations: the first differenced equations, whose regressors are instrumented by their lagged levels, and the level equations, whose regressors are instrumented by their first-differences. The instruments to be used depend on the assumptions whether the variables are endogenous, predetermined or exogenous (Note 3). Variables including Lagged growth, size, cash flow, leverage asset, capital and labor quality are assumed to be endogenous and use lagged values and as GMM type instruments. Age, legal status, ownership type and location are considered as exogenous regressors.

The first column in Table 8 present difference GMM regression results where only continuous variables are included and column 2 reports is the preferred specification two step System GMM where both continuous and binary control variables are included in the regression. Unlike pooled OLS, most coefficient are now significantly different from zero at 5 percent significance level.

In both regressions, the coefficient for lagged growth is negative and statistically significant indicating the presence of convergence in firm performance. This is consistent with the finding by Mengistae (1996) that small firms eventually achieve similar level of employment as large firms.

The negative coefficnet on firm size indicates that Gibrat (1931) LPE is rejected. In contrary to Gibrat firm growth is not independent of its initial size. Rather, the result shows that small firms grow faster than large firms. This results are similar with that obtained by Evans (1987) in US, Oliveira and Fortunato (2006) and Alfaro et al.

(2008) for Turkey.

Table 7. OLS and FE result of growth estimation

	(1)Pooled OLS		(2) Fixed Effects	
	Coecient	Std.Err	Coecient	Std.Err
Firm growth (lagged)	-0.00485	(0.055)		
Firm size†	-0.239*	(0.122)	-0.241*	(0.120)
Leverage ratio†	0.0631	(0.077)	-0.0526	(0.093)
Cash Flow†	-0.0196	(0.050)	0.0885	(0.061)
Firm age (year)†	-0.151	(0.113)	-0.861***	(0.239)
Asset value†	0.102	(0.101)	-0.0126	(0.231)
Capital intensity†	-0.0196	(0.050)	-0.0885	(0.061)
Labor quality†	0.352**	(0.138)	0.437	(0.276)
Productivity†	-0.132	(0.108)	-0.0647	(0.167)
Liability (1 if unlimited)	-0.198	(0.221)	1.766	(4.640)
Location (1 if urban)	0.141	(0.441)		
Ownership (1 if private)	-0.1	(0.200)		
Constant	-1.254	(1.254)		
No. of observations	4734		4734	

√ *Note*. Standard errors in parentheses. On the table *,** and *** represent significant at 10%, 5% and 1%.

† denotes lagged value of the variable in logarithm.

Table 8. GMM regression of firm growth

	(1) DIF-GMM		(2) SYS-GMM	
	Coefficient	W.C.R. Std. Err.	Coefficient	W.C.R. Std. Err.
Firm growth (lagged)	-0.143***	(0.028)	-0.024***	(0.006)
Firm size†	-0.085	(0.149)	-0.404***	(0.029)
Leverage ratio†	0.369***	(0.099)	0.185***	(0.029)
Cash Flow†	0.0836*	(0.099)	0.0405***	(0.024)
Firm age (year)†	-0.727***	(0.112)	-0.190***	(0.055)
Asset value†	0.0141	(0.101)	0.272***	(0.020)
Capital intensity†	0.084*	(0.032)	0.0405***	(0.009)
Labor quality†	0.521*	(0.201)	0.431***	(0.040)
legal form (1 if unlimited)			-0.064*	(0.028)
Location (1 if urban)			-0.176	(0.109)
Ownership (1 if private)			-0.071**	(0.030)
No. of observations	4734		4734	

√ *Note*. Robust standard errors in parentheses;

-*, ** and *** represent statistical significance at the 10%, 5% and 1% levels.

