THE VALIDITY OF MARSHALLIAN HYPOTHESIS AMONG THE ETHIOPIAN TENANT FARMERS: EFFICIENCY DIFFERENCE BETWEEN SHARECROPPING AND FIXED RENT TENANT FARMERS

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ABSTRACT

This study attempts to estimate technical efficiency and examines its difference between sharecropping and fixed rent tenant farmers. A Stochastic frontier Cobb-Douglass production function was estimated based on the data of 144 tenant households obtained from the First Round Ethiopian Household Survey of the Economics Department of the Addis Ababa University. The result indicated that all tenant farmers on the average operated at about 62.5 percent of their technical efficiency. The findings tended to go in line with the Marshallian hypothesis or Tenant Models, which predicts that a sharecropper undersupplies variable inputs and operates less efficiently as compared to a tenant that works under the fixed rent arrangement. The finding tended to suggest that landowners and tenants should consider fixed rent arrangement as it could generate relatively higher level of efficiency of factor inputs and maximize their mutual benefits.

INTRODUCTION

Land tenancy, which is a system where by land is cultivated not by the owner of the land but by another farmer (a tenant) who pays some kind of rent to the former (landholder), is as old as a recorded history. It has been prevailing in the different parts of the world for many centuries (Byres, 1983). The policy environment and the scale of tenancy operation have varied in Ethiopia during the different regimes. During the Imperial era, land was primarily under "private" ownership, the distribution was extremely uneven in many parts of the country and tenancy was a legally recognized and acknowledged way of access to land for the landless. In the Northern part, land tenure did not exist as such as it did in the rest of the country. Through a system called *REST* individuals having descent kinship ties with the original founder of the community were entitled lifetime usufruactual right over their share. In the South, land ownership was highly concentrated in the hands of few landlords who gave a large portion of their land to tenants (Desalegn, 1994).

The 1975 Land Reform Proclamation totally banned private ownership and temporarily changed the land distribution pattern and tenancy operation. This condition was transitory and could not address landlessness once and for all. After traversing for about fifteen years, the Military Government formalized land tenancy market through the "Mixed Economic Policy" in 1990. Although the policy kept land as a state property, it allowed farmers leasing or bequeathing 'their' holdings for a short and legally recognised period of time (Daniel et al., 1997).

The existing government also adheres to the policy of the previous regime. It has redistributed land in certain parts of the country through which a certain segment of landless population got access to farming plots. However, the redistribution has not addressed the demands of all land claimants. Thus, land tenancy has continued to be a means of accessing land for the landless or land deficit farmers.

Fixed rent and sharecropping are the two common forms of contracts that are usually made between landholders and tenants in Ethiopia. Fixed rent is an arrangement whereby a tenant is supposed to pay a fixed amount of crop or cash whereas sharecropping is a mode of contract through which a tenant pays a percentage of his crop for the service of the land. Within the sharecropping tenancy experiences vary from one area to the other. For instance, in Mafud District of the Amhara Regional State, a type of sharecropping arrangement known as *Ma¨gazo* is dominantly applied among highlanders, in which *Erbo* (1/4) and *Siso* (1/3) of the total produce is given as a rent for the owner of the land. In the lowlands, the tenancy land is described as *Ye-gamis or Ya-gamash*, whereby the tenants and owners equally share the harvest. There is no a clear distinction between *Magazo* and *Ya-gamash*, except the rate (Ege, 1994). Teferri (1994) found in Wayu and Anget Mewgiya areas of Northern Shewa that in all forms of *Magazo*, the landowner and the tenant contribute seed proportional to their output share. If only the tenant or the landholder is able to contribute the required amount of seed, he would be compensated the same from the produce.

There are different arguments about the efficacy of tenancy in relation to efficiency. Some scholars contend that tenancy is a mechanism of redistributing resources for their optimal use - Bereket and Croppenstedt (1995) and Lipton (19985). Thus, this system allows for optimal use of idle land, labour and capital, which could be found in the hands of landholders and landless or land scarce farmer. Others, on the other hand, argue that tenancy, particularly sharecropping reduces the incentive to adequately supply the required amount of inputs and maximize the efficiency of farmers - Marshall (1920), Bell (1977), Bardhan and Srinivsan (1971). Irrespective of the mode of contractual agreement, tenants lack security to invest on assets the returns of which would be fetched in the long run. The effect of tenants' sub-optimal operation goes beyond the twô parties and harms the welfare of the society at large. In spite of these controversies, tenancy has existed for years as a means of generating livelihood for the landless and a source of income for the land owners. The issue then becomes the choice of an arrangement that would maximize efficiency and returns of both tenants and land owners.

The views about the expediency of fixed rent and sharecropping contractual arrangements also vary. Some argued in favour of the Marshallian hypothesis that fixed rental allows tenants to maximise the residual output, over and above the rental fee, which is not related with the level of output. While in the case of sharecropping, the amount of output that goes to the landowner increases with a certain proportion (which is the rental share) with the level of the harvest. Thus, output distribution arrangement emplaced in the sharecropping tenancy tends to reduce the incentives of tenant farmers to maximize output. This argument may, however, be challenged in view of the Ethiopian situation. The enormous pressure of potential entrants to the tenancy market due to rapid population growth, lack of accessible land for farming and lack of alternative non-farm income sources could compel the incumbent tenants to operate under normal conditions without undersupplying their variable inputs and efforts. Instead, they could even strive to increase their productivity and maximize the output, which is over and above the rent. On the contrary, one could contend a view that even under the prevailing Ethiopian condition, fixed rent arrangement is a very good way for both the landowner and the tenant. It gives a chance for the land owner to secure a fixed amount of output that has already been stipulated on the contract as a rent regardless of output fluctuations. On the other hand, it gives the chance for tenants to operate without managerial hurdle and intense supervision. These controversies are a source of inspiration for an empirical investigation of this sort.

