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GOVERNMENT POLICY AND DYNAMIC SUPPLY RESPONSE - A STUDY OF THE COMPULSORY GRAIN DELIVERY SYSTEM*[*]

Abstract

The impact of government policy on the dynamics of agricultural supply in the 1980s is explored. Specifically, an intertemporal acreage allocation model that allows for the impact of compulsory grain delivery is developed. Subsequently, an estimable dynamic acreage demand equation is derived, and estimated for a crop using region-level data. Generalized method of moments (GMM) estimators for dynamic panel data models are used. The elasticity estimates thus obtained suggest that the demand for crop acreage (and hence the supply of crop output) responded negatively to the level of forced grain procurement, and positively to output price.

I. INTRODUCTION

In the 1980's Ethiopian farm households were subject to a system of compulsory grain delivery (CGD). Under this system, such households were required to sell a portion of their output to the government at fixed prices[1]. After meeting this obligation (commonly referred to as the 'quota') these producers were allowed to buy and sell farm output on the local 'open' or 'free' market. Generally such a system affects the welfare of producers. It may also affect their resource allocation decisions. The first objective of this paper is to investigate the impact of CGD on the production decisions of Ethiopian farm households. Accordingly, the paper can be viewed as a quantitative inquiry into an aspect of the recent economic history of Ethiopia.

In principle the impact of the compulsory delivery system can be modelled in different ways. That it is an implicit form of taxation (or rent) seems to be the common view[2]. Thus, identifying an equivalent form of explicit taxation facilitates the analysis. Accordingly, it is proposed that the 'quota' should be viewed as a proportional output tax implicitly imposed on farm households. One way of modelling this is to consider the 'quota' as a proportion of output. This is consistent with the most common criteria used in determining the level of a household's 'quota' obligation, namely[3].

- the potential crop output of the household; and

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[1] The government agency responsible for administering the CGD was the Ethiopian Agricultural Marketing Corporation (EAMC).

[2] See Taffesse (1989), Franzel et al (1989), Azam (1992), Dercon (1994), Pickett (1991). This view is shared by those who analyzed the procurement system in general, as well as its specific applications - see Sah and Stiglitz (1992), Sah and Sirnivasan (1987).

[3] To the extent that it was not based on a 'quota' schedule, the determination of 'quota' levels to be delivered by households was not uniform. Nevertheless, the most common practice was the imposition of relatively higher 'quota' on households with higher outputs [see Alemayehu (1987)]

- the wealth (or, more precisely, the overall income-generating capacity) of the household, measured by variables including size of land-holding, number of oxen and other livestock owned, and non-farm income.

In contrast, Azam (1992) identifies the 'quota' as an implicit lump sum tax, and proceeds to model its impact accordingly. This formulation excludes the possibility of the 'quota' system affecting the production decisions of farmers. It also does not accurately reflect the process of 'quota' allocation to peasant households. Moreover, this characterization has the added advantage of allowing the study of the impact of an agricultural price policy (i.e., CGD) in the content of supply response models. This is an important advantage, since the second objective of the paper is to assess the price responsiveness of farm households' crop supply in Ethiopia during the period of study. The possibility of jointly studying these effects is created by defining the average price of crops subject to CGD as follows:

$$P = \phi P^s + (1-\phi)P^m$$

where: P = the weighted average price; P^s = the procurement (or EAMC) price; P^m = the 'free' or 'open' market price; ϕ = the 'quota' as a proportion of the farm household's total output (or the rate of 'quota').

To achieve the objectives stated above, a simple dynamic farm household model is developed. The model is a variant of the linear rational expectations model [Sargent (1987), Hansen and Sargent (1980) as applied to agricultural supply response analysis [Ecksten (1984, 1985), Tegene, Huffman, and Miranowski (1988)]. The main innovation is the direct introduction and analysis of CGD in the framework. furthermore, the decision problem of the farm household is explicitly placed in the agricultural household models framework in a very simple manner. On the basis of the model elasticities of acreage demand for crop cultivation are computed. Subsequently, an estimable acreage demand equation is derived, and estimated for a crop using region level data. The elasticity estimated thus obtained suggest that the demand for crop acreage (and hence the supply of crop output) responds negatively to the 'quota and positively to output price.

The rest of the paper is organized as follows. Section (5.2) presents a simple dynamic model of farm household production choices and the elasticities thereof. Section (5.3) describes the details of the empirical analysis including the data, econometric specification, estimation procedure, and estimation results. Section (5.4) concludes. The final section is an appendix detailing the procedure used for obtaining an explicit solution for the acreage decision rule, as well as some of the properties of the generalized method of moments (GMM) estimators employed.

2. A DYNAMIC MODEL OF FARM HOUSEHOLD PRODUCTION CHOICE

A simple dynamic model is presented in this section as a means of investigating the impact of CGD on the intertemporal production choices of the farm household[4].

[4] The model stated below is an adaptation of Eckstein (1985) considers the demand for acreage (in levels rather than shares) by farmers in the absence of forced crop procurement by the state. He also does not address the question of separability of production and consumption decisions.

2.1 Assumption and Characterization

1. Consider a representative infinitely-lived dynastic farm household which maximized its discounted expected intertemporal utility via its consumption, production, and saving choices[5]. This farm household is assumed to have a (common) one-period utility function, $u(x_{i+j})$ which is linear, i.e.,

$$u(x_{i+j}) = \Theta_0 + \Theta_1 x_{i+j}; \Theta_0, \Theta_{1>0}, t, j = 0, 1 \ldots \quad \textbf{(1.1)}$$

where $u(x_{i+j})$ represents consumption in period $i + j$. In other words the household is deemed to be risk-neutral. In other words, the impact of the randomness of some variables on the choices farmers make is considered without modelling their behaviour towards risk. It is further assumed that the intertemporal utility function is additively separable, and that each period yield and price risk are realized before consumption decisions are taken. Under these circumstances, the farm household's production and consumption decisions are separable. Thus the farm household maximized its discounted expected utility by first maximizing its discounted expected profits, and subsequently choosing the level of consumption and/or savings subject to the corresponding budget constraint. This budget constraint has three components, savings from the previous period, s_{i+j-1}, the interest (or return accruing to those savings at a rate, r (which is assumed to remain constant over time), and current profits, π_{i+j}, i.e.,

$$x_{i+j} + s_{i+j}, = (1+ r)\, s_{i+j-1} + \pi_{i+j}\ ;\ \ t, j = 0, 1, \ldots \quad \textbf{(1.2)}$$

Savings represent the cash-equivalent of different savings instruments available to the farm household, including cash, other financial assets, and grain storages.

2. Using its exogenously given total cultivable land, A_{i+j}, and subject to yield risk, the farm household is assumed to produce two (groups of) annual crops under a fixed-proportions technology of production[6]. This technology is represented by two production functions which are linear in acreage, stochastic, and involve a one-period lag between cultivation and harvest (harvest at $t+j$ is a function of acreage at $i+j-1$)[7]. Formally[8]:

$$Q_{1,t+j} = y_1 A_{1,t+j-1} + \varepsilon_{1,t+j}; y_1 > 0, \text{t,j} = 0, 1, \ldots \quad \textbf{(1.3)}$$

[5] The structure of our model is such that the conditions for exact aggregation are satisfied. Hence, the 'representative' household is equivalent to the 'average' household. In fact, Eckstein (1985) aggregates a closely related model over a (stable) population of farmers to characterize rational expectations equilibrium of the market for a crop.

[6] The size of the farm household's landholdings may vary over time, primarily due to land redistribution. But this is beyond the control of the household.

[7] Under the assumed fixed-coefficients technology, each crop is produced by using land and non-land factors in fixed proportions. The output of each crop, as well as the direct cost of its production, can thus be expressed as a function of the amount of acreage allocated to its cultivation. It is in this sense that (1.3) and (1.4) are production functions. See also Tegene, Huffiman and Miranwski (1988).

[8] Crop 1 is identified as the crop subject to CGD whiled Crop 2 may be considered as free from CGD. However, even if both are subject to CGD the analysis below will not be affected.

$$Q_{2,t+j} = y_2 A_{2,t+j-1} + \varepsilon_{2,t+j};\ y_2 > 0,\ \text{t,j} = 0, 1, \ldots \qquad \textbf{(1.4)}$$

$Q_{1,t+j}$ = output of crop *i (i = 1,2) at time t + j;* $A_{1,t+j}$ = the proportion of total acreage allocated to crop *i* at time *t + j;* y_1 and y_2 are parameters; $\varepsilon_{1,t+j}$ = exogenous shocks to production during *t + j* which have zero mean, constant variance, and are serially uncorrelated. In line with the fact that crop production involves biological gestation periods of some (sometimes considerable) length, the one-period lag in production captures the phenomenon that the farm household has to make acreage decisions in terms of its expectations about unknown future output prices. This introduces price risk into the decision problem of the farm household.

3. It is assumed that the direct cost of producing a crop is a function of acreage allocated to its production. This cost has two components distinguished by the period during which they are incurred (or known); costs known at the time of planting and costs known at the time of harvest. The latter is an attempt to capture the flexibility of input use after planting and up to and including harvest and the uncertainty of output given the lag in production. The focus here is on Crop 1. Given this focus it is assumed that there are additional adjustment-cost-like expenses related to Crop 1. To capture these costs as well as the direct costs is assumed that a quadratic cost function is associated with that crop. This function takes the following specific form[9]:

$$C_{1,t+j} = \left(v_{1,t+j-1} + f_{1,t+j}\right)A_{1,t+j-1} + \frac{b}{2}A^2_{1,t+j-1} + dA_{1,t+j-1}A_{1,t+j-2};\ b>0;\ d \lessgtr 0 \qquad \textbf{(1.5)}$$

where: $v_{1,t+j-1}$ and $f_{1,t+j}$ are non-land costs of producing Crop 1 over the total available acreage at the time of cultivation (*t+j-1)* and at the time of harvest (*i+j*) respectively[10]. The term $\frac{b}{2}A^2_{1,t+j-1}$ eventuates decreasing returns to scale in the long-run. Two contracting dynamic effects are captured by *d* [Eckstein (1985)]. The first is the tendency to rotate crops is successive cultivation of the same crop on a plot substantially reduces soil fertility and increases the cost of production. The second is the incentive to recultivate the crop planted last period if the cost of land preparation for that crop has been high and the current cost of production is lower as a result[11]. The sign of *d* is determined by which of these two dominate. If the first effect dominates, then $d > 0$, while $d < 0$ if the second effect is dominant. For simplicity it is

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[9] Although quadratic cost functions are commonly used, this specific form as applied to agricultural supply response analysis is due to Eckstein (1985). In this regard, Eckstein (1985) notes that a combination of the terms $\frac{b}{2}A^2_{1,t+j-1}$ and $dA_{1,t+j-1}A_{1,t+j-2}$ (with d < 0) is equivalent to the standard adjustment cost formulation.

[10] More explicitly, v_i represents the total non-land costs that would be incurred during the cultivation period if total acreage is planted with crop i(i=1,2), i.e:

$$v_i = \text{(non-land cultivation costs of crop } i \text{ per hectare)} \times A$$

where *A* is total available acreage. Similarly:

$$f_1 = \text{(non-land harvest costs of crop i per hectare)} \times A$$

[11] In other words, planting a crop different from the one cultivated last period involves costs higher than replanting with the same crop. In that sense, this tendency is induced by the presence of adjustment costs.

also assumed that a linear cost function of the following form is associated with Crop 2:

$$C_{2,t+j} = \left(v_{2,t+j-1} + f_{2,t+j}\right)A_{2,t+j-1} \qquad \textbf{(1.6)}$$

where: $v_{2,t+j-1}$ and $f_{2,t+j}$ are non land costs of producing crop 2 over the total available acreage at the time of cultivation (*t+j-1)* and at the time of harvest (*t+j)*, respectively.

4. At the beginning of this paper it is argued that the 'quota' should be viewed as a proportional output tax implicitly imposed on farm households[12]. Accordingly, the impact of the 'quota' is analyzed by defining an average price in the following manner[13]:

$$P_1 = \phi_1 P_1^s + (1-\phi_1)P_1^m$$

where P_1 = the weighted average price of Crop 1; P_1^s = the procurement (or EAMC) price of Crop 1; P_1^m = the 'free' or 'open' market price of Crop 1; ϕ_1 = the 'quota' as a proportion of the farm household's total output of Crop 1 (or the rate of 'quota'). The average price defined this way represents the household's marginal value of a unit of output. It increases with P_1^s and P_1^m, and falls with ϕ_1. Since P_1^s is less than P_1^m, and since, $0 < \phi_1 < 1$, the average price is less than the corresponding market price[14]. The valuation of the corresponding crop output at P_1 thus captures the tax nature of the 'quota'. As will be clear shortly, however, using this expression for the average price in a dynamic setting is very cumbersome. In particular, it is difficult to accommodate within the linear-quadratic framework set out below. The main problem stems from its nonlinearity in the variables, such that it introduces higher-order moments in the otherwise linear solution (in first-order moments). Hence it is useful to adopt a liner alternative. To do so, a first-order Taylor approximation around the means of the three variables involved in adopted. Let $x = [\phi_1 \quad P_1^m \quad P_1^s]$, and representing the means, $\bar{x} = [\overline{\phi_1} \quad \overline{P_1^m} \quad \overline{P_1^s}]$, such that:

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$$\begin{aligned} P_1(X) &= \phi_1 P_1^s + (1-\phi_1)P_1^m \\ &\cong \iota_0' + \iota_1\phi_1 + \iota_2 P_1^m + \iota_3 P_1^s \end{aligned}$$

where:

$$\iota_0' = P_1(\bar{x}), \qquad \iota_1 = \left(\frac{\partial P_1}{\partial \phi_1}\right)_{\bar{x}}, \ \iota_2 = \left(\frac{\partial P_1}{\partial P_1^m}\right)_{\bar{x}}, \ \iota_1 = \left(\frac{\partial P_1}{\partial P_1^s}\right)_{\bar{x}}$$

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[12] The analysis blow does not consider ways other than adjusting crop-mix that households may have devised to avoid delivering the quota or minimize its impact. Thus ϕ_1 has to be viewed as relating to the implicit output tax actually paid by farm households. In line with that the empirical analysis used actual procurement by the EAMC to compute .

[13] If Crop 2 is also subject to CGD, then the same procedure can be applied to define its average price. None of the results will be affected as a consequence. But, additional results pertaining to the effects of the 'quota' rate and market price of that crop will be obtained.

[14] There are anecdotes of some farm households buying crops to meet their 'quota' obligations. In such instances $\phi_1 > 1$, and thus, $P_1 < P_1^s$. Hence, the definition of the average price can accommodate these cases. However, these cases are not considered since they are unlikely to be typical.

The subscript $\bar{x}$ indicates that the derivatives are evaluated at $\bar{x}$ [15]. Observe also that $\iota_1 < 0$; $0 < \iota_2 < 1$; and $0 < \iota_3 < 1$. Thus the alternative expression possesses all the properties of the original. The fact that procurement prices changed very little over time (see section 3.1.3 below) is exploited to simplify the new expression further and obtain:

$$P_1 = \iota_0 + \iota_1\phi_1 + \iota_2 P_1^m \qquad \textbf{(1.7)}$$

where $P_1 = \iota_0 + \iota_3 P_1^s$.

Finally, the farm household is assumed to form expectations rationally. Following the most common characterization, rational expectations are identified as expectations which, in the context of specific models describing the behavior of the relevant variables, are equal to the mathematical expectations of those variables conditional on the information available at the time the forecasts are made[16].

2..2 The Model

With the above assumptions, the farm household's problem can be characterized as maximizing its discounted intertemporal expected utility by choosing decision rules for consumption, savings, and acreage allocations under yield and price risk. These choices are made subject to the sequence of budget constrains, which is partly determined by the linear production technology, the exogenously given total household land-holding and the relevant information available to the household. The exogenously given initial level of savings, P_{t-1}, constitutes an additional constraint. The optimization problem can thus be summarized as follows[17]:

$$\max_{\{x_{t+j}, s_{t+j}, A_{i,t+j}\}} \lim_{T\to\infty} E = \left\{ \sum_{j=0}^{T} \beta^j (\ell_0 + \ell_1 x_{t+j}) \right\} \; ; \qquad t = 0,1,... \qquad \textbf{(2.1)}$$

subject to:

$$x_{i+j} + s_{t+j} = (1 + r)s_{i+j-1} + \pi_{t+j}; \quad t,j = 0,1,... \qquad \textbf{(2.2)}$$

$$Q_{1,i+j} = y_1 A_{1,t+j-1} + \varepsilon_{1,t+j}; \qquad t,j = 0,1,... \qquad \textbf{(2.3)}$$

$$Q_{2,i+j} = y_2 A_{2,t+j-1} + \varepsilon_{2,t+j}; \qquad t,j = 0,1,... \qquad \textbf{(2.4)}$$

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[15] The partial derivative with respect to ϕ_1 captures only the direct impact of the 'quota' rate on the average price. The effect that may operate via P_1^m is introduced later.

[16] The nature and/or validity of rational expectations will not be considered any further. There is a huge literature concerning these issues. Among others, See Sargent (1987), Pesaran (1987), Cuthberston and Taylor (1987), and Blanchard and Fisher (1989).

[17] Note that consumption is the numeraire, i.e., all prices are measured relative to an index of consumption goods' prices (say, for instance, a consumers" price index). This reflects the view that farm households consider relative prices in making their choices.

and s_{t-1} given, where: $\pi_{t+j} \equiv (P_{1,t+j}Q_{1,t+j} - C_{1,t+j}) + (P_{2,t+j}Q_{2,t+j} - C_{2,t+j}) =$ farm profits at time $t + j$; $\beta = (1 + r)^{-1}$ = the discount factor, r being the household's rat of time preference; $P_{i,t+j}$ = average price (as defined above) of crop i household's information set at time t. In this regard, the information set is assumed to contain: current and past realizations of prices, costs, and production shocks; as well as the history of household production, consumption, and savings choices up to and including $(t-1)$. Note that $0<\beta<1$. The rest of the notation is as above.

First, consumption is factored out from (2.1) by using (2.2) to substitute for it. Then, π_{i+j} in (2.1) is expanded by using (2.3) - (2.4), (1.5) - (1.6) and (2.5) to respectively substitute for $Q_{1,t+j}, Q_{2,t+j}, C_{1,t+j}, C_{2,t+j}, and A_{2,t+j}$. Correspondingly, the objective of the farming household can summarized as:

$$\max_{\{A_{1,t+j}, s_{t+j}\}} \lim_{T\to\infty} E_t = \sum_{j=0}^{T} \beta^j \{\ell_0 + \ell_1[P_{1,i+j}y_1 - R_{1,t+j} - V_{1,t+j})$$

$$A_{1,i+j-1} - \frac{b}{2}A_{1,t+j-1}^2 - dA_{1,t+j-1}A_{1,t+j-2} + (P_{2,t+j}y_2 - v_{2,t+j-1} - f_{2,t+j}) + P_{1,t+j}\varepsilon_{1,t+j} + P_{2,t+j}\varepsilon_{2,t+j} + (1+r)s_{t+j-1} - s_{t+j}]\}$$

(2.6)

subject to $(A_{1,t-1}, s_{t-1})$ given. $\boldsymbol{E}_t$ represents $\boldsymbol{E}(\,.\,|\,-t\,)$, *while*

$R_{1,i+j} \equiv (P_{2,t+j}y_2, and\ V_{1,t+j} \equiv (v_{2,t+j-1} + f_{1,t+j}) - (v_{2,t+j-1} + f_{2,t+j})$. The Sum of R_1 and V_1 captures the total (actual and opportunity) cost of producing Crop 1. Briefly, the farm household chooses a contingency plan $\{A_{1,t+j} + \varepsilon_{t+j}\}$ to maximize its discounted expected intertemporal utility. Obviously x_{i+j} and $A_{2,t+j}$ are obtained via (2.2) and (2.5), respectively.

Equation (2.6) represents a linear-quadratic optimization problem in discrete time. the corresponding first order conditions (including the transversality conditions) are obtained by differentiating the equation with respect to $A_{1,t+j}$ and s_{t+j} ((j=0,1,...T)[18]. In this regard, note that A_{t+j} directly affects π_{t+j+1} and π_{t+j+2}, which in turn affect contemporaneous consumption and utility via the budget constraints. Similarly, s_{t+j} impacts on consumption and utility during $(t + j)$ and $(t + j + 1)$ through the corresponding budget constrains. After rearranging, the following Euler equations for $j = 0, 1,\ldots, T - 1$ are thus obtained:

$$E_t\{\beta^{j+1}[u'(x_{i+j+1})(P_{1,t+j+1}y_1 - R_{1,t+j+1} - V_{1,t+j+1} - bA_{2,t+j} - dA_{2,t+j-1}) - \beta u'(x_{t+j+2})dA_{1,t+j+1}]\} = 0$$

(2.7a)

$$-E_t\{\beta^j[u'(x_{i+j}) - \beta(1+r)u'(x_{1,t+j+1})]\} = 0 \qquad \textbf{(2.7b)}$$

and for $j = T$, the transversality conditions:

[18] The relevant rule of differentiation is Leibniz's rule [whiteman (1983)].

$$\lim_{T\to\infty} E_t\{\beta^{T+1}u'(x_{i+T+1})(P_{1,t+T+1}y_1 - R_{1,t+T+1} - V_{1,t+T+1} - bA_{2,t+T} - dA_{1,t+T-1})A_{1,t+T}]\} = 0 \quad \textbf{(2.8a)}$$

$$\lim_{T\to\infty} E_t[\beta^{T+1}u'(x_{i++Tj})(1+r)s_{t+T}] = 0 \quad \textbf{(2.8b)}$$

where $u'(.)$ represents the partial derivative of $u(.)$ with respect to x.

Two remarks about the first-order conditions. First, by the linearity of the one period utility function, the marginal utility of consumption over time is constant. By (1.1) it is equal to Θ_1. Hence the $u'(.)$ terms drop out of all first order conditions. Second, they reveal that, under the specified circumstances, production and consumption decisions are separable. Combined with the production functions, (2.7a) and (2.8a) determine household production choices independent of consumption. Accordingly the production decision of the farm household can be separately considered via the first-order conditions relating to $A_{1,t+j}$. As a first step towards a solution the Euler equations are restated by applying the law of iterated conditional expectations to (2.7a) and rearranging[19]:

$$E_t\{E_{t+j}(P_{1,t+j+1}y_1 - R_{1,t+j+1} - V_{1,t+j+1} - bA_{1,t+j} - dA_{1,t+j-1} - \beta dA_{1,t+j+1})] = 0$$

$$t = 0, 1, \ldots$$
$$j = 0, 1, \ldots, T - 1$$

For these equations to hold for all realization of $(P_{1,t+j+1}, R_{1,t+j+1}, V_{1,t+j+1})$ it is necessary that the term in parentheses is equal to zero. Therefore, after substituting for P_1 from (1.7) above, the first-order conditions for the farm household's production problem can be stated as:

$$\beta E_{t+j}\left[A_{1,t+j+1} + \frac{b}{d\beta}A_{1,t+j} + \frac{1}{\beta}A_{1,t+j-1}\right] = E_{i+j}\frac{1}{d}[(\iota_0 + \iota_1\phi_{1,t+j-1} + \iota_2 P^m_{1,t+j+1})y1]$$
$$- E_{t+j}\frac{1}{d}[R_{1,t+j+1} - V_{1,t+j+1}] \quad \textbf{(2.9)}$$

for all $j = 0, 1, \ldots, T - 1$.

Equation (2.9) form a set of stochastic Euler equations. Since these equations are linear, it is possible to explicitly solve for the optimal decision rule if the additional assumptuon is made that the exogenous stochastic process $\{P^m_{1,t+j+1}\}^{\infty}_{j=0}, \{R_{1,t+j+1}\}^{\infty}_{j=0}, and \{V_{1,t+j+1}\}^{\infty}_{j=0}$ are of mean exponential order less than $\frac{1}{\sqrt{\beta}}$ such that for some $M > 0$, and $1 \le q < \frac{1}{\sqrt{\beta}}$ [see Sargent (1987, 393); Hansen and Sargent (1980, 12)]:

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[19] The law of iterated conditional expectations states that, for $_{-t} \subseteq_{-t+j}$ (i.e., for a nondecreasing information set):

$$E(.\,|\,-t) = E[E(.\,|\,-_{t+j})\,|\,-t]$$

In the short-hand we use:

$$E_t(.) = E_t[E_{t+j})(.)]$$

$$\left|E_t(P^m_{1,t+j+1})\right| < Mq^{t+j+1}; \qquad \left|E_t(R_{1,t+j+1}\right| < Mq^{t+j+1}; \qquad \left|E_t(V_{1,t+j+1}\right| < Mq^{t+j+1};$$

for all t and all j ≥ 0[20]. The assumption (roughly) implies that $E_{t+j}(P^m_{1,t+j+1}), E_{t+j}(R_{1,t+j+1}),\ and\ E_t(V_{1,t+j+1})$ will not grow faster than $\beta^{(t+j+1)/2}$; [Epstein and Yatchew (1985, 238], or more formally, the two stochastic processes are bounded in the mean [Eckstein (1985, 206). This assumption is made to ensure that the solution satisfy the transversality condition.

With this assumption (2.9) can be solved for $A_{1,t+j+1}$, the solution being :[21, 22]

$$A_{1,t+j} = \lambda_1 A_{1,t+j-1}$$

$$-(\frac{\lambda_1}{d})\sum_{i=0}^{\infty}(\beta\lambda_1)^i E_{t+j}[y_1(\iota_0 + \iota_1\phi_{1,t+j+1+i} + \iota_2 P^m_{1,t+j+1+i}) - R_{1,t+j+1+i} - V_{1,t+j+1+i}] \qquad \textbf{(2.10)}$$

When λ_1 is the smaller of the roots satisfying $\frac{1}{\lambda_1} = -\frac{b}{d} - \beta\lambda_1$.

Equation (2.10) represents the farm household's demand for land relating to Crop 1. It implies that his demand is a function of past allocation of acreage to Crop 1, expected output prices, expected rate of 'quota', and realized and expected non-land input and opportunity costs. Because the terms $E_{t+j}(\phi_{1,t+j+1+i}),\ E_{t+j}(R_{1,t+j}),\ E_{t+j}(P_{1,t+j+1+i}),\ E_{t+j}(R_{1,t+j+1+i})\ \ and\ \ E_t(V_{1,t+j+1+i})$

are present, that equation does not yet constitute a decision rule. To make it one, it is necessary to express those expectational variables as functions of elements of the current information set $(-_{t+j})$, , i.e., as functions of variables known to the farm household at time $t + j$. This will be done in a later section. Nevertheless, as it stands, (5.14) can be used to compute acreage demand elasticities with respect to relevant variables.

2.3 Elasicities

One of the main objectives in this paper is to examine the impact of CGD on the intertemporal production choices of farm household under risk. The simple model presented above reduces this to analyzing the effect of CGD on the acreage allocation decisions of farm households. The obvious route, in this regard, is to identify the long-run an short-run elasticities of expected acreage with respect to changes in the expected rate of 'quota', using equation (2.10). The response of

[20] Since, by definition, it is bounded within the interval [0,1] there is no need to make the same assumption about ϕ_1.
[21] The solution procedure used is described in the first section of this chapter's appendix.
[22] The solution stated as (2.10) displays the certainty equivalence property, i.e. the same solution would result if we had maximized the criteria formed by substituting

$[E_t(p_{1,t+j}),\ E_t(R_{1,t+j}),\ E_t(V_{1,t+j})]\quad for\quad [P_{1,t+j}, R_{1,t+j}, V_{1,t+j}]$ and dropping the expectations operator from outside the sum in the objective function (2.6). Also see Sargent (1987), and Hansen and Sargent (1980).

these allocations to prices can also be examined in a similar fashion. This section deals with the task[23]. Recall that Crop 1 is subject to CGD, the rate of 'quota' being 1. Also recall the definition of the average price of that crop as:

$$P_1 = \iota_0 + \iota_1\phi_1 + \iota_2 P_1^m$$

Hence, the unconditional and conditional expectations of te average price can be respectively represented as[24];

$$E(P_1) = \iota_0 + E\iota_1(\phi_1) + \iota_2 E(P_1^m)$$

$$E_{i+j}(P_{1,t+j+1+i}) = \iota_0 + \iota_1 E_{t+j}(\phi_{1,t+j+1+i}) + \iota_2 E_{i+j}(P^m_{1,t+j+1+i}) \qquad \textbf{(2.11a)}$$

The previous equations express the argument that the expected rate of 'quota as well as the expected output market price operate via the expected average price of Crop 1. As noted earlier a change in the quota rate has a direct, negative effect on P_1. That impact is captured by the negative parameter. That an average farm household is being considered implies that the 'average' quota rate may also influence the corresponding market price. The possible routes through which this effect may occur include: the income effect on farm households demand for goods (including Crop 1); the effect on the supply of Crop 1 in the rural market; the impact on the purchases of Crop 1 made by urban consumers/traders. A rise in the 'quota' rate reduces the income of farm households. It may thus lower their demand for Crop 1 if it is a normal good. It is also likely to induce a fall in that part of urban demand for Crop 1 which is met via direct purchases on the rural grain market. This is a consequence of the fact that a fraction of the amount of Crop 1 procured goes to urban consumers. On the other hand, a rise in the 'quota' rate leads to a decreased supply on the rural market. The first two tend to push the market prices downward, while the third exerts a pressure in the opposite direction. The ultimate effect on the market price of Crop 1 in the rural market is dependent on the relative strength of these contraction pressures.

In line with the observations in the previous paragraph, (2.11a) is differentiated with respect to the relevant expected 1, to derive the impact of the latter on the unconditional and conditional means of the average price of Crop 1, respectively:

$$\frac{\partial E(P_1)}{\partial E(\phi_1)} = \iota_1 + \iota_2 \frac{\partial E(P_1^m)}{\partial E(\phi_1)}$$

$$\frac{\partial E_{i+j}(P_{1,t+j+1+i})}{\partial E_{i+j}(\phi_1,_{t+i+1+i})} = \iota_1 + \iota_2 \frac{\partial E(P^m_{1,t+j+1+i})}{\partial E(\phi_{1,t+j+1+i})} \qquad \textbf{(2.11b)}$$

[23] The discussion below focuses on acreage elasticities. Note, however, that the linear production functions can be used to translate the response of acreage demand in to that of output supply.

[24] It is possible to make ι_0, ι_1 and ι_2 time varying parameters to reflect the possibility of changes in the relative strength of the three determinants of *P1*. That route is not followed so as to keep the model as close to what can be estimated as possible.

The analogous expressions for the effect of P_1^m are:

$$\frac{\partial E(P_1)}{\partial E_{i+j}(P_1^m)} = \frac{\partial E_{t+j}(P_{1,t+j+1+i}^m)}{\partial E_{i+j}(P_{1,t+j+1+i}^m)} = \iota_2 \qquad \textbf{(2.11c)}$$

Note that an expected rise in P_1^m always increases the expected average price ($\iota_2 > 0$). In contrast, a rise in expected ϕ_1 generates two potentially counteracting effects. The direct effect is always negative since, given P_1^s *and* P_1^m, a higher 'quota' rat results a lager expected share of the lower P_1^s in the average price. The indirect effect, which operates via P_1^m, is ambiguous since the impact of ϕ_1 on P_1^m cannot be singed *a priori*. If the indirect effect is negative (or zero), then, an expected rise in the 'quota' rate leads to an expected fall in the average price of Crop 1. In contrast, if the indirect effect is positive, but the direct impact exceeds the induced change in absolute value, i.e.,

$$|\iota_1| > \iota_2 \frac{\partial E(P_1^m)}{\partial E(\phi_1)}$$

$$|\iota_1| > \iota_2 \frac{\partial E(P_{1,t+j+1+i}^m)}{\partial E(\phi_{1,t+j+1+i})}$$

Then, the net effect is an expected fall in the average price of Crop 1[25].