-Arellano-Bond test for AR(2) in first differences is no rejected for all cohorts;

-Sargent and Hansen test of over. restrictions: $\chi_{58}^2 = 61.97$, Pr $>\chi^2=0.058$

-Hansen test of overid. restrictions: $\chi_{58}^2 = 44.88$, Pr $>\chi^2 =0.519$

In contrast to the Pooled OLS results, financial constrains including cash flow, leverage and asset are are signifcant and have expected sign. Leverage ratio which is a proxy for access to finance is positively related to firm growth. It implies that access to finance (bank loans) is key determinant of firm growth and expansion. Thus, favourable environment for financial institutions may play important role for firm growth and investment expansion through easing financial constraints. Cash flow is also found to have a positive impact on firm growth. Firms with higher profit grow faster. Asset is also included as an additional proxy for financial and investment strength of the firm. Not surprisingly,it has positive and significant coefficients indicating that it has an important role in expanding investment and spur growth rate of firms.

The relationship between sources of financing and firm growth can be heterogeneous across size cohorts. 9 reports system GMM results when the sample is divided into three size cohorts, small, medium and large, using World Bank classification. The result reveals that only large firms are benefited from bank loan in expanding

their business. As Stiglitz and Weiss (1981) discussed, this could be the result of asymmetric information and its effect on size and cost of loan. Financial institution may not provide significant amount of loan to small firms fearing their repayment ability. They may also assign higher cost of loan for smaller firms than larger firms. Both reasons reduce the size of loan for small firms which in turn affect level of investment and growth. One implication of the result is that there may be certain threshold amount that loan help small business to grow.

Table 9. Estimates of firm growth by size catagories

Variable	Small	Medium	Large
Firm growth (lagged)	-0.349***	-0.322**	-0.128
	(9.21)	(2.03)	(1.03)
Firm size†	-1.632***	-0.608***	-0.092***
	(-4.16)	(-15.26)	(-4..26)
Firm leverage ratio†	0.0452	0.0695	0.678***
	(1.13)	(1.22)	(6.01)
Firm Cash flow†	0.153***	0.106***	0.0446
	(-7.31)	(-3.24)	(-0.85)
Firm age†	-0.257***	-0.093**	-0.035*
	(-5.04)	(-2.85)	(-2.01)
Firm asset†	0.125**	0.420**	0.516*
	(2.81)	(2.73)	(2.23)
Firm capital intensity†	0.153***	0.105***	0.0446
	(7.31)	(3.24)	(0.85)
Firm labor quality†	0.256***	0.360***	0.926
	(3.8)	(5.87)	(1.68)
legal form (1 if Unlimited)	-0.234*	-0.233	-0.536**
	(-2.02)	(-0.73)	(-3.31)
location(1 if Urban)	-0.475***	0.436	-0.693*
	(-8.34)	-1.75	(-2.24)
Ownership form(1 if yes)	-0.159	0.345	0.492
	(-0.52)	-0.5	-0.88
No. of observations	2826	206	1702

√ *Note.* t-values in Parentheses.

-*, ** and *** represent significance at the 10%, 5% and 1% levels.

-Arellano-Bond test for AR(1) in first differences: z = −1.77, Pr >z =0.016.

-Arellano-Bond test for AR(2) in first differences: z = −1.10, Pr >z =0.415.

-Sargan and Hansen test of over identification is valid

† denotes value of the variable in logarithm.

Looking at other key determinants, the negative and significant effect of size on firm growth holds for all sub samples. There is, however, a significant decline in magnitude of the size coefficient from small firms to medium and large firms. Small firms with initially small number of employee tend to grow faster perhaps explained by the passive learning model. Entrepreneurs learn about their productivity over time following their entry, and thus growth is highest during this early period of learning as indicated by Jovanovic (1982) model. The estimated coefficient on laggrowth is negative only for small and medium firms. It is consistent with the catch up theory that firms eventually converge in terms of size.