The main objective of this study is, therefore, to estimate and assess technical efficiency differential between fixed rent and sharecropping tenants. The study uses a stochastic frontier Cobb-Douglass production function to estimate technical efficiency. The source of data for the study is the 1993/1994 first round Ethiopian Rural Household Survey collected by Economics Department of Addis Ababa University in collaboration with Oxford University of the United Kingdom and the International Food Policy Research Institute (IFPRI).

In a country where the agricultural sector engages the bulk of the labour force and access to land has increasingly been a problem, estimating efficiency and investigating its variation among tenants helps to draw policy implications on which contractual arrangements better benefit not only parties that are involved in land use transaction but also the economy at large. Few studies have been undertaken in this respect in Ethiopia and some of them used data collected from a certain geographical area. In this respect, this paper will have its own value added on the existing empirics.

LITERATURE REVIEW

Theoretical Literature

There are different contractual forms that a landlord could indulge in. The most common options are three. Ray (1998) described the three forms in a very simple mathematical expression. If Υ denotes agricultural output on the rented land, then the total Rent R could be written as

$$R = \alpha\Upsilon + F \qquad (1),$$

where $\alpha = 0$ and $F > 0$, this is a fixed-rent contract with rent F. If $F = 0$ and $0 < \alpha < 1$, then this is a sharecropping contract, where α is the share to the landlord and $1 - \alpha$ is the share to the tenant. Finally, if $\alpha = 0$ and $F < 0$, this can be interpreted as a "pure wage contract", where the wage is $w = -F$. The tenant is not a tenant at all, but a labourer on the landlord's land.

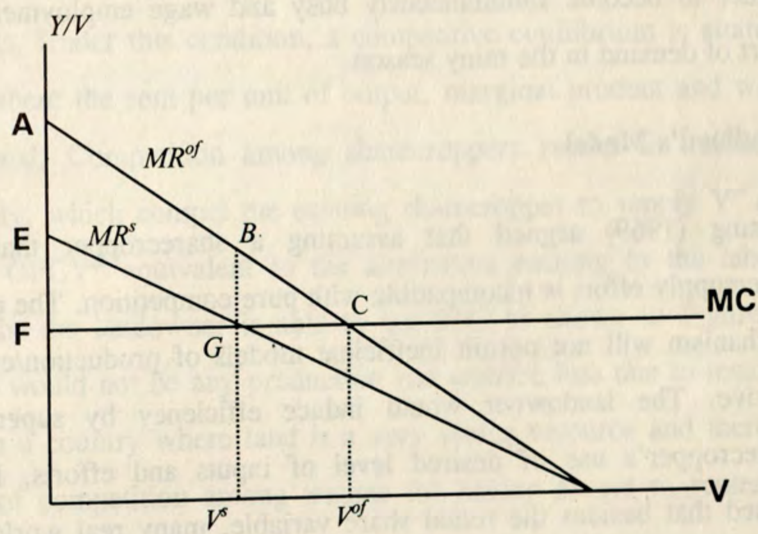
Our main focus here is on the economic rationale for opting for sharecropping or fixed rent arrangement. In this respect, there are competing theoretical predictions and models favouring one over the other. Broadly speaking, these theories could be categorized into five groups on the basis of similarities of arguments.

The Tenant's Model

On the basis of a pioneer work of Alfred Marshall in 1920, Bell (1977) illustrated what is known as the Tenant's Model. This model assumes purely competitive markets for outputs and inputs including land, tenants and hired labour. There exists perfect certainty and smooth enforceability of contracts. There are only one fixed rent tenant (or owner operator) and one sharecropper. The sharecropper pays a fraction (r) of his output for land rental. Both farmers use homogeneous fixed input; land (H) and one variable input V and produce output (Y). Given a competitive market, both farmers encounter horizontal marginal cost curve (MC). The model presumes downward slopping marginal revenue curves MR^{of} and MR^{s} for the fixed rent tenant/owner operator and the sharecropper respectively, where $MR^{s} = (1-r)MR^{of}$. The sharecropper pays rMR^{of} per unit of output for land rent. Ceteris paribus, as rational economic agents, both of them strive to maximise their output by equating their respective MR_i and MC.

As can be observed from Figure 1 below, a fixed rent tenant employs V^{of} units of variable input at point C, where as the sharecropper uses V^{s} units. Given the marginal condition, the sharecropper under supplies variable input by V^{of} - V^{s} amount. The fixed rent tenant and the sharecropper produce $OACV^{of}$ and $OABV^{s}$ respectively. The output difference between the two farmers is BGC, which could be considered as a welfare loss to the society. After withholding the opportunity cost of the variable input, $OFGV^s$ and the land rental, EABG, the sharecropper remains only with an output level, EFG. If the share parameter "r" increases, the slope of MR^s further declines and the consequent welfare loss will be formidable. When "r" goes to a level of forcing the MR^s curve to pass through point F, it is less likely for the sharecropper even to operate in the system.

Fig. 1: The Foundation of Marshallian Hypothesis



Source: Bell, 1977

Thus, "under competitive conditions, fixed rent contracts will lead to a pattern of resource allocation, which is Pareto-optimal, so that production under sharecropping will not be efficient" (Bell, 1977: 318). Thus, it is commendable for the government to intervene in setting the maximum level of rental share or prohibit the operation of the sharecropping system not to jeopardize social welfare.

This model is criticised for its failure to consider certain merits of sharecropping comparing it with wage labour. According to Lipton (1985), some of these advantages are reduction of supervision and some (if at all) research costs and risk-sharing attributes. Notwithstanding an effective supervision on wage labour, possibilities might exist for every farmer to become simultaneously busy and wage employment may fail short of demand in the rainy season.