2.3.1 Long-run elasticities

The long-run elasticities express the impact of expected changes in mean prices and the mean 'quota' rate on the farm household's mean acreage demand. Consider the effect of the 'quota' rate first. The long-run elasticity of expected acreage demand with respect to expected ϕ_1, $\xi_{A,\phi}^L$, is derived by first taking the unconditional expectation of (2.10), differentiating with respect to $E(\phi_1)$ and making use of (2.11b), and weighting the result by the ratio of the unconditional means $E(\phi_1)$ and $E(A_1)$[26].

The final result is:

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[25] Obviously, the two opposite effects may cancel each other out if they are equal.

[26] Take unconditional expecations of both sides of (2.10) and rearrange to obtain:

$$(1-\lambda_1)E(A_1) = -(\frac{\lambda_1}{d})E\left[y_1(\iota_{0+}\iota_1\phi_{1+}\iota_2\phi_2 + \iota_2 P_1^m) - R_1 - V_1\right]\sum_{i=0}^{\infty}(\beta\lambda_1)^i$$

Given $|\beta\lambda_1| < 1$, it is also the case that:

$$\sum_{i=0}^{\infty}(\beta\lambda_1)^i = \frac{1}{(1-\beta\lambda_1)}$$

such that: $(1-\lambda_1)E(A_1) = -\left[\frac{\lambda_1}{d(1-\beta\lambda_1}\right] E\left[y_1(\iota_{0+}\iota_1\phi_{1+}\iota_2\phi_2 + \iota_2 P_1^m) - R_1 - V_1\right]$

$$\xi^{L}_{A,\phi} = \left[\frac{\partial E(A_1)\partial E(P_1)}{\partial E(P_1)\partial E(\phi_1)}\right]\frac{E(\phi_1)}{E(A_1)} = -\left(\frac{\lambda_1 y_1}{d(1-\lambda_1)(1-\beta\lambda_1)}\right)\left[\iota_1 + \iota_2\frac{\partial E(P_1^m)}{\partial E(\phi_1)}\right]\frac{E(\phi_1)}{E(A_1)} \qquad \textbf{(2.12a)}$$

The long-run elasticity of expected acreage demand with respect to expected market price of Crop 1, ξ^{L}_{A,P^m}, is derived in analogous manner:

$$\xi^{L}_{A,p^m} = \left[\frac{\partial E(A_1)\partial E(P_1)}{\partial E(P_1)\partial E(P_1^m)}\right]\frac{E(P_1^m)}{E(A_1)} - \left(\frac{\lambda_1 y_1}{d(1-\lambda_1)(1-\beta\lambda_1)}\right)\iota_2\frac{E(P_1^m)}{E(A_1)} \qquad \textbf{(2.12b)}$$

The corresponding elasticity with respect to R1 is obtained in the same way:

$$\xi^{L}_{A,R} = \left[\frac{\partial E(A_1)E(R_1)}{\partial E(R_1)E(A_1)}\right] = \left(\frac{\lambda_1 y_1}{d(1-\lambda_1)(1-\beta\lambda_1)}\right)\iota_2\frac{E(R_1)}{E(A_1)} \qquad \textbf{(2.12c)}$$

Recall that: $0 < \beta < 1$; $0 < |\lambda_1| < 1$; y_1 is positive; and λ_1 *and* d can be positive or negative. However, the latter two will have opposite signs since d 0 implies λ_1 0[27]. In addition, the nature of the CGD implies that and $0 < E(\phi_1) < 1$, ι_1 is negative, and $0 < \iota_2 < 1$. By making use of these features, the following can be inferred from (2.12a) and (2.12c)[28].

1. The long-run 'quota' elasticity, $\xi^{L}_{A,\phi}$, is negative if both the direct and indirect effects of ϕ_1 are negative, or if: the latter, though positive, is less than the former in absolute value;

$$|\iota_1| > \iota_2\frac{\partial E(P_1^m)}{\partial E(\phi_1)}$$

It implies that the imposition of or increase in the rate of, the 'quota' on Crop 1 reduces the acreage share of that crop in the long-run. The impact occurs via the average price, P_1. A rise in the mean rate of 'quota' decreases the mean P_1, and thereby makes Crop 1 less profitable. As a result the household lowers its mean acreage demand for the crop, provided that it is feasible to do so. The reduction is conditioned by production possibilities via b, y_1 -- and d, as well as household rate of time preference through β. If Crop 2 is also subject to 'quota', however, the choice between the two corps will be affected not only by production possibilities, but also

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[27] That, $\lambda_1\lambda_2 = \frac{1}{\beta}$, and $0 < \beta < 1$, implies, $\lambda_1\lambda_2 > 0$, such that λ_1 *and* λ_2 have the same sign. Further, with b and β positive, $\lambda_1 + \lambda_2 = \frac{b}{\beta d}$, means that the sign of λ_1 *and* λ_2 depends on that of d. In short, if $d > 0$, *then* $\lambda_1 + \lambda_2 = 0$, and thus, $\lambda_1\lambda_2$ 0.

[28] Note that analogous results hold in the static case under certainty (see Taffesse (1999)).

by the relative magnitude of the 'quota' rates. Briefly, in the long-run, the system of forced grain procurement may reduce the production of the crops it directly affects, and may even lead to a fall in crop production as whole. On the other hand, the $\xi^{L}_{A,\phi}$ is positive if:

$$|\iota_1| < \iota_2 \frac{\partial E(P_1^m)}{\partial E(\phi_1)}$$

In other words, a positive indirect effect more than compensates for the negative direct effect, such that mean P_1 rises. This rise, in turn, provides that incentive for the household to increase its long-run acreage demand for Crop1.

2. The long-run price elasticity, ξ^{L}_{A,P^m} is positive but lower than what it would have been in the absence of CGD. Indeed a one percent rise in Crop 1's market price counts as a ι_2 percent (less than one percent) increase for the farm household's acreage decisions. Thus, the system of compulsory grain delivery reduces the long-run price responsiveness of crop supply.

3. The long-run elasticity of acreage demand for Crop 1 production with respect to $\xi^{L}_{A,R}$ is negative. A permanent rise in the revenue (per hectare) obtainable from the cultivation of Crop 2 creates the incentive for the household to switch into that crop, and out of Crop 1.

2.3.2. Short-run elasticities

The short-run elasitcities capture the effect, on current acreage demand, of changes in expected prices and 'quota' rates, *(i+1)* periods hence. These elasicities are computed in the same way as their long-run counterparts, but directly using (2.10), with (2.11b) and (2.11c). For ϕ_1 P_1^m and R_1 these elasticities, evaluated at the unconditional means of ϕ_1 P_1^m, R_1 and A_1 are:

$$\xi^{i+1}_{A,\phi} = \left[\frac{\partial E_{t+j}(A_{t+j})\partial E_{t+j}(P_{1,t+j+1+i})}{\partial E_{t+j}(P_{1,t+j+1+i})\partial E_{t+j}(\phi_{1,t+j+1+i})}\right]\frac{E(\phi_1)}{E(A_1)}$$

$$= -\left(\frac{\lambda_1 y_1}{d}\right)(\beta\lambda_1)^i\left[\iota_1 + \iota_2\frac{\partial E_{t+j}(P^m_{1,t+j+1+i})}{\partial E_{t+j}(\phi_{1,t+j+1+i})}\right]\frac{E(\phi_1)}{E(A_1)} \qquad \textbf{(2.13a)}$$

$$\xi^{i+1}_{A,P^m} = \left[\frac{\partial E_{t+j}(A_{t+j})\partial E_{t+j}(P_{1,t+j+1+i})}{\partial E_{t+j}(P_{1,t+j+1+i})\partial E_{t+j}(P^m_{1,t+j+1+i})}\right]\frac{E(P_1^m)}{E(A_1)}$$

$$= -\left(\frac{\lambda_1 y_1}{d}\right)(\beta\lambda_1)^i\,\iota_2\frac{E(P_1^m)}{E(A_1)} \qquad \textbf{(2.13b)}$$

$$\xi^{i+1}_{A,R} = \frac{\partial E_{t+j}(A_{t+j})}{\partial E_{t+j}(R_{1,t+j+1+i})}\frac{E(R_1)}{E(A_1)}$$

$$= -\left(\frac{\lambda_1}{d}\right)(\beta\lambda_1)^i \iota_2 \frac{E(P_1^m)}{E(A_1)} \qquad \textbf{(2.13b)}$$

Again the aforementioned results concerning λ_1, β, d, y_1, $\iota_1$and ι_2 are used. In addition, note that, given the sign of d, the sing of $(\beta\lambda_1)$, depends on whether i is even or odd. Suppose the decline in land productivity is the dominant dynamic effect such that d is positive. Then λ_1 and $(\beta\lambda_1)^i$ are negative. Hence, $(\beta\lambda_1)^i$ is negative (positive) with i odd (even). In contrast, d is negative if adjustment costs dominate dynamic behavior. Accordingly, λ_1 and $(\beta\lambda_1)^i$ are positive, such that ( ), is positive for all i. Hence:

$(\beta\lambda_1)^i < 0$, *if (d > and i is odd)*
$(\beta\lambda_1)^i > 0$, *if (d > and i is even) or (d < 0)*

Note also that $(\beta\lambda_1)^i$, approaches zero as i gets larger, implying the further into the future a period is the less important to current decisions it becomes. These features enable us to make the following observations concerning short-run elasticties on the basis of (2.13a) and (2.13c).

1. The short-run elasticity of acreage demand with respect to expected rate of 'quota' alternates sign with i if $d > 0$. It is, however, negative for all i provided that $d<0$, and that the direct and indirect effects of ϕ_1 are both negative, or if: the later, though positive, is less than the former in absolute value:

$$|\iota_1| > \iota_2 \frac{\partial E(P^m_{1,t+j+1+i})}{\partial E(\phi_{1,t+j+1+i})}$$

Furthermore, as the forecast period becomes longer (i.e., the higher i is), this elasticity gets closer to zero.

2. The short-run elasticity of acreage demand with respect to expected market price of Crop 1 alternates sign with I if $d > 0$. It is, however, positive for all i provided that $d < 0$. Like its long-run counterpart, this elasticity is lower than the level that would obtain in a CGD-free environment. In addition, the magnitude of this elasticity becomes smaller in absolute value as the forecast period gets longer.
3. The short-run elasticity of acreage demand with respect to R_1 alternates sign with i if $d > 0$. It is however, negative for all i provided that $d < 0$. Like the other short-run acreage elasticities, this elasticity declines (in absolute value) towards zero as the forecast period gets longer.

Two examples illustrate some of these features. In both cases, assume that the effect of expected ϕ_1 on expected P_1 is negative. First, suppose the farm household anticipates a rise in next (or harvest) period's 'quota' rate. In this case, where $i=0$, the short-run elasticity is negative, implying that the household responds by reducing the current acreage share of Crop 1. The household expects a lower return from

cultivating Crop 1 and accordingly reduces its current acreage allocation to that crop. In contrast, an expected increase in the harvest period's P_1^m, and thus a higher profit from Crop 1, will induce a higher acreage share for the crop. Second, suppose the household expects to rise two periods hence (i.e., $i=1$ or during $t+j+2$). Consequently that period's expected return from Crop 1 falls. Further assume that $d > 0$. Then deteriorating soil fertility means that the household has to plant more (less) of Crop 1 during ($t+j+1$) depending on whether it has cultivated less (more) of that crop during the current period (i.e. $t+j$). To counter the potential loss of revenue and simultaneously satisfy the need for crop rotation the household grows more of Crop1. In short, current acreage demand for Crop 1 rises because lower expected profitability combines with the dynamic effect of declining land productivity to make that crop more attractive for current production. On the other hand, since it involves a potential gain in income, the converse will apply for an expected increase in Crop 1's market price that will obtain during ($t+j+2$).

To summarize by decreasing the returns to farm households, CGD is likely to have reduced, directly as well as though lower own-price responsiveness, the long-run acreage share (and thus output supply) of the corps it affected. The corresponding short-run effects are more complicated in that they also depend on the pattern of the dynamic effects at work. Moreover, both of these effects are further complicated by the impact of the 'average' rate of 'quota' on market price – an impact which cannot be signed *a priori*. On the other hand, it is shown that acreage demand generally responds positively to a crops own price and negatively to the revenue from competing crops.

3. Empirical Analysis

3.1 The Data

The basic features of the data used are described in this section. The main sources of information are the publications of the Central Statistical Authority (CSA) and the Ethiopian Agricultural Marketing Agency (EMAC)[29]. The dataset thus complied contains information on: acreage, output, and yield of major annual crops; producer prices of crops; and EAMC purchases and procurement prices.

Before moving on to considering other characteristics of the data, the following remarks about its spatial and temporal dimensions are deemed helpful.

[29] As part of the grain market reforms, this agency has been reorganized and renamed the Ethiopian Grain Trade Enterprise (EGTE)

1. The unit of observation are administrative regions. Up to 1988 there were 14 administrative regions in the country. Of these, data is not available for two (Eritrea and Tigray). In 1988 a new administrative structure with thirty regions was introduced. Twenty-six of these are covered by the dataset used. In addition to Eritrea and Tigray, two new regions (Assab and Ogaden) are not covered by the reports available[30]. The twenty-six regions are aggregated into twelve to make the coverage compatible with that of the previous years[31]. Although inexact, this aggregation is not likely to involve substantial errors.
2. The data set covers the period from 1980/81 to 1989/90. There are a number of reasons for restricting the analysis to this period. First, although introduced in 1979, the centralized CGD system was not fully operational until 1981. This was particularly true of its impact on farm households. Second, the main source of consistent time-series date is the annual Agricultural Sample Survey of the CSA. This survey has began in 1980/81. Third, the CGD system was abolished in 1990. Fourth, a new government assumed power in 1991, and subsequently adopted a radically different administrative structure as well as an economic structural adjustment program. The first two facts mean that it is reasonable to start with 1980/81, whereas the last two imply that it is problematic to go beyond 1989/90.

3.1.1 Acreage allocation patterns

Table 3.1 reports the average regional acreage shares of cereals as a group and its five main constituents[32]. The first row of figures in that table confirm what has been observed before; cereals constitute by far the most important annual crop to farm households, accounting for more than 80 per cent of the total area planted with annual crops. The rest is cultivated with pulses and oil seeds. From among cereals, maize and Teff have the largest shares, respectively accounting for 25 percent and 23 per cent. The table also shows the considerable regional variation in land allocation among crops. For instance, Arssi and Bale farm households concentrate on growing barely and wheat, while those residing in Gojam and Gondor allocate more than half of cereal-cultivated land to barley and *Teff*. Such variation reflects differences in natural endowments, technological possibilities, tastes, and the historical processes which affect all of these regional and individual attributes. In the analysis below, this regional variation will be exploited jointly with the variation across time periods.

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[30] Assab and Ogaden are not major crop producing areas. That they are not included for the years 1988/89 and 1989/90 is unlikely to materially affect compatibility with the data for the years before 1988.

[31] The aggregation involved the following. For 1988/89 and 1989/90:

Old	**New**
Arssi =	Arssi
Bale =	Bale
Gamo Gofa =	North Omo + South Omo
Gojam =	East Gojam + West Gojam + Metekel
Gondar =	North Gondor + South Gondor
Hararghe =	West Hararghe + East Hararghe + Dire Dawa
Illubabor =	Illubabor + Gambela
Keffa =	Keffa
Shewa =	East Shewa + North Shewa + South Shewa + West Shewa
Sidamo =	Sidamo + Borena
Wellega =	Wellega + Asosa
Wollo =	North Wollo + South Wollo

[32] Note that Producers' Cooperatives and State Farms are excluded, such that all figures relate to private peasant producers.

Table 1: Mean Regional Acreage Shares (1981-90)

Region	Cereals	Barley	Maize	Sorghum	Teff	Wheat
National	0.87 (0.06)	0.18 (0.13)	0.25 (0.18)	0.18 (0.16)	0.23 (0.13)	0.10 (0.10)
Arssi	0.83 (0.03)	0.37 (0.04)	0.11 (0.02)	0.05 (0.02)	0.10 (0.02)	0.34 (0.04)
Bale	0.89 (0.03)	0.43 (0.06)	0.12 (0.05)	0.01 (0.01)	0.08 (0.04)	0.25 (0.04)
Gamo Gofa	0.92 (0.04)	0.14 (0.03)	0.37 (0.12)	0.31 (0.07)	0.15 (0.08)	0.03 (0.02)
Gojam	0.81 (0.02)	0.21 (0.06)	0.13 (0.02)	0.05 (0.02)	0.43 (0.03)	0.08 (0.02)
Gondor	0.75 (0.02)	0.24 (0.07)	0.06 (0.02)	0.18 (0.04)	0.33 (0.04)	0.09 (0.03)
Hararghe	0.94 (0.02)	0.05 (0.02)	0.26 (0.08)	0.59 (0.08)	0.05 (0.01)	0.04 (0.01)
Illubabor	0.94 (0.02)	0.05 (0.01)	0.41 (0.03)	0.18 (0.03)	0.32 (0.02)	0.02 (0.01)
Kefa	0.90 (0.03)	0.06 (0.03)	0.41 (0.06)	0.19 (0.04)	0.26 (0.07)	0.04 (0.02)
Shewa	0.82 (0.02)	0.19 (0.04)	0.17 (0.03)	0.14 (0.03)	0.33 (0.03)	0.17 (0.02)
Sidamo	0.91 (0.02)	0.12 (0.04)	0.61 (0.10)	0.07 (0.03)	0.15 (0.05)	0.04 (0.02)
Wellega	0.87 (0.02)	0.07 (0.02)	0.33 (0.07)	0.15 (0.03)	0.36 (0.04)	0.02 (0.01)
Wollo	0.82 (0.04)	0.27 (0.09)	0.05 (0.02)	0.27 (0.08)	0.25 (0.04)	0.14 (0.02)

NOTES: Standard deviations in parentheses. Shares are computed from data compiled from CSA, Statistical Bulletin No. 56, No 74, No. 79 and No. 103. The share of cereals is out of total acreage cultivated with annual crops, while those of individual crops are out of total cereal acreage.

3.1.2 'Quota' rates

The available data regarding EAMC's procurement of crops from farm households can be grouped into two[33]. The first group consists of the annual domestic purchases of EAMC by crop (including the five major cereals) and source of supply (including merchants, and farm households via Peasant Association and Service Cooperatives). The second category is formed by the annual purchases of EAMC from farmers and merchants (together), by crop and administrative region. From the first set the share, at the national level, of farm households in the total domestic procurement of different crops by EAMC can be computed. The analogous share of merchants is similarly obtained. The relative shares of the two suppliers are then calculated, and the results are subsequently applied on the corresponding regional procurements from farmers and merchants so as to arrive at an estimate of the annual level of 'quota' by crop and administrative region. Finally, the ratio of the 'quota' level thus obtained to the corresponding regional output gives us the desired 'quota' rates. In short the next formula is used;

Table 2: Mean Regional 'Quota' Rates (1981 - 90)

Region	*Barley*	*Maize*	*Sorghum*	*Teff*	*Wheat*
National	0.02 (0.03)	0.02 (0.05)	0.02 (0.03)	0.03 (0.05)	0.15 (0.08)
Arssi	0.08 (0.05)	0.07 (0.15)	0.03 (0.03)	0.01 (0.01)	0.19 (0.08)
Bale	0.07 (0.07)	0.02 (0.02)	0.02 (0.02)	0.01 (0.03)	0.19 (0.11)
Gamo Gofa	0.00 (0.00)	0.01 (0.01)	0.00 (0.01)	0.01 (0.01)	0.00 (0.00)
Gojam	0.03 (0.02)	0.03 (0.02)	0.08 (0.05)	0.18 (0.06)	0.08 (0.03)
Gondor	0.01 (0.01)	0.01 (0.01)	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)
Hararghe	0.00 (0.00)	0.00 (0.00)	0.00 (0.01)	0.01 (0.02)	0.03 (0.07)
Illubabor	0.00 (0.01)	0.01 (0.01)	0.01 (0.02)	0.01 (0.01)	0.00 (0.01)
Kefa	0.02 (0.04)	0.01 (0.01)	0.01 (0.01)	0.00 (0.01)	0.01 (0.01)
Shewa	0.03 (0.02)	0.08 (0.04)	0.04 (0.03)	0.05 (0.01)	0.06 (0.03)
Sidamo	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.01 (0.01)
Wellega	0.01 (0.01)	0.03 (0.03)	0.02 (0.02)	0.03 (0.02)	0.04 (0.03)
Wollo	0.00 (0.00)	0.03 (0.04)	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)

[33] All the information concerning the operation of the EAMC are compiled from EAMC (1987) and EGTE (1995).

Notes: Standard deviations in parentheses.

$$\phi_{ikt} = \frac{\left(\frac{{}_{s}F_{it}}{{}_{s}F_{it} + {}_{s}M_{it}} \right) X_{ikt}}{Q_{ikt}}$$

Where ϕ_{ikt} is the rate of 'quota' applying to crop i and region k in year t; ${}_{s}F_{it}$ and ${}_{s}M_{it}$ are, respectively, the (national share of farm households and merchants in EAMC's total domestic procurement of crop i in year t; X_{ikt} represents the total amount of crop i purchased by EAMC from the farmers an merchants of region k in year t; and Q_{ikt} is the total output of crop i produced by the farm households of region k in year t. The rates calculated in this manner are to be viewed as the average rates of 'quota' which farm households of region k faced during year t.

At the national level, the average share of farm households in EAMC's total domestic purchases range from 60 percent for maize to 76 percent for *Teff*. The corresponding 'quota' rates range from 2-5 percent see Table 3.2). However, there were substantial regional differences in 'quota' rates. The relevant rates for the five main cereals are summarized in Table 3.3. The average regional 'quota' rate can be as low as zero for most crops (Gamo Gofa), and as high as 19 percent for wheat (Arssi and Bale). In this regard, the general pattern has been that higher regional output of a crop meant higher regional 'quota' level. The corresponding correlations are all positive, and are mostly large and significant (see Table 3.3). This pattern reflects the 'quota' determination process described above. It also provides some support to the argument that the 'quota' should be treated as an implicit proportional output tax[34].

Table 3: Correlations between Regional Crop Output and 'Quota' Level

Year	*Barley*	*Maize*	*Sorghum*	*Teff*	*Wheat*
1980/81	0.60 (0.038)	0.77 (0.004)	0.59 (0.045)	0.63 (0.027)	0.70 (0.011)
1981/82	0.52 (0.083)	0.84 (0.001)	0.68 (0.016)	0.63 (0.029)	0.72 (0.008)
1982/83	0.49 (0.106)	0.36 (0.246)	0.58 (0.049)	0.79 (0.002)	0.60 (0.041)
1983/84	0.48 (0.113)	0.80 (0.002)	0.53 (0.075)	0.67 (0.016)	0.66 (0.018)
1984/85	0.90 (0.000)	0.77 (0.003)	0.20 (0.536)	0.84 (0.001)	0.92 (0.000)
1985/86	0.53 (0.076)	0.49 (0.102)	0.66 (0.019)	0.81 (0.001)	0.82 (0.001)
1986/87	0.59 (0.042)	0.81 (0.002)	0.80 (0.002)	0.75 (0.005)	0.77 (0.004)
1987/88	0.88 (0.000)	0.74 (0.006)	0.56 (0.059)	0.71 (0.010)	0.90 (0.000)
1988/89	0.81 (0.001)	0.86 (0.000)	0.39 (0.218)	0.70 (0.011)	0.86 (0.000)
1989/90	0.95 (0.000)	0.87 (0.000)	0.56 (0.057)	0.80 (0.002)	0.95 (0.000)

NOTES: Each entry is Pearson's correlation coefficient between regional output and 'quota' level of the crop identified in the column, during the year identified in the row. Figures in parentheses are two-tailed significance levels.

[34] It does not however imply that these two variables are positively correlated overtime.

Table 4: Mean Panterritorial Procurement Crop Prices (1981-90)

Barley	*Maize*	*Sorghum*	*Teff*	*Wheat*
28.2 (1.93)	20.0 (1.83)	23.8 (1.34)	39.3 (2.21)	31.6 (0.97)

Notes: Computed form the information in EAMC (1987). Standard deviations in parentheses.

3.1.3 Crop Prices

Two sets of crop prices are relevant for the present analysis, namely, procurement Prices were administratively determined by the central government. They were also pan-territorial in that they apply to all parts of the country. Mean procurement prices for the five main cereals are reported in Table 3.4. As indicated by the low standard deviations, these prices did not change significantly in the 1980s. In fact they were raised only once for barley and wheat, and twice for the remaining three cereals during that period. Not only were the increases infrequent, they were also very modest, involving Birr 1 – Birr 4 per quintal[35].

Market pieces, in contrast, refer to producers' prices obtained on the 'free' market. In this regard, the CSA collects monthly retail and producers prices in rural areas since 1981. The data thus collected are summarized as regional quarterly prices and are published[36]. Annual regional producers' prices of crops are computed as the simple mean of the corresponding quarterly prices[37]. Table 3.5 reports the cereal prices calculated in this manner. First, these prices are considerably higher than the corresponding procurement prices. Second, substantial regional variation in crop prices can be observed. It is reasonable to expect that this variation reflects regional aspects of demand and supply including production patterns, supply shocks, and the degree of urbanization.

Table 5: Mean Regional Market Crop Prices (1981-90

Region	***Cereals***	***Barley***	***Maize***	***Sorghum***	***Teff***	***Wheat***
National	54.5 (19.9)	54.4 (19.2)	47.6 (19.4)	52.6 (21.6)	74.8 (25.0)	65.4 (20.2)
Arssi	44.7 (13.1)	38.2 (11.4)	38.1 (12.0)	46.0 (12.6)	68.6 (18.6)	51.3 (14.7)
Bale	45.3 (14.4)	44.9 (14.6)	47.1 (17.0)	54.8 (18.4)	72.1 (23.2)	60.4 (18.8)
Gamo Gofa	47.1 (12.0)	47.9 (11.3)	40.9 (12.3)	42.4 (11.8)	75.1 (16.0)	70.3 (14.7)
Gojam	43.6 (11.6)	42.7 (13.4)	36.2 (9.9)	33.2 (9.6)	51.6 (13.9)	48.8 (13.8)
Gondor	55.3 (15.4)	50.9 (16.3)	45.2 (14.0)	51.8 (16.7)	65.0 (18.0)	57.6 (16.4)
Hararghe	70.9 (22.4)	70.8 (23.6)	63.3 (18.9)	73.4 (23.9)	96.1 (22.1)	79.0 (24.2)
Illubabor	54.8 (15.3)	61.8 (14.7)	47.2 (13.8)	48.5 (14.6)	75.7 (23.7)	66.9 (15.1)
Kefa	47.8 (15.5)	52.4 (17.3)	41.0 (16.2)	43.9 (12.1)	68.9 (19.6)	62.6 (17.7)
Shewa	66.0 (23.6)	59.7 (20.5)	51.3 (21.6)	59.8 (25.9)	84.1 (27.7)	75.8 (21.6)
Sidamo	50.2 (11.3)	56.0 (11.4)	45.4 (10.5)	53.4 (23.0)	74.3 (17.3)	67.5 (12.6)
Wellega	53.4 (13.1)	58.9 (15.2)	45.8 (12.4)	50.5 (13.5)	68.3(18.6)	67.9 (19.9)
Wollo	75.0 (33.9)	69.0 (28.9)	69.5 (36.8)	73.0 (34.0)	97.4 (42.1)	77.4 (28.8)

NOTES: Computed form the information in CSA (1985), CSA (1988a), CSA (1988b), CSA (1991a), CSA (1991b), CSA (1992). Standard deviations in parentheses.

[35] Unpublished EAMC document.
[36] For the year 1987/88 - 1989/90 the monthly prices themselves are reported.
[37] Ideally some weighting scheme is desirable to account for seasonality. In the absence of any information that can serve as a basis for devising such a scheme, the simple strategy is opted for.

3.2 Econometric Specification

In this section an explicit solution for the farm household's acreage demand decision rule is derived first. Then an estimable form of that rule is formulated. The formulation is a specific application of (2.10), *Teff* taking the place of Crop1[38]. Teff is a major cereal in terms acreage and output shares accounting, respectively, for 23 percent and 17 per cent. It is highly demanded as a good crop, particularly in urban areas. Partly as a consequence of this demand, it is the most commercialized food crop, consequence of this demand, it is the most commercialized food crop, constituting a major (for many parts of the country the major) source of cash income for farm households. For the same reason Teff has also been the main target of EAMC in its cereal procurement effort. On average, it accounted for 36 per cent of EAMC's annual cereal purchases from farm households. As a result, the imposition of the Teff 'quota' on farm households is likely to have had a very large impact on their cash income and, through it, their welfare. These reasons are behind the decision to make Teff the focus of the empirical analysis.

An explicit solution for the acreage decision rule

As noted earlier, equation (2.10) does not constitute a decision rule because the expectational terms $E_{i+j}(\phi_{1,t+j+1+i}), E_{t+j}(P_{1,t+j+1+i}), E_{t+j}(R_{1,t+j+1+i})$ *and* $E_{t+j}(V_{1,t+j+1+i})$ are present. To transform it into such a rule, it is necessary to express those expectational variables as functions of elements of the current information set (- $_{t+j}$). One way of achieving this involves first postulating autoregressive processes for P_1^m, ϕ_1, R_1 *and* V_1, and then apply the Weiner-Kolmogorov prediction formula to solve for the expectational variables[39]. Towards that end, alternative specifications for these processes are explored using the available data.

A simple strategy is adopted for selecting from among alternative specifications. First, autoregressive models of the first- and second-order $(AR(1)$ *and* $AR(2)$, respectively) are specified for $P_1^{m'}$ *and* ϕ_1[40] [41]. The model for P_1^m thus specified incorporate the possible impact that ϕ_1 may have. Second a combination of the Akaike Information Criteria (AIC) and tests for parameter significance is used to

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[38] For the sake of notational economy, the subscript 1 is retained, but now used to identify variables relating to *Teff*.

[39] See Hansen and Sargent (1980) for further details.

[40] It is possible to postulate higher-order and/or vector autoregressive processes for P_{1t} *and* ϕ_{1t}. Solutions analogous to (3.1a) below can still be obtained [see Hansen and Sargent (1980). Indeed, the ideal procedures is to postulate AR processes without specifying the order, and then empirically choose the appropriate lag length. Restricting the choice to AR (1) and AR (2) processes reflects data constraints. To that extent it is rather arbitrary.

[41] Data on V_1 is unavailable. Consequently, it is excluded from this effort. However, we postulate that it is generated by an *AR(1)* process. The case of R_1 is more complicated. It measures the revenue per hectare from all cereals and pulses other than Teff, and is computed as:

$$R_1 = \sum_{j=2}^{J} P_j y_j$$

where: $P_j = \phi_j P_j^s + (1-\phi_j) P_j^m =$ the average price of the crop j; P_j^s = the procurement price of crop j; P_1^m = the market price of the crop j; ϕ_j = the rate of 'quota' on crop j. All attempts to consistently estimate an *AR(1)* and *AR(2)* processes describing R_1 failed. It is possible to consider more complicated models. But the resulting acreage equation will be very problematic to implement using the data available. As a result, the assumption that the law of motion of R_1 is *AR(1)* is maintained.

select the better specification. The details of this exercise are reported with the other results in section (3.4). At this juncture it suffices to report that the following specifications are selected in this manner.

$$P_{1t}^{m}, \theta_1 P_{1,t-1}^{m} + \theta_2 \phi_{1,t-1} + \theta_3 \phi_{1,t-2} + u_t^{p}; \ \ |\theta_1| < 1 \qquad \textbf{(3.1a)}$$

$$\phi_{1t} = \gamma \phi_{1,t-1} + u_t^{\phi}; \ \ |\gamma| < 1 \qquad \textbf{(3.1.b)}$$

Moreover let us assume that the stochastic variables R_{1t} and V_{1t} are generated by the following *AR(1)* processes:

$$R_{1t} = \alpha R_{1,t-1} + u_t^{R}; \ \ |\alpha| < 1 \qquad \textbf{(3.1c)}$$

$$V_{1t} = \rho V_{1,t-1} + u_t^{V}; \ \ |\rho| < 1 \qquad \textbf{(3.1d)}$$

where u_t^{P}, u_t^{ϕ}, u_t^{R} and u_t^{V} are zero-mean, constant-variance, and serially uncorrelated random variables[42]. Two remarks have to be made at this point. First, the farm household is assumed to derive its decisions rules taking the price, cost, and 'quota' rate stochastic processes as given. In other words, it operates according to the belief that its actions do not affect these processes. Second, recall that the specific AR processes for P_t^{m} and ϕ_t are selected via a simple procedure involving estimation and testing. This procedure is legitimate only under rational expectations. The reason is that, under rational expectations, the models used by the farm household to form expectations about random variables are identical to the actual laws of motion of those variables [Epstein and Yatchew (1985)].