4.2 Stochastic Frontier Analysis

Stochastic frontier allows to identify output differences that cannot be explained by difference in inputs. In this section, I examine how initial size and financial constraints affect technical efficiency of firms. In a very influential theoretical paper, Jovanovic (1982) suggest that when a firm gets older and larger, it grows more confident about its efficiency implying that large and old firm are efficient. In another prominent paper by Stiglitz and Weiss (1981), imperfect information results credit rationing. When firms face credit rationing, cost of borrowing money will be higher than cost of funds generated internally. Then, the firms may react in two ways. Either, it cut its investment and lower operating cost or it may force managers and worker to increase effort and reduce inefficiencies. This implies that financial constraints can affect level of efficiency. To test both

theory predictions, a parametric stochastic production frontier using two step procedures is applied. First translog production function is estimated and then efficiency scores are used to analyse the impact of firm size, leverage and cash flow in the second step.

Following Battese and Coelli (1992), production frontier function specified as:

$$y_{it} = f(\phi_k x_{it}).exp(v_{it})\ TE_{it} \quad (2)$$

Where yit is total production of firm i at time t, xit represents exogenous input quantities. Technical inefficiency TEit is therefore defined as the ratio of observed to frontier production that would be obtained under full efficiency:

$$TE_{it} = \frac{y_{it}}{f(x_{it} : \varphi).exp(v_{it})} \quad (3)$$

Following the work by Green (2008) the modified trans-logarithmic specifications of production functions to be estimated is given by:

$$ln\, y_{it} = \varphi_0 \sum_{j=1}^{4} \varphi_j ln x_{jit} + \sum_{j=1}^{4}\sum_{k=1}^{4} \varphi_{jk} ln X_{jit} ln X_{kit} + \varepsilon_{it} \quad (4)$$

The error-term ($\varepsilon_{it} = v_{it} - u_{it}$) is composed of two random variables: random error-term, vit and the stochastic technical inefficiency term, uit in the production which is assumed to have half normal distribution. The intuition behind inefficiency term is that it captures deviation from the frontier production by some factors. This includes factors which are under firm's control such as effort and motivation of its worker, the ability to distinguish between good and bad workers and the nature of risk averse versus risk lover attitude of managers (Aigner et al., 1977).

The results reported in Table 10 confirms the fact that the main determinates of production frontier including capital, labor and raw material are positive and significant. Thus, production frontier is monotonically increasing in all inputs suggesting that increasing any of the three inputs increases output. The results from estimation of efficiency sores indicates that firm size is positively related to firm technical efficiency implying that large firms are more productive than small firms. One explanation for the low productivity of small firms may be the inability to take the advantage of scale of economies and the informality of contracts with clients. Furthermore, lack of resources in terms of qualified human capital could explain the low efficiency of these firms. The result is consistent with the passive learning theory and corresponds with the result obtained in Pitt and Lee (1981) Mengistae (1996).

Table 10. Frontier estimation results

Variable	Production		Efficiency		
Constant	0.697***	0.07	Constant	0.281***	0.012
log(K)	0.267***	0.062	Firm size	0.044***	0.0023
log(L)	0.138*	0.066	Leverage	-0.02	0.001
log(R)	0.473***	0.098	Cashf low	0.64***	0.006
Year	0.103*	0.027			
$(\log(K))^2$	0.762*	0.346			
$(\log(L)^2$	0.506***	0.157			
$(\log(R))^2$	0.281**	0.115			
log(K) ∗log(L)	-0.297	0.475			
log(K) ∗log(R)	0.158**	0.075			
log(L) ∗log(R)	-0.783	0.728			
Location (urban=1)	-0.107***	0.244			
Ownership†	0.052*	0.244			
Gamma(γ)	0.476***	0.001			
Loglikelihood	-326.95				

√ *Note.* *, ** and *** represent statistical significance at the 10 %, 5 % and 1% levels.

† Ownership = 1 if a firm is owned by a HH or Partner.

The estimated coefficients of the efficiency are listed in the third column of Table 10. The result shows that cash flow affects technical efficiency positively and significantly whereas leverage has a negative impact. Though it is not significant, the negative coefficient on leverage is consistent with hypothesis that once a firm cannot have access to bank loan, then it has an incentive to improve its technical efficiency over time to gains in productivity and stay in the market. Whereas the positive coefficient cash flow implies internal source of finance are productivity improving.