Landlord's Model

Cheung (1969) argued that assuming a sharecropper that tends to undersupply effort is incompatible with pure competition. The competitive mechanism will not permit inefficient models of production/exchange to survive. The landowner would induce efficiency by supervising the sharecropper's use of desired level of inputs and efforts. He further argued that besides the rental share variable, many real world contracts consider items such as land size, non-labour inputs, etc.

According to Johnson (1950), landowners can use three ways of enforcing optimal application of inputs. These ways are specifying guidelines what the tenant must do, contracting the land on a short-term lease basis and renewing the contract based on periodic assessment of the tenant's performance and sharing the cost of production of the tenant in the same proportion as the shares in gross output.

On the bases of Johnson's proposal, Cheung (1968) approached the problem from the side of the landlord. Assume that the landowner is able to enforce contracts both on the rental share and the use of the desired amount of variable inputs by the sharecropper through appropriate control levels. The model further assumes that there is a perfectly elastic labour supply and labourers can freely engage in tenancy or in other alternative employments. Under this condition, a competitive equilibrium is attained at a point where the rent per unit of output, marginal product and wage rate are equal. Competition among sharecroppers results in unlimited labour supply, which compel the existing sharecropper to supply V^{of} and earn a fee $OFCV^{of}$ equivalent to the alternative earning in the labour market whilst the landowner is able to tax EFG as shown in Figure 1. Thus, there would not be any production and welfare loss due to tenancy operation in a country where land is a very scarce resource and there is high level of competition among tenants for having access to rented-in land.

A similar outcome could be resulted from the Coase theorem. Since the maximum the landlord is willing to pay could be in excess of the minimum the share tenant is willing to accept, obviously there is a room for trade until to points such as C in Figure1 (Quibria and Rashid, 1984). At this point, the landlord may regain BGCS level of output at V^{of}, and the tenant may accept any amount greater or equal to his labour cost GCS. The implication of the theorem is that rental share is a function of the tenant's output and the owner should oblige tenants to pay more than a certain threshold level of rent.

However, Cheung assumed a monopoly land owner, who can decide the number and the size of land parcels distributed amongst share tenants, decide rental share, and stipulate the amount of tenant labour input which is required in the share contract. He also assumed free and smooth transfer of labour from one activity to the other. These assumptions are contestable. A monopoly landowner does not exist in a country such as Ethiopia. In the presence of competition among landowners, it is less likely to absolutely control the rental share and the assumption of effective monitoring on the use of variable inputs does not consider its associated costs (Ellis, 2000). In other words, in accordance with the Coase-theorem, rental share is a pre-determined variable and could not necessarily be adjusted with the level of output.

The General Equilibrium Model

The Bardhan and Srinivsan (1971) General Equilibrium Model (GEM) brings together both the Marshallian Tenant's Model and Chueng's the Landlord's Model. GEM assumes the tenant to either lease in land or engage as a wage labourer. Similarly, the landlord rents-out his land or hires labour. The labour market is presumed to be competitive. The demand for land is inversely related to the rental share and the opportunity cost of labour or the wage rate. The willingness of landholders to rent-out their plots increases with an increase in rental share and the wage rate. The model further assumes that both the landholder and the tenant could play a role in enforcing contracts, and both parties strive to maximise their utilities in terms of income and leisure. The equilibrium rental share is determined by equating demand and supply for land. However, the equilibrium rental share does not ensure the most efficient level of operation. Similar to the case of the Marshallian Paradigm, this model concludes that sharecropping is an inefficient mode of tenancy.

Risk Sharing and Market Imperfections

The Tenant and General Equilibrium models give emphasis to fixed rent tenancy as against sharecropping on grounds of efficiency, while the Land Lord model concluded that it is possible to make sharecropping as efficient as fixed rent. This particular model argues that uncertainty and risk diversion could be considered as an alternative objective as against efficiency for the choice of sharecropping. Different contracts entertain different degrees of risk for the landholder and the tenant. In the fixed rental system and in the case of hired-labour, the entire risk burden falls on the tenant and the landowner absorb the entire risk respectively. In between is sharecropping, as a dispersion mechanism through which risks could be shared between the landlord and the tenant (Huang, 1975).

Newbery and Stiglitz (1979) also argued that sharecropping forces tenants and landowners to work on addressing possible effects of risks and uncertainties and helps to economize information. According to this view, sharecropping is preferable as compared to the alternative if risks are significant enough to merit the "tax equivalent" output loss as it is described in the Tenant's Model. According to Ellis, (2000), this notion works better for the land owner than the tenant depending on the nature of the market available. In a competitive market, the landowner could arrange a cash tenant tenancy and a wage-labourer which would provide the same degree of risk spreading as sharecropping, while avoiding the possible inefficiency effects of the latter. It is rather the imperfect information, on as to the kind of risks that separately affect tenants and landowners, which determines the rationale for sharecropping. The existence of imperfect labour market in particular forces tenants to opt for a sharecropping arrangement so as to reduce the risk of being idle or unable to be employed as a wage labourer. Neither the landowners seeking for a wage labour could easily hire those who have appropriate skills at the right time. Instead, they use sharecropping as means of accessing tenants that possess desirable attributes rather than relying on unknown seasonal workers.

In agrarian countries, incomplete or non-existent markets, mainly because of imperfect information usually, give rise to sharecropping. Stiglitiz (1986) argued that lack of information in transactions involving land, labour and credit brings about higher risk, as well as higher levels of transaction costs like supervision and enforcement. In the absence of providing adequate collateral, in the presence of high risks of default and imperfect information, share tenancy gives the possibility to minimize risks and control farm inputs and outputs.