Now turning to the task of solving for the farm household's acreage decision rule, being by restating (2.10) for *j=0*, to simplify notation:

$$A_{1t} = \lambda_1 A_{1,t-1} - \left(\frac{\lambda_1}{d}\right)\sum \ P_{1t}^{m}, \theta_1 P_{1,t-1}^{m} + \theta_2 \phi_{1,t-1} + \theta_3 \phi_{1,t-2} + u_t^{p}; \ \ |\theta_1| < 1$$

Also define Wt = ----------, where ' represents the matrix transpose operation. Then, following Hansen and Sargent (1980), state:

Furthermore, by defining = ----, and combining (3.1a) and (3.1b) the law of motion of can be rewritten as

---

[42] These variables are defined as:

$$u_t^{P} = P_{1t}^{m} - E_{t-1}(P_{1t}^{m}), \ \ u_t^{\phi} = \phi_{1t} - E_{t-1}(\phi_{1t}), \quad u_t^{R} = R_{1t} - E_{t-1}(R_{1t}), \quad u_t^{V} = V_{1t} - E_{t-1}(V_{1t})$$

such that:

$$E_{t-1}(u_t^{P}) = 0, \ \ E_{t-1}(u_t^{\phi}) = 0, \ \ E_{t-1}(u_t^{R}) = 0, \ = E_{t-1}(u_t^{V}) = 0$$

I is (2X2) identity matrix, and L is the lag operator with, L-------- Similarly rearranging using the lag operator it follows that:

==========

where: y(L)= 1-yl); a(L) = (1-aL); and p(L) = (1-pl). Note also that the assumption that ---------- ensure the existence of moving average representations for Wt, ------- and ---. Finally not that the Wiener-Kolmogorove prediction formula provided by Hansen and Sargent (1980) explicitly solves for ----. This it has to be slightly modified in order to solve for -----. This is done by exploiting the following equality:

Where----. Substituting for ------ from ht Hansen Sargent version provides the desired formula. This modified version of the WienerKolmogorov prediction formula is applied to obtain:

Substituting these in (2.10a)', and rearranging results in:

Under the above assumptions, (3.3) represents a closed form solution for the decision rule for A1t. It expresses the optimal acreage allocation rule of the farm household as a function of acreage allocated last period, current output price, current and once-lagged 'quota' rate, and current actual and opportunity costs of cultivating Crop 1. All of these variables are elements of the current information set of the household. Note also that w3 and w4 jointly capture the direct and indirect effects of the 'quota' rate described in section 2.3).

Econometric specification

As it stands equation (3.3) is nonstochastic. All right-hand-side variables are elements of the farm household's information set at t (or –t). It can be made stochastic by the introduction random disturbances. Towards that end, first take expectations of (3.3), while exploiting the fact that all right-hand-side variables are elements of –t. Then add (A1t-E(Alt) to the resulting equation to obtain:

Where ------. Note that may represent random errors of optimization/forecasting as well as errors in data (Hansen and Sargent (1980), and Epstein and Yatchew (1985)). More over, ---

On the other hand, data on V1t is not available. In the process a stochastic relation estimable with available data is obtained. In equation (3.4) et represents shocks to non-land costs of producing Teff and other cereals. It can also be used a means of including random errors of optimization and errors in data (Epstein and Yatchew (1985)). This equation is directly estimated as the underlying model are neither exploited nor their validity established empirically. However, primary objective of estimating acreage elasticities can be achieved using the unrestricted version. Next, a brief account of how these elasticities are computed.

Moreover, data on V1t is not available. A solution to both is provided by the Koyck transformation. Applying the Koyck Transformation, (A1t--------- and using (------, leads to :

In the process a stochastic relation estimable with available data is obtained. In equation 93.5) --- represents shocks to non-land costs of producting teff and other cereals. It can also be used as a menas of including random errors of optimization and errors in data (Epstein and Yatchew (1985)., This equation is directly estimated as the unrestricted the structural parameters. Thus, the restrictions implied by the underlying model are neither exploited nor their validity established empirically. However the primary objective of estimating acreage elasticities can be achieved using the unrestricted version. Next, a brief discussion of how these elasticities are computed.

The long-run elasticity of expected acreage demand with respect to mean -----, is derived by first taking the unconditional expectation of (3.5), differentiating with respect to ----, and weighting the result by the ratio of the unconditional means ---- and ---. The result is:

The long-run elasticity of expected acreage demand with respect to mean --- and mean R1 are obtained similarly:

The corresponding short-run elasticities, ----------, and ------- are computed in an analogous fashion. All are evaluated at the unconditional means of acreage shares, prices, and the rate of 'quota' associated with Teff, and appear as:

Estimation Procedure

The models for ---------- are estimated using available data on the relevant variables. As noted above the data set employed is composed of region-level information over ten years. To exploit this panel dimension, the equations are restated in the appropriate from by introducing regional effects. The resulting Teff acreage demand can be written as:

Where: I (i=1,…., N) identifies regions; y----------
Unobserved region-specific effects; and

To ensure stationarity, it is also assumed that, ----------. Similarly, the following for the Teff prices equation and the Teff 'quota' rate equation are respectively obtained:

Where :----------. Again, the subscript I indexes regions. Note that:

Represent the "fixed effects" decomposition of the disturbance terms commonly adopted in panel data models, with --------- representing white noise,.

Equations (3.8) – (3.10) form a set of dynamic panel data models. This each has to be estimated using estimation techniques applicable to such models. Recently a variety of estimators have been developed for the parameters of these models (Anderson and Hsiao (1982), Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1995). From among alternatives, a specific variant of the linear Generalized Method of Moments (GMM) estimator is chosen, namely, the system estimator proposed by Blundell and Bond (1995). This estimator is based on the estimation of the first-difference equations and the levels equations and the levels equations together as a system. In this process, lagged levels of (y, x) are used as instruments for the equations in first difference, while lagged differences are used as instruments for the equations in levels. To distinguish betweens them, this estimator and the usual GMM estimator based on the equations in first differences, are refereed to as the GMM (II) estimator and the GMM (I) estimator, respectively[43].

[43] Further details regarding the two estimators are provided in the appendix.

The estimation results are reported in Tables 3.1-3.3. To highlight the advantages derived from using the GMM (II) estimator, results relating to some of the alternatives are also presented. The GMM(I) and GMM(II) estimates are reported for all equations. Two more estimates for the Teff acreage demand equation are also reported. The first is obtained by applying OLS directly to the p0ooled data (i.e., ignoring regional effects. The results included in the column of Table 3.3 identified as OLS. The second is derived by applying the Within-groups estimator. To accommodate regional effects, this estimator uses the data transformed by subtracting the appropriate time-means of the relevant variables. The resultant estimates are reported under the heading 'Within' in Table 3.3

In addition to the estimates themselves, a number of test statistics are reported.

1. The first pair relate to the Wald tests of the joint signifi8cance of the regressors and the time-dummies, respectively. One is a test of the null hypothesis that the estimated coefficients of the regressors in an equation are all zero. Under the null the test statistic is asympotiically distributed ------, where the degrees of freedom p is eaual to the number of regressors. This statistic is rported as x2-Regressors. The other relates to the null hypothesis that the coefficients of the time dummies are jointly zero. It is asymptotically distributed ------ under the null, where q is equal to the number sof time-dummies. This statistic is reported as x2-Time dummies.
2. The second pair of reported test statistics is associated with testing thre absence of first-order and second-order serial correlation in the residuals. Because, the first-differenced residual is an (MA(1) process, first-order serial correlation is to be expected. On the other hand, if the original residuals are serially independent, there will be no second-order autocorrelation in the residuals of the equations in first differences. Thus, not rejecting the null of no second-order serial correlation in the first-difference residuals implies either no serial correlation in the errors in levels or the residuals in levels follow a random walk. The former is necessary for the consistency of the GMM estimators, while the latter will make both OLS and GMM estimates of the first-difference equation consistent. Which of the two possibilities (no serial correlation in the errors in levels or the residuals in levels follow a random walk) apply may be determined by the test for first-order serial correlation in the differenced residuals. In this regard, Arellano and Bond (1991) developed test statistics for first-order and second-order serial correlation bvased on the residuals from the equations in first-differnces. Under the respective nulls fthese tests are distributed asymptotically as standard normal. The tests are reported as m1 and m2.

3. The Sargan test of the overidentifying (moment) restrictions I the third test reported. It is base on the two-step estimated so the model in first-differences. Under the null of optimal instruments, the Sargan test-statistic is asymptotically distributed ----- with as many degrees of the freedom as overidentifying restrictions. In the tables of results, this statistic is reported as ----sargan test.

4. Finally, the Akaike Information Criteria (AIC) is reported for the market price and the 'quota' rate equations. It is computed as:

Where: RSS is the residual sum of squares, and K represents the number of regressors.

Results

This section presents the main empirical findings. These findings are summarized in Tables 3.1-3.4. Before considering other results, let us remark on the merits of the two main estimaors emplyed. Overall, the GMM(II) estimator performed better than it sGMM(I) conterpart. The efficiency gains due to the former are substantial. All standard errors (except one) are lower compared to those associated with the GMM(I) estimator. Accordingly, the discussionof results, including the comparison between the AR(1) and AR(2) models for the Teff market aprice and the Teff 'quota' rate, refer to te correstpnding GMM(II) estimator.

1. The main results pertaining to the market price of Teff are reported in Table 3.1. first the AR(1) and AR(2) specifications for the market price of teff are compared on the basis of the respective GMM(II) estimates. The AR(1) model is superior in that: the coefficient of --------- is not significantly different form zero.

Parameter	AR(1)		AR(2)	
	GMM(I)	GMM(II)	GMM(I)	GMM(II)

NOTES: Standard errors in parentheses, and degrees of freedom in saueare brackets. All standard errors are consistent in the presence of general heteroskedasticity. The Sargen test statistic corresponding to GMM(I) is not reported, because it is not well-determined.. (*),(----------) represents significance at 1 per cent, and 10 per cent, respectivel.

From zero; the AR(2) model induces second-order serial correlation in the errors, which can be viewed as a sign of misspecification; and the AIC is smaller for the AR(1) model. Second, the estimate of the coefficient of ----- in the preferred AR(1) process shows that the process is stable ------. Third, the coefficient ----- is positive buyt insignificant, shile that of ----- is negative and significant. It suggests that temporary or short-run changes in the 'quota' rate do not affect the market price of

Teff. In contrast, permanent or long-run changes in --- reduce the market price of Teff.

2. Table 3.2 summarized the results relating to the law of motion of the Teff 'quota' rate. First, GMM(II) estimates favour the AR(1) specification. Apart from generating an insignificant coefficient of ------ the AR(2) model leads to second-order autocorrelation in the errors. Second, the estimate of ------) indicate the stability of the AR(1) process.
3. Estimates of the parameters of the Teff acreage equation are reported in Table 3.3. They correspond to the OLS, within-groups, GMM(I) and GMM(II) estimators. The first three of these are included for comparison purposes. GMM(II) estimates are the preferred estimates. Observe that the estimates of ---------- satisfay the stationary conditions for an AR(2) process.

Finally, the long-run and the short-run elasticities of acreage demand for Teff production are computed using the equations (3.6) and (3.7) together with the GMM(II) parameter estimates in Table 3.3 The results are reported in Table 3.4. All the elasticities are evaluated at the sample menas of the relevant variables.

1. The long-run elasticity of Teff acreage demand with respect to the 'quota' rate is negative but relatively small. That it is negative is consistent with the

Table 7. One-step GMM Estimates of the Teff 'Quota' Rate Equations

Parameter	AR(1)		AR(2)	
	GMM(I)	GMM(II)	GMM(I)	GMM(II)

NOTES: Standard errors in parentheses, and degree of freedom in square brackets. All standard errors are consistent in the presence of general heteroskedasticity.------- represent significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

Table 8: One-step GMM Estimates of the Teff Acreage Demand Equation

Parameter	OLS	Within	GMM(1)	GMM(II)

Notes:: Standard errors in parentheses, and degrees of freedom in suare brackets. All standard errors are consistent in the presence of general hetroskedasticty. The Sargan test statistic corresponding to GMM(I) and GMM(II) is not reported, because it is not well-determined.--------- represent significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

Table 9: Elasticities of Teff Acreage Demand

Long-run		Short-run	

Prediction of the theoretical model set out earlier in this paper. It suggests that the long-rrun acreage demand for Teff cultivation has been reduced by the institution and expansion of the CGD. The reduction appears to have been relatively small. In contrast, the associated short-run elasticity is positive, but very small. Observe, however, that the coefficients of ------ in the Teff acreage equation is insignificant. The latter suggests that the 'quota' rate did not affect short-run acreage decisions of farm households.

2. The long-run and short run elasticities of acreage demand for Teff production with respect to the market price of Teff are positive. The signs of these elasticities conform with those of their theoretical counterparts. As would be expected, the long-run price elasticity is greater than the short-run one. In addition, the levels of the two elasticites are somewhat lower relative to those obtained by other studies. This is particularly true of the long-run elasticity. This relatively low own-price responsiveness may be partly explained by the presence of CGD, which is an outcome predicted by the theoretical model.

4. Consistent with the prediction of the theoretical model, the long-run and short-run elasticiteis of Teff acreage demand with respect to revenue from other annual crops are negative. Again, the short-run elasticity is smaller (in absolute value) than the corresponding long0run elasticity is smaller (in absolute value) than the corresponding long-run elasticity. In fact, permanent changes in the revenue from other crops induce the strongest response from long-run acreage demand for Teff cultivation. This is due to the fact that such changes represent a favorable shift in the profitability profile of, not a single alternative crop, but, most likely, a number of other annual crops. As a result the farm household affords a greater degree of flexibility in its acreage reallocation decision.

To summarize, the demand for teff acreage responds positively to the market price of teff, and negatively to the revenue obtainable from other cereals and pulses. In addition, the long-run demand for teff acreage is negatively affected by the 'quota' rate imposed on that crop.

4. Conclusion

This paper set out to investigate the impact of compulsory grain delivery (CGD) and crop prices on the production choices of farm households in Ethiopia. For that purpose, a simple dynamic agricultural household model is developed under rational expectations and risk neutrality. In that model the effect of CGD is introduced via a weighted average price of crops. This price is approximated as a linear combination of the relevant 'quota' rate, crop procurement price, and crop, and the revenue from alternative crops. It is demonstrated that, in general, these elasiticites depend on the technology of production, the cost of adjusting acreage allocations, the pattern of dynamic productivity effects, and household time preference., More specifically, it is shown that the long-run and current acreage allocations to a crop respond positively to that crop's market price, and negatively to the corresponding 'quota' rate and the revenue from competing crops.

Subsequently, an estimable dynamic acreage demand equation is derived by explicitly solving for the farm household's acreage allocation decision rule. This equation is then estimated for Teff – a major crop produced by Ethiopian farm households using region-level date. Recently developed techniques for estimating dynamic panel data models are employed for that purpose. The resulting estimates of elasticities of acreage demand for Teff production are consistent with the predictions of theoretical model.

The empirical evidence suggests that CGD is likely to have reduced the long-run acreage share (and thus the long-run supply) of the crops to which it applied to. It is likely to have done so by directly and indirectly (through lower market prices) reducing farm households' returns from these crops. It should also be noted that CGD may have affected crop supply in ways other than acreage reallocations. For instance, the lower crop profitability induced by CGD may adversely affect the farm households to reduce their dependence on crop cultivation and seek alternative income sources, such as animal husbandry. These possibilities, viable or otherwise, cannot be explicitly captured by the simple model employed in this paper. Nevertheless, on the basis of that model and the related empirical results, it is possible to conclude that the policy of compulsory grain delivery is unlikely to have been beneficial to the growth of crop production.

The empirical results also imply that acreage demand for the cultivation of a crop rises with the crop's price, and falls with revenue obtained from competing crops. In other words, the empirical evidence supports a normal supply response to prices furthermore, a comparison with elasticities reports by other studies indicate that the output price elasticities of acreage demand may have been somewhat lower in Ethiopian during the 1980's. It appears that this is in part explained by CGD.

INSTABILITY OF ETHIOPIA'S EXPORT EARNINGS, PRICES AND QUANTITIES

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Abstract

This article examines Ethiopia's instability in export earnings, prices and quantities of the major export commodities over the period 1964-2002. Analysis of the composition of exports through time reveals that Ethiopia has not diversified the commodity structure of its exports in that its export earnings depend on only a few agricultural products. In fact, the results of this study show that six agricultural commodities (chat, coffee, fruits and vegetables, hides and skins, oilseeds, and pulses) accounted for about 86% of the total export earnings of the country. The results indicate that the amplitude of instability varied from one commodity to another. Moreover, the results show that for the major export commodities, except for coffee, domestic supply factors were more important in explaining instability in earnings than demand related factors. The findings of this study suggest that the country needs to break away from its heavy dependence on traditional export commodities for which it is a marginal exporter, thus a price taker.

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I. INTRODUCTION

There has been a considerable discussion during the past five decades on the problem of instability of export earnings and the effects of such instability on the economic growth of developing countries which are heavily dependent on the export of primary commodities. Since the early 1950s, many economists and policy makers have argued that instability in export earnings has been an impediment to development, especially for countries, which derive the bulk of their export earnings from few primary commodities[1]. There are two types of empirical studies on instability of export earnings: cross-country (transversal) studies; and country specific studies. The former ones analyze export earnings instability (its causes and/or consequences) among several countries and the latter focus on individual country studies. The great majority of previous studies on export earnings instability have been transversal in nature, whereas specific country studies on export earnings instability are few and far between.

In most of the transversal studies on export earnings instability of developing countries, Ethiopia was one of the countries frequently included in the samples[2]. However, these studies did not help either to draw tangible conclusions about the impacts of export earnings instability on the Ethiopian economy or to gauge the contributions of major export commodities to the instability in total export proceeds. A survey of relevant literature reveals that the only country specific studies on Ethiopia's export earnings instability are those made by Love (1975), Teressa (1987) and Yohannes (1992). The first of these studies covered the period 1963-1970 and fluctuations were computed as the year-to-year changes in export earnings without eliminating the trend component from the time-series. The second and the third studies covered the 1962-1981 and 1978/79-1988/89 periods, respectively. These two studies employed trend corrected instability indices. However, they did not measure the contribution of major export commodities to the instability of total export earnings. Nor did they decompose instability of export earnings into its constituents. The present study departs from the previous studies in two ways. First, it covers a longer sample period (1964-2002). Second, and perhaps more importantly, **it** measures the contributions of the major export commodities to the instability of total export earnings and decomposes the instability of export earnings into its constituents.

The specific objectives of this study are:

(i) to analyze the degree of instability in export proceeds, prices and quantities of the major export commodities;
(ii) to compare levels of fluctuations among major export commodities and **to** measure the share of instability attributable to each commodity; and
(iii) to decompose the instability in export earnings of major export commodities into quantity effect, price effect, combined effect of prices and quantities, compensations between fluctuations of quantities and prices from their respective trends, and a residual factor.

The rest of this paper is organized in three sections. Section II discusses the source of data and the analytical procedures of the study. Statistical results are discussed in section III. Conclusions are presented in the fourth section.

II. METHODOLOGY

A closer look at the time-series estimates of the country's major macro-economic variables shows that different sources report different values for the same variables. In fact, many empirical studies on the Ethiopian economy are based on data gleaned from different sources. It is obvious that the quality and reliability of the data vary from one source to another. Therefore, piecing together data from various sources may lead to erroneous conclusions. In order to avert this problem and ensure the consistency as well as comparability of results, we opted for using data published by the National Bank of Ethiopia (NBE). In view of the objectives of this study, time-series data on values of exports and imports were extracted from various issues of the Quarterly Bulletin published by the NBE. Moreover, statistics pertaining to exported quantities and export earnings from the major export commodities (coffee, hides and skins, oilseeds, pulses, chat and fruits and vegetables) were extracted from the same source.

2.1 Data Coverage

This study covers 39 years, from 1964 to 2002. Review of the different publications of the NBE (Annual Reports and Quarterly Bulletins) reveals that data are available on export earnings, prices (unit values) and quantities of the major export commodities since 1964[3]. Therefore, the absence of data on earnings, unit values and exported quantities of some of the major export commodities for the years before this period, rules out the possibility of extending the study period beyond 1964. As the latest

available data on external trade of the country are that of 2002, the last year of the study period is 2002.

2.2 Definition and Measure of Instability

The meaning of the word instability, in the literal sense, does not pose any problem for it is incontrovertible and signifies the absence or lack of stability. When it comes to economics, this word has been defined in many ways and no unifying principle has underlain its quantification. The absence of a universally accepted definition for the word instability has three serious consequences. Firstly, measurements of instability proliferate. At least 16 distinct indices may be found in the development literature alone. This destroys cross study comparability. Secondly, existing indices fail to indicate clearly the type of fluctuations being measured; no rigorous classification of fluctuations is employed. Third, the relative emphasis on different fluctuations currently arises out of the ad-hoc characteristics of index and data, rather than from any underlying theory about why the fluctuations are presumed to matter. This is especially serious as inappropriate measurements may lead to faulty policy orientations (Gelb, 1979).

In spite of the absence of a universal definition for the term, it is accepted now that instability must be defined relative to a 'normal' value. This approach involves equating trend values with the 'normal' or anticipated path of earnings and regarding deviations from trends as comprising instability (Love, 1990). At present, there is a consensus among researchers to eliminate any trend element from a time series in estimating instability. The removal of the trend is required to avoid interpreting consistent annual increase or decrease as indicating instability. Otherwise, instability, and therefore instability index, of a series with a rapid or even a constant growth rate would tend to be biased upward (Aggarwal, 1982; Cuddy and Della Valle, 1978).

As to the instability indices used in the previous studies, they differ from one study to another[4]. The most frequently used instability indices are: Coppock's log-variance measure, normalised standard error measure, semi-log standard error measure, autoregressive moving average measure, five year moving average measure and average absolute deviation from the trend. For the purpose of this paper, the average absolute deviation instability index is used because, unlike most of the indices, this index does not impose *a priori* the same trend form for the export series of all the countries in the sample (Demeocq and Guillaumont, 1983)[5]. While using this index, export series, which is a function of time is adjusted according to a model that is

assumed to be either linear or exponential (with the better fit of the two being retained)[6].

2.3 Method of Measuring Percentage Contributions

Instability in total export earnings does not give a clear picture of the nature and degrees of fluctuations in earnings from different commodities exported by the country. Export proceeds from all commodities don't fluctuate at the same time and in the same direction. It is, therefore, worth analyzing the amplitude of instability in export earnings from the major export commodities and the contribution of the latter to the instability in total export earnings. Towards this end, the methodology used in some empirical studies (Coppock, 1977; Demeocq and Guillaumont, 1984; Kingston, 1973; Stein, 1979) is adopted with slight modifications[7].

The percentage contribution of each commodity to the instability in total export earnings is a function of its relative share in the total exports of the country. Thus, weighing the instability index of export earnings from each commodity by its average relative share gives a measure, which indicates the relative contribution of each commodity to the instability in total export earnings.

Consider a country exporting *m* commodities, where,

X_t: total export earnings in year *t*

X_{it}: export proceeds from commodity *i* in year *t*

I_X: instability index of total export earnings

I_{Xi}: instability index of export earnings from commodity *i*

for $i = 1, \ldots, m$ and $t = 1, \ldots, n$

Thus, the average relative share of commodity *i* in the total export earnings of the country (p_i) is given by :

$$P_i = \sum_{t=1}^{n} \frac{\left(\frac{X_{it}}{X_t}\right)}{n} \qquad \textbf{(1)}$$

The weighted instability index of commodity *i* (I'_{xi}) is then equal to : $I_{xi} . p_i$; and the total weighted instability index for the m commodities exported by the country ($\hat{I}_X$) can be written as:

$$\hat{I}_X = \sum_{i=1}^{m} I'_{Xi} = \sum_{i=1}^{m} I_{Xi} P_i \qquad \textbf{(2)}$$

Thus, it is possible to compute the percentage contribution of commodity i to the instability in total export earnings (α_i) as follows:

$$\alpha_i = \frac{I'_{Xi}}{\hat{I}_X} \qquad \textbf{(3)}$$

$$\text{with } \sum_{i=1}^{m} \alpha_i = 1$$

Empirical studies have shown that the total weighted instability is greater than the instability in total export proceeds of a country (Demeocq and Guillaumont, 1984). This is possibly because of the fact that by definition the total of the export earnings (X_t) is the sum of export proceeds from the *m* commodities, that is $X_t = \sum_{i=1}^{m} X_{it}$, and instability in earnings from some commodities can possibly be offset by the relative stability of proceeds from other commodities. The level of this compensation (C') can, therefore, be measured by the difference between the instability in total export earnings and the total weighted instability index for the different commodities :

$$C' = I_X - \sum_{i=1}^{m} I_{Xi} P_i \qquad \textbf{(4)}$$

2.4 Method for Decomposing Export Instability: Instability of Export Earnings, Prices and Quantities

The degree of fluctuations of export earnings depends not only on the fluctuations of prices and quantities from their respective trends but also on whether fluctuations of prices and quantities are offsetting each other or move in the same direction. In what

follows, the method used to decompose instability of export earnings into its constituents is presented[8].

Let us consider the case of a country over a period of n years. The relative annual variation in earnings is given by :

$$\frac{\Delta X}{X} \approx \frac{\Delta Q_X}{Q_X} + \frac{\Delta P_X}{P_X} \qquad \textbf{(5)}$$

Where : X is the export earnings ;
Q_X is the volume (quantity) of exports ; and
P_X is the price of exports.

The annual variation in earnings results, on one hand, from quantity variation, $a = \frac{\Delta Q_X / Q_X}{\Delta X / X}$

and, on the other hand, from price variation, $b = \frac{\Delta P_X / P_X}{\Delta X / X}$ (provided that $\frac{\Delta X}{X} \neq 0$).

However, a and b may not move in the same direction, and price and quantity variations may partially offset each other. Therefore, three factors, measured in absolute terms, should be distinguished in the relative variation of export earnings of each year :

- the absolute value of the quantity variation $|\Delta Q_X / Q_X|$ its contribution being $|a|$
- the absolute value of price variation $|\Delta P_X / P_X|$ its contribution being $|b|$
- the compensation taking place possibly between price and quantity variations when the two move in opposite directions, i.e. :

$$C \approx \left|\frac{\Delta X}{X}\right| - \left|\frac{\Delta Q_X}{Q_X}\right| - \left|\frac{\Delta P_X}{P_X}\right| \qquad \textbf{(6)}$$

its contribution to the relative variation in earnings being if $\frac{\Delta X}{X} \neq 0$

$$c = \left|\frac{C}{\Delta X / X}\right| \approx 1 - |a| - |b|$$

It is thus possible to determine what proportion of the variation in the annual export earnings is due to quantity and price variations and the possible compensation between the variations in prices and quantities[9].

It would then be possible to average the results obtained for each year. But in doing so one would determine the factors of annual variation in export earnings but not the factors of their instability, which are in fact measured in relation to their trend.

How should the role of the three identified factors in determining the instability index of export earnings be detected? Given that we measure the instability of export earnings using the absolute average deviation in relation to the trend, or:

$$I_X = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{X - \hat{X}_t}{\hat{X}_t}\right| \qquad \textbf{(7)}$$

where $X_t = Q_{Xt} \,.\, P_{Xt}$ and $\hat{X}_t$ the value of exports estimated over the trend.

The deviation observed in each year t is equal to $\left(Q_{Xt} \,.P_{Xt} - \hat{X}_t\right)$ and it can result from five factors :

- the absolute value of deviations in export earnings resulting from deviations of exported quantities from their trend values, prices being assumed to be equal to their trend values, i.e.

$$\left|A_t\right| = \left|\left(Q_{Xt} - \hat{Q}_{Xt}\right).\hat{P}_{Xt}\right| \qquad \textbf{(8)}$$

Where $\hat{Q}_{X\,t}$ is the quantity (volume) of exports estimated over the trend.

- the absolute value of deviations in export earnings resulting from deviations of export prices from their trend values, exported quantities being assumed to be equal to their trend values, i.e.

$$\left|B_t\right| = \left|\hat{Q}_{Xt}.\left(P_{Xt} - \hat{P}_{Xt}\right)\right| \qquad \textbf{(9)}$$

where $\hat{P}_{X\,t}$ is the export price trend value in year t.

- the absolute value of deviations in export earnings resulting from the combined action of deviations of exported quantities and prices, from their respective trends, i.e.

$$\left|\hat{Y}_t\right| = \left|\left(Q_{Xt} - \hat{Q}_{Xt}\right).\left(P_{Xt} - \hat{P}_{Xt}\right)\right| \qquad \textbf{(10)}$$

- a residual factor, other than the possible compensation of price and quantity deviations, resulting from the fact that, as price and quantity trends are not the same, the sum of the algebraic values of the three previous deviations is not necessarily equal to the observed deviation ; let Z be this residual factor :

$$\begin{aligned} Z_t &= \left|X_t - \hat{X}_t\right| - \left|A_t + B_t + Y_t\right| \\ &= \left|X_t - \hat{X}_t\right| - \left|Q_{Xt}.P_{Xt} - \hat{Q}_{Xt}.\hat{P}_{Xt}\right| \\ &= \left|X_t - \hat{X}_t\right| - \left|X_t - \hat{Q}_{Xt}.\hat{P}_{Xt}\right| \end{aligned} \qquad \textbf{(11)}$$

The residual factor corresponds to the fact that the trend values of export earnings are not necessarily equal to the products of price and quantity trend values.

- the possible compensation between price and quantity variations when they work in opposite directions, i.e. :

$$\begin{aligned} C_t &= \left|X_t - \hat{X}_t\right| - \left|A_t\right| - \left|B_t\right| - \gamma\left|Y_t\right| - Z_t \\ &= \left|A_t + B_t + Y_t\right| - \left|A_t\right| - \left|B_t\right| - \gamma\left|Y_t\right| \end{aligned} \qquad \textbf{(12)}$$

with $\gamma = +1$ if A+B > 0
$\gamma = -1$ if A+B < 0

It should be verified that $C_t = 0$ when Y > 0 and $C_t < 0$ when Y < 0. Actually, the combined element Y_t , included above as an absolute value and which is negative when A and B move in opposite directions becomes a positive compensating element only if the value of the positive element (A or B) is higher than the absolute value of the negative element, i.e. if A+B > 0, in other words only when the deviations in export earnings, relative to their trend, resulting from inverse price and quantity movements, is positive[10].