5. Robustness Regressions

Only surviving firms are included in the data set, which may result a bias in the estimates. As exit is more common among smaller firms, the selection bias could affect the estimated relationship between growth and size. McPherson (1996) Evans and Jovanovic (1989) and Audretsch and Klepper (2000) analyses the possible selection bias resulting from the exclusion of exiting firms on the size and growth relationship finds this bias to be insignificant. They also find a significant relationship between firm growth and size, controlling for exit of firms. Relative to the sample in this paper, the possible selection bias could be Mildred by re-estimating separated regression to small, medium and large firms in the sample. As shown in Table 9 and Appendix 1 the results are robust.

6. Conclusions

This paper analyse the key determinants of firm growth and technical efficiency of Ethiopian manufacturing firms and examine how the source finance affect growth and efficiency differently for firms in different size categories. The results indicates that small and young firms tend to grow faster than large and old firms. Leverage and cash flow are also binding constraints. However, their effect are found to be heterogeneous. Internal finance (Cash flow) significantly affect growth of smaller firms which are found to be reliant on internal earnings whereas leverage (borrowing) affect growth of large firms. This fact is consistant with the sories of asymmetric information and credit rationing which affect the size and cost of loans. Moreover, I examine the presence of significant differences in efficiency across firms and identify the effect of finance and size on efficiency scores. The result from two step estimation of stochastic frontier model shows that firms have different level of efficiency score. It increases with firm size and cash flow but decrease with borrowing. The main results are robust to change in growth measure.

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Notes

Note 1. This data has been widely used by researchers in the field including Bigsten and Gebreeyesus (2007) Bigsten and Gebreeyesus (2007) and Shiferaw (2007).

Note 2. The values of sale, output, capital asset are in millions of Ethiopian Birr (ETB).

Note 3. The validity of the instruments is based on the assumption that both lagged levels and first differenced variables (instruments) are correlated with endogenous regressors but uncorrelated with the error term.

Appendix

Appendix 1. Result from GMM: Sales Growth

Table 11. Regression result of sales growth by age catagories

Variable	Young	Mature	Old
Firm growth lagged	-0.145***	-0.365***	-0.365***
	(0.036)	(0.03)	(0.03)
Firm size†	-0.262***	-0.349***	-0.349***
	(0.0461)	(0.0729)	(0.0729)
Firm leverage ratio†	0.046	0.394***	0.394***
	(0.0355)	(0.058)	(0.058)
Firm Cash flow	0.253***	0.206***	0.0246
	(-7.31)	(-3.24)	(-0.85)
Firm age†	0.145**	0.0696	0.0696
	(0.0466)	(0.0627)	(0.0627)
Firm asset	0.123**	0.351***	0.351***
	(0.0457)	(0.0911)	(0.0911)
Firm capital intensity†	-0.00332	0.0663**	0.0663**
	(0.0193)	(0.0239)	(0.0239)
Firm labor quality†	-0.278***	-0.350***	-0.350***
	(0.0636)	(0.0895)	(0.0895)
Legal status(1 if unlimited)	-0.363***	-0.00631	-0.00631
	(0.0551)	(0.0703)	(0.0703)
Location(1 if Urban)	-0.181***	-0.342***	-0.342***
	(0.0388)	(0.0805)	(0.0805)
Ownership (1 if Private)	-0.0257	0.112	0.112
	(0.191)	(0.239)	(0.239)
Constant	1.622***	-1.22	-1.22
	(0.34)	(1.312)	(1.312)
No. of observations	1392	1262	2080

√ Note-growth is measured by sale growth.

-figures in brackets are standard errors.

-*, ** and *** represent statistical significance at the 10%, 5% and 1% levels.

-Arellano-Bond test for AR(2) in first differences is no rejected for all cohorts.

-Sargan and Hansen test of over identification is valid.

† denotes lagged value of the variable in logarithm.

Appendix 2. Geographical distribution of firms in 2005/6 (Source, A Bigsten 2007)