Quibria and Rashid (1984) tried to examine sharecropping under dual labour market conditions in an agrarian economy assuming information asymmetry and unequal power of enforcing contracts between the landowner and the tenant. The cost of wage labour is assumed to be strictly positive, family labour being zero. Given this duality, sharecropping is likely to be inefficient. It is because of the fact that the tenant with his family may supply labour to a level where marginal product less rental share [MP (1-r)] equals zero. This is not likely to be the case for hired labour. Although there may exist duality, the assumption of zero opportunity cost for family labour in the model is superfluous in countries such as Ethiopia where almost every member of a rural household could work at different capacities.

Interlocking Markets

In agrarian countries land lease markets are usually interlocked with other markets in which tenants are supposed to transact inputs and outputs with landowner and borrow credits. They also work or provide other services like housing, water, fuel wood, etc., for landlords. There are two counter arguments on the impacts of such markets on efficiency of tenants (See Taslim, 1988). Some argue that given incidences of costly monitoring and moral hazard problems peculiar to less developed countries, provision of cheap credits by landowners helps improving allocative efficiency through availing inputs at the right time and quantity. It is argued in this respect that under conditions of capital imperfections, both capital constrained landlord and a tenant with adequate amount of capital would benefit if they agree on a point where both parties receive a share of output equivalent to a share of capital cost (Quibria and Rashid, 1984).

Others consider interlocking as landowners' strategy to extract a significant amount of surplus from tenants and keep them in perpetual bondage of indebtedness. It discourages technological innovations initiated by landlords with the belief that loss of benefits from such investments could be compensated by interest payments on credits from tenants. Interlocking also reduces the freedom of poor tenants to compete and bargain in free markets and constrains them from operating around the production frontier. In general, however, the net effect of interlocked markets should be seen in light of the availability of a more viable option and the kind of contract agreed upon by the two parties. Interlocked markets are more applicable in sharecropping arrangements than fixed rent tenancy as the former gives more leverage to the landowner to influence the tenant.

Empirical Findings

As varied theories, empirical literatures came out with considerably varied findings. Bell (1977) tested the Tenant and Landlord Models using simple linear regression and other statistical techniques. In line with tne Marshallian hypothesis, he found sharecropping to be economically inefficient as compared to own operators and fixed rent tenants in Purnea District of North India. Seleem (1988) estimated a profit function using Seemingly Unrelated Regression method to examine the relative efficiency of sharecropping and fixed rent arrangements in irrigated cotton farms of the Sudan called Joint Account (JA) and Land-Water-Charge (LWC) Systems, respectively. He found farmers operating in the two systems to be technically, allocativelly and hence economically equally efficient. From his finding the author implied that the experiences on Sudanese cotton farms lent no support of the Marshallian theory. Huang (1975) conducted a study on rural villages in Malaysia using the census data on agriculture and found sharecroppers to be more productive than the fixed-rental contracts.

In the Ethiopian case, Bereket and Croppenstedent (1995) found that in cases of limited off-farm employment opportunities and in the absence of complimentary inputs for the landholder, sharecropping helps increasing efficiency as compared to the alternative. Gavian and Ehui (1996) tried to test the relative efficiency of three different informal and "less" secure land contracts (fixed rent, sharecropping and borrowed) on the basis of data collected from 407 plots in Arsi Zone. According to their finding, although farmers of the informally-contracted lands applied inputs more intensively, lands were found to be cultivated 7% to 16% less efficiently compared to own-operated farmers. From this result they concluded that the widespread insecurity of rural land in Ethiopia suggests the need for more stable, enforceable leases to all farm land. In their study, the methodology used was total factor productivity. This measure would not enable authors to compare the observed level of output of each group of farmers as against the "best practice" or the maximum possible level of output.

Ahmed et al. (2002) undertook a study on a similar area covering 161 households operating on 477 plots. Among the 161 households, 115 households had their own land, while the rest operating on leased land. They found that "... land tenure affects the technical efficiency of agriculture significantly. Sharecropped and gifted/borrowed plots are significantly less efficient than owner-operated plots. However, there was no significant difference in efficiency between owner-operated and fixed rental plots. Moreover there was no significant difference between sharecropped and fixed rental, and between sharecropped and gifted/borrowed plots. Fixed rental plots were more efficient than gifted/borrowed plots". The results seemed incompatible and yet one could observe that fixed rent plots were not less efficient as compared to sharecropped, if not the other way round. One important finding from their study was that "... the use of seed, inorganic fertilizer and herbicides did not change with variations in land tenure systems. There was no significant difference in land quality by tenure" (Ibid, 2002).

Model Specification

The Model

Scholars use different methodologies of measuring the extent to which farmers utilize their inputs. These methodologies apply simple descriptive statistics, linear programming, or econometrics. The first two methodologies assume deterministic relationship between inputs and outputs. Deterministic or engineering relationships assume that all farmers within the model operate on similar institutional setting, physical resources, and environmental conditions and imply that the difference in the production levels from equal amount of inputs could arise only from internal problems in properly managing and using inputs. Econometric techniques, on the other hand, give a room also for the influences of external factors on the production process. In so far as agricultural production is affected by non-observable external factors, a methodology that uses an econometric approach will be more appropriate. Splitting the influences of external and internal factors, and indicating the level of technical inefficiency attributable to conditions under full control of farmers requires the application of stochastic frontier production function.