Thus, each annual deviation observed in relation to the trend can be broken down into five factors:

$$\left|X_t - \hat{X}_t\right| = \left|A_t\right| + \left|B_t\right| + \gamma\left|Y_t\right| + Z_t + C_t$$
$$\text{with } C_t \leq 0 \qquad \textbf{(13)}$$

The instability index (I) computed over a period of n years can itself be broken down into these five factors:

$$I_X = \frac{1}{n}\sum\frac{|A_t|}{|\hat{X}_t|} + \frac{1}{n}\sum\frac{|B_t|}{|\hat{X}_t|} + \frac{1}{n}\sum\frac{\gamma|Y_t|}{|\hat{X}_t|} + \frac{1}{n}\sum\frac{C_t}{|\hat{X}_t|} + \frac{1}{n}\sum\frac{Z_t}{|\hat{X}_t|} \qquad \textbf{(14)}$$

Or, in percentage

100 = A + B + Y + C +Z

with

$$A = \frac{100}{nI}\sum\frac{|A_t|}{|\hat{X}_t|} = \%\ \text{of instability due to quantity variations}$$

$$B = \frac{100}{nI}\sum\frac{|B_t|}{|\hat{X}_t|} = \%\ \text{of instability due to price variations}$$

$$Y = \frac{100}{nI}\sum\frac{\gamma|Y_t|}{|\hat{X}_t|} = \%\ \text{of instability due to combined action of quantity and price variations}$$

$$C = \frac{100}{nI}\sum\frac{C_t}{|\hat{X}_t|} = \%\ \text{of instability due to compensation between quantity and price variations}$$

$$Z = \frac{100}{nI}\sum\frac{Z_t}{|\hat{X}_t|} = \%\ \text{of instability due to residual factor}$$

III. RESULTS AND DISCUSSIONS

In this section the descriptive results and the analytical findings are presented and discussed.

3.1 Structure and Instability of Ethiopia's Exports

The external trade of the country was running at the level of some 3.62 billion birr for exports and 14.3 billion birr for imports in 2002 (NBE)[11]. These figures, when compared with the external trade statistics of the early 1960s, show that Ethiopia's exports have increased significantly in birr values. However, the value of imports has risen at even higher rates exceeding exports in all but one year (1973) since 1960. In fact, during 1960-2002, the annual growth rates of exports and imports were 7.24 percent and 10.37 percent respectively[12]. Merchandise exports accounted for an average of 5.8 percent of the GDP during the period 1990-1999, which was lower than the African average of 21.6 percent (ADB, 2002). The same source reveals that, over the same period, merchandise imports accounted for 16.6 percent of the country's GDP compared to the African average of 21.9 percent.

3.1.1 Export Structure

The country's export structure can be characterized by its heavy dependence on few agricultural commodities. OECD and ADB (2002) reported that the country's diversification index in 1999 was 2.5[13]. This shows that the economy is less diversified compared to some other African countries like Cameroon (6.8), Côte d'Ivoire (4.6), Egypt (9.6), Ghana (7.1), Kenya (10.5), Senegal (9.2) and Zimbabwe (8.9). As indicated in Table 1, six export commodities (Coffee, Hides and Skins, Oilseeds, Pulses, Chat, and Fruits and Vegetables) accounted, on average, for 86 percent of the country's total export earnings during the 1964-2002 period[14]. Coffee alone accounted for more than half of the total export earnings of the country over the period 1964-2002. It was distantly followed by hides and skins and oilseeds.

Table 1: Percentage Shares of Major Export Items in total Value of Exports: 1964-2002

Export items	1964-1973	1974-1983	1984-1993	1994-2002	1964-2002
Coffee	56.52	58.90	61.91	56.31	58.46
Hides and Skins	10.46	10.39	15.31	11.56	11.94
Oilseeds	9.58	5.76	1.14	5.26	5.44
Pulses	7.69	6.69	1.66	3.39	4.90
Chat	1.08	1.86	3.69	8.87	3.75
Fruits &Vegetables	2.32	0.99	1.33	1.16	1.46
Others	12.33	15.39	14.95	13.44	14.04
Total	100	100	100	100	100

Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

The figures in Table 1 indicate that agricultural commodity trade is an important source of export earnings. Available empirical evidence reveals that such an overwhelming dependence on few agricultural commodities has an adverse effect on the economies of developing countries like Ethiopia[15].

One notable point on the export side is that oilseeds, pulses, and fruits and vegetables, which are the country's traditional export commodities, are losing their relative importance. In fact, a closer look at Table 1 shows that the average shares of oilseeds and pulses have shrunk from 9.58 percent, and 7.69 percent respectively in the 1964-1973 period to 1.14 percent, and 1.66 percent, respectively in the 1984-1993 period. Though the average shares of oilseeds and pulses increased in the 1994-2002 period as compared to that of the period 1984-1993, they were still lower than their levels of the 1964-1973 period. The principal explanation for the decline in the average shares of oilseeds and pulses is the fact that during 1974-1991 the combined effect of recurrent droughts, political instability and military conflicts, in the major producing areas of these commodities, has severely affected the total volume of production and consequently the quantity of exports (Belay, 1998). As to the average share of fruits and vegetables in the total export earnings of the country, it declined from 2.32 percent in the period 1964-1973 to about 1 percent in the 1974-1983 period. It then increased slightly to 1.33 percent in the period 1984-1993 and then dropped to 1.16 percent during the 1994-2002 period. Another important change in the export structure is the rapid increase of relative importance of chat in the total export earnings of the country. In this respect, the relative share of chat in export earnings has been growing at a rate of 7 percent per annum over the 1964-2002 period[16]. It is also interesting to note that Chat was the third important export commodity, in terms of export earnings, over the period 1994-2002. In recent years, Chat was the second largest export after coffee, accounting for 14 percent and 14.2 percent of export earnings in 1999 and 2000, respectively (Computed from data in NBE). Some of the reasons for the increasing importance of Chat include: the persistent decline of coffee price in the world market, since the second half of the 1990s, has led the replacement of the coffee plant by Chat in the major coffee producing areas; the market for chat has been growing over the years (it has been legally exported to Djibouti and the United Kingdom since the early 1980s and in recent years with the liberalization of exports to Somalia its market has grown considerably); and the Chat plant is relatively drought resistant, fetches higher income per unit area as compared to annual crops and in recent years the acreage under this plant has increased significantly especially in the Southern and Eastern parts of the country (Belay, 1994; Belay and Manig, 2004; World Bank, 2002).

3.1.2 Instability of Export Earnings

The first step in computing an instability index is the estimation of a trend equation. Thus, both linear and exponential trend forms were fitted to the export series. Of the two trend forms the one that best fits the actual export proceeds, in terms of the coefficient of determination (R^2) and significance of the regression coefficients, was retained for the computation of the instability index (see Table 2).

Table 2: Summary of Trend Estimates for Export Earnings

Dependent Variable (Export Earnings in thousands of Birr)	Constant	Time trend Coefficient	R^2 adjusted	D-W
Total	12.252	0.069	0.381	1.32[a]
		(5.03)***		
Coffee	11.75	0.064	0.323	1.55[a]
		(4.48)***		
Hides and Skins	9.88	0.078	0.687	1.62[a]
		(9.46)***		
Oilseeds	-24229.25	5180.55	0.060	2.07[a]
	(LIN)	(2.10)**		
Pulses	9.44	0.045	0.001	1.63[a]
		(1.41)		
Chat	7.24	0.132	0.604	1.91[a]
		(7.75)***		
Fruits & Vegetables	-7299.53	1263.27	0.190	1.85[a]
	(LIN)	(3.30)***		
Others	10.02	0.080	0.395	1.31[a]
		(5.18)***		

LIN indicates that the trend equation is linear. In all other cases it is exponential.
Figures in parentheses are t- values.
*** statistically significant at 1 % level or better ; ** statistically significant at 5 % level.
a - As the trend estimates by the method of Ordinary Least Squares manifested the presence of autocorrelation of the error terms, the Prais-Winsten transformation was applied in order to compute the respective coefficients.

Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

The results in Table 2 show that except for oilseeds and fruits and vegetables where the linear fit produced better results, in all other cases the exponential fit produced higher R^2 s and t values for the regression coefficients. It is important to note that the time path for pulses can be regarded as trendless since the fit of the equation is very

poor. For a more formal verification of the appropriate trend that best fits the actual data, it was found logical to compare, for pulses, the relatively better trend indicated in Table 2 with curves for actual export earnings and the one calculated using five year moving average method. A careful visual inspection of different curves for this commodity indicated that the five year moving average trend form provided by far the 'best fit'. It was noted, however, that in the process of averaging, four terms were lost (two in the beginning and two in the end). Moreover, in using moving averages one should be alert to the fact that the length of the chosen interval influences the degree of smoothing, and where it is small, the moving average tends to absorb some of the short term fluctuations possibly causing an underestimation of instability (Aggarwal, 1982; Love, 1987; Stein, 1977).

Love (1987) points out that the moving average is more strongly influenced by outlying observations than linear and exponential trends. As the moving average method has certain anomalies in measuring instability and as the objective of this study is to compare the degree of instability among different commodities, it was imperative to fit trends of the same form for export series of the different products, albeit, of course, that which best fit the data for most of them. For the computation of the instability indices, it is in practice necessary to keep uniformity in the trend estimation methods hence the trend form shown in Table 2 is used.

As already noted, in this study, export instability is considered to be an 'unpredictable' deviation over an observed time series with respect to its trend. Therefore, the export earnings time series were de-trended using the trend forms which provide the best fit for the time series (see Table 2). The de-trended data were used to compute the instability of export earnings presented in Table 3.

Table 3: Instability of Export Earnings (in percentage): 1964-2002

Instability of earnings from	Instability
Coffee	23.17(6)
Hides and Skins	21.44(7)
Oilseeds	48.66(1)
Pulses	46.60(2)
Chat	46.35(3)
Fruits &Vegetables	43.96(4)
Others	24.57(5)
Total Exports	16.30(8)

Note: Figures in parentheses indicate rankings by degree of instability
Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

As can be seen from Table 3, the instability of total export earnings in the period 1964-2002 was 16.3 percent. Given the fact that the instability index used in this study is constructed in such a way that the lower the instability, the lower will be the value of the index, with the value of zero indicating no instability, the results of this study suggest that the country has been experiencing considerable fluctuations in its export earnings over the study period. A review of the empirical literature on export earnings instability reveals that there is no as such a threshold instability level below which export earnings fluctuations are not harmful to the economy of a given country (Belay, 1997). However, for a country like Ethiopia that derives a substantial proportion of its foreign exchange earnings from the export of few primary products, instability in export earnings, no matter how low this could be, has adverse effects on the performance of the economy (Aiello, 2000; Belay, 1994; Love, 1975, 1987). It is, therefore, important to note that instability of export earnings has been a structural problem that the country has to live with and it calls for measures aimed at stabilizing earnings and/or attenuating the magnitude of instability.

Examination of rankings in Table 3 reveals that during the period 1964-2002, the fluctuations of total export earnings were lower than that of earnings from individual commodities. This can partly be explained by the fact that earnings form these products are affected by different demand and supply conditions. These conditions could engender either increasing or decreasing trends for export proceeds of the different commodities whereby fluctuations in earnings from these products could offset each other. The inter-commodity comparison of instability levels indicates that the commodities that suffered severe fluctuations in earnings, in descending order, were oilseeds, pulses, chat, fruits and vegetables, coffee, and hides and skins. The rankings indicate also that, with the exception of hides and skins, commodities which exhibited enormous volatility in export earnings over the study period were the ones with relatively smaller shares in total export earnings. These results point to the fact that the instability of the country's total export earnings depends on the nature of the exported products, their relative weight in total exports and the correlation among earnings from different products.

3.2 Contribution of the Principal Export Commodities to the Instability of Total Export Proceeds

During the period 1964-2002, the instability index for total export earnings was 16.3 % and the total weighted instability index was 26.86 % (Table 4). These results indicate that the instability in total export earnings is by far less than the weighted instability index. As export earnings from all commodities did not fluctuate at the

same time and in the same direction, the level of compensation between earnings instabilities from different commodities was 10.56 percent. In reality, had it not been for the compensations among fluctuations in export proceeds from different commodities, the total export instability would have increased by 65 %. During the same period, the level of instability in coffee export proceeds was 23.17 %. As this product accounted for 58.46 % of the total export earnings, its contribution to the instability in total exports was 50.41 %. Coffee's contribution to total instability is less than (by 8 points) its share in total export earnings. Hides and skins accounted for 9.53 % of the instability in total export earnings and their contribution was less than (by 2.4 points) their share in the total export earnings. As for oilseeds, pulses, chat, and fruits and vegetables, they have contributed respectively 9.86 %, 8.49 %, 6.48 % and 2.38 % to the total export fluctuations. These products contributed disproportionately to the fluctuations in total export earnings in that their contributions were greater than their respective shares in the total export revenues.

The results in Table 4 indicate that coffee accounted for 50.4 % of the instability in total export earnings over the period 1964-2002. The percentage contribution of coffee is quite significant and largely determines the degree of instability in total export earnings. Consequently, any attempt to stabilize Ethiopia's export proceeds should begin by stabilizing coffee export earnings.

Table 4: Contribution of the Major Export Commodities to the Instability of Total Export Earnings: 1964-2002

Export item	instability in export earnings	average share in total exports	Weighted instability index	percentage contribution
Coffee	23.17	58.46	13.54	50.41
Hides and Skins	21.44	11.94	2.56	9.53
Oilseeds	48.66	5.44	2.65	9.86
Pulses	46.60	4.90	2.28	8.49
Chat	46.35	3.75	1.74	6.48
Fruits & Vegetables	43.96	1.46	0.64	2.38
Others	24.57	14.04	3.45	12.84
Total	**16.3***	**100.00**	**26.86**	**100.00**

* This figure shows magnitude of instability of total export earnings
Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

It is to be noted that during the first four Lomé conventions (1975-1998), Ethiopia was one of the largest recipients of European Union's STABEX transfers, ranking in the

fourth place coming next to Côte d'Ivoire, Cameroon, and Senegal[17]. In the period 1975-1998, Ethiopia received a total of 311.8 million ECU in the form of STABEX transfers (Aiello, 2000). This represents 7.16 % of all the STABEX transfers made during the same period. In fact, the highest proportion of STABEX transfers was made to compensate for losses in export earnings from coffee. A study by Aiello (2000) reveals that the instability of Ethiopia's export earnings which was 21.4 percent over the period 1975-1998 fell to 20.8 percent as a result of STABEX transfers made over the same period. The findings of the study imply that STABEX transfers resulted in a 2.8 percent stabilizing effect on the instability of the country's export earnings over the study period.

In sum, Table 4 shows clearly that, over the 1964-2002 period, the major export items, with the exception of coffee and hides and skins, contributed more to fluctuations in total export earnings than their relative shares in total exports. More precisely, coffee and hides & skins had a stabilizing effect on the instability in total export earnings because their contributions were significantly lower than their respective shares in total export proceeds[18]. However, earnings from oilseeds, pulses, chat, and fruits and vegetables were unstable and amplified fluctuations in total export earnings.

3.3 Instability of Prices and Quantities

As variations in export earnings stem from variations in world market prices and volume of exports, it is necessary to examine whether instability in export proceeds is due principally to the fluctuations in prices or quantities exported. Following the methodology used in computing instability indices for export proceeds, deviations from the appropriate trends (see, appendix Tables A and B) are considered to compute instability in prices (unit values) and quantities of the major export items.

Table 5: Instability of Earnings, Unit Values and Quantities of Major Export Commodities in Percentage: 1964-2002

Export item	Instability in		
	Export earnings	Unit values	Quantities
Coffee	23.17	22.48	15.07
Hides and Skins	21.44	22.30	28.86
Oilseeds	48.66	18.25	85.21
Pulses	46.60	23.51	42.07
Chat	46.35	23.31	45.14
Fruits & Vegetables	43.96	20.35	26.69

Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

Table 5 reveals that, except for coffee, quantity fluctuations were higher than price fluctuations. This implies that much of the explanation for instability in export earnings is to be found on the supply side. More precisely, exported quantity varied significantly from year to year. One obvious reason for this phenomenon is that the country's export earnings are derived form few agricultural commodities and Ethiopian agriculture is highly weather dependent so much so that poor rains mean crop failure and famine. In addition to weather variability, factors such as pest attacks, disease infestations, utilization of poor quality seeds, post-harvest grain losses, etc. affect the total volume of production and quantity of exports. Another important reason for instability in export quantity is the domestic consumption of exportable commodities. Nearly all of Ethiopia's export products have strong domestic demand. For some items, such as oil seeds, vegetables and fruits and animal products the domestic market is the dominant outlet of supply. Given a fixed domestic consumption ratio (domestic consumption as a percentage of production), the exported quantity varies in relation to the volume of production (Belay, 1994). Export quantity variations can also result from the size and importance of illegal exports. Though exact figures about the volume of smuggling are difficult to find, there is an agreement in the literature that illegal exports from Ethiopia represent a considerable proportion of the exportable production (Belay, 1994). For instance, the Ethiopian government estimated the level of smuggling to be up to 25 percent of exports (TGE, 1992).

In the period under consideration, coffee suffered wide fluctuations in earnings due mostly to instability in the world market price, over which the country had no control. In this respect, the World Bank (2002) noted that Ethiopia's share of the world coffee market has been stable at less than two percent since the early 1980s. Available evidence reveals that coffee price volatility has been a common feature since 1989 (year of suspension of the International Coffee Agreement). It is also important to note that fluctuations in export earnings from coffee, pulses, chat, and fruits and vegetables were higher than the variations in their respective unit values and quantities. For oilseeds, the instability in export earnings was higher than that of their respective unit values but lower than that of their respective quantity. Whereas, fluctuations in export earnings from hides and skins were lower than that of their respective unit values and quantity.

3.3 Decomposition of fluctuations in export earnings

In the previous section the magnitudes of instability of unit values, quantities and export earnings were analyzed separately. In this section, fluctuations in export earnings are

decomposed into five components: price effect, quantity effect, combined effect of prices and quantities, compensations between fluctuations of quantities and prices from their respective trends, and a residual factor. The magnitude of export earnings instability depends on whether fluctuations in unit values and quantities from their respective trends are offsetting each other or move in the same direction. More precisely, if fluctuations of unit values and quantities from their respective trends move in opposite directions (offsetting fluctuations), then fluctuations in export earnings will be small and the resulting instability index will be relatively smaller. However, if fluctuations of unit values and quantities from their respective trends move in phases rather than offsetting each other, fluctuations in export earnings will be large and the resulting instability index will be relatively higher.

Table 6: Decomposition of Instability of Export Earnings in percentages (1964-2002)

Export items	Instability due to				
	Quantity variation	Price variation	Combined action of quantity & price variations	Compensation between price & quantity variations	Residual factor
Coffee	67.24	100.1	10.92	-78.08	-0.17
Hides and Skins	138.62	3	20.20	-135.26	-23.41
Oil seeds	76.30	99.91	7.30	-36.29	28.36
Pulses	157.92	24.35	-12.40	-62.88	-59.23
Chat	96.78	76.61	12.64	-64.14	5.50
Fruits & Vegetables	53.46	49.21	-1.11	-18.15	24.93
		40.88			

Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

Table 6 shows that with the exception of coffee, quantity effects dominated price effects. Coffee had larger unit value volatility than quantity volatility. In other words, during the study period, the quantity effect was the most significant determinant of export earnings volatility for all major export commodities except coffee. However, it should be noted that fluctuations of unit values and quantity from their respective trends have quite often moved in opposite directions thereby helping attenuate the amplitude of instability of export earnings. It should be recognized that the combined absolute actions of fluctuations of unit values and quantities (when they moved in the same directions or were not offsetting each other) were smaller than the levels of compensations between price and quantity variations for all the commodities considered. This is a clear indication of the fact that the magnitudes of instability in export earnings would have been higher

than their current levels in the absence of compensations between variations of unit values and quantity.

IV. CONCLUSION

This paper has evaluated the magnitude of instability of export proceeds, prices and quantities of the major export commodities and has decomposed the instability of export proceeds from these commodities into their constituents. The levels of instability of export proceeds, prices and quantities were estimated using an index based on de-trended values of the time series. The results of the study indicate that for the major export commodities, except for coffee, fluctuations in quantity of exports were the major sources of earnings instability. Given the fact that exports are dominated by few agricultural products and the inherent uncertainties associated with the production of these products, the findings of this study point to the fact that the country must diversify its exports in terms of both products and markets. This is precisely because concentration on a few agricultural products, whose production level depends for the most part on factors beyond the control of producers, reduces the country's chances of having fluctuations in one direction in some of its exports offset by counter fluctuations in others.

The efforts, which have been made since the late 1980s, to diversify exports into the non-traditional products, such as flowers, clothing, leather products are encouraging signs. However, it must be pointed out that the markets for these products are intensely competitive both in price and quantity terms. Moreover, the products are facing trade barriers that limit the nation's ability to export. Be that as it may, in the Ethiopian context, the diversification of exports into non-traditional products would call for, among others, creating an enabling environment for the private sector to invest in the production and processing of non-traditional export products; strengthening domestic supply capability through technological upgrading and infrastructure development; and organising efficient input, output, and financial marketing systems.

It is also important to note that Ethiopia's export structure is characterized by high degree of geographical concentration. In other words, the major export markets are some countries in Europe, USA and Asia where the demand for the country's traditional exports is growing very slowly. This geographical concentration serves as a mechanism for the transmission of recession from the major trading partners to Ethiopia. Given this state of affairs, increasing trade with other countries in the

Eastern and Southern African region might help to stabilize earnings. Available evidence shows that over the period 1990-1999, the country exported, on average, about 11 percent of its total exports to other African countries, which was higher than the African average of about 9 percent (ADB, 2002). The same source shows that, over the same period, imports from African countries accounted for about 5 percent of the total imports, which was lower than the African average of about 10 percent. Ethiopia is currently a member of the Common Market for Eastern and Southern Africa (COMESA) and of the Inter-Governmental Authority on Development (IGAD). However, the performance of these regional organizations is not as expected. Some of the factors which explain their poor performances are: poor regional transport infrastructure, most of the countries in the region export the same products; mistrust of regional partners; lack of information about regional markets; and high cost and low quality of regional goods. Consequently, concerted efforts should be made, by all concerned, to alleviate these problems and make regional trade an engine for development.

NOTES

1. See, for example, Belay (1994), Dawe (1996), Demeocq and Guillaumont (1984), and Lancieri (1978).
2. See, for example, Aiello (2000), Belay (1994, 1997), Coppock (1977), Lancieri (1978), Love (1985, 1992), Massell (1970) and Savvides (1984).
3. Average prices (unit values) of the different commodities were computed by dividing export earnings by quantity of exports.
4. For a detailed discussion of the different instability indices, see Love (1987); Demeocq and Guillaumont (1983).
5. For a description of the inconvenience of *a priori* choice of the form of the trend, see Tan (1983).
6. The Average Absolute Deviation Instability index (AAD) is computed by using the following formula:

$$AAD = \frac{100/n \sum_{i=1}^{n} \left\| X_t - \hat{X}_t \right\|}{\hat{X}_t}$$

Where: X and $\hat{X}$ are the actual and trend values in period t,
n is the number of years considered in the study.

7. While earlier studies measured the relative share of individual commodities in the total export earnings of a country by dividing the average export value of the individual commodities by the average total export earnings of the country over the entire study period, in this study it is computed with slight modifications. More precisely, it is computed in two steps. In the first step, the annual export earnings of individual commodities are divided by the total

annual export earnings of the country. In the second step, the mean values of the relative share of individual commodities are computed by dividing the sum of the results obtained in step one by the total number of years covered in the study

8. On the method for decomposing instability of export earnings, we have drawn heavily from Guillaumont (1982).

9. To be more exact, it should be written as:

$$\frac{\Delta X}{X} = \frac{\Delta Q_X}{Q_X} + \frac{\Delta P_X}{P_X} + \frac{\Delta Q_X}{Q_X} \cdot \frac{\Delta P_X}{P_X}$$

and four factors (not three) should be distinguished relative to the variation in export earnings X, the additional factor being more or less equal to the absolute value of the combined effect of price and quantity variations :

$$\left|\left(\Delta Q_X / Q_X\right).\left(\Delta P_X / P_X\right)\right|$$

10. If Y < 0, the following values of C will obtained:

A + B > 0, A > 0, B < 0 : C = 2B + 2Y
A + B > 0, A < 0, B > 0 : C = 2A + 2Y
A + B < 0, A > 0, B < 0 : C = -2A - 2Y
A + B < 0, A < 0, B > 0 : C = -2B - 2Y

In all the cases C < 0, but the absolute value of C is increased by Y in the first two cases and is decreased by Y in the last two cases.

We can also write:

$$C = -2|A + Y| \text{ if } |A| < |B|$$
$$C = -2|B + Y| \text{ if } |A| > |B|$$

11. Birr is the Ethiopian national currency. Between February 15, 1973 and September 30, 1992, the birr had been pegged to the US dollar at the rate of 1 US = 2.07 birr. The Transitional Government of Ethiopia devalued the birr in September 1992 and fixed the exchange rate at 1 US = 5 birr. Currently, the exchange rate is determined by inter-bank exchange of currencies and it is around 1 US = 8.8 Birr.

12. Computed by fitting exponential trend forms to the time-series in National Bank of Ethiopia, Quarterly Bulletin, various issues. The regression coefficients are significant at less than 1 percent significance level.
13. The diversification index measures the extent to which exports are diversified. It is constructed as the inverse of a Herfindahl index, using the disaggregated exports at 4 digits (following the SITC 3). A higher index indicates more export diversification.
14. Chat (C*atha edulis*) is a natural stimulant plant, which reaches heights from 3 to 7 meters. Fresh chat leaves, which are typically chewed like tobacco, produce a mild cocaine- or amphetamine-like euphoria that is less potent than either substance. Chat is widely used in eastern and southern parts of the country. It is also exported to Djibouti and Somalia.
15. For more information on the effects of commodity concentration, see, among others, Belay (1994), Knudsen and Parnes (1975), Massell (1970), MacBean and Nguyen (1987) and Sheehey (1977).
16. Rate computed by fitting exponential trend form to the yearly percentage shares. The regression coefficient is significant at less than 1 percent significance level. The result is available from the author on request.
17. STABEX is a facility that compensates for lost export earnings caused by fluctuations in world prices for and/or volumes of basic agricultural commodities. Only ACP countries (African, Caribbean and Pacific states signatories of the Lomé convention) are beneficiaries of STABEX.
18. This does not, however, mean that the country should concentrate on the production and export of Coffee and Hides & Skins. Rather, the implication is that, had it not been for these two commodities, the instability of total export earnings would have been higher than its computed value of 16.3 %.

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Appendix Table A: Summary of Trend Estimates for Unit Values of Major Export Commodities

Dependent Variable (unit values in thousands of Birr)	Constant	Time trend Coefficient	R^2 adjusted	D-W
Coffee	0.606	0.057 (5.19)***	0.397	1.81[a]
Hides and Skins	0.402	0.092 (25.32)***	0.944	1.94
Oilseeds	-1.132	0.072 (9.61)***	0.704	1.90[a]
Pulses	-1.565	0.072 (15.96)***	0.870	1.61
Chat	0.442	0.092 (7.72)***	0.603	1.99[a]
Fruits & Vegetables	-1.599	0.059 (7.40)***	0.581	1.97[a]

LIN indicates that the trend equation is linear. In all other cases it is exponential.
Figures in parentheses are t- values.
*** statistically significant at 1 % level or better.
a - As the trend estimates by the method of Ordinary Least Squares manifested the presence of autocorrelation of the error terms, the Prais-Winsten transformation was applied in order to compute the respective coefficients.
Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

Appendix Table B: Summary of Trend Estimates for Quantity of Major Export Commodities

Dependent Variable (Export quantities in metric tons)	Constant	Time trend Coefficient	R^2 adjusted	D-W
Coffee	67540.32 **(LIN)**	764.40 (1.99)*	0.05	1.99[a]
Hides and Skins	9.49	-0.014 (2.83)***	0.156	1.82
Oilseeds	10.70	-0.030 (0.71)	0.0001	1.62[a]
Pulses	70040.14 **(LIN)**	-981.32 (1.14)	0.001	1.73[a]
Chat	6.83	0.039 (2.58)**	0.109	1.77[a]
Fruits & Vegetables	20348.37 **(LIN)**	-145.28 (0.76)	0.0001	2.12[a]

LIN indicates that the trend equation is linear. In all other cases it is exponential.
Figures in parentheses are t- values.
*** statistically significant at 1 % level or better; ** statistically significant at 5 % level; * statistically significant at 10 % level.
a - As the trend estimates by the method of Ordinary Least Squares manifested the presence of autocorrelation of the error terms, the Prais-Winsten transformation was applied in order to compute the respective coefficients.
Source: Computed from data in National Bank of Ethiopia, Quarterly Bulletin, various issues.

THE DISTRIBUTIONAL IMPLICATIONS OF PERSONAL INCOME TAX REFORMS: THE CASE OF CIVIL SERVICE SECTOR IN ETHIOPIA

Abu Girma Moges**

Abstract

The principles of horizontal and vertical equity are central in fiscal policy. The distributional implications of a taxation system are derived from how the tax codes incorporate these principles for a given pattern of income distribution. This paper examines the distributional issues and implications of personal income tax reforms in Ethiopia with reference to the civil service sector. The theoretical issues and policies are analyzed in light of the 1994 and 2002 income tax reforms. We argue that whereas the reform measures undertaken so far have addressed some problems in the fiscal system, further measures are needed to improve the capacity of the tax code to promote the principles of equity and to encourage capital accumulation and growth efforts. The built-in structure of the tax system, coupled with conventional approaches in tax policy design and implementation, has contributed towards policy stances that weaken the role that the tax system could play in promoting sustainable economic growth and address problems of chronic poverty.

Key words: income tax, progressive tax rate, income distribution and redistribution, tax reform.

JEL classification: H24

1. INTRODUCTION

Governments make use of fiscal policies to pursue a number of objectives. One of the most common uses of these policies is to mobilize revenue resources that would be used for financing public expenditure. A significant share of this revenue originates from income taxes. This is more apparent in the fiscal system of developed countries than in developing countries. In the developing countries, the fiscal system depends more on indirect taxes since their fiscal network has limited access to the direct sources of taxation. Nonetheless, income taxes are widely used by governments in developing countries for both revenue and non-revenue objectives.

One of the objectives of taxation is to generate revenue to the government and perhaps influence the pattern of income distribution without creating costly disincentive factor for labor force participation and capital accumulation efforts. Policymakers combine taxation and government spending policies to address the competing objectives of who should get what from the national production process and how that would affect the incentives to economic agents to engage in economic activities. Changing the distribution of wealth and income, however, is a slow process and consistent and sound public policies are required to address distributional issues over time.

The principle of equal sacrifice is at the center in the theory and practice of income taxation and its implications on distributional issues. The traditional rationale of the principle emphasize that those who are better off should pay at a higher rate because they can absorb the loss in utility with more ease than low income taxpayers(Young, 1994:99; Mitra and Ok, 1996:925). However, this rationale does not address and could not be extended to long term issues that shape the patterns of income distribution. The distribution of income is highly influenced by resource endowment, employment opportunities, labor market regulations, educational achievement, work experience, the growth dynamics of sectors, and government policies. The equity principles are commonly interpreted in tax codes as progressive income taxation, which levies tax liability at a progressive rate relative to income, and as a result would make the after-tax income distribution less unequal. Pursuing progressive tax schedule to improve income distribution, however, is problematic because not all differences in income are inequitable and after-tax income need to reflect the contribution of factors in the production process. When the factors market is not distorted and competition broadly guides the allocation and rewards for factors, factors are paid in line with their contribution in the production process. If individual agents work hard, invest on themselves through education, training and experience,

exert efforts to save and accumulate economic resources and engage in entrepreneurial activities, their remuneration should reflect these attributes. It is important that the incentive to engage in these activities should be preserved so as to have a healthy dynamics in the national economy.

The principle of equal sacrifice has been widely used to formulate income tax policy and design tax schedules. The theoretical and policy debate about income taxes has primarily focused on the nature and magnitude of progressivity of income tax rate structure. The principle states that tax obligations should be distributed in such a way that different income units are treated differently according to their ability to pay. This is based on the premise that higher income groups have higher capacity and the tax-induced sacrifice in utility would decline with income. The principle of equal sacrifice implies not only progressive income taxes but also a stronger conditionality of progressive marginal tax rate (Mitra and Ok, 1996). The main issue is how far a government should pursue such principle and implement progressive income taxation on money income. Is it possible to reshape the distribution of income by tax policy without affecting the average level of income in the system? If not, what are the balancing mechanisms to achieve a compromised objective of equity oriented economic growth. Do equity principles in taxation help a country address the underlying factors that influence the distribution of income? These are some of the issues that need to be addressed from theoretical and policy perspectives.

In the context of a poverty stricken and subsistence agriculture dominated economy, the choice of policy objectives between growth and equity is always contentious. In an economy where generalized poverty is dominant, the issue of increasing total output of the country takes precedence over the distribution issues. Economic policies should be geared towards increasing aggregate output and realizing the potentials of its economic agents and the national economy. In such economies, where redistribution has limited potential, the system simply does not have the capacity to generate resources and output that could ensure subsistence for all the population and public policy priorities need to focus on achieving sustainable economic growth that could open opportunities to an increasing portion of the population. In this regard, fiscal policy and other policies need to redirect their effort towards enabling economic agents realize their economic potential and in the process enable the economy achieve the essential capacity to generate sufficient output and employment opportunities that weaken the grips of chronic poverty in the country.

The subject matter of this paper is to analyze the recent income tax reforms in Ethiopia and discuss their distributional implications. The central premise of this

paper is that a country cannot force redistribution policies through income tax policies upon itself on a sustainable manner without hampering the very process of economic activity. We argue that an equitable distribution of income requires addressing the underlying economic, social and political constraints that give rise of uneven distribution of income and inequality in the system. Information on the Ethiopian civil service sector is used to illustrate the policy and practice of income taxation and recent reform measures. The choice the civil service sector was dictated not only the availability of a relatively better organized data but also for the sector represents one of the implementation organs of public policies. Moreover, relative to the rest of the economy, the sector commands high remuneration for its employees. We examine the remuneration structure and its distributional features, the taxation structure and its progressivity, and its distributional implications within the context of civil service reform program. A quantitative analysis of changes in the salary scale, amendments of the income tax proclamation, and their interactions is conducted. To this effect, the rest of the paper is organized as follows. Section two addresses the main theoretical issues of income taxation and its progression, section three observes the Ethiopian civil service sector and the distribution of remunerations across professional categories, taxable income, and tax liabilities and how the ability to pay and equal sacrifice are addressed in the tax laws. Section four examines the recent income tax reforms in comparative perspective and section five derives relative progression indices of recent tax reforms and their distributional implications. The final section draws concluding remarks.

2. INCOME DISTRIBUTION AND PROGRESSIVE INCOME TAXATION

A fair and egalitarian distribution of income is an important social objective that facilitates the provision of opportunities to all economic agents and to sustain the growth dynamics of an economy. Whereas there is wide agreement on the target of egalitarian distribution of income, the means to achieve such an objective is often times not clear and attempts to impose them involves significant cost to an economy. When markets are fairly competitive and government interventions are kept to the minimum, the distribution of income generally tends to reflect contributions of factor inputs in the production process. The more market forces and competition operate to solve the problem of distribution, the better not only for the sustainability of economic opportunities but also for increasing the size of aggregate output from which individuals would have to share from. These dual processes interact in the economy

and policies that influence the distribution of income would have important implications for the size of aggregate output and its growth rate.

The ability of individual economic agents to improve their relative share of income in an economy involves a slow and gradual process. In a competitive system, the market allocates factors and income in a way that maximizes allocation efficiency. Differences in income hence basically reflect the underlying differences in the resource endowment, skill, experience, saving behavior of economic agents and perhaps luck. It is therefore difficult, at least in the short-term, to change the distribution of income significantly without distorting the size and growth of total production of goods and services. The implication of such factors in influencing the distribution of income hence is that public policies, including taxation and expenditure policies, should be targeted towards encouraging and creating the opportunities for economic agents acquire and equip themselves with these resources. The extent to which the distribution of income across economic agents reflects the respective contributions of factor inputs is an unsettled empirical issue. Factors markets are far from being perfect and returns to factor inputs are widely regulated in most economic systems. The extent and influence of government regulation on returns to factors varies significantly even if both market forces and regulations seem to play a role in the process. It is therefore an open issue as to what extent could tax policies be used to reshape the distribution of economic resources and income.

2.1 Distribution and Redistribution of Income

The issue of distribution of income is closely related to the question of what the total and average levels of income are and how much the individual level of income differs from the average. An economy maximizes its efficiency by rewarding economic resources in line to the contribution of each economic agent. A system achieves a short-to-medium term optimum pattern of income distribution when it is not possible to improve productivity through changes in the relative distribution of rewards for factor inputs. Income distribution is efficient when it rewards factor contributions according to their relative productivity. If economic agents were endowed with and contribute fairly equal economic resources and factor inputs, the system of distribution with reference to either factor inputs or economic agents yields similar outcomes. However, economic agents in reality have different attributes and capabilities. Their factor contributions also vary making their earning capacity differ from the average. Enabling and empowering those economic agents with lower capacity relative to the average improves not only the distribution but also the average income and its growth rate. This is a long-term and slow process that

requires addressing the underlying differences among economic agents through public policies and inclusive institutional arrangements.

However, most governments in practice attempt to redistribute economic outcome instead of addressing the core problems behind capability differences. Such policies were pursued both in the factors markets by administrative control of returns to factor contributions and through fiscal policies that influence the net returns. In both approaches, distortions emerge that influence not only the rate of growth of the national economy but also the sustainability of the redistribution policy. We approach this issue from distribution and taxation perspectives separately and we turn to examine the interaction of the two processes.

The size distribution of income, as a measure of dispersion of income relative to the overall average, could be summarized using the Gini-coefficient that measures the degree to which income distribution deviates from its perfectly equal distribution. For our purpose, we deal with discrete income, x_i, and its distribution across N income recipients. Consider that the income of N income-units is arranged in an ascending order from x_1 to x_N:

$$\mathbf{x_1 \leq x_2 \leq x_3 \leq \ldots \leq x_N} \qquad \textbf{[1]}$$

And the corresponding frequency of income units is denoted by $w_1, w_{2, \ldots,} w_N$ and the total of the income-units, W, is given by summing all income units.

If total income is given by X (where $X=\sum_{i=1}^{N} w_i x_i$) and the total size of income-units is defined by W (where $W=\sum_{i=1}^{N} w_i$), then the share of each income-units and their corresponding income share, both relative and cumulative, is computed to observe the distributional patterns. The cumulative share of income of the lowest p percent of income units and the corresponding cumulative share of income is used to generate the Lorenz Curve, L(p).

$$\mathbf{L(p) = \sum_{i=1}^{j}(x_i/X) \qquad where\ 1 \leq j \leq N} \qquad \textbf{[2]}$$

Note that L(0)=0 and L(1)=1. In the case of discrete income and with finite data points, the Lorenz curve is piece-wise linear and it broadly follows a convex curve (see figure 1). The Lorenz curve depicts how the distribution of income deviates from perfectly equal distribution as depicted by the diagonal 45^0 line. Moreover, whereas the 45^0-line has a constant slope of unity, the Lorenz curve has slopes, defined for each linear segment, that increase from almost zero at lower levels of p to unity that

corresponds to the average level of income and increases steadily afterwards. The Lorenz curve is parallel to and have the same slope with the 45^0-line at the point where the cumulative share of the population attains the overall average level of income.

This is also the point where the two curves exhibit the highest vertical difference, captured by the Sultz-coefficient, which measures what it takes to achieve perfect equality starting from a given pattern of income distribution. In other words, perfect equality could be achieved by transferring income from those above the average to those below the average so as to remove deviation of income from the average. This imposed equity objective, however, might influence what the average income will be in the future. We will discuss later on whether it is prudent public policy to impose perfectly equal distribution of income through tax policies without addressing the forces behind such distributional structures.

Gini Coefficient, G, summarizes in a single index number the characteristics of the Lorenz curve. It measures the degree by which the distribution of income deviates from perfectly egalitarian distribution. The coefficient is computed from the Lorenz curve.

$$G = 0.5 - \sum_{i=0}^{1} L(p_i) \qquad [3]$$

The area under the Lorenz curve for the case of discrete income data could be computed by separately calculating the marginal share of each income unit in terms of income share and population share.

2.2 Income Taxation and Redistribution

Taxation is a system of reallocating economic resources from the private sector to the government. It does not necessarily redistribute income from one economic agent to another. When governments levy taxation as a legalized form of siphoning of resources from the public, they determine what is available at the disposal of individual economic agents. What the taxation system does is legalize the claim of resources by the government from the economy through a piece of legislation. Taxation takes the income away from those who earned it, transfers the purchasing power to the government and in the process creates a powerful agent with concentrated revenue power, and influences the behavior of economic agents in factor accumulation, investment, production, and consumption.

In all fiscal systems, taxation is accompanied by public expenditure measures. However, it is important to note that independent processes and forces guide the taxation and the expenditure components of the fiscal system. Even if there is a tendency for public expenditure to redistribute the resources that were mobilized through taxation, there is little systematic relationship between revenue contribution and benefits. Unless the government is engaged in the public provision of private goods and services, public goods by their very nature do not discriminate across economic agents. Even in the extreme case of public provision of private goods, there is a problem of identifying the preferences and priorities of individuals. This generates inefficient use and allocation of economic resources.

The impact of taxation on the pattern of after-tax income distribution, however, depends on the nature and structure of the tax system. It is possible that the government might levy heavy or light tax burden on economic agents and yet maintain the distribution of income intact if it pursues a proportional tax schedule on all income groups. A proportional income tax is neutral in its effect on distribution and a government can generate its revenue without changing the pattern of income distribution. A tax structure can change the relative share of after-tax income of individuals only if it has progressive or regressive tax schedule. In most countries, governments at least nominally pursue tax policies to influence the pattern of income distribution besides mobilizing revenue. To this effect, the income tax schedules have progressive tax rate structure with an increasing marginal tax rate. This practice of income taxation has an equalizing effect by levying a larger share of tax liability to higher income units and hence reducing the after-tax income gap across income groups relative to its pre-tax distribution. In this sense, progressive taxation is a method of levying a relatively higher tax liability on high-income than low-income units and in the process reduces the gap in after-tax income distribution.

The distribution of after-tax income is influenced by a number of factors including the pattern of pre-tax income distribution, the level of income tax rate, the choice of tax units, the existence of tax allowances and deductions, the demographic and social consideration of the tax laws, the concept and scope of income for taxation purposes, and most importantly the degree of income tax progression. The degree of income tax progression can be measured in a number of alternative ways each varying in focus, scope and policy implication. The alternative approaches provide different information about the nature of income tax progression and how policies could be designed to shape their configurations.

Progressive income tax refers to a schedule where a higher proportion of income is taxed as the level of taxable income increases. There are two justifications behind the tendency of income tax regimes to pursue progressive income tax schedules, namely the principles of horizontal and vertical equity. Horizontal equity objectives require that income units with the same ability to pay should face the same tax obligation whereas the vertical equity principle upholds that income units with different income and capacity to pay should pay different levels of income taxes. This of course raises a number of relevant issues with respect to income tax policy and practice. The fact that the ability to pay is influenced by non-income attributes of income units, such as family size and wealth situations, suggests that the principles could be breached in practice. Moreover, the principle of vertical equity might be compromised if income units have ways to influence their reported taxable income. Even if these principles are upheld, practical challenges remain as to what degree of tax progression is justified on the horizontal and vertical equity considerations. This does not address the problem of what should be the degree of vertical and horizontal equity that fiscal policies should target.

The determination of income tax schedules involves both distributive and normative issues. It is essentially a process of determining who should get how much out of total income as net reward to factor contribution in the production of goods and services. A progressive marginal tax structure can help reduce the pre-tax income disparities and in the process leaves all economic agents, except the government, with diminished purchasing power at their disposal. Unless the government is involved in the provision of private goods and services and their distribution is systematically related to tax contribution, which is unlikely and practically impossible, then the problems of resource allocation and efficiency will remain. Even if one is to make such a strong assumption that benefits from public expenditure are closely related to tax contributions, the fact that individuals are deprived of using their resources for purposes that they value the most generates inefficiency of resource utilization.

Before we address the distributional effects of a progressive income tax schedule, it is instructive to examine its salient features. Progression could be either structural/local or effective/global in nature. The structural measure of progression focuses on the attributes of a tax schedule for changes in income across economic agents or over time for a given pattern of pre-tax income distribution. The effective or global measure of progression quantifies to what extent income taxation reshapes a given pattern of income distribution. These two aspects of income tax progression provide complementary perspectives that characterize an income tax schedule. To assess the nature and characteristics of income tax schedule with respect to the

distribution of tax liabilities and after-tax income, we need to examine the main structure of income tax liability determination.

The progression of a tax schedule is dependent on the proportion of income that is taxable, the provisions of lump sum allowances and income or expenditure related deductions, and the prevailing marginal tax rate and how it grows with respect to taxable income. The ability of the fiscal network to capture important components of the economic power of income units, such as non-cash compensations, fringe benefits, imputed income from owner occupied house and the like, is important from equity principles in the taxation system. Accurate measurement of such income flows is difficult and yet they are unevenly distributed with significant erosion on the tax base. If we consider gross income, Z, to measure cash and non-cash income, imputed income, and income derived from wealth endowments and the like, the equity principle is breached as far as taxation is not based on such a comprehensive concept of income. If the portion of gross income that is used for the purpose of income tax computation is denoted by y, then Z-y measures income and capacity to pay that escapes the taxation network altogether. Depending on the nature of the fiscal network, such erosion of the taxation base could be significant and plays an endogenous role in influencing tax policies and rates on reported income.

Moreover, tax regimes in practice provide lump sum allowances, *a*, and income related deductions, *d(y),* further reducing taxable income. Taxable income, x_i, is then determined by reducing income related deductions and allowances.

$$x_i = y_i - a - d(y_i) \qquad [4]$$

The lump sum allowance, a, is equal and applies commonly across all income units and the rationale for its provision is to exempt subsistence income from paying taxation. This argument, however, is not compelling since the tax system has not negative taxation or subsidies for income units whose income falls short of the subsistence threshold. Applications of income-related deductions are limited for specific cases such as pension and other social security contributions and deductions are allowed at the same rate, d. Even if income tax regimes in practice have provisions based on non-income attributes of income units, for reasons that will be clear later on, we assume that all income units with equal taxable income are treated the same irrespective of other attributes.

The fact that most income tax schedules are piece-wise linear in a given domain of taxable income bracket provides a way to summarize their features in tax equations.

This may provide a useful tool to computing the tax obligations as well as analyzing the salient features of the income tax schedules. Let the marginal tax rates for each class of taxable income brackets are denoted as follows:

$$0<\alpha_1<\alpha_2<\alpha_3<\ldots<\alpha_n$$

And the corresponding threshold of income in each tax bracket on which the marginal tax rates applies is denoted as:

$$\beta_1<\beta_2<\beta_3<\ldots<\beta_n$$

The income tax function, t(x), for a given amount of taxable income, could be summarized for each income tax brackets as follows:

$$t(x_j) = \begin{cases} 0 & \text{for } x_0 \in (0, \beta_0] \\ \alpha_1 x_1 + \theta_0 & x_1 \in (\beta_0, \beta_1] \\ \alpha_2 x_2 + \theta_1 & x_2 \in (\beta_1, \beta_2] \\ \ldots & \\ \ldots & \\ \alpha_n x_n + \theta_{n-1} & x_n \geq \beta_{n-1} \end{cases} \qquad [5]$$

Where $\alpha_1, \alpha_2, \ldots, \alpha_n$ denote the marginal tax rate for each tax bracket (with $\alpha_j \neq \alpha_{j+1}$); $0< \alpha_j < 1$; and $\theta j = t(\beta_j) - \alpha_{j+1}\beta_j$ for all j = 1,2, …, n-1.

When the tax function is partitioned linear, progressive tax could be defined from two perspectives. The tax structure would be progressive if $x \Rightarrow [t(x)/x]$ is a non-decreasing mapping on R_{++}. An alternative and stricter concept of progressive tax structure is marginal rate progression where marginal tax rate is non-decreasing everywhere suggesting convex tax function with $\alpha_1< \alpha_2 < \ldots < \alpha_n$.

Under such a setting, there are a number of fiscal provisions that are commonly practiced and might affect the effective progression of a tax schedule. As we mentioned above, the horizontal and vertical equity of a taxation system could be compromised and its effective progression altered whenever the concept of income for the purpose of taxation fails to measure income in a comprehensive manner. Income units with sources of income that escape the fiscal definition of income in effect evade part of their tax liability and hence breach the principle of horizontal equity. Moreover, the practice of providing allowance and income related deductions

introduce elements of progression in the taxation system. First, lump-sum allowance for all income units irrespective of their income level provides a decreasing share of income as allowance as the level of income increases. This implies that, ceteris paribus, as the level of income, y, increases so does the proportion of income that is categorized as taxable income, x. In other words, if an income unit A has a 10 percent higher income than unit B, and similar amount of allowance is provided for both, then unit A will have more than 10 percent higher taxable income than unit B. Second, some taxation regimes allow expenditure and income related deductions or similar provisions for income units, in our notation, d(y). These provisions reduce the taxable income proportionately and hence reduce the progression of the tax schedule. Taxable income declines proportionate to income and partially reverse the progressive elements introduced by allowances. The interaction of these two provisions of allowances and deductions would ultimately determine how the tax burden is distributed across income units and constitute the base effect in the progression of a tax schedule.

The other element in the tax function that influences the progression of the tax schedule is the marginal tax rate, α_j, and how it varies across tax brackets. The marginal tax rate is a critical factor that determines the tax liability within each respective tax brackets and its increasing structure ensures the overall progressivity of the tax schedule. In most income tax regimes, the marginal tax rates are largely determined in an arbitrary manner with little theoretical justification. And yet, changes in the marginal tax rate constitute a core policy variable and arguments about income tax reform are largely intended to change the marginal tax rate for its rate effect is the dominant factor that influences progression (Young, 1994).

Progressive income taxation also implies elastic revenue collection with respect to changes in the level of taxable income. This has important macroeconomic stability implications. Moreover, there is inflation tax that imposes implicit taxation on income units beyond the explicit cash based taxation. In most tax schedules, the determination of tax liability is based on nominal income of tax units. Even if the cross section observation of a taxation structure remains more or less intact, inflation introduces extra taxation on income units. When pre-tax income increases, in real or nominal terms, income tax revenue increases more than proportionately if the income tax structure is progressive. However, unless we assume indexation of income, changes in nominal and real incomes exhibit wide differences leading to extra taxation[1].

[1] Inflation also affects progression by altering the impact of and justification for allowances and deductions in the tax schedule on the overall progression. This concern poses the critical issue of what is the appropriate base of taxation and whether taxation should be based on nominal or real income.

We examine the properties of a progressive income tax schedule from its basic functional relation. Consider the following income tax function:

$$t_i = t(x_i) \qquad [6]$$

Where x_i refers to taxable income of an income unit and t(.) is the corresponding tax liability function. If we further denote the average tax rate by $ATR_i = t(x_i)/x_i$, and the marginal tax rate, MTR=d[t(x)]/dx, then we can express the different approaches to quantify the degree of progression in income taxation. The essential feature of a progressive income tax schedule is that the average tax rate increases steadily with the increase in taxable income. That is:

$$d(t(x)/x)/dx > 0 \text{ for all } x. \qquad [7]$$

This is equivalent to the condition that the marginal tax rate should be higher than the average tax rate[2].

Progression can be measured in terms of either structural or distributional contexts. The structural progression measures the extent to which an income tax schedule distributes tax liability and hence after-tax income across income units. It is a measure of how average and marginal tax rates increase as the level of taxable income increases. A related approach of measuring tax progression, effective tax progression, quantifies how the distribution of tax liability and after-tax income are influenced by the taxation regime relative to the distribution of pre-tax income.

Progressive income taxation implies deviation from proportional distribution of tax liability in a sense that average tax rate increases with the level of taxable income[3]. Progressive income tax implies tax burden is distributed in such a way that average tax liability increases with the level of taxable income so that after-tax income is distributed more equally than would have been the case in proportional tax regime. Departure from proportionality could emerge either because of the progression in tax liability, or looked from another perspective, regressive impacts on the residual or after-tax income distribution across income units. The tax liability progression, LP(x) which measures the elasticity of income tax with respect to a percentage change in

[2] Expanding the inequality, we have:
$d(t(x)/x)/dx > 0 \Rightarrow \{[MTRx-t(x)]/x^2\}>0 \Rightarrow \{(MTR-ATR)/x\}>0 \Rightarrow MTR>ATR$

[3] Average tax rate can increase even if the marginal tax rate is constant or declining. Strictly speaking, the principle of equal sacrifice and progressive taxation requires progressive marginal tax rate.

income, should be above unity to qualify for income tax progressivity. In other words, progressive income taxation implies that:

$$LP(x) = \varepsilon^{t(x),\,x} = [\Delta t(x)/t(x)]/[\Delta x/x] = [\Delta t(x)/\Delta x]/[\,t(x)\,/x] = MTR(x)/ATR(x) > 1 \qquad [8]$$

A closely related measurement of tax progression is residual progression, RP(x), that measures the responsiveness of after-tax income relative to a percentage change in income.

$$RP(x) = \varepsilon^{x-t(x),\,x} = [\Delta(x-t(x))/(x-t(x))]/[\Delta x/x] = [(1-MTR(x))/(1-ATR(x))] < 1 \qquad [9]$$

The implications of both measures of elasticity is that income tax liability is distributed in such a way that tax liability increases or after-tax income increases more (less) than respectively as the income of tax units increases by one percent.

Besides these measures, it is also possible to quantify the degree of progression of a tax schedule by the structure and growth of the average and marginal tax rate with respect to income. As we mentioned earlier, the average tax rate and its growth with respect to income levels is an important indicator of progression. Average rate progression hence measures how the average tax rate changes when the level of taxable income changes. This condition could be expressed to mean that marginal tax rate should be greater than the average tax rate for income levels. The average rate progression, however, is not a strict criterion. Progressive income taxation requires a stricter condition that the rate of growth of the marginal tax rate should be greater than zero.

The effective or global measure of income tax progression deals with how the distribution of pre-tax income has been reshaped by the adoption of a certain tax schedule. It compares the pre-tax Lorenz-curve with the concentration curves of after-tax income distribution and the concentration curve of tax liability distribution. These measurements of the structural and effective progression of a tax schedule relative to a given pattern of income distribution could also be complemented by measures of relative share adjustment that show how the income tax regime influences the relative share of income units in aggregate income and tax liability. The income tax schedule leads to relative share adjustments in the income and tax liability of income units and can be observed from two interrelated measurements, namely, the relative income share progressivity [RISP] and relative tax share progressivity[RTSP] (Baum, 1987; Agrawal, 1994).

The relative income share progressivity (RISP) measures the impact of income tax on the relative income share of a certain income group:

$$\mathbf{RISP}_j = \{[Y_j - T_j]/[Y-T]\} \div \{Y_j/Y\} \qquad [10]$$

Where Y_j measures pre-tax gross income of group j; T_j is the tax obligation of group j; and j refers to the jth group of income earners and taxpayers. Y and T denote the aggregate income and tax of the population under consideration. Rearranging the terms and expressing the average tax rate, t = T/Y, we can express RISP as[4] :

$$\mathbf{RISP}_j = [1-t_j]/[1-t] \qquad [11]$$

A value of $RISP_j<1(>1)$ indicates that the jth group of taxpayers pays a higher (lower) relative share of taxes than they would have paid under a proportional tax, making the tax burden relatively heavier (lighter) on the group under consideration.

The sequence $RISP_j$ (j =1,2, …, k) describes the overall progression of the income tax schedule. A decreasing RISP from low income to higher income groups of taxpayers indicates progressivity. Note that proportional income tax has $RISP_j$ = 1 for all j groups maintaining the pre-tax share of the respective groups.

A related concept of measuring tax progressivity, the relative tax share progressivity (RTSP), measures how average tax rates are configure along the income ladder. This measurement compares for each income units their average tax burden relative to the overall tax liability of the whole income units. Hence:

$$\mathbf{RTSP}_j = [T_j/T]/[Y_j/Y] = t_j/t \qquad [12]$$

The two approaches of measuring tax progressivity are related to each other since we can express one in terms of the other. In notations,

$$\mathbf{RISP}_j = [1- t\,(RTSP_j)] / [1-t] \qquad [13]$$

[4] RISP is related to the average rate progressivity (ARP) concept that measures the rate of change in average tax rate as income changes. That is:
$ARP_j = dt_j/dY_j = d\,(T/Y)_j/dY_j = -T_j / Y_j^2$
and the rate of change in RISP with respect to pre-tax income is:
$dRISP_j / dY_j = d\,(\{[Y_j - T_j]/[Y-T]\} \div \{Y_j/Y\})/dY_j = [-T_j/Y_j^2]/(Y-T)/Y = ARP_j/(1-t)$

The two concepts of income tax progressivity are systematically related since the average tax rate, ranging between zero and unity, could link them as a weighted average of the two measurements[5]. A change in average tax rate that alters all the after-tax income in the same proportion keeps the RISP unchanged. The RISP indicates the re-distributive impact of income taxes at disaggregated levels.

This section has focused on the examination of the issues of how, for a given pattern of income distribution, the income tax regime and its progression shape the pattern of after-tax income distribution. We argued tax policies alone could not address the problem of inequality of income that is a reflection of economic, political and social forces in a system. However, the tax policies could be refocused towards encouraging economic agents in the accumulation of capital, employment generation and technological progress. In the subsequent sections, we deal with the issues with particular emphasis on the Ethiopian civil service sector.

3. THE ETHIOPIAN CIVIL SERVICE SECTOR

The subsistence agriculture dominated economy of Ethiopia has left its imprints on the output, employment, export, and living standards in the country. The majority of the population earns its living from subsistence agriculture whose productivity can support only bare survival and leaves half of the population in chronic poverty. Income per capita and productivity is not only low but also has stagnated for a long period of time. Addressing the chronic poverty situation, creating the environment in which the pace of economic growth is fast and sustainable, and sharing economic opportunities to an increasing proportion of the population are fundamental policy challenges in the country.

The role of the government in economic affairs is a controversial issue the rationale of which changes over time and depends on the level of development of the country under consideration and the development of market forces. However, it is clear that in the context of developing countries, governments and their prudent intervention in the economy could increase their developmental role and enable the private sector to realize its potentials. The role of the government in Ethiopia and its intervention in the economy exhibited remarkable shifts with the political regimes in power. The stance

This is simply quotient of the ARP_j divided by the ratio of after-tax to before-tax income or one minus the overall average tax rate. Since (1-t) is a constant at a given point in time, the rate of change in RISP with respect to income of an income group is a constant proportion of the change in the average tax rate.

[5] The notation could be put as a weighted average of RISP and RTSP since;
$(1-t).\ RISP_j + t.\ RTSP_j = 1$

of government intervention was minimalist during the Imperial regime followed by rampant interventionist stance of the military regime. Since 1991, the country has been on the reverse and gradual course in terms of government policy stance. The civil service sector closely followed these patterns over its relatively short span of operation.

Ethiopia has undertaken a number of reform measures in recent years that attempt to redefine, reorient, introduce and liberalize various factors that had impact on the economic, political and social sectors of the country. Several developments occasioned the need for reform measures and fresh start: the change in government, the end of the long civil war, serious and unsustainable macroeconomic imbalances, excessive domestic and external debt situation, under-capacity operation of public enterprises, weak and corrupt bureaucratic and civil service system, weak and depressed private sector, chronic and generalized poverty situation, and pressure from the international financial institutions. These factors created the opportunity to open a new chapter and have influenced the policy stance of the government. The broad tenet of the reform measures has been allowing market forces and the private sector play active role in the economy, and in the process, redefine the role of the government in economic affairs.

Effective delivery of public services and implementation of economic policies are essential for the functioning of an economy and require the employment of skilled, motivated, honest, professional and responsible civil servants[6]. The civil sector of the country has been inefficient and its capacity to deliver public services has been weak and deteriorating over time. The accumulated problems and weaknesses of the civil service sector necessitated undertaking a comprehensive civil service reform measures. The main themes of the recent civil service reform measures consist of improving the efficiency and effectiveness of the civil service, improving the quality of public services and increasing the capacity of the sector to conduct core government functions. In most accounts, the size and quality of the civil service sector in Ethiopia indicate thinly distributed, centralized and urban concentrated patterns. The majority of the population has no access to basic public services. These problems necessitated ad hoc measures to address pressing issues in the civil service sector and yet addressing the problems of the sector on a sustainable manner required major reforms in civil service policies. The initial measures of redrawing the political

[6] The concepts of civil service sector and civil servants do not have unambiguous and universally applicable definitions. The different interpretations of the concepts generate important distinctions in practice. We define the civil service sector in which career professionals at the federal, regional and local government levels and branches of

map of the country, formation of states in a federal structure, and decentralization and devolution of decision making resulted in reallocation, retrenchment, and recruitment of civil servants. These initial measures, coupled with problems of transition and political interventions, stretched the already limited capacity of the civil service sector and threatened the capacity and willingness of civil servants to execute their professional responsibilities to administer and implement public policy decision at different hierarchy of government.

The civil service sector has expanded from its small size over the years. However, the rapid expansion during the 1970s was closely related with the policy of the former military regime of Ethiopia to pursue socialist political ideology and its policy of economic management by central planning. This was also helped by the overriding influence of the policy thinking of the time in which the role of the government in economic affairs was widely acknowledged and countries pursued interventionist policies. The share of the public sector in the national economy increased dramatically, partly through the massive program of nationalization of privately owned manufacturing industries, land, financial institutions, wholesale and retail businesses, hotels, extra urban houses, health and educational institutions. New ministries, agencies, corporations and departments were created in the government sector to control and guide the economy. The public sector expanded rapidly replacing and displacing the private sector and the nascent competitive market mechanism.

The process created large-scale demand for skilled labor force in these newly expanding sectors and the government became the dominant employer in the formal sector. Despite the fact that the formal sector provided employment to only about 5 percent of the labor force, the public sector maintained dominance with a share of more than 70 percent in the formal labor market. Moreover, trained manpower to execute the policies of the government was in high demand. The expansion was so rapid that there emerged apparent shortage of skilled manpower and lack of institutional capacity of the public sector to undertake its new responsibilities. The government attempted to address the problem by imposing restrictions on labor mobility, automatic employment and central allocation of graduates from higher education institutions for various public sector positions and allowing individuals to assume posts with lower qualification than technically required. These factors gave rise to inefficient civil service delivery and relatively high cost of public service provision. These approaches had their toll on the quality of services. It is also notable that the scope and quality of civil service has remained weaker than the average

government provide service to the public on permanent, contractual or temporary basis. The focus is on non-political

figure portrays because of its urban bias leaving the majority of the rural population without basic public services.

The rapid expansion of civil service employment had budgetary implications and the government made use of socialist "wage equalization" policies such as salary ceilings, delays in promotions and freezing remuneration rate, and conducting implicit taxation on earnings to cope with the problem. For instance, the minimum wage remained at Birr 50 per month since 1975 until the salary scale adjustment raised the level to Birr 105 effective in 1993/4[7]. These measures helped somewhat limit the expansion of payroll but created disincentive factors especially for highly skilled and experienced civil servants. And yet, in the context of high and rapidly increasing population, there is under provision of public services in Ethiopia. The country has a ratio of civil servants to population of about 5 per 1000 population, among the lowest ratios in Sub-Saharan Africa countries (Lienert and Modi, 1997). The civil service sector, however, should be observed in the context of the rest of the economy. In light of the agrarian dominated, low productive, and very low per capita income economy, the public sector in Ethiopia commands considerable premium in terms of income and employment opportunity to those who manage to secure employment in the sector (Taye, 1999). As an important component of the public sector, the civil service sector also commands wage premium especially for lower grade jobs. Even the minimum wages remained significantly higher than the average per capita income in the country. Moreover, civil servants enjoy higher wage premium than comparable positions in the infant private sector and this is especially true for the lower grade and less skilled workers.