A stochastic frontier production function with output Y and inputs X_j is specified as:

$$Y_i = F(X_{ij}, \beta_j)e^{v-u} \quad \text{..................} \quad (1)$$

or

$$Y = F(X)\exp(v-u).$$

v_i are assumed to be independently and identically distributed as $N(0, \sigma_v^2)$ and the covariance between u_i and v_i to be zero. u_i are assumed to have a non-negative truncation of either half-normal, exponential or gamma distribution (Battese, 1992: 190). The usual non-stochastic frontier econometric specifications usually have one error term ( ) and the decomposition of this error term into two gives one important implication. The non-negative error term u_i, measure the degree of technical inefficiency, and the usual error term (v_i) with its expected properties. In view of this, the maximum production limit (Y) is bounded above by a stochastic quantity $F(X_{ij}; \beta)\exp(v_i)$.

is decomposed into v and u as:

$$\varepsilon = u + v \quad \text{.............} \quad (2)$$

where v and u assume the usual normal distribution with constant variance and zero mean, $N(o, \sigma_v^2)$ and truncated normal distribution

$$F(u) = \frac{2}{\sigma_u \sqrt{2\pi}} \exp\left[\frac{-u^2}{2\sigma_u^2}\right], u \geq 0 \quad \text{......... (3)}$$

Assuming u and v to be independently distributed,

$$F(\varepsilon) = \frac{2}{\sigma} \phi\left[\frac{\varepsilon}{\sigma}\right]\left[1 - \Phi(\frac{\varepsilon\lambda}{\sigma})\right] \quad \text{......... (4)}$$

$$\text{where } \sigma^2 = \sigma_u^2 + \sigma_v^2 \quad \text{.......... (5)}$$

$$\lambda = \frac{\sigma_u}{\sigma_v} \quad \text{.......... (6)}$$

and $\phi(.)$ and $\Phi(.)$ are density and distribution functions of the standard normal distribution, respectively (Fishe and Maddala, 1994). λ in equation (6) indicates the relative influences of forces that are under the control of farmers and events external to them.

Given equation 1 above, the level of technical efficiency for each farmer is given as:

$$e^{-u} = \frac{Y_i}{\left[F(X_{ij,}\beta_j)e^{v_i}\right]} \quad \text{..................... (7).}$$

A farmer is said to be technically efficient if and only if his actual output equals to the predicted level of output or else there will be a deviation by $(1\text{-}e^{-u})$ * the potential output.

According to Assefa (1995), parameters of the frontier and density functions of the two error terms are estimated through maximising the following log-likelihood function:

$$\ln L(Y/\beta,\lambda,\sigma^2) = N\ln\sqrt{\frac{2}{\pi}} + N\ln\frac{1}{\sigma} + \sum\ln\left[1 - F(\frac{\phi_i\lambda}{\sigma})\right] - \frac{\sigma^2}{2}\sum\phi_i^2 \quad \ldots (8).$$

Since v_i are not observable, Jondrow et al. (1982) estimated farm level technical efficiency as:

$$E\left(u_i/\varepsilon_i\right) = \frac{\sigma_u\sigma_v}{\sigma}\left[\frac{\phi(\varepsilon_i\lambda/\sigma.)}{1-\Phi(\varepsilon_i\lambda/\sigma)} - \frac{\varepsilon_i\lambda}{\sigma}\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where $\phi(.)$ and $\Phi(.)$ are standard normal density and distribution functions estimated at $\frac{\varepsilon_i\lambda}{\sigma}$ and λ is estimated at $\lambda = \frac{\sigma_u}{\sigma_v}$ respectively. After replacing ϕ, σ, and λ by their estimates in equation (9), the values for u_i and v_i are estimated and technical efficiency of individual farmers would be calculated subsequently as

$$e^{-u_i} = Exp[-E(u_i/\varepsilon_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots (10).$$

The average technical efficiency of all farmers in the sample is given by

$$E(e^{-u_i}) = 2\exp(\sigma^2_u/2)(1-\Phi^*(\sigma_u)) \quad \ldots\ldots\ldots\ldots (11),$$

where Φ^* is the standard normal distribution function (Ibid, 1995).

Estimation Procedures

Supposing all tenant farmers in the sample operate on a similar technological system, a stochastic Cobb-Douglas production function is estimated through the Maximum Likelihood Iteration Method using the Limdep 7[1] econometric software using 144 tenant households. On the basis of the estimated function results, technical efficiency of farmers is calculated.

The estimated stochastic Cobb-Douglas production function is specified as:

$$Y_i = \alpha_0 + \sum \alpha_i X_i + v - u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (12),$$

where

Y= log of cereal output in kg per household,

X_i = log values of labour days, land in hectares, fertiliser in kg, number of oxen and bulls, etc. (for detail description see Annex 2).

[1] Limdep7 (1998) is a software written by William H. Greene and Windows interface is made by M.J. Lowe.

u = Technical efficiency parameter, assumed to take non-negative values with a half-normal probability distribution.

v = the usual stochastic disturbance term, normally distributed with $(0, \sigma_v^2)$.

Farm specific technical efficiency is estimated through the Jondrow et al., (1982) as

$$TE_i = \exp[-E(u_i/\varepsilon_i)] \quad \text{..................} (13).$$

Battese and Coelli (1988) noted that a simple average of farm specific technical efficiency values could provide a misleading notion about the over all sample. Instead, mean population efficiency is approximated in logarithmic specifications through,

$$E(e^{-u_i}) = 2\exp(\sigma_u^2/2)(1-\Phi^*(\sigma_u)) \quad \text{..............} (14),$$

where $\varepsilon_I = \mu_i + v_i$, Φ (.) is distribution function, σ_u^2 and σ_u are variance and standard errors.

Definition of Variables

1. *Output (Y):* Farmers produce include *tef*, (mixed black and red *tef*), barely, wheat, maize, sorghum and millet. The monetary values of these items are summed up and deflated through weighted prices to come-up with "real" output levels.

2. *Land (H):* Land size is captured through the number of hectares under cereal cultivation during the period. The average share of rented-in land was about 57% of the total cultivated land but there was no information about the inputs used and amount of cereals harvested from the rented-in plots.

3. *Oxen-Bulls (OB)*: Number of oxen and bulls is considered as draught input. The number of ploughing days was considered but it was found to be highly correlated with labour input and thus abandoned. Given the very low understanding of respondent farmers on the importance of recording or estimating the number of working days that oxen and bulls were on the farm, it is likely to be severely affected by measurement error. Thus, the number of oxen and bulls is found to be more appropriate information to capture this input.

4. *Farm Labour (L):* Labour is measured through number of days worked by family, hired and exchange (like *Debo)*. Labour is heterogeneous in its productive capacity and education, age and other variables are considered to capture the impacts of such differences in the equation.

5. *Wealth of Households (M):* Wealth, as collateral for credit and as an indication for farmers' effort, is captured through the kind of materials used for roofing of residences. A dummy value of "1" is assumed if the roof was made of wood, galvanised iron, or stone, bricks or cement, and "0" otherwise.

6. *Fertilizer (F):* (F) stands for all kinds of chemical fertilisers measured in kilograms. An interaction variable, *Intfhs,* is used to capture the impact of "large" size (more than 2.5 hectares) land on fertilizer application.

7. *Credit (Cr):* A dummy value of "1" is given for those who obtained credit in three consecutive years (1991, 1992, and 1993) and "0" otherwise. The credit was offered in financial terms.

8. *Soil fertility (Lq) and topography of land (Ls):* On the basis of respondents' valuation, quality of land is encoded as 1=*lem* (fertile), 2=*lem-teuf* (semi-fertile) and 3=*teuf* (infertile). Steepness is encoded as 1=*medda* (flat), 2=*dagath-ama* (semi-flat) and 3=*geddel* (steeply).

9. *Education*: Farmers' education has a bearing on access to information on modern farm practices and managerial skills. Two different education variables are considered.

   a) *LEDH1* has a value of "0" for those household heads who have no formal schooling or adult literacy certificate. If a farmer reads and writes or has adult literacy certificate or religious or traditional education, he is given "2". Values 3, 6, 8, and 12 are to capture those who attained primary education but fail to complete, completed primary, junior secondary and high schools respectively.

b) *EDH* is given a value of "1" if there are one or more members of the household other than the head, who can read and write, and "0" otherwise.

10. *Age of household head (lA): lA* is taken as a proxy variable for experience in farming and 'endurance' as agricultural activities require strength and long-time practices on activity management and timing (Mulat and Croppenstedt, 1998).

11. *Rainfall (R2, R3, and R4):* Timing, magnitude and intensity of rainfall are important variables in agricultural production modelling particularly in countries such as Ethiopia. On the basis of the respondents' judgement, *R2* is set at "1" if there was sufficient rain at the beginning of the *Meher* season, and 0= if there was excess or shortage. *R3* is encoded at "1" if there was sufficient rain during the growing period of cereals, and "0" in the case of excess or shortage. *R4* is given a value of "1", if the rain stopped on time and "0" otherwise.

12. *Family Size (lfs):* Family size is taken as mere number of household members with a fear of multicollinarity with the labour variable. Family size is expected to positively affect the level of production in terms of availing labour and triggering farmers to produce sufficient amount for their consumption. On the other hand, depending on the age composition within the family, large family size may turn out to negatively contribute for output as dependency is relatively high.

EMPIRICAL FINDINGS

Descriptive Statistics

The study is based on the First Round Ethiopian Rural Household Survey of Addis Ababa University, and focuses on tenant farmers. Albeit, there is no any rule of thumb, households cultivating less than 0.25 hectares, using less than 60 (one-man equivalent) working days and/or producing less than a quintal in *Meher* are excluded from the study. Assuming the use or not use of fertiliser and the mode of ploughing reveals technological differences among farmers; the study considers only fertilised farms operating mainly through oxen ploughing. With regards to the selection of seasons, only the cereal output of *Meher,* as the main growing season, is considered to capture annual value of production. Observations with zero values for key variables such as land, oxen, labour or output are not considered. The study focused on 144 tenant households drawn from twelve different sites of Amhara, Oromiya and Southern Nations and Nationalities People Regions (SNNPR). About 107 were sharecroppers and the remaining 37 were fixed rent tenants. There was a significant disparity in the composition of tenants across regions. The Amhara region alone held about 65% of the total number of sharecroppers, whereas the Oromiya region accounted for around 70% of tenants operating with a fixed rent arrangement. 15% of the sharecroppers and 8 % of the fixed rent operators existed in SNNPR.

Table 1. Regional Distribution of Tenants

Region	Share-croppers		Fixed Rent		All Tenants	
	Number	%	Number	%	Number	%
Amhara	70	65	8	22	78	54
Oromiya	21	20	26	70	47	33
SNNPR	16	15	3	8	19	13
Total	107	100	37	100	144	100

Source: Own Calculation from the Survey Result

Comparisons are made on the level of inputs used and the amount of output produced between sharecroppers and fixed-rent tenants. A sizeable difference has been observed in the mean output levels between the two groups of tenants. Sharecropper households produced an average of 10.6 quintals, whereas fixed rent tenants were able to produce as much as 17.4

quintals over a one year period. This difference is found to be statistically significant at 10%. This difference might have been attributed to variable input use differences and access to information[2]. Sharecroppers on the average spent about 158.6 labour working days and applied 67.6 kg of fertilisers per hectare of land. Fixed rent tenants, on the other hand employed 422.3 labour working days and used 90.8 kilograms of fertilizer. Around 35% of the fixed rent tenants acquired credit from different sources but only 17% of the sharecroppers were able to do so. The majority of fixed rent tenants were in Oromiya region, nearer to Addis Ababa, which might have allowed having a better access for information, modern technologies and output markets. Regarding oxen and bulls and land size, there was no statistically significant difference between the two groups.