These features, coupled with developments in the labor market, have given rise to polarizing tendencies in the labor market. Whereas highly skilled and experienced civil servants have increasingly attractive offers from the non-government sector to which most, if not all, take the opportunity at the expense of privileges in the public sector, those with lower grade civil servants have little opportunity to benefit from joining the private sector. This process might have resulted in the concentration of less educated, less trained and inexperienced, and less motivated civil servants to remain within the civil service whereas others search for better opportunities elsewhere. This contributed to deterioration in the quality of public services,

civil servants, also excluding the military and the workers in corporations and government parastatals.

[7] During the same period, the price level has increased by more than 330 percent that implies a real wage of only Birr 15.15 per month just before the salary adjustment. The salary adjustment effective in 1994 raised the minimum wage by 110 percent and yet could not even maintain the real wage of 1975. In other words, to just maintain the real wage of 1975, the minimum wage needed to increase to Birr 165 per month.

expansion of corrupt and rent seeking practices, as well as inefficient use of public resources.

Civil servants in the Ethiopian public sector[8] constitute about a third of government employees. This class of employees consisted of 241,316 workers by 1992/3 and has grown gradually even if the main expansion was in the unskilled and clerical categories especially in the regional states (IMF, 1999). Professional and science service workers constituted about 8.2 percent. The administration service workers had a share of about 3.1 percent of the total whereas sub-professional service workers were the majority comprising about 43.3 percent of the total work force in civil service.

The erosion of the real earning of civil servants has given rise to a number of consequences affecting the overall working environment and productivity in the provision of government services. Civil servants have lost their motivation, increasingly seeking moonlighting, rent-seeking, and corruptive activities. However, this window of opportunity was open only to those civil servants in key positions with some discretionary power of decision. The nature of official duties is such that different class of civil servants would have different access and success of averting the erosion in their real earnings. The moral ground and ethics of public duties and responsibilities have deteriorated to such an extent that the collective rule of the game tends to support abusive behavior than sense of public service in the face of wide spread poverty and destitution in the society. Professionals and scientists and to some extent other service workers benefit from some forms of fringe benefits making their remuneration higher than what it appears. The distribution of fringe benefits, however, is somewhat arbitrary and non-transparent that there is no clear account of how such benefits are used to compensate for the falling real wages of some of the civil servants.

3.1 The Distribution of Salary in the Civil Service Sector

The distribution of earnings in the civil service sector reflects broadly human capital attribute, performance of the national economy, government policies, and forces in the labor market. The design of remuneration scheme needs to take into account the skill and professional requirements of the different positions in the civil service, the labor market situation of the country, the cost of living and inflationary conditions in

[8] The civil service excludes the military, public parastatals, and Ethiopian delegations abroad in embassies and international organizations.

the economy, incentive preserving capacity of remuneration and the like. The differentiation of the remuneration according to skills, leadership qualities, competence and achievements of civil servants are important factors in attracting and maintaining efficient and motivated civil servants. The civil service sector in Ethiopia represents a small portion of the labor force and yet it enjoys remuneration package that is significantly above the average income in the country. Since most of the civil servants are skilled and experienced, the remuneration should reflect these attributes. The main issue of interest is what should be the principle that guides the design of remuneration package for civil servants.

Whereas it is important that income distribution should reflect differentiations that are inherent in the human capital attributes of the labor force, ad hoc measures to adopt salary adjustments that do not reflect overall performance of the economy would cause problems. Unlike the private sector where performance and pay are largely guided by the forces of the labor market and negotiations between employers and employees, the public sector usually administratively determines the remuneration scheme. In a setting where the salary scale has been administratively and centrally determined, as is the case in civil service sector in Ethiopia, establishing transparent and clear criteria with reference to the remuneration system is a process that needs to balance fiscal constraints, the need to improve the remuneration system, and maintain the overall wage bill within affordable range to poverty-ridden taxpayers. The problem of valuation of civil service output, and the practice of measuring output of public services by the cost of providing the services, makes designing efficient and cost effective remuneration scheme difficult. Moreover, it is important to take into account the remuneration in the non-government sector in comparison to civil service payments of comparable positions since it reflects the opportunity cost to civil servants and for the social value of income depends on relative as well as absolute remuneration of economic agents. The policy of socialist wage equalization and excessive compression of the salary scale created significant distortions and failed to differentiate among civil service positions with different skill and expertise requirements.

The current distribution of salary across civil servants in Ethiopia exhibits the remnants of wage equalization attempts and various constraints to address the problem in a comprehensive manner. As figure 1 portrays, the salary scale was highly compressed as reflected by the Gini-coefficient of about 0.276 for the salary scale regime during the early 1990s. The bottom 50 percent of the civil servants received about 30 percent of the total wages and salaries whereas the top 10 percent of civil servants had a share of about 20 percent of the total salary. This was the situation

even after the upward adjustment of the salary scale in 1994 by an average of about 21 percent and relaxation of the practice of salary ceilings and freeze in the remuneration system. This reflects the compromise between budget constraints and necessity to control the expansion of the wage bill in relation to the relatively fast expansion of public sector employment. At the same time, the apparent failure of the public sector to recruit and retain efficient manpower and provide adequate civil service necessitated civil service reforms, including salary adjustment, to improve the work environment and capacity building to deliver services at affordable cost to the economy.

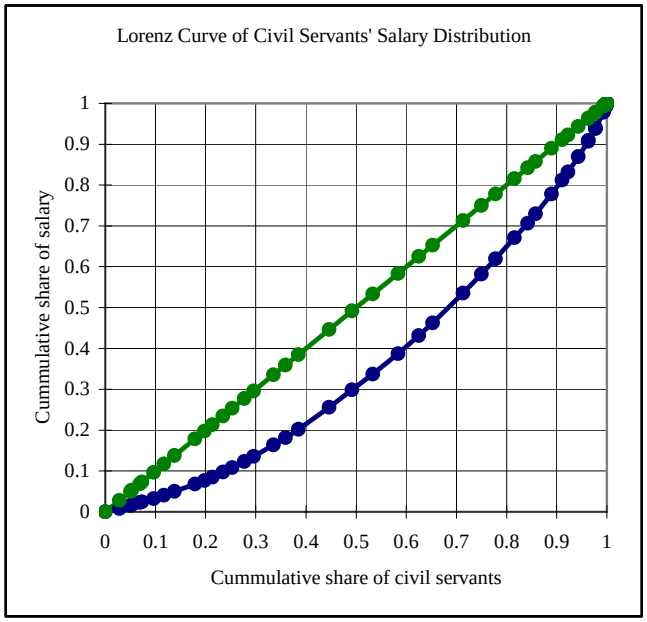

Figure 1: The Lorenz Curve of civil service salary distribution 1994. The distribution of basic salary was fairly compressed even after the upward adjustment of the salary scale in 1992/93 that became effective in 1994. The average basic salary was Birr 349 per month and Gini-Coefficient of this distribution was 0.27644.

The Schultz's coefficient for this distribution is about 19.64 percent that suggests perfect equalization of salary distribution could be attained by transfers from income units above the average to those below the average so that everybody receives the average income. This is a relatively small share of the total income and yet extremely

difficult to pursue as a public policy[9]. The attempt to bring everybody to the average in this manner without due consideration to the apparent and genuine differentiation of income units in terms of productivity and human capital attributes would not be prudent and is counterproductive. Instead of generating sustainable equity, it generates long lasting disincentive problems affecting the decision behavior of economic agents in terms of human capital accumulation and efforts towards higher productivity. All the same, the coefficient quantifies what it takes to bring about immediate equality across income units. In practice, there are differentiation of workers according to their skills and educational achievement and remunerations should at least partially reflect such attributes. There are political and economic factors, besides budget constraints, that hinder the adoption of transparent and efficient remuneration schemes.

The adjustment of the remuneration scheme, liked with overall indicators of performance, should take into account further variables in the labor market to maintain appropriate incentive scheme. First, adjustment of the salary scale must evaluate the current salary scale from a number of perspectives. Does the remuneration system property reflect the difference in human capital among the work force? Are positions in the civil service filled by competent workers with appropriate educational background and experience? Are there appropriate mechanisms to evaluate performance of civil servants and reward them accordingly? Is the remuneration system transparent and merit based enough to provide incentive for current and future public servants to join and develop their career? Second, on the basis of these evaluations, and subject to budgetary implications, the salary scale adjustment needs to take into consideration how the measures affect the relative income of civil service positions. Adjustments should realistically reflect skill differentiations and efficiency of civil servants and due consideration should be taken both comparative and absolute level of payments. Third, the adjustment process should take into account changes in the cost of living between salary adjustments. Inflationary pressure creates arbitrary redistribution of purchasing power and erosion of real earnings leading to problems that could not be solved by adjustment of remuneration scheme alone. This requires broader macroeconomic stabilization policies and commitment of price stability in the economy.

[9] Considering the fact that this implies only those earning above the average income, which consists about 41.9 percent of civil servants, should bear the cost of equalization, it indeed becomes a considerable burden. The cost involves progressive taxation (extortion) of earnings from those earning above the average ranging from 5.6 percent to 83.3 percent of basic salary or on average 32.05 percent of the basic salary of those above the average earnings.

Turning to the issue of salary adjustment in the civil service sector of Ethiopia, two important scale adjustments for civil servants were undertaken in 1994 and 2002. First, the adjustments as components of the first generation of civil service reform program focused on salary adjustment to remove the accumulated erosion in real earnings. They have not addressed the problems of matching remuneration with the human capital and experience requirements of the various positions in the civil service. Since the current remuneration scheme does not reflect such differentiations, it requires comprehensive revision of the scheme. The marginal adjustments seem to emphasize, more for political reasons, on increasing wages for lower grade positions by a significant percentage than higher level positions. This can further distort the relative reward system and incentive for professionals and administrators with possible implications on service delivery, public resource utilization, and behavior of employees towards their career in the public sector. Second, the salary adjustments so far were not sufficient enough to clear the accumulated erosion of real earnings over time. The fact that the salary adjustments made only marginal adjustment for higher grades, the erosion in the real wage was more pronounced in the higher professional grades. As Appendix table 1 summarizes, the salary adjustment in 1994 increased the wages for the first 10 grades by an average rate of about 80 percent whereas grades 51-56 got salary increment of about only 5.2 percent. The salary adjustment hence was far short of removing the disincentives that the remuneration scheme generated. The average salary increment in 2002 was significant compared to the previous ones and stability of prices in recent years suggests considerable rise in the real earnings of civil servants.

The administrative measures to adjust the salary scale at a lower rate for higher grade job positions, even if it was necessitated by financial constraints and political imperatives, exacerbates the disincentive factor. The low grades, such as high-school graduates and manual workers, the salary increment was significant making its wage premium even higher compared to comparable positions in the private sector. However, for the professional and scientific category, the salary increment in November 1994 was between 4.75 percent and 6.4 percent whereas the cost of living was increasing many folds. The measure has kept the expansion of the wages and salary bill in check. However, the determination of remuneration with limited consideration on merits and human capital attributes of civil servants is problematic and generates more serious problems. There were different reactions to such developments. Qualified and competent civil servants simply left for alternative and high salary paying jobs. Others responded by engaging in moon lighting activities that could provide additional resources to maintain their standard of living. And yet others learn the art of using their positions as a means of earning income even if that means

engaging in illegal and corrupt practices. And the rest, somewhat lost motivation of public service and translated their frustrations into refusal to provide timely and good quality service to the public. There is a real risk that the civil service sector might be left with demoralized, incompetent and corrupt workers unless the growing concern is addressed in time.

Third, the erosion in the real wages and salaries of civil servants has not been evenly distributed. Some of the civil servants receive in-kind payments and fringe benefits that are not captured in the monetary payment data that we have discussed earlier[10]. The allocation and entitlement criteria for such benefits are not transparent and yet the imputed value of some of the fringe benefits could be even more than the basic salary of these employees. Such benefits consist of housing, chauffer driven cars, board directorship in various public enterprises, subsidized services and the like. The monetary value of these benefits is not imputed and conceals the distribution of remunerations and the real cost of running the civil service. This practice also creates a behavior among civil servants to seek compensation in the form of non-taxable and non-monetized benefits which might contribute towards inefficient use of public resources. The recent amendment of the income tax code and the provision that the imputed monetary value of fringe benefits would be included in the computation of income for the purpose of income taxation, if appropriately implemented, would help depict a better and clearer picture of the distribution of earnings across civil servants[11].

The remuneration structure and the distribution of monetary income in the civil service sector has been compressed and lacks realistic depiction of the actual cost of running the government bureaucracy and related institutions. The recent adjustments in the salary scale and the amendments in the income tax laws have had a decompression effect both on the distribution of before and after-tax income across the civil service sector. Considering the federal civil service sector alone, the gini-coefficient has reached 0.3807 compared to the index level of 0.2764 during the

[10] Currently, there are an estimated 423,000 publicly owned houses in the country. Most of these houses were nationalized from private owners with the exception of a small number of houses built by the government over the years. Of the total occupants, 40 percent are civil servants. Around 15,000 of these houses are used rent free by politicians, civil servants, and other government officials. The remaining houses have rents far below the market rent indicating considerable subsidies and abuse of public property as well as a continuation of gross injustice with respect to the legitimate former owners of the houses.

[11] Income tax proclamation no. 286/2002 promulgated and yet the Council of Ministers regulation exempted income derived from board directorship in public enterprises from income taxation. Such a practice might encourage most high ranking civil servants and political appointees to seek for such nominal positions and generate extra sources of remuneration with income tax exemption privileges. However, it is important for the tax policy of the country to recognize and incorporate the imputed value of in-kind remuneration to public servants and other tax payers for the purpose of income taxation.

1990s. It is also important to note that while salary adjustment and pecuniary incentives are important factors in attracting and retaining skilled and efficient civil service sector, the work environment and the opportunities to develop career plans and freedom to exercise decision making on professional and ethical manner without excessive political intervention remain important elements of the overall remuneration and job satisfaction of career civil servants.

In a number of countries in sub-Saharan Africa, including Ethiopia, external donors recommend for aid recipient governments to adopt a rule of thumb that attempts to contain the wage bill around 6 percent of GDP (Lienert and Modi, 1997; FDRE, 2004). This quantitative guidance serves as a broad parameter to set the total wage bill in the public sector, which constitutes roughly a third to half of their recurrent expenditure. This figure does not take a comprehensive view of the cost of running a government and the economic cost involved in the process. This is particularly the case when there are widespread cases of inefficient use of public resources, unreported non cash and in-kind remunerations, and under provision of quality public services. In the context of poor countries, where chronic poverty and stagnation is common, the wage bill and related payments in the public sector become relatively expensive for the economy. Addressing the issues in the public sector payment scheme hence depends ultimately on the performance of the rest of the economy and it becomes important to relate remuneration in the public sector with the performance of the rest of the economy. What better criteria could there be more than the performance of the non-government sector for which public servants suppose to serve. It is not affordable for an economy that suffers from hostile policy environment and stagnates over an extended period of time and yet its policymaking and implementing agencies to deserve improved remuneration scheme. It is necessary for the public sector in developing countries to pursue proactive measures and initiatives that facilitates and actively promotes the performance of the rest of the economy. Establishing this critical linkage forms the basis for all public servants to have a vested interest in exerting their best effort towards promoting the growth of the economy.

4. INCOME TAXATION OF CIVIL SERVANTS

We have discussed in the last section the issue of the distribution of remuneration in the civil sector of Ethiopia. This section focuses on how taxation of income reshapes the pattern of distribution and other issues that arise in the process. The income tax regime of Ethiopia defines income from employment for the purpose of taxation as the basic salary of the individual and the taxation unit is the individual employee. Non

cash payments including fringe benefits largely escape the computation of taxable income. We examine the practice of income taxation in Ethiopia, and the various amendments to the tax laws, from the perspective of the definition of taxable income, allowances and deductions allowed for tax exemptions, the appropriate unit of taxation and as to whether income taxation should be based on nominal or real earnings of tax units. One of the weaknesses of the income tax regime is its failure to develop a comprehensive measurement of income for the purpose of taxation. This should in principle include resource inflows to the tax unit from various sources including employment income. Moreover, individual employees are considered as income units for taxation purpose. It is relevant to note, however, that in a country where family is an important unit of economic decision making and where family values are still strong, the practice of income taxation based on the income of the employed individual alone would breach important equity principles. The practice makes individuals with the same level of income, and yet with different family attributes and capacity to pay, liable for the same income tax obligation.

With respect to income taxation on civil servants, it is possible to identify the main factors that are considered in the computation of tax liability and its progression. First, the level of taxable income is determined by reducing lump sum allowance from the basic salary and reducing pension contributions from the basic salary. The recent amendments in the income tax code and schedule in 1994 increased the amount of allowance from Birr 105 per month to Birr 120 per month. Furthermore, income tax proclamation 286/ 2002 has increased the level of monthly allowance to Birr 150 per month. These increments have significant base effect on the taxable income. Second, all civil servants contribute 4 percent of their basic salary in the form of pension contribution. This contribution is exempted from income taxation and income tax proclamation 286/2002 provides a provision that allows employees to contribute up to 15 percent of their basic salary in the form of provident fund[12]. These provisions, when they are available for employees, would provide a significant shield from taxation and the potential impact on the tax base might be rather significant. However, the validity of the argument that allowances are intended to provide relief for all

[12] Such schemes were effectively used in some countries to encourage the public participate in planned pension scheme that also significantly increase the domestic saving rate of the economy. In such a setting, the provident fund is centrally administered by an independent body and every individual joining the national provident fund program has a defined account of contribution and withdrawal. If the scheme could be extended to all income units so that such contributions are exempted from income taxation, it could significantly improve the saving rate of the private sector from its recent distressingly low level. This effect could generate long lasting effects on the economy even more than the lost government revenue that such a scheme could result in. However, the practice of exempting provident fund contributions from income taxation without defined provident fund administration scheme would turn the provision into a taxation loophole without necessarily encouraging economic agents engage in saving and investment opportunities.

income groups for basic subsistence does remain weak and unconvincing. Even if it is true that a certain threshold of income should be exempted from income taxation from welfare considerations, it is not a prudent policy to target welfare objectives through tax policies alone. Such exemptions after all are significant in a country where per capita income hovers around only a third of such basic allowances. If there is a strong reason to reduce the taxation burden of individuals and families whose income falls short of providing basic necessities, which I believe is justifiable argument across low income families, then it is prudent to exempt these families from taxation or even introduce negative taxation schedule. However, the practice of exempting an increasing magnitude of threshold of income across the board from tax liability introduces distortion in the fiscal system.

To illustrate our case, we discuss the practice of exemption of a threshold income of Birr 120 per month from income taxation. In 1993/94, about 2.8 percent of the civil servants were exempted from income taxation because their wages were less than the minimum taxable income. Moreover, the income tax code allowed a zero marginal tax rate on the first slice of taxable income of Birr 120 per month for all income tax units whose income was beyond the threshold level. Of the total wage and salary bill, about 34.7 percent lies in this category of income slice that attracts a zero marginal income tax rate. Allowance to average salary ratio stood at 34.4 percent in 1994 indicating the relative significance of allowances in the setting of tax burdens in the fiscal system. This share is rather significant and is by no means a trivial magnitude to be ignored in light of the narrow income tax base of the Ethiopian fiscal system. The problem remains to be addressed. This built in feature of the schedule effectively erode the base of taxable income and tempts fiscal authorities to resort to all sorts of revenue generating schemes some of which have significant adverse effect on economic behavior and performance. This introduces a source of inefficiency in income tax mobilization which creates a strong leak to the taxation system. It is important to reconsider how to effectively use such allowance schemes towards promoting basic welfare and social objectives.

Income tax is calculated according to the tax schedule that classifies the taxable income categories with the corresponding marginal tax rate. It is progressive in that a higher proportion of income is taxed as income increases. The overall computation of the tax obligation depends on the level of gross earnings, provisions for tax exemptions in the form of exemptions and allowances, and the corresponding marginal tax rate in each taxable slice of income. We turn our discussion of the assessment of the income taxation to examine the schedules and tax rate structure.

4.1 Income Tax Schedules

The Ethiopian income tax code and schedule has recently been amended. A closer examination of the recent income tax schedules[13] will be used to develop our argument in the previous section in light of the repeated amendments of the schedules. The current income tax schedule (income tax proclamation no. 286/2002) is a further amendment of the 1992 (proclamation no. 30/1992) and 1994 income tax schedules (proclamation 107/1994). The amendments have had significant effects on the marginal tax rate, the structure of income taxes, and taxable income, and distributional issues[14]. The comparison of the recent three income tax schedules exhibits remarkable shifts in the structure of the income tax in which the tax brackets broadened considerably and the maximum marginal tax rate, adjusted for taxable income, reduced from 50 to 35 percent for twice taxable income of the appropriate category.

The current income tax schedule departs from its predecessors in a number of ways. First, each taxable income bracket is broader with a reduced number of income brackets. The wider the tax bracket relative to the overall range of the taxable income, the tax structure move more towards flat tax rate structure. The more the income of civil servants falls within one tax bracket, the more the tax schedule approaches flat rate or proportional tax schedule. Second, the marginal tax rates were reduced at each segment of the taxable income brackets. The maximum marginal tax rate now is 35 percent as compared to 40 percent according to proclamation no 107/1994 and 50 percent according to proclamation no 30/1992. Each income tax amendment, however, increased the taxable income threshold for exemption as a result of which allowances increased from Birr 120 to the current Birr 150 per month[15]. The practice of exempting the first slice of income from taxation for all tax-payers irrespective of their earnings poses some problems in the context of the Ethiopian fiscal system. What makes the case typical in Ethiopia is that the allowance is significant relative to the average payroll of civil servants and average per capita income in the economy.

[13] The income tax schedule of Ethiopia was amended in 1992(proclamation 30/1992) replacing a highly progressive income tax schedule (proclamation 155/1978) with the maximum marginal tax rate of 85 percent. Despite the staggering figures of the statutory schedule, however, the total number of civil servants whose salary exceeds the 20 percent marginal tax rate did not sum up to even one percent of the total. About 96.3 percent of the civil servants had income level less than or equal to the 15 percent marginal tax rate category.

[14] Appendix Table 4 summarizes the main features of the recent income tax schedules.

[15] The provision of proclamation no. 286/2002 to exempt from income taxation up to 15 percent of basic salary for provident fund contribution has even greater impact on the tax base.

The progression properties of the income tax schedule indicate that the marginal tax rate is in all instances higher than the average tax rate. Moreover, tax liability progression, which measures the responsiveness of income tax for a percentage change in income, for each taxable income groups is positive and greater than unity. The elasticity ranges from 65.3 when income reaches beyond the threshold level and the income unit starts to pay income tax down to 1.3617 at the highest income brackets. The range, however, is not monotonous since the step wise marginal tax rate structure makes those income levels at the break points exhibit higher elasticity. In the same token, the residual progression of the income tax schedule for civil servants indicates that the elasticity falls below unity for all income range while there are oscillations around the higher marginal tax rate levels. This provides further support to the elasticity of tax liability progression since both indicate how the income tax shapes tax and after-tax income of income tax units.

The comparison of relative earnings, their distribution and income taxation in the context of the Ethiopian civil service sector should take into consideration changes both in the salary scale and the income tax schedules. In this respect, we consider how the change in the income tax law affects tax liabilities and the distribution of income. As summarized in appendix table 4, there are important issues of interest that came into the fiscal network with the promulgation of the 2002 income tax proclamation: rise in the threshold level of allowance to Birr 150 per month from Birr 120, widening of the income tax brackets, effective reduction in marginal tax rates when adjustment is made for taxable income domain, the provision for a broader and comprehensive concept of income for the purpose of taxation, and provision for pension contribution in provident fund arrangements up to 15 percent of income. These important introductions to the income tax regime have effects both on the base, tax progression, and the after-tax distribution of income.

4. 2 Income Tax Equations

One common feature of the income taxation system in the developing countries is its complexity and this feature has its bearings on the effective implementation of tax codes. There are justifiable reasons to make tax liability computation both simple and transparent so that both taxpayers and tax administrators have a better understanding of tax liabilities and also better chances to identify reform areas. The fact that personal income tax schedules are segmental linear implies that tax liabilities could be summarized in simplified forms as elaborated in equations [4] and [5] above. Appendix table 5 reports the tax equations under the 1994 and 2002 tax schedules. The table indicates that the income tax schedules are progressive with respect to

reported cash payments to civil servants. It is also evident that both allowances and deductions have important role in the determination of tax liability. The allowances are significant not only relative to the per capita income of the country but also relative to the average earnings of civil servants. In terms of deductions, so far only pension contributions were allowed for exemption from income taxation. However, the recent tax code provision for provident fund contributions suggests and reflected on the tax equations important impacts on tax liability and on the overall distributional attributes of the tax code.

The discussion on the current income tax regime, and the reform measures that were incorporated in the amendments of the tax codes, reveals the weakness of the tax regime to play an important role in addressing core and long-term problems of the economy besides generating revenue to the government. First, the mechanism for provident fund contribution and administration requires establishing independent body that mobilizes and allocates resources from defined contributions for various development oriented and sustainable projects. Second, there is a strong reason to consider income tax exemption provisions to encourage saving and capital accumulation by allowing taxpayers to save aside a certain share, say 10 to 15 percent, of their basic salary in a defined saving program. This is particularly important in light of the very low and declining trend in private sector saving rate of the country. Third, there is unsettled issue with respect to the appropriate base of computing income taxation. Even if a comprehensive definition of income is used for the purpose of taxation, there is a need to determine tax liability based on real capacity to pay. This would not be an issue when indexation is practiced or inflation is literally zero. Even if inflation in Ethiopia has remained within manageable bounds, the computation of the tax liability on nominal earnings distorts important economic principles and exerts extra burdens and implicit taxation on taxpayers. To illustrate the point, we computed inflation rate adjusted income, allowances, and pension contributions and then recalculated income tax liability of average income of civil servants in Ethiopia from 1994 to 2002. We find that the tax liability on the average income was 8.4 percent higher than tax liability computed based on inflation adjusted figures. This indicates extra income tax burden due to implicit taxation and the rate is particularly high for higher income levels and some income groups that would be categorized into higher marginal tax rate due to the practice of using nominal income figures for the computation of income taxation. The income tax equations indicate how simplified tax computation can improve the administration of taxation as well as easily shed light on issues in the income tax system that require reform measures.

5. INCOME TAX PROGRESSION INDICES

In the previous sections, we discussed the distribution of remuneration in the civil service sector in Ethiopia and the practice of income taxation. The interactions of resource distribution and income taxation, coupled with reform measures, is used to analyze the extent to which such policy reforms impacted the capacity of the sector and by implication the economy to address its core challenges. This section addresses the progression properties and indices of the Ethiopian tax regime.

The Ethiopian income tax schedule is marginal tax progressive. The rate exhibits an increasing statutory marginal rate. Common in most income tax schedules with progressive income taxes is a zero tax rate for the first slice of taxable income. This applies for all income categories irrespective of the group of income earners. The recent personal income tax reforms in Ethiopia share common features with fiscal reform measures undertaken elsewhere. There is a general tendency to reorient fiscal policy towards encouraging private sector led growth and reduce disincentive effects of taxes. The income tax amendments have reduced the marginal and average tax rates, reduced the number of taxable income brackets, and broadened the taxable income base (OECD, 1986; Wart and Ruggeri, 1991). These reforms have changed the progressivity of income tax rates and hence the distributional impact of income taxes (Agrawal, 1990, Wart and Ruggeri, 1991). The recent reform measures in Ethiopia have increasingly relegated the objective of using income taxes to influence the pattern of income distribution through income taxation mechanisms. The recent focus on reducing the disincentive implications of highly progressive income tax structures, broadening the tax base and reducing the marginal tax rate have become policy priorities that appeal to donors.

The recent measures to amend the tax codes and also adjust the salary scale for civil servants provides important background to examine the impact of such measures on progression indices. The data is not comparable over time and its does not have panel attributes. And yet it indicates the structure and degree of progression across positions in the civil service sector and as a partial indicator of distributional changes across income groups and over time. To depict a broader picture, we constructed a consolidated income tax schedule from the recent three tax codes. We computed the relative income share progression (RISP) and relative tax share progression (RTSP) for groups reclassified according to the income tax schedules. The results are reported in appendix table 6. A number of interesting features emerge from the results. First, the average tax rate and the marginal tax rates declined for comparable income categories with each reform measures. Second, the salary adjustment in

2002 was significant making all civil servants, including the lowest grades, have income level higher than the allowance threshold for exemption making every civil servant liable for income taxation. Third, the relative income share progressivity, observed across income groups, indicates that under the three tax schedules progressive taxation shifted the relative income share of income groups. As income increases, so does the tax liability to such an extent that the relative income share declines whereas the relative tax share increases. Moreover, under all schedules, the relative tax share progression has been increasing with the level of income in a group. In the case of 1994 tax schedule, those who earned above Birr 4800 per year had RTSP more than unity indicating the increasing share of tax burden relative to the average. The provision under tax schedule 2002 moves the threshold to income above Birr 12,000 per annum beyond which the relative tax share progressivity increases. These features capture the essential and bottom-line impacts of the recent income tax reforms on the after-tax distribution of income.

The relative distribution of civil servants in Ethiopia, as indicated in appendix table 4, exhibits high concentration in income groups that attract 10 percent marginal income tax rate. The percentage share varies with the salary scale regime and with the income tax schedule, ranging from 62.5 percent under the 1992 tax schedule, to 87.2 percent under the 1994 schedule and then falling marginally 82.6 percent under the 2002 tax schedule. The income bracket in this group expanded significantly over the reform cycles. Whereas the 1994 income tax reform increased the relative tax share progressivity of this group, the 2002 reform reduced the relative tax share and increased the relative income share of this group. These features suggest that not only is the effective marginal tax rate approaching proportional tax regime, perhaps flat tax rate would have marginal impact on the structure of income taxation. It might also provide further simplification to the taxation system and potentially increasing the effectiveness of tax administration. As Table 6 describes, this group has benefited significantly from the income tax reforms and witnessed its relative income share progressivity increasing and tax share progressivity declining in response to the tax reform measures. The main benefit of the recent personal tax reform accrued to higher salary groups in the civil service. This is clearly depicted by our measures of relative tax progressivity.

The amendments in the income tax schedule feature a typical policy move from progressive tax structure to that of flattening the rate schedule. The measures have resulted in the reduction of both the marginal and average tax rates on taxable income. The policy stance unmistakably reflects the tendency among policymakers to discount the role of the tax system in reducing inequality in income distribution and

instead indicates moves towards a flat tax rate regime that is close to proportional tax rate schedule. There are justifiable economic reasons to avoid using the tax system alone to pursue redistribution objectives since it involves considerable cost to the economy and creates significant distortions in resource allocation. And yet, the taxation system needs to maintain its core principles of horizontal and vertical equity. These principles make the adoption of efficient tax policy to be guided by combinations of equity, distribution, and revenue objectives. As far as the factors market operates reasonably well, the distribution of income should reflect the relative contribution of factors in the production process. It is costly to attempt to rectify problems that emerge from the inequality of opportunities and income in the factors market through taxation policy. Taxation, as is commonly practiced, is effective in siphoning off resources from those who earn it which does not necessarily translate into redistribution in favor of those who find themselves below the average income or opportunities. A sustainable approach to the problem ultimately rests in creating institutional arrangements and policies that promote the realization of the potentials of economic agents to compete and benefit from equal opportunities.