An investigation on the rental share revealed that around 53% of the sharecroppers paid half of their harvest for the landowner and 43% of them withheld about 67% of the produce. Others, on the other hand, paid as much as 67% of their produce to the landholder. In terms of spatial distribution, 1/2:1/2 share between tenants and landholders widely prevailed in Yetmen locality of the Amhara region, Adele Keke and Turufe Ketchema localities of the Oromiya region, Aze Deboa and Gara

[2] However, examining output per unit of a particular input (partial productivity) conceals the effects of all other factors of production and provides a misleading result.

Goda localities of the SNNP region. In Sirbana Godeti of Oromiya, Kormargefia, Karafino and Fajina Bokafia of Amhara, tenants grappled a major share (2/3 of the produce). Exceptional was the case of tenants in Dinki Peasant Association of the Amhara region where 50% of the tenants delivered the lion's share (2/3) of their harvest to the landholders.

Presumably, mode of input cost financing has its own impact on tenancy efficiency. Only in 5 % of the cases, both tenants and landholders equally shared the costs of acquiring inputs as seeds and fertilizer. In 20% of the cases, either landholders financed input costs or tenants initially finance the cost with a condition that they would be fully compensated during the harvest. In 74% of the cases, tenants took care of all the costs. Interlocking markets took different forms like assisting the landowner while he was working on his own land. In this respect, only 36% of tenants assisted owners whenever landholders required them to do so.[3] About 28% of tenants reported that their activities were supervised by landowners either regularly or some times during the harvesting period.

Econometric Findings

Technical Efficiency

A Cobb-Douglas production function is estimated both through Ordinary Least Squares (OLS) and Maximum Likelihood Estimation (MLE)

[3] The information on the existence and nature of interlocking markets in terms of credit, output sales, etc. is limited.

procedures. The OLS estimate is used to examine the average response of output with respect to changes in the amount of inputs, while the stochastic frontier version of the MLE is used to calculate technical efficiency of farmers.

Table 2. Ordinary Least Squares Regression Estimates of Cobb-Douglas Production Function

Dependent variable (Y)	Residuals:
Mean values (6.803574219)	Sum of squares (43.48569968)
Standard Deviation (0.9619584425)	Standard Deviation (0.58516)
Model Size:	Fitness of the Model:
Observations (144),	R-squared (0.671377)
Parameters (17)	Adjusted R-Squared (0.62998)
Degrees of Freedom (127)	Diagnostic:
Model test:	Log-Likelihood (118.1157), &
F[16, 127] (16.22)	Restricted (b=0), Log-Likelihood (198.2405)
Prob value (0.0000)	LogAmemiyaPrCrt. (-.960),
Autocorrelation:	Akaike Info. Crt. = 1.877
Durbin-Watson Statistics (1.84031)	Results Corrected for hetroskedaticity:
Rho (0.07985)	Breusch – Pagan chi-squared (17.5890), with 16 degrees of freedom

Variable	Coefficient	Standard error	t-ratio	P [/T/ >t]	Mean of X
Constant	4.575944855	.6301599	7.261	.0000	
L	.1828484474	.5736581E-01	3.187	.0018	5.3660404
H	.4642306761	.13456385	3.450	.0008	.57976401
OB	.2753349628	.86940767E-01	3.167	.0019	.88531448
M	.3911047417	.10147646	3.854	.0002	.51388889
Variable	Coefficient	Standard error	t-ratio	P [/T/ >t]	Mean of X
Cr	.1141242966	.12622204	.904	.3676	.21527778
R2	.7522708024	.18158279	4.143	.0001	.31944444
R3	.2702143674	.18455751	1.464	.1456	.27083333
R4	-.3561752980E-01	.15674294	-.227	.8206	.24305556
Lq	-.2024898831	.81679790E-01	-2.479	.0145	1.7463293
Ls	.1773514709	.17628933	1.006	.3163	1.2226478
EDH	-0.5607182192E-01	.31554466E-01	-1.777	.0780	1.3296216
F	.1999676524	.71914522E-01	2.781	.0063	4.6255908
Intfhs	.3435510618E-01	.28886539E-01	1.189	.2365	2.9583761
La	-.1441885054E-01	.15198621	-.095	.9246	3.7434927
Lfs	-0.3513591320	.11031197	-3.185	.0018	1.8093418
LEDH1	.1438366836	.96728233E-01	1.487	.1395	.53949446

As could be observed from Table 2, the model in its entirety is robust and able to attribute about 67 percent of the variation in output to the variables incorporated in the function. The responsiveness of output (Y) to a change in land size (H) is considerably high as compared to other conventional inputs, oxen and bulls (OB) and labour (L). This is an indication of the extent to which land is a scarce resource for tenant farmers as compared to other inputs. Consistent to the manner it was coded, quality of soil and land topography are found to be negatively related to output. This could definitely imply that as the quality and topography of land deteriorates its return to output declines. It may not be surprising in a country such as Ethiopia to observe a rainfall variable, capturing adequacy of rainfall at the beginning of the *Meher* season (R2), to have a significant impact on the level of production.

Wealth (M) and fertilizer (F) are found to contribute significantly to cereal output. Wealth facilitates the acquisition of inputs. Wealth is usually the result of hard work, creativity and good management, and in this respect it could be used as proxy for the potency of the farmer. It has been demonstrated that unless it is applied without considering the soil type and the amount of the dosage, fertilizer improves productivity of the land and the overall efficiency of farmers. The existence of one or more persons in the family other than the household head who can read and write (EDH) is found to contribute negatively to production. Most of these family members are children below the age of twelve who do not have the capacity to give advice about new ways of doing things. Instead they might even share resources for financing their schooling, which would have otherwise been utilized in purchasing inputs. The variable for age of the household (lA) is found to be not statistically different from zero. Normally, for a traditional way of farming, age might help to build up experience on how to properly manage activities. However, younger farmers might strongly and positively respond for the application of modern inputs and technologies. These seemingly opposite effects of age on farm efficiency might nullify each other.

Family size (Fs) is found to be negatively associated with production. In rural Ethiopia, mostly a family constitutes many dependents, (more than 45% of the rural population below the age of 15 - CSA 1999), who might even share the productive time of the active labour force for taking care of them. Even in households having a relatively large stock of active labour force, there is a possibility that diminishing returns might set in due to the fact that the average operational land is very small.

The mean technical efficiency of sampled tenant farmers is around 62.5%. This implies these farmers operated by about 37.5% below the frontier level or the best practicing farmer from their group. Thus, without any change in the level of technology, these farmers could compensate the short fall only by addressing their internal problems and properly use their inputs. The level of efficiency reported by tenant households significantly varies; the minimum and the maximum next to the reference farmer being 15% and 86% respectively.

The Tenant and the General Equilibrium Models consider sharecropping arrangement to be an inefficient system as compared to fixed rent contract. Mean and maximum technical efficiency levels from Table 3 below tend to support this view. On the contrary, the median and minimum efficiency levels demonstrate the opposite.

Table 3. Efficiency by Form of Tenancy

Descriptive Statistics	Sharecroppers	Fixed Rent Tenants	Total
Minimum	0.24149	0.14947	0.14947
First Quartile	0.36435	0.32832	0.3473
Mean	0.623969	0.62978	0.62546
Median	0.64558	0.62604	0.6413
Third Quartile	0.70000	0.68602	0,6952
Maximum	0.852922	0.86487	0.86487

These mixed results could not allow holding a strong position in favour of one mode of tenancy against the other. In an attempt to observe a better picture, central tendency and scatter variability figures were recalculated by excluding 10% of the observations, which are found to be either extreme efficient or inefficient farmers. The new result reveals that sharecropping is an inefficient system and this goes in line with the discussion on the descriptive statistics in section 4.1. It has been observed that fertilizer and labour inputs were under supplied among sharecroppers as compared to fixed rent operators. This could be a major reason for efficiency difference between the two groups of tenants.

Table 4. Efficiency by form of Tenancy: Excluding 10% Extreme cases

Statistics	Sharecroppers	Fixed Rent Tenants	Total
Minimum	0.3576	0.3665	0.3576
Mean	0.6287	0.6423	0.6320
Median	0.6468	0.65728	0.6493
Maximum	0.8173	0.8199	0.8199

However, one should be cautious while arriving at this kind of conclusion. Many of the fixed rent tenant farmers were located in the Oromiya region where farm technologies and output markets were relatively accessible.. This might ease the conditions for these farmers to produce higher levels of outputs than other farmers who are found in other areas[4]. In other words, social and geographical conditions might have had their own impact on efficiency of farmers and differences in the mode of tenancy might not necessarily reflect the situation on the ground. Thus, comparing efficiency of tenants operating with different mode of land holding requires taking account of the possible influences of ğeographic, social and other similar factors.

[4] For further information, see Worku, 1999.

CONCLUSION AND POLICY IMPLICATIONS

Theoretical and empirical findings provide mixed notions on the relative efficacy of one form of tenancy over the other. The main objective of the paper was to estimate and investigate technical efficiency differences between sharecropping farmers and fixed rent tenants in the case of Ethiopia. Using data from the 1st Round of the Ethiopian Household Survey of the Economics Department of Addis Ababa University, a Cobb-Douglas Stochastic frontier production function was estimated using observations on 144 tenant households and consequently technical efficiency values were calculated.

Land, an indispensable input for tenant farmers, is found to be the major contributor of output. Along the lines of predominate predictions, labour, oxen and bulls, wealth, fertilizer, and quality of land, the sufficiency of rainfall and wealth held their expected sign in the estimated production function and positively contribute to output. On the other hand, variables representing family size and the presence of family members who can read and write are found to be negatively associated with output. This might be because of the fact that the rural population distribution is lopsided towards children. Thus, most household members, who can read and write might be below the age of influencing the decision process and meaningfully contribute for production. Instead, they may share the productive time and resources of the active labour force of the family.

Sample households operated at about 62.5% of the potential or frontier level of output. Further enquiry by mode of tenancy revealed that fixed rent tenants were better endowed with variable inputs and demonstrated higher levels of output and efficiency than otherwise. Nonetheless, one need to be cautious while concluding in line with the predictions of the Tenant and the General Equilibrium Models at least in the case of this particular study. Not only the observed efficiency is insignificant but also this could even be explained substantially by geographic (accessibility to input and output markets) and other similar factors.

Although the nature of the data set and the empirical findings may not allow providing conclusive recommendations, the study tends to imply the following policy implications. Land is found to be a limiting factor in the production process with a very high response rate. Thus, finding ways of availing land for the landless from areas where relatively abundant land is available will increase the level of output at the farm level in particular and in the economy at large. Meanwhile, tenancy as means of accessing land for the landless should be based on a fixed rent contract so much so that efficiency will be improved.

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Annex

Comparative Analysis of Mean Values between Tenants

Variables	Sharecroppers	Fixed Rent Tenants	F-value
Output	1061	1741	17.6
Labour days	284	421	3.47
Labour days per Hectare	158.6	223.1	3.67
Fertilizer in Kg/ Household	121	169.8	3.15
Fertilizer in Kg/Hectare	67.6	90.8	4.12
No. of Oxen and Bulls	1.97	1.61	1.07*
Land Quality	1.827	1.51	6.7
Land Topography	1.21	1.247	0.35*
Land in Hectares	1.79	1.87	1.3*
Fertiliser in Kg	73.6	171.7	19.6
HH Possessing Credit (%)	17	35	16.7
Houses with Galvanised Iron Sheet (%)	51.3	51.4	0.00
Years of Schooling (Head)	1.49	1.28	0.18*

* 10%.

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Addis Ababa, Ethiopia,