The taxation system can address important public priority concerns especially when it is systematically combined with the public expenditure policies. There are serious limitations in the current taxation system that breaches the equity principles. The income tax regulations contain a number of loopholes that fail to assess comprehensively income and extra benefits that should have been included in the assessment of income for taxation. There are non-transparent and arbitrary distribution of fringe benefits, allowances, and subsidized services that never appear in the income tax returns. The underassessment of actual receipts and benefits would widen the inequality within the civil servants, and the rest of taxpayers, under a nominally highly progressive marginal tax rate. It is important to make the taxable income assessment comprehensive enough to reflect the capacity to pay and the tax liability should be determined accordingly.

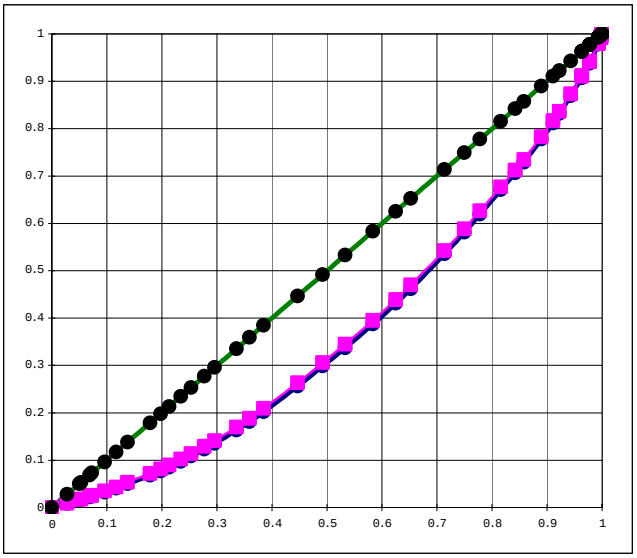

Figure 2: Lorenz-and Concentration Curves for Civil Service sector 1994.
Note: The Gini- coefficient of the blue curve is 0.27644 and the concentration index, the pink curve, measures 0.26535.

A relevant issue in this context perhaps is to what extent has income taxation helped reshape the distribution of income besides generating government revenue. The answer is not very much. The effective tax schedule that is applicable to the majority of income units under our consideration is quite similar to proportional tax schedule and has limited progressive structure. This could be observed by comparing the before and after tax salary distribution among the civil servants. We cannot infer about the implication at national level and that requires a comprehensive study of all taxpayers in the economy. However, our examination of the overall distribution of civil servants' salary exhibits little change before and after income taxation. Figure 2 depicts the Lorenz cure and the concentration cure. It depicts how much the pattern of income distribution has changed due to income taxation in the civil service sector. It is apparent from the graph that the change is rather marginal and the index of concentration stood at 0.26535 as compared to the Gini coefficient of 0.27644 which amounted to about 4 percent decline in the index. In effect, even at the nominal basis and without taking into account the difference between the reported and total benefits, the progressive income tax structure is not as progressive as its schedule seems to depict at face value. Most of the tax burden has mainly been absorbed by low and middle-income civil servants, and when provisions are made to unreported income, the overall structure tends in effect towards regressive tax structure.

The distribution of the before and after tax salary of civil servants, for both before and after the 1994 income tax amendment, is depicted to shed a broad picture of the situation and examine the distributional effects of the reform measure. Civil servants were categorized by the nearest deciles. As appendix table 3 summarizes, the bottom 10 percent of the civil servants, which used to get only about 3.25 percent of the total pre-tax earnings, had a marginally higher share of after-tax income of 3.4 percent. The bottom 50 percent of the civil servants received around 29.8 percent of the total earnings and the after-tax income share stood around 30.7 percent and exhibited hardly any change despite the nominally significant reforms in the tax schedules. Extending the observation to take into consideration the income tax reform measure and provisions of proclamation 286/2002, we computed the index of concentration using the 1994 salary scale. Since the provision for provident fund contribution is relatively new to the system and is not being practiced widely, we avoided including it in the computation of taxable income and instead retained the standard deductions and exemptions. The index of concentration curve turned out to be 0.26408 relative to a Gini-coefficient of 0.27644 and a corresponding concentration ratio of 0.26535 under the previous income tax schedule. This would inform us what would have been the change in the after-tax income distribution had the salary scale was not adjusted and hence provides a better footing for comparison. It also provides a clear indication as to the limitations and ineffectiveness of the current income tax schedule to address distributional issues and concerns.

The adoption of a revised salary scale and the income tax amendment of 2002 changed both the income and taxation sides of the equation. The scope of the data available for analysis became limited to civil servants in the federal government alone and hence it would not be comparable to the previous analysis. However, it provides some perspectives and general trends. As appendix figure 1 depicts, there is a decompression of the salary scale and changes in the pattern of income distribution is observable. The Gini-coefficient is 0.3807 and the corresponding concentration ratio is 0.36312 or about 4.6 percentage decline in the index. Note that the two indices are not directly comparable and yet it shows how limited effect the income tax reform alone has on the distribution of income.

It is therefore apparent that the seemingly progressive tax structure did not change the distribution of salary in the Ethiopian civil service significantly. Moreover, the recent reform measures tend to deviate more from the equal sacrifice principle of income taxation and attempt to emphasize on reducing the disincentive effects of taxation without due emphasis on the overall distributional and equity considerations. This tendency of the income tax schedule to move effectively towards distribution neutrality and breaching the equity principles, coupled with the probable tendency of under reporting of taxable income

by higher income groups, suggests that the overall income tax system might share important attributes of regressive tax regime.

6. CONCLUDING REMARKS

The design and appropriateness of income tax policy reforms depends on the extent to which it could be used to address priority problems in a national economy. Tax policies, in combination with public spending and other public policies, should encourage the accumulation of capital, promotion of sustainable growth, macroeconomic stability, reduction of poverty, and the realization of economic potentials of the country besides the objectives of revenue mobilization. This paper addresses the issues of income taxation and its distributional attributes based on data in civil service sector. The income tax regime of Ethiopia has progressive statutory tax schedule with nominally high and yet incentive preserving average and marginal income tax rates. However, income taxation was burdensome relative to the declining real income of the civil servants encouraging workers to seek alternative sources of compensation schemes that could easily evade the taxation network. And yet, the effective rate of marginal income tax rate was fairly low since most of the civil servants have wages and salaries that are concentrated within 15 percent or lower marginal tax rate categories. The recent income tax reform measures further reduced the marginal and average tax rates.

Income taxation is an important policy instrument in a market oriented economic system. Its design and implementation should be such that it minimizes disincentives on the decision behavior of economic agents and should proactively encourage economic agents improve and realize their potentials. In such a setting, tax policy reforms need to reorient their priorities and change the practice of using income taxation to reshape the distribution of income. The practice of using income taxation as an instrument for redistribution, irrespective of genuine differences among tax units, has limited efficacy and involves considerable cost that hampers the growth of the average income. Tax policies should strengthen the principles of equity and reduce the disincentive effects of taxation. This could improve the capacity of tax policies to address core priorities of the economic system, such as poverty reduction, encourage capital accumulation and saving, and employment promotion. We identified that the taxation regime needs to adopt a comprehensive definition of income for the purpose taxation that reflects the actual capacity to pay, the need for changes in the appropriate unit of taxation, and the weakness of the tax code to provide incentives to economic agents engage in saving and capital accumulation efforts. These reforms can improve the equity attributes of the income tax regime and in the process improve the capacity of the economy to generate sustainable and shared economic growth and opportunities.

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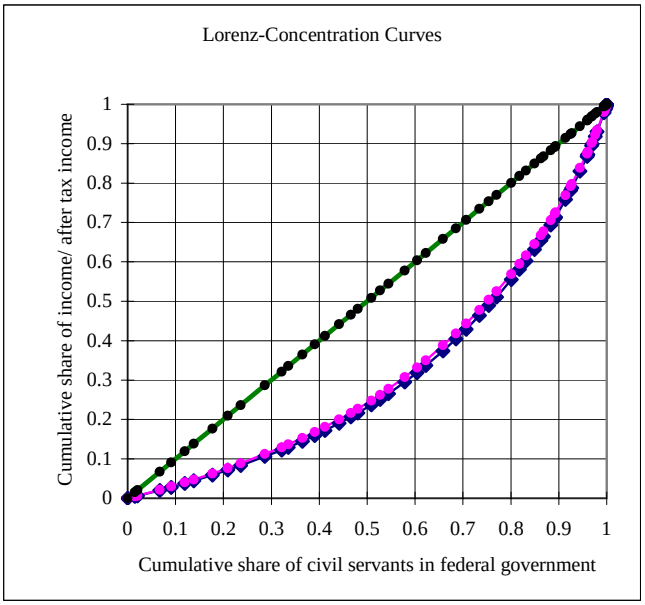

Appendix Figure 1: Lorenz – Concentration Curves of the Federal Civil Service Sector of Ethiopia, 2002.
Note: The Gini-Coefficient for the federal civil service sector is about 0.380703 and the average tax rate was 9.38 percent. The corresponding concentration ratio is 0.36312.

Appendix Tables

Appendix Table 1: Civil Service Salary Distribution and Increments

Grades	Before Nov. 1994	After Nov. 1994	Weighted percentage increment in 1994	After 2002 salary adjustment	Weighted percentage increment (%)
1-10	50-105	105-167	79.56	200-325	97.54
11-20	115-247	182-326	36.65	342-560	66.12
21-30	265-472	326-500	17.77	595-990	88.75
31-40	500-835	532-880	5.93	1040-1565	93.66
41-50	880-1440	930-1520	5.71	1635-2325	73.58
51-56	1530-2000	1620-2095	5.22	-	-
51-60				2425-3575	32.57
Total range	50-2000	105-2095		200-3575	
Average income	288.51	349.13	21.01	724.94	107.64

Note: The data for the 2002 was for the federal civil service sector only and we have no accurate data on the regional civil service sector and the percentage increments in the average salary of civil servants by grade categories is not strictly comparable.
Sources: The Wage Board and the Federal Civil Service Commission

Appendix Table 2: Cumulative percentage distribution of civil servants and their salary in Ethiopia in 1992/3 and 1994

Cumulative percentage of civil servants	Cumulative percentage of wages and salaries 1992	Cumulative percentage of wages and salaries 1994
2.79	0.48	0.84
5.04	0.91	1.58
9.63	1.97	3.25
17.87	4.49	6.78
19.79	5.19	7.70
25.34	7.66	10.85
29.58	10.0	13.53
38.49	16.01	20.23
44.65	20.92	25.62
49.2	24.82	29.87
58.36	33.58	38.72
65.25	41.06	46.21
71.35	48.4	53.55
74.97	53.04	58.17
81.56	62.40	67.09
85.78	69.05	72.91
91.08	78.47	81.19
96.27	89.37	90.73
97.78	93.07	93.96
99.30	97.49	97.81
100.0	100.0	100.0

Source: Wage Board of Ethiopia

Appendix Table 3: Cumulative Percentage Distribution of Pre-tax and After-Tax salary in Civil Service of Ethiopia 1994

Cumulative percentage distribution of civil servants 1994	Cumulative before tax distribution of civil servants' salary 1994	Cumulative after-tax distribution of income in 1992 tax schedule	Cumulative distribution of after tax income under 1994 tax schedule	Cumulative distribution of after tax income under 2002 tax schedule
2.791	0.839	0.910	0.900	0.891
5.037	1.579	1.706	1.694	1.676
9.628	3.249	3.486	3.475	3.448
21.335	8.508	8.999	8.982	9.008
29.584	13.533	14.174	14.136	14.198
38.488	20.232	21.003	20.930	21.018
49.204	29.868	30.758	30.626	30.728
62.504	43.112	44.119	43.899	44.006
71.348	53.554	54.581	54.304	54.397
81.563	67.085	68.022	67.741	67.802
91.081	81.188	81.924	81.704	81.720

96.274	90.732	91.214	91.073	91.081
99.304	97.811	97.972	97.917	97.921
100	100.0	100.0	100.0	100.0

Note: The last column is computed with the assumption that the salary for civil servants remained unchanged. It provides a perspective as to how the change in the income tax schedule affected the after-tax income, ceteris paribus, for tax payers whose income did not increase over the period under consideration. Moreover it is apparent that because of the salary scale there is little noticeable change in after-tax income share despite nominally significant changes in the tax schedule.

Source: Author's calculation based on data from Wage Board of Ethiopia.

Appendix Table 4: Profile of Recent Personal Income Tax Schedules of Ethiopia

1992 tax schedule			1994 tax schedule			2002 tax schedule		
Annual Income Brackets (In Birr)	Marginal tax rate (%)	Civil servants by income bracket (%)	Annual Income Brackets 1994 (In Birr)	Marginal tax rate (%)	Civil servants by income bracket (%)	Annual Income Brackets (in Birr)	Marginal Tax rate (%)	Civil Servants by Income Bracket (%)**
< 1260	0	2.8	< 1440	0	5.04	< 1,800	0	11.71
1261 - 4800	10	62.5	1400 – 7200	10	87.21	1801-7800	10	82.60
4801 - 8400	15	31.0	7201 - 14400	15	7.56	7801-16800	15	5.67
8401 - 12000	20	3.1	14401 - 24000	20	0.191	16801-28200	20	0.03
12001 - 15600	25	0.6	24001 - 36000	30	0.003	28201-42600	25	n.a.
15601 - 19200	30	0.02	> 36,000	40	na*	42601-60000	30	n.a.
19201 - 22800	35	0.0034				>60000	35	n.a.
22801 - 26400	40	0.0016						
26401 - 30000	45	0.0025						
> 30000	50	na*						

Note: * na refers to not applicable since the maximum salary of civil servants did not fall in that income bracket. ** refers to the share only to civil servants in the federal government. The data on civil servants in the regional states is not comprehensive enough and yet it does not seem to change the picture as such since most of the civil servants in the regions fall in the lower grades of professional hierarchy.
Sources: Ministry of Finance of Ethiopia and Ministry of Inland Revenue (Income Tax Proclamation 30/92; Income Tax Proclamation 107 /1994; Income Tax Proclamation 286/2002.

Appendix Table 5: Linear Equation of Personal Income Tax from employment

Cash Income (y) Brackets (Birr per annum)	Income tax equation with respect to basic salary 1994	Income (cash + non-cash?) Brackets (Birr per annum)	Income tax equation with respect to basic salary 2002b	Income tax equation with respect to basic salary and deductions for provident fund contributions
Below 1440	0	Below 1,800	0	0
1,441- 7,200	$0.096y_1 - 288$	1,801-7,800	0.096y1 – 360	0.085y1 – 360
7,201 - 14,400	$0.144y_2 - 720$	7,801-16,800	0.144y2 – 840	0.1275y2 – 840
14,400 - 24,000	$0.192y_3 - 1512$	16,801-28,200	0.192y3 - 1,770	0.17y3 – 1,770
24,000 - 36,000	$0.288y_4 - 4056$	28,201-42,600	0.24y4 – 3,270	0.2125y4 – 3,270
More than 36000	$0.384y_5 -7800$	42,601-60,000	0.288y5 – 5,490	0.255y5 – 5,490
		More than 60,000	0.336y6 – 8,580	0.2975y6 – 8,580

Source: Author's computation. Note: Where taxable income $x_i = y_i - 1440 - 0.04y_i$, Birr 1,440 is annual allowance for each income unit and a 4 percent pension contribution under income tax proclamation 107/1994. Under proclamation 286/2002, there are two scenarios one with 4% pension contribution, the other 15%(the maximum) contribution in the form of provident fund.

Appendix Table 6: A Consolidated Income Tax Schedule for Civil Servants and Measures of Income tax progression

Income Group	36/1992				107/1994				286/2002*			
Birr Per Year	MTR	ATR	RISP	RTSP	MTR	ATR	RISP	RTSP	MTR	ATR	RISP	RTSP
up to 1260	0	0	0	0	0	0.000	1.067	0.000	0	-	-	-
1261 – 1440	10	0.87	1.158	0.060	0	0.000	1.067	0.000	0	-	-	-
1441 – 1800	10	5.4	1.105	0.375	10	0.443	1.062	0.071	0	-	-	-
1801 – 4800	15	8.87	1.065	0.616	10	5.232	1.011	0.832	10	4.391	1.055	0.468
4801 – 7200	15	10.3	1.047	0.718	10	7.090	0.991	1.128	10	6.512	1.032	0.694
7201 – 7800	20	12.2	1.026	0.847	15	7.713	0.985	1.227	10	7.219	1.024	0.770
7801 – 8400	25	14.4	1.000	1.000	15	7.814	0.984	1.243	15	7.332	1.023	0.782
8400 – 12000	25	15.8	0.984	1.097	15	8.937	0.972	1.422	15	8.748	1.007	0.933
12001 – 14400	30	17.5	0.964	1.215	15	10.373	0.956	1.650	15	10.101	0.992	1.077
14401 – 15600	35	19.8	0.937	1.375	20	10.984	0.950	1.747	15	10.615	0.986	1.132
15601 – 16800	40	21.8	0.914	1.514	20	11.323	0.946	1.801	15	10.891	0.983	1.161
16801 – 19200	40	23.0	0.899	1.597	20	12.237	0.937	1.947	20	11.498	0.977	1.226
19201 – 22800					20	13.334	0.925	2.121	20	12.548	0.965	1.338
22801 – 24000					20	13.976	0.918	2.223	20	13.146	0.958	1.401
24001 – 26400					30	14.331	0.914	2.280	20	13.562	0.954	1.446
26401 – 28200					30				20	14.009	0.949	1.494
28201 – 30000					30				25	14.309	0.946	1.526
30001 – 36000					30				25	15.171	0.936	1.617
36001 – 42600					40				25	16.540	0.921	1.763
42601 – 60000					40				30	17.262	0.913	1.840
>60000					40				35	-	-	-

Note: * the data for the 286/2002 refers to federal civil servants only. MTR, ATR, RISP and RTSP refer, respectively, to marginal tax rate, average tax rate, relative income share progressivity, and relative tax share progressivity. Since the practice of contribution to provident fund is not widely used currently, the computation of tax liability is based on the former procedure. The table consolidates the provisions in the three income tax schedules for income from employment that is applicable to the civil service sector.

Source: Computed on the basis of income tax proclamations no 36/1992, 107/1994, and 286/2002 and data from the wage board as well as the Federal Civil Service Commission.

HAS PRIVATIZATION PROMOTED EFFICIENCY IN ETHIOPIA? A COMPARATIVE ANALYSIS OF PRIVATIZED INDUSTRIES VIS-À-VIS STATE OWNED AND OTHER PRIVATE ESTABLISHMENTS

Worku Gebeyehu*

Abstract

There has been still a debate about the efficacy of privatization for economic transformation of countries. Nonetheless, many developing countries including Ethiopia have privatized public owned enterprises as a manifestation of their commitment to implement the reform packages induced by multilateral institutions through the Structural Adjustment Program. The proponents for pro-privatization strongly argue that private enterprises operate more efficiently than those that are owned by the state. The main objective of this paper is, therefore, to assess the extent to which privatized industries operate more efficiently as compared to those that remain under the public domain and other private industries. A Cobb-Douglass stochastic frontier production function is estimated for the group and separately for privatized industries. The econometric result revealed that the average technical efficiency for the whole sample was about 73.4% during the period 1998/99-2001/02. Privatized industries were found relatively inefficient with a score of 69%, while public and other private industries reported 75% and 71%, respectively. It was also found that efficiency of privatized enterprises continuously declined during the same period. It is an indication, at least in the Ethiopian context, that privatization may not necessarily ensure efficiency gain. Thus, government should revitalize its hasty move towards transferring public enterprises to private hands.

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I. INTRODUCTION

Privatization has been practiced in several countries for many years. It later emerged as an economic order induced by multilateral financial institutions as part of the over all reform package of the Structural Adjustment Program. In the same manner privatization was introduced in Ethiopia in 1994 as one component of the overall reform program, which substituted central planning with market-driven economic system. Government found it necessary to revitalize the crucial role of the private sector in general and getting rid of loss making and overstaffed state owned enterprises (SOEs) in particular to curtail unproductive resource drain and promote economic development. This is based on a widely held view among proponents of the market economy that effects of property right and public-agent problems are non-existent or marginal in the private sector as against the case in the public sector. This makes it possible for the private sector to make an effective management for efficient operation of business enterprises.

However, some might argue otherwise. If adequate measures are taken to create a level ground for fair and free competition between public and private firms, and the later acquire autonomy with a challenge to determine their existence through market forces, privatization may not be necessary. The relocation might even deteriorate the conditions of privatized industries if the new owners or their managers do not have a priori experience and adequate information on how to effectively manage privatized enterprises by taking into account their peculiar conditions. Profit maximization being their prime motive, private entrepreneurs may lay off workers, whose social cost may not be bearable in countries such as Ethiopia.

Since the Ethiopian private sector is weak and fragile, there would be many gaps if government withdraws from and leaves the economy to individual entrepreneurs. Thus, the role of the state should not be limited to the provision of certain economic and social infrastructures, but go as far as investing in areas where the private sector is unable to involve due to fear of long gestation periods, huge capital requirements and less profitable in pure financial terms. It should also maintain large ventures under its disposal, the privatization of which might cause social shocks in the process of restructuring. This could create additional production capacity and employment opportunities in the economy.

Given the controversies on the need for privatization, the issue of whether it has achieved the intended result or accentuated inefficient operation of firms and causing

unintended social costs are the focuses of discussions in countries which underwent this process. The objective of this paper is also to assess, among other things, the extent to which privatized firms operate more efficiently as compared to state owned enterprises and how much are they comparable in efficiency terms to other private sector firms in the Ethiopian context.

Due to data limitations, the analysis on efficiency entirely focuses on the manufacturing sector and the main data source for this purpose is the Central Statistical Authority. One hundred twenty eight industrial establishments, which have a four year (1998/99-2001/02) uninterrupted data on key variables, have been selected for the discussion. Industries are drawn from nine industrial groups and consisted of ten privatized, seventy nine privately owned (not transferred from the public sector) and 31 public owned firms. All the industrial groups have at least one establishment from the three types of mode of ownership. The source of information for other discussions is primarily the Ethiopian Privatization Agency.

II. LITERATURE REVIEW

Scholars define privatization in different ways. Young (1991) in Kumssa (1996) defined privatization as follows.

….. Privatization can be defined both in its narrow and broad meaning. In its narrow meaning, it simply entails a shift of production activities or services being undertaken by the public sector to private ownership or control. In its broader meaning, it refers to a process by which the state's role within the economy is circumscribed while at the same time the scope for the operation of private capital is deliberately extended (1991:50).

In other words, privatization, in its broader context, is the process of lessening regulations and facilitating a shift of ownership and economic management from public domain to the private sector. The second one, which is the focus of this paper, entails physical transaction of industries and there by transferring property rights from public to private.

The theoretical foundation for pro-privatization process bases on the different strands of the literature on government failure to efficiently guide the functioning of economic agents. As pointed out in Cook (1997), public-owned agencies poorly perform due to differences in the interests of bureaucrats and politicians. The principal agent theory

also explains that due to divergence of the goals of the agent (employees) and the principal (government as an owner); there may not be an agreement between the two on the mode of operation of enterprises. It also becomes difficult for the government to make an effective monitoring due to information asymmetry. Lack of clearly defined property rights has also been considered as a major reason for weak organizational structure and managerial activities, which led most SOEs to inefficiency.

According to Porta and Silanes (1999), the critical agency conflict could emanate either of the two: managers or politicians. Managers may lack either the incentive or proper monitoring to handle SOEs. The other equally possible cause could be high political interference in the firm, which results in excessive employment, poor choice of product and location, and lack of investments. According to these theories, government should make a rational choice between those types of activities that have serious agency and property right problems, hence, that have to be transferred to the private sector, and those which should remain under the public domain such that economic efficiency would be ensured at a national level.

Naya (1990) attributed the following reasons for the privatization drive.

(i) There is a host of empirical evidence supporting that market-based economies have done significantly better than countries with unrestrained government interventions.
(ii) Developing countries face fluctuating export earnings, balance-of-payment problems, fiscal imbalances, diminishing inflow of external capital and protectionist policies of developed countries. They now recognized the potential contribution of the private sector in harnessing their economies and in coping up with the changes in the international economic environment.
(iii) Public owned enterprises largely suffer from budget deficits and public debts, which have become too much of a financial burden on the state. Many countries, thus decided that the state should withdraw from economic activities that can be possibly handled by the private sector.

Gulilat (1994) indicated also the need for reducing budget deficits created by subsidizing loss making SOEs, raising additional revenue through non-tax system to finance the growing investment need of the public sector; reducing the size and improving the performance of the public sector, and facilitating the expansion of the private sector are common rationales behind privatization. The state should withdraw itself from business ventures and focus on the provision of public and merit goods

(education, health, defense, public order, etc.,) the development of social overhead (transportation, communications, power system, etc.) and on the institution of a transparent legal and regulatory framework. The will facilitate the dissemination of information, stifle discretionary practice of bureaucracy, induce efficient allocation of resources, promote scientific and technological R&D activities, and consequently bring speedy development of the economy.

Despite the attempt to give theoretical rationale and empirical backing, international financial institutions are behind the move for privatization in most developing countries. According to Kumssa (1996), World Bank and IMF imposed a condition on Sub Saharan African countries to privatize their public enterprises, if they are to qualify for stabilization and structural adjustment funds. This position of the World Bank was explicitly discussed in its report entitled Bureaucrats in Business: The Economics and Politics of Government Ownership (1996). According this report, only a handful of SOEs perform well but wealth anecdotal evidences suggesting that many of them do not. Private enterprises are generally more efficient. SOEs contribute to fiscal deficit, inflation and ultimately lower economic growth. The larger SOEs, the lower would be its growth. Thus, countries should consider privatization as a strategy to boost their economy.

Shapiro and Willing (1990) do not accept this gross generalization and policy implication of the World Bank. They argue that higher profitability of privatized firms has come at the expense of the rest of the society through the exploitation of market power. State-owned enterprises help to curb market failures by implementing pricing policies that take account of social marginal costs. While privatizing enterprises, the apparent positive outcome might appear to be financial profitability but workers bear the burden of restructuring through layoffs and wage cuts.

Cook (1997) argues that the propositions of property right and principal-agent theories are based on unrealistic assumptions which include the existence of efficient capital market and perfect flow of information for private shareholders, which could make effective monitoring and ensure managerial efficiency. Sub-optimal monitoring of agents by principals could occur even in countries with reasonably well functioning markets in industrialized countries. In the developing world, markets are fragmented and underdeveloped. Neither is the private sector strong. The pursuit of short-term benefit by enterprise managers, lack of viable takeover threats and lopsided shareholder distribution make performance monitoring difficult and widen the scope for free ridden opportunities.

As Chang and Singh (1997) claim public sector to be the backbone of an economy. They argue that large private sector firms, which are found in financial trouble also, get rescued or even nationalized by the government in many countries, when political costs of their redundancies and bankruptcies are expected to be large. Enterprises, which are currently making losses, may be generating foreign exchange. They may be subsidizing private sector enterprises by supplying intermediate products at a very low price. According to them, the position of the World Bank (1995) fails to take account of these attributes of SOEs.

Bayliss and Fine (1998) also reflect a similar view that the pressure to privatize comes from an unfounded belief in the superiority of the private sector, a neglect of the pre-conditions required for privatization to be successfully managed and a neglect of the broader social, political and economic environment in which privatization is located. Public enterprises are established not only to make profits but also to achieve some social objectives such as creating employment, providing low-priced goods to benefit the poor, improving the economic conditions of particular regions and the like. SOEs may deviate from profit maximization or societal objectives because of political grounds. In many developing countries, managers are often appointed to their posts based on their ethnic background, political orientation or party loyalty than their qualification or merit. Incompetent managers deter proper functioning of SOEs [Kumssa, 1996]. While market forces did not bring about the intended changes in many Sub Saharan African countries, South Korea, Japan and the East Asian tigers became successful through government intervention including subsidy to their exporting firms. The World Bank (1994) itself revealed that out of 29 Sub-Saharan countries which had adopted the structural adjustment program including privatization, the economic conditions of 11 had deteriorated and 9 others showed only a little improvement.

A pioneer study was conducted by Rebeka (2001) in the Ethiopian context aiming at comparing the technical efficiency of 25 privatized industries before and after privatization. She found a mixed result. While privatization had a positive effect of improving technical efficiency in the food processing industries, it had a negative effect the beverage, textile and leather sectors. For non-metal, wood, printing and chemical industries, privatization had neither a positive nor a negative effect on efficiency. She considered the period between 1992/93 and 1998/99. The first few years, when these industries were under government ownership, were characterized by stabilization and rehabilitation which had been highly affected due to the civil war. During this period, the industrial sector was not expected to function at its normal

swing. Situations calmed down in the subsequent years and steady state of operation was anticipated to take-off. Given this difference in the working environments during the post and pre-privatization periods, one would have expected the stabilization process could create a positive bias towards improving efficiency during the later period. Despite this expectation, many privatized industries performed less efficiently in the later period than the case otherwise.

The on going debate and contentious positions of scalars and multilateral organizations and above all the mixed empirical findings including the case in Ethiopia inspires to reexamine the effect of privatization on efficiency from another angle.

III. PRIVATIZATION IN ETHIOPIA: SOME REFLECTIONS

3.1 The number and Composition of Privatized Enterprises

The Ethiopian Government launched the Privatization Program in accordance with Proclamation No.87/1994. The official objectives of privatization in Ethiopia are

- To promote the economic development of the country through encouraging the expansion of the private sector,
- To generate revenue required for financing development activities undertaken by the government,
- To change the role and participation of the Government in the economy to enable it exert more effort on activities requiring its attention.

To realize these objectives, government established the Ethiopian Privatization Agency by law and subsequently privatized public enterprises of different size and operating in different economic sectors. Between the period of initiating the process and 2001/2002 (Ethiopian Fiscal Year), around 223 public enterprises were transferred to the private sector. About 60 percent (or 133) of these enterprises were small firms operating in the retail trade sector. Large and medium scale industries constituted around 17% (40). Agricultural enterprises, hotels and tourist attractions sites and mining enterprises held a share of 13 percent, 8 percent and 0.4 percent respectively.

Table 1: Privatized Public Enterprises (1994/95 – 2001/02)

Sector	Privatized Enterprises		Transferred to		Investors Share %	
	Number	% share	Domestic Investors	Foreign Owners	Domestic	Foreign
Manufacturing	40	17	31	9	77.5	22.5
Agriculture	31	13	15	16	48.4	51.6
Hotel & Tourism	18	8	17	1	94.4	5.6
Retail Trade	133	60	133	0	100.0	0.0
Mining	1	0.4	0	1	0.0	100.0
Total	223	100	196	27	87.9	12.1

Source: Ethiopian Privatization Agency (2002)

According to EEA (2002), the total contractual value of the 223 enterprises was about birr 3,496.3 million. Birr 2977.1 million (86% of the commitment) was settled during the same period. Regardless of having a significant share from the total number of privatized establishments, the revenue collected from retail shops was not more than 6 percent. Manufacturing industries and one enterprise from the mining sector constituted about 79 percent of the total revenue collected from privatization. The total amount of proceed collected from privatization was equivalent to 12.5% of the total investment outlay in the country during the same period. Other things remaining the same, had it not been for privatization, this amount of additional new investment could have augmented the existing capacity of the economy rather than being used merely for transfer of ownership.

Table 2: Number of Privatized Industries

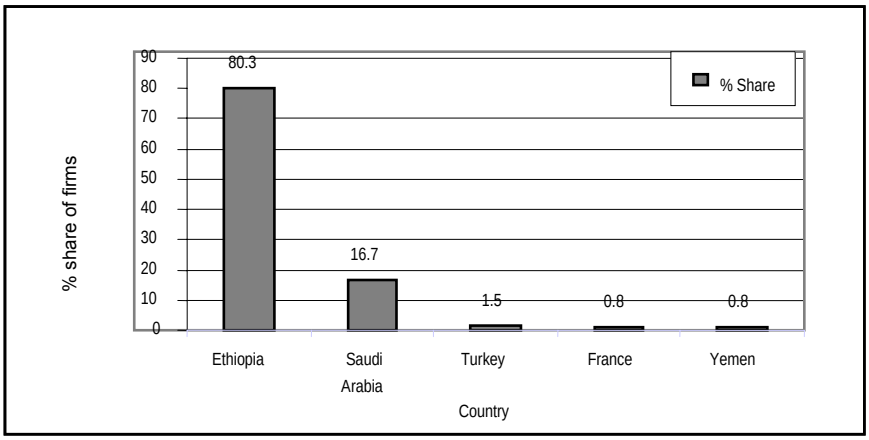
Period	No. Enterprises Returned to Previous Owners	Privatized Enterprises	% share
1994/95		12	5.4
1995/96		122	54.7
1996/97		27	12.1
1997/98		15	6.7
1998/99	5	13	5.8
1999/00	4	22	9.9
2000/01	4	10	4.4
2001/02	1	2	0.9
Total	14	223	100

Source: Ethiopian Privatization Agency, (2002).

The process of privatization has not been steady. 122 (54.7%) public firms were transferred to the private sector only in 1995/96. It took six additional years to privatize the remaining 89 (41.3%) enterprises. After the year 2001/02, no significant event has been observed.

Although FDI has its own shortcomings, it plays important roles in terms of, for instance, the transfer of technology, market access and exchange of experience in business management.

Fig 1: Share of Owners of Privatized Firms by Country of Origin



Source: Ethiopian Privatization Agency (2002).

The sale of public firms is one of the most important venues of entry for foreign direct investment (FDI). Most state owned enterprises, which have been ready for privatization, are found in accessible areas, with relatively developed infrastructural facilities. Albeit other attributes of these firms, privatization provides leverage over investments on the establishment of new enterprises and thus possibly attract FDI in countries such as Ethiopia where access to infrastructural services is a painstaking undertaking in terms of time and cost. Nonetheless, privatization has failed to attract meaningful FDI in Ethiopia and thus contributed little to create dynamic private sector. Ethiopian investors have held about 80% of all the privatized firms, albeit their share from the total commitment has been about 70%, or 2338 million birr.

The total FDI coming to Ethiopia through privatization was not more than 30%. Except the Saudi Arabians, in particular MIDROC that acquired relatively many firms,

and one each from Turkey and France, no tangible FDI has come to Ethiopia from the rest of the world.

3.2 Effects of privatization: Some insights

It is not a simple venture to provide a clear picture and conclusive evidence on the effects of privatization in the overall economy. Nonetheless, there are some observable effects for discussion. The prime motive of private firms is profit maximization and they tend to employ lesser workforce per machine or use modern technologies, which are relatively capital intensive. It is clearly demonstrated in Table 3 below that among selected industries for this particular study, privatized enterprises and other private firms engaged lesser number of labor force per one birr worth of fixed asset as a compared to state owned enterprises.

Table 3: Capital-labor composition of selected industries for 2001/02

Indicators	Privatized firms	Other private firms	Public firms
Fixed asset per person engaged in birr	74980.47	108115.6	69270.77
Machinery and equipment per person in birr	28574.73	59542.86	39141.64
Share of machinery and equipment from total fixed asset	0.381096	0.550733	0.565053

Source: Own Calculation.

Nevertheless, the value of machinery and equipment employed per person in privatized enterprises was significantly lower compared to state owned enterprises. The situation was even worse in the case of asset combination. Productive assets, machinery and equipment, constituted less than 60% of the total value of fixed assets in all modes of ownership and yet it was about 38% in the case of privatized firms. Unless these industries have been labor intensive, which might be possible as it could be examined vis-à-vis other private firms, the prevailing input combination is likely to lead them to rampant inefficiency. This might have inspired privatized firms to lay-off some of their workers, such that they could balance their resource mix and become efficient.

According to EPA (2002), the number of employees of privatized enterprises was 15370 before they were transferred to private hands. This figure has declined by 12% and became 13537 as of July 2002. Had not they created job opportunities for 896 new workers, the number of their workers could have been lower by 2729 (18%).

Controversial views might arise on this outcome. Most of the reduction was from the manufacturing sector.

Table 4: Manpower Situation of Privatized Enterprises

Sector	Transferred workers when privatized	Workers, July 2002	Difference	
			in number	in %
Agriculture	760	603	-157	-20.7
Manufacturing	14036	12474	-1562	-11.1
Hotels	170	145	-25	-14.7
Trade	334	241	-93	-27.8
Mining (Water)	70	74	4	5.7
Total	15370	13537	-1833	-11.9

Source: Ethiopian Privatization Agency (2002).

One could argue that maintaining an optimal combination of labor and capital through reducing the number of workers has a long-run societal benefit over and above its direct effect on improving efficiency of privatized firms. Although measures taken by privatized firms might affect some workers in the very short-run, larger number of people would benefit from the spill-over effect of their efficient operation in the long-run.

Conversely, some might argue that there is no any guarantee of compensating the social cost that some workers have been paying in terms of loosing their livelihood. The prevailing trend is rather dim. The additional number of job opportunities that have been created in the medium and large scale industries could by no means compatible to the demands of the growing urban job-seekers leave alone contributing towards changing the lopsided economic structure in terms of creating gainful employment to the bulk of disguisedly employed labor force in the rural areas [CSA, Various Years].

Curbing budget deficit either through avoiding loss making enterprises or generating revenue from the sales of public enterprises is one of the rationales for privatization. As a policy, government avoided incentives to public firms in the form of financial subsidy. There is no gain that the country could anticipate by curtailing resource drain towards loss making public firms through privatization. In terms of generating revenue, privatization proceeds accounted about 10-21% of non-tax revenue and about 4 – 8% of the overall government revenue, excluding grants.

Table 5: Government Revenue and Expenditure (1995/96 – 1999/00)

	1995/96	1996/97	1997/98	1998/99	1999/00
Revenue					
Total Revenue (excluding grants) (TR)	6966.2	7878	8400	9453	10084
Non Tax Revenue (NTR)	2242.9	2519	3139	3862	3637
Privatization Proceeds (PP)	0	347	312.5	800	650
PP as % of NTR	0	13.77	9.955	20.72	17.87
PP as % of TR	0	4.405	3.72	8.463	6.446
Expenditure					
Current	5582.2	5717	7095	10127	13747
Capital	3705.4	4300	4265	4430	3426
Total	9287.6	10017	11360	14557	17173
Budget Deficit	-1225	-636	-1687	-3341	-5365

Source: National Bank of Ethiopia; Quarterly Bulletin, (Vol. 17, No.1, 2002).

Nonetheless, against greater expectations, the budget deficit has been increasing particularly since 1997/98. During this period, border conflict and other factors might have negatively contributed for the budgetary imbalance. Although it is difficult to segregate the amount of revenue that government got from privatized firms through taxes, one could safely argue that the privatization process has contributed little to shape the fiscal structure of the country.

3.3 Model Specification and Estimation Procedures

A Cobb Douglass stochastic frontier production function would be estimated both for the entire sample and separately for privatized firms through the ordinary least squares (OLS) and maximum likelihood (MLE) estimation. Cobb-Douglass production function is selected merely because of its simplicity and appealing characters of its coefficients for interpretation.

Aigner, Lovell and Schmidt (1977) proposed a Cobb-Douglas type stochastic production function for cross section analysis of the form

$$\ln(y_i) = x_i\beta + v_i - u_i\,, \qquad i=1, 2\ldots N. \qquad (3.1)$$

where y_i is the logarithm of output for the ith firm, x_i is (k+1) row vector, representing input quantities, β_i is a (k+1) column vector of unknown parameters to be estimated,

and v_i represents the conventional error term capturing random or exogenous positive and negative shocks attributed to weather, strikes, luck, unspecified input variables, etc. V_i are assumed to be i.i.d with $N(0,\sigma_v^2)$ independently of the u_i s. u_i is a non-negative random variable, associated with technical inefficiency and assumed to be i.i.d exponential or half-normal random variable.

Based on the works of Aigner, Lovell and Schmidt (1977), Pitt and Lee (1981), and Battese and Coelli (1992) propose a stochastic frontier production function for panel data having the usual stochastic error term, exogenous to the system and one that represents firm level technical inefficiency effects. The later is to be distributed as half-normal or truncated normal random variable and assumed to systematically vary over time. The generic representation of the model is:

$$\ln(Y_{it}) = X_{it}\beta + V_{it} - U_{it}, \text{ i= 1, 2…. N; t = 1, 2… T;} \qquad (3.2)$$

where

- Y_{it} is the output of the ith firm at the tth time period;
- X_{it} denotes a (1XK) vector of (transformed) input values and other associated variables;
- β is a (KX1) vector of unknown scalar parameters to be estimated;
- V_{it} are the usual random errors, measuring the positive and negative effects of exogenous shocks, assumed to be i.i.d with N(0, σ_v^2) independently of the $U_{it}s$; and
- $U_{it}s$ hold non-negative values which are assumed to account technical inefficiency in the model.

V_{it} and U_{it} are the two components of the commonly observed error term in econometric specifications, e_{it} and thus $\sigma^2{}_e = \sigma_v^2 + \sigma_u^2$. The variance share of the technical inefficiency term from the total variance is represented as

$$\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2 \qquad (3.3)$$

Technical efficiency for i^{th} firm in the tth time period is defined by,

$$TE_{it} = \exp(-u_{it}) \qquad (3.4)$$

There are two different views about the possibility of changing values of technical inefficiency with time. Some assume that weaknesses that are attributable to firms are inherently persistent in their very nature and the resultant technical inefficiency of firms remains constant. Time-invariant technical inefficiency effects are:

$$u_{it} = u_i, \quad i = 1, 2\ldots N;\ t = 1, 2\ldots T \qquad (3.5)$$

Nonetheless, firms are not dormant. They could change their mode of input use management with time. Accordingly, Battese and et al (1998) defined technical inefficiency effects as a function of time. The relationship is expressed as:

$$u_{it} = \{\exp[-\eta(t-T)]\}u_i, \qquad i = 1, 2\ldots N;\ 1, 2\ldots T \qquad (3.6)$$

U_i are assumed to be i.i.d as the generalized truncated normal random variable, N (μ, σ_u^2) and represent technical inefficiency effects for i^{th} firm in the last period of the panel. Equation 3.6 expresses technical inefficiency effects of the firm for earlier periods as the product of technical inefficiency effects of the last period and the value of the exponential function, exp [-η (t-T)]. If the parameter η has a more than zero value, -η (t-T) would be greater than zero and subsequently the exponential function provides a value greater than one. In such cases, technical inefficiency effects in earlier periods would outweigh the case during the last period of the panel, $u_{it} > u_i$. If the value of η= 0, technical inefficiency effects of ith firm do not vary over time, $u_{it} < u_i$ and if η< 0, then $u_{it} = u_i$ implying technical efficiency declines over time [Ibid, 1998].

On the basis of these theoretical foundations, a Cobb Douglas specification of stochastic frontier production function of selected medium and large scale industrial enterprises for the period 1998/99 -2001/02 is represented below in equation (3.7).

$$y_{it} = \beta_0 + \sum_{j=1}^{3} \beta_j x_{jit} + v_{it} - u_{it}, \qquad (3.7)$$

where i= 1,2, …, N, representing industrial enterprises, and N=148 and t = 1,2, 3,4, representing the time period between 1998/99 to 2001/02, and j = 1,2,3 denote explanatory variables incorporated in the equation. Variables, y_{it} and x_{jit} denote log of output and factor inputs respectively.

Based on Battese and et al (1998), the model assumes time variant technical inefficiency effect. The probability distributions of both v_{it} and u_{it} are as described above. β_j ,η, μ, σ^2 , σ_v^2 and σ_u^2 are parameters to be estimated.

The log values of the following variables are considered to represent output and input in equation (3.7).

1. *Gross Value of Production (GV_{it}):* Output of a certain enterprise could be expressed either in gross value of production or value added. Production is the result of the interplay of labor, raw materials and fixed assets, where as value added attributes all efforts to capital and labor only, disregarding the possible effects of the quality and quantity of raw materials used. Thus, in this study gross value of production is found to be a more reasonable measure of output. It is also less affected by measurement errors as compared to value added.

2. *Wages and Salaries (WS_{it}):* Labor is a heterogeneous input not only in terms of biological make-up but also education, work experience and other similar attributes. Wages and salaries are presumed to better consider such differences and represent the extent of labor input use.

3. *Fixed capital (FC_{it}):* It represents those assets of enterprises with a productive life of one year or more. It shows the net book value at the beginning of the reference year plus new capital expenditure minus the value of sold and disposed machineries and equipment and depreciation during the reference year.

4. *Inputs (Inp_{it}):* Inputs include the value of principal and auxiliary raw materials by the firm.

On the basis of the MLE estimates of the Cobb-Douglass production function results technical efficiency would be estimated and comparison will be made within the different groups of firms. Specialized econometric software on stochastic frontier

estimation with the name Frontier 4.1, which was designed by Battese and Collie (1994), will be developed.

The proper way of assessing efficiency changes due to privatization would have been a before and after approach. However, the two periods are entirely different. The period prior to privatization was characterized by political instability and unfavorable condition for proper functioning of the manufacturing sector. If one goes back some six to seven years in search of a normal period, he will find a totally different political setting and economic policy regime. As a result, comparing efficiency of enterprises under different policy and working atmosphere would not give a correct picture. Beyond this, it would be a very costly and impractical venture to collect firm level data for the period of some 15 years back from now. Short of this limitation, the model and the estimation procedures are expected to shade some light on how privatization plays in improving efficiency of industrial enterprises.

IV. ECONOMETRIC RESULTS

4.1 Production function

Table 6 below lists OLS and MLE estimates for parameters of the Cobb Douglas production function. The OLS specification assumes that the difference in output among firms is entirely attributed to external shocks and there are no technical efficiency effects, or the one-sided error term is not included in the model. In this average response model, all the parameter estimates are found to be statistically significant.

According to Coelli et al (1998), OLS estimates of the input coefficients (β_1, β_2 and β_3) are unbiased but the intercept term β_0 and the variance parameter (sigma squared) are biased. Sigma squared in the Frontier 4.1 estimation procedure is $\sigma^2{}_e$ [1], which is different from σ_v^2. Thus, it is possible to discuss the economic implications of the remaining parameters except the intercept and the variance parameter.

[1] $\sigma_e{}^2 = \sigma_\mu{}^2 + \sigma_v{}^2$

Table 6: Econometric Result of the Whole Sample: Error component frontier (Version 4.1)

The model= Cobb Douglass Stochastic Frontier Production Function, Number of observations 128, Time-4

Estimates	OLS		MLE	
	Coefficients	t-ratio	Coefficients	t-ratio
β_o	0.83579866	3.8300742	0.91009564	3.5656013
Inp_{it}	0.62731639	24.13003	0.62913575	22.310099
FC_{it}	0.08422477	3.8694702	0.085560387	10.803086
WS_{it}	0.32140252	11.24422	0.30142061	4.0296018
Log likelihood function	-522.80248		-498.22271	
LR test of u_{it}			49.159534	
$\sigma^2{}_e$	0.4548278		1.2146050	4.029618
$\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$			0.72009076	9.0819527
μ			-1.8704287	-2.22684243
η_{it}			0.01709415	0.4102291

Source: Own computation.

The coefficients of factors of production reveal the responsiveness of output due to a one unit change in the use of a respective factor input. It appears that the most critical factor of production is raw material input. On the average, a one unit change in the raw material usage brings about a 0.63% change in the level of output. The responsiveness of output to changes in the level of fixed asset is extremely low. It is due to the fact that most medium and large scale industries operate by far below their production capacity and in most cases than not the supply of raw materials and access to market critically determine what and by how much to produce under the prevailing situation of the industrial sector in Ethiopia. Although most industries operate with obsolescence machinery and equipment, the role of fixed capital as a

limiting factor could only be manifested in the failure of industries to produce standard quality outputs, and not on the quantity. Nonetheless, quality assurance is also the most important prerequisite for tradable goods producing sectors such as industry to survive and prosper under the globally competitive environment. Labor had a modest contribution to output.

The estimate of γ is statistically significant implying that technical inefficiency effects had non-zero impact on the operation of industries. The value of the coefficient for γ is very high indicating that firm level attributes or technical inefficiency effects have had more impact than external shocks on the functioning of the selected industries.

We also conduct a one-sided generalized likelihood-ratio test (LR) to confirm whether or not there were apparent technical inefficiency effect and determine the estimation procedure (MLE or OLS) that better characterize the underlying production function of the selected industries. LR has a mixture of chi-square distribution, $\frac{1}{2}\chi_0^2 + \frac{1}{2}\chi_1^2$ (Collie, 1995). The null hypothesis, H_0: γ=0, the model is equivalent to the OLS average response function, without u_{it}. The test statistic is calculated as:

$$LR = -2\{\ln[L(H_0)/L(H_1)]\} = -2\{\ln[L(H_0)] - \ln[L(H_1)]\} \qquad (4.1)$$

where $L(H_0)$ and $L(H_1)$ are values of the likelihood function under the null and alternative hypothesis respectively. The critical value for the test of α level of significance is equal to the value of $\chi_r^2(2\alpha)$, where r is number of restrictions. The Frontier 4.1 gives a value of 49.2 for likelihood ratio (LR) test for the one-sided error. The corresponding critical value for the test is 7.81. Accordingly, we reject the null hypothesis H_0: γ=0 in favor of the alternative that H_1: γ>0. The result demonstrates that firm level differences in management, work ethics and similar attributes significantly influence the extent to which enterprises efficiently utilize their factors of production. As a result, under the given policy setting and external environment, industries were producing different level of output even if they used equal value of factors of production.

4.2 Technical Efficiency Comparison

Selected industries were operating on average at about 73.4% of their potential during 1998/99-2001/02. This rate appears to be higher than the rate of average capacity utilization of all medium and large scale industries as reported by Central Statistical Authority during the same period. This is due to the fact that frontier production function specification by its very nature gives a score of hundred percent for the firm that produces the maximum output within the given amount of resources. In other words, the model may consider a firm the most efficient among selected industries although it may not operate at its maximum level of designed machinery capacity. Thus, the level of inefficiency reported from other firms is measured by the distance that they deviate from the level of operation of the reference firm.

Table 7: Pooled Data (Four Years)'

Technical Efficiency Statistical Values

Statistical indicators	Technical efficiency
Maximum	0.957000
Mean	0.733955
Minimum	0.125000
Range	0.875000

Source: Own Calculation.

There has been a significant efficiency difference among sample industries. The range in technical efficiency between the most efficient firm operating on the frontier line and the most inefficient firm was 87.5%. Given the prevailing tense market competition that industries face with imports of other countries, there could be little chance for firms operating at the bottom of the frontier to survive. Although external conditions may not be the same in practice due to the leading party's vested interest as the owner of some establishments, and possible positive bias from the side of the government towards public enterprises, this much efficiency gap could not have any strong economic justification for a firm operating with profit maximization motive. Thus, such firms should realize how much they have been left behind due to their firm specific weaknesses and strive to make-up output shortfalls without committing additional resources.

Table 8: Mean Technical Efficiency for the Period 1998/99-2001/02

Period	Technical Efficiency
1998/99	0.728836
1999/00	0.732195
2000/01	0.735734
2001/02	0.739055

Source: Own calculation.

Mean technical efficiency was not significantly changing during the period, despite a slight improvement from time to time. The average technical efficiency was within the range of 72 and 74%. The coefficient of η_{it} in the MLE production function is found to be positive but statistically insignificant. This also implies that technical efficiency did not show a statistically significant change over time during the study period.

A comparative analysis of privatized enterprises vis-à-vis public enterprises reveal a result contrary to the predictions of the neoclassical economists and the World Bank position that privatization could enhance efficiency.

Table 9: Average Technical Efficiency by Mode of Ownership

Sector	Privatized enterprises	Other Private Firms	Public firms
Meat and vegetable processors	0.599875	0.623833	0.904
Edible oil	0.338	0.620154	0.649857
Flour and flour products	0.80975	0.700882	0.770036
Malt liquors and malt	0.837	-	0.685813
Spinning, wearing and finishing	0.7865	0.784737	0.768982
Wearing apparel except fur	0.59225	0.789469	0.77425
Soap, detergent and petroleum jelly	0.739	0.683475	0.7205
Plastic	0.84675	0.737846	0.675375
Articles of concrete and cement	0.6455	0.775944	0.815938
Average	0.688292	0.714542	0.751639

Source: Own calculation.

As it could be observed from Table 8, public enterprises reported a mean technical efficiency of 0.75. On the other hand, privatized and other private firms were operating 31% and 29% far behind the frontier level of output. Some could argue that most private owned firms are newly established infant industries, and may require a learning period to acquire adequate managerial, entrepreneurial, technical and labor

skills, and secure sustainable market access in the face of the prevailing competitive market environment. For the last 20 to 30 years, the dominant mode of ownership has been the public sector and yet the industrial sector remains quiescent. Neither the optimism for the greater private sector to bring changes in the process of industrialization has been realized. The last ten years could have been a sufficient period for the private sector at least to cope with the low state of performance of the public sector, if not operating better.

Under such conditions, it would be ambitious to expect privatized firms to be more efficient as compared to those industries that still remain under the public domain. The t-test for equality of means demonstrates that the difference in the mean technical efficiency between privatized firms and public enterprises reported during the period 1998/99 – 2001/02 was found to be statistically significant. In like manner, the same test indicates that they operated in a statistical significant difference in the level of efficiency of other private enterprises [See, Annex 1].

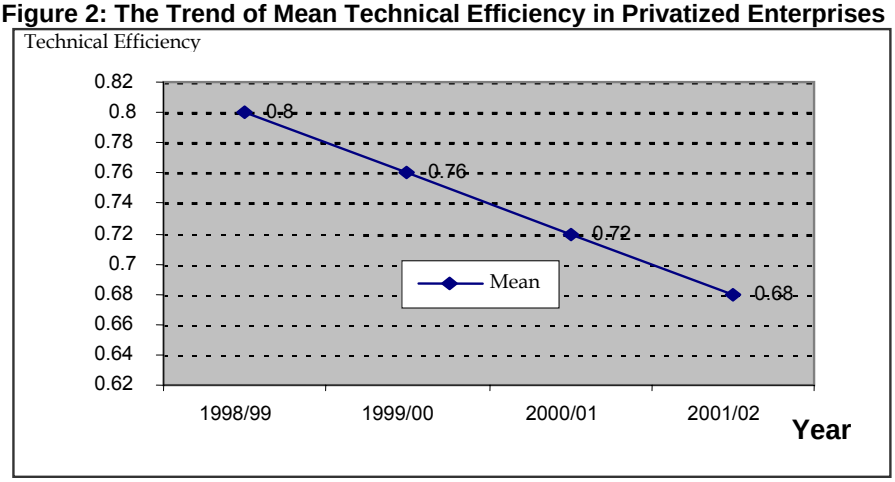
One major explaining factor could be the obsolescent or moribund nature of machinery and equipment that most privatized industries acquired during the transfer of ownership and the subsequent loss of output due to significant down time. This situation could be captured by the capital labor ratio and the share of machinery and equipment from the total fixed asset as represented in Table 3 above. Both ratios were the lowest in the privatized industries as compared to firms operating in other modes of ownership. The other reason might be the period required before new owners could reorganize and bring these industries to full swing operational status. All the privatized firms considered in this study were operating at least for four consecutive years under the new mode of ownership. Four year is a long period to make changes in the composition of factors of production and reorganize the whole system to enhance the level of efficiency of these enterprises. Instead labor lay-off was considered by many privatized enterprises as a strategy to create an optimal input combination. This strategy might have rather caused adverse selection whereby productive and experienced workers lose their jobs and substituted by less or non-experienced workers. The ultimate effect of this move could be declining in efficiency of these industries.

However, public industries were not efficient in all industrial groups. Privatized enterprises were operating more efficiently in the manufacture of flour, wearing apparel except fur, soap, detergent and perfumes and plastic. There could not be any tangible justification as to why privatized industries became more efficient in these

areas while they were very much unproductive in the areas of meat and vegetables processing, spinning, wearing and finishing, edible oil, and manufacture of concrete and cement.

Having observed invariable mean efficiency for the whole sample and the lowest record from the side of the privatized firms, it would become imperative to assess what was going on among privatized firms. With the intention of examining the trend of efficiency of privatized enterprises, a separate production function was estimated through Frontier 4.1. As it is indicated in Annex 2, γ is statistically significant and the coefficient holds a value of more than 0.90. This is a clear indication of how considerable were technical inefficiency effects or firm level weaknesses in affecting operation of privatized firms. The trend variable η_{it} was also statistically significant at 10% level of significance, and it has a negative value signifying a declining trend in technical efficiency among these enterprises. Definitely one could not be certain whether this declining technical efficiency had started in these enterprises before privatization. In any case, privatization has failed to demonstrate its capacity of mitigating this problem. The extent of efficiency loss over the period could be clearly observed in Figure 2 below.

Figure 2: The Trend of Mean Technical Efficiency in Privatized Enterprises



The lower level and declining trend of technical efficiency in the privatized industries tends to imply that efficiency gain as a rationale for privatization may not be valid in the context of Ethiopian industrial sector. Under the existing situation, public

enterprises justify their existence through superior efficiency besides playing societal roles in terms of cushioning the workforce from possible lay-off in the face of rampant unemployment. It also entails the need to cautiously assess the capability of new owners to effectively manage enterprises before hand-over. Post privatization follow-up and support should also be strengthened. The existing post privatization activities of the government has not exceeded more than collecting and analyzing information about the performance of privatized industries. Nonetheless, these industries still require attention and support from the side of the government both from efficiency and societal benefit grounds.

In addition to their internal weaknesses, privatized enterprises suffer from several external constraints as other industries do. According to the Central Statistical Authority (1994), more than 40% of privatized enterprises reported market related problems in terms of failure to compete or absence of demand for their products as the most severe constraint. Some other (27%) privatized industries considered shortages of raw materials as the single most detrimental bottleneck. Working capital shortage and frequent machinery breakage were also equally harmful to the remaining others. Given the very short period of the private sector resurgence, those who bought these enterprises were either operating in the service, merchandize businesses and small industrial venture or emerging entrepreneurs. Hence, they might not have developed their technical and managerial capabilities to effectively direct their industries under the prevailing competitive environment.

V. CONCLUSION

The industrial sector has been traversing through policy turmoil for more than a decade. In the 1970's and 1980's, the country embarked upon state-controlled economic development policy, involving central planning and a large public sector. The transition from market-oriented economic system to directive system of management was swift and it was carried out through nationalization of large and medium private enterprises while holding back new private entrants in the sector. It took quite a long time to drain off resources from other areas, rehabilitate and guide nationalized enterprises to the right path. These enterprises were able to expand at the cost of the private sector participation.

Since the first half of the 1990's, the tide has completely turned its direction. The country has been liberalizing the economy and undergoing privatization. The theoretical basis for the growing plea of multilateral financial institutions and the

government for privatization is mainly the neoclassical economic thought, which presumes the private sector to ensure superior efficiency. For this purpose, government should not intervene in the economy. Nonetheless, many scholars argue on the contrary. Neither has there been conclusive evidence to support a free market without government having a role to play.

Given this situation, one would then raise whether or not privatization has achieved the intended result in the last couple of years in the Ethiopian condition? More importantly, have privatized industries become more efficient as compared to those enterprises, which are still under government control? This paper tried to address this issue by estimating a stochastic frontier Cobb-Douglass production function and technical efficiency indices involving privatized, public and other private industries and examining whether efficiency has grown over time in privatized industries in particular.

Econometric findings reveal that the average level of technical efficiency for the whole sample was about 73.4% during the period, 1998/99 – 2001/02. Contrary to the expectation, privatized industries were operating with the lowest level of efficiency among the three modes of ownership. They reported a score of 69% where as state owned and other private industries were able to operate at a level of 75% and 71% of the frontier level of output. This difference was found to be statistically significant. A separate production function for privatized enterprises demonstrates that mean technical efficiency of these firms was consistently declining during the same period.

Certainty, it would be very difficult to give tangible reasons for such differences. As it has been already observed, the average value of machinery and equipment employed per labor was found to be the lowest in privatized industries and either was the case with respect to the ratio of machinery to total fixed asset. This could roughly indicate that privatized enterprises were operating with morbid machinery and equipment and there has been little effort to augment this short fall in the input and asset composition during the period under consideration. Indeed, most privatized industries were transferred to local entrepreneurs, who were either operating largely in the service or merchandize business or have been emerging in the last few years. Consequently, they have not adequately developed their technical and managerial capabilities to effectively manage their industries in the face of the fiercely competitive market environment. As a result, most of these industries suffer from marketing problems and raw material shortages over and above other industries do. On the

other hand, the country was not able to attract sufficient FDI such that it could improve the technological and managerial capabilities of privatized industries.

Albeit the existing empirical evidence is not conclusive enough to suggest any strong recommendation, one could fairly suggest the following implications. From the findings, it has been learnt that privatization does not necessarily improve efficiency and government should revitalize its position in this respect. It requires to critically assessing the entrepreneurial capabilities and future plans of potential buyers with respect to rehabilitation of machinery and equipment and institution of proper management system before selecting the best bidder on financial grounds. The post privatization activities of the government should also be strengthened to the extent of supporting new owners in terms of augmenting their capabilities of creating access to markets, raw materials, and upgrading technologies. The monitoring mechanism should also have an enforcement mechanism to realize plans that the new owners submitted while offering their price.

Unless the possible effects of hesitation to respond for the growing appeal of multilateral financial institutions and the interests of foreign investors for the changing structure of ownership towards the private sector is not formidable, there will not be a strong economic rationale not to keep up those industries under state control, possible mismanagement of which could cause significant economic and social costs due to privatization.

In general, the private sector is emerging and it is not at the stage of being left to the mercy of the market. It requires active government intervention and support to ensure economic efficiency at a national level. Thus, government should continue strongly working in ensuring an enabling environment for a vibrant private sector and curbing negative effects of market failure in getting access for the required services. Meanwhile, maintaining and investing on areas that are not affordable to the capacity and interest of the private sector but likely to have a catalyst role in creating dynamism in the overall economy should not be overlooked.

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Annex 1: Equality of Mean Technical Efficiency Test Results

Independent Samples Test: Between Privatized and Other Private Firms					
	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	Degrees of freedom	Sig. (2-tailed)
Equal variances assumed	5.82633	0.016295	-2.21873	354	0.027139
Equal variances not assumed			-1.89376	45.79136	0.064584
Independent Samples Test: Between Privatized and Public Enterprises					
Equal variances assumed	4.615943	0.032916	-3.06306	194	0.002502
Equal variances not assumed			-2.78666	54.40788	0.007318

Annex 2: Econometric Results of the Sample for Privatized Firms

Output from the program Frontier (Version 4.1)

Error component frontier (See Battese and Coelli, 1992)

The model= Cobb Douglass Stochastic Frontier Production Function, Number of observations 10, Time-4

Estimates	OLS		MLE	
	Coefficients	t-ratio	Coefficients	t-ratio
β_o	11.520060	1.991305	0.41374021	0.55700675
Inp_{it}	0.83856379	16.943379	0.83699758	17.574014
FC_{it}	-0.0764266	-2.028974	-0.02072868	-0.5620128
WS_{it}	0.22571338	3.0168370	0.25129431	3.2323297
Log likelihood function	-19.790380		-140.45546	
LR test of u_{it}			11.489667	
$\sigma^2{}_e$	0.17499506		0.993532290	0.33774193
$\gamma = \sigma_u^2 / \sigma_v^2 + \sigma_u^2$			0.92279764	4.0134952
μ			-1.2165667	-0.18737699
η_{it}			-0.2003022	-1.9347748