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# Do cooperatives benefit the poor? Evidence from Ethiopia

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# Do cooperatives benefit the poor? Evidence from Ethiopia\*

Maria F Rodrigo<sup>†</sup>

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## Abstract

This paper analyzes how producer cooperatives benefit households in rural environments. In particular, it explores if cooperatives help poor households to exit poverty through three mechanisms: increases in prices, total factor productivity, and relaxation of credit constraints. In a multi-period model I characterize the conditions that must hold so that the “always” poor can exit poverty when participating in cooperatives.

## 1. Introduction

In recent years, many developing countries have presented cooperatives as one development strategy that may empower communities to exit poverty ( Develtere et al., 2008; Emanu, 2009, ). However, despite the potential gains that cooperatives have for poor rural communities (e.g., increasing bargaining power of smallholders in imperfect markets; facilitating access to new markets; allowing communities to share risk collectively), it is not clear if they can achieve these gains (Bernard et al., 2010). In fact, studies have shown that poor households are less likely to participate in cooperatives and that in most cases, cooperatives

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are located in areas where access to markets are better than average. This suggests that cooperatives tend to favor better-off households (i.e., more educated and with more land) (Bernard et al., 2008).

Following Carter and Barrett (2006), a poverty reduction policy should be oriented for those individuals who otherwise would not be able to climb out of poverty on their own. They propose the analysis of an asset-based approach to poverty which differentiates between transitional and structural poverty by identifying an asset threshold at which individuals can escape poverty (i.e., above this threshold a poor individual could escape poverty in the long run, but below this threshold he would be “trapped” in poverty). Therefore, if cooperatives are meant to reduce poverty, it is necessary to understand if poor smallholders participate in cooperatives and if this participation provides a means to exit poverty for those individuals who are structurally poor.

Based on the theory of asset dynamics and poverty traps (Barrett et al. 2008; Carter and Barrett 2006; Carter and Ikegami 2007; Fletschner and Carter 2008), this paper presents a theoretical model that explores the conditions under which a producer may benefit from a cooperative. A feature of my analysis is the inclusion of labor in the production function. A limitation of the models that do not consider labor in the production function is that further analysis regarding how substitution between capital and labor inputs affect market power cannot be done (Sexton and Lavoie, 2001). This addition is relevant to consider, especially in scenarios of industries with market power.

I assume that producers choose between a high and a low production technology. In equilibrium, producers who always use the low technology are always poor. However, a poor producer that chooses the high technology is able to exit poverty in the long run. The high technology is always preferred to the low technology once a producer achieves a certain level of capital which I define as the technology adoption frontier. Comparative dynamics of the model suggest that an increase in prices, total factor productivity (TFP) of the high technology, or a decrease in credit constraints may decrease poverty by facilitating poor households access to high technology. The model predicts that the best policy would be to increase the TFP of the high technology. On the other hand, the second best policy depends on the parameters of the model. For example, a percentage decrease in the fixed costs of accessing the high technology (i.e., relaxation of credit constraints) is better than a percentage increase in prices of the same magnitude if the output elasticity of labor is smaller than  $\frac{1}{2}$  (i.e., an industry with market power). Furthermore, a policy that increases the TFP of the low technology discourages producers to invest in the high technology. In this case, the magnitude of the reduction in poverty would be the lowest.

To test the predictions of the model, I will use the Ethiopian Rural Household Surveys (ERHS) from 1994, 1997, 1999, 2004 and 2009. These surveys include information of 1,477 households in 15 villages of Ethiopia in each round. A second version of this paper will present the impact of cooperatives on decreasing poverty in Ethiopia between this period.

This paper is organized in four parts including this introduction. Section two develops the theoretical model of households' capital accumulation. Section three shows comparative dynamics and explores how cooperatives may facilitate access to the high technology through three mechanisms: increasing prices and TFP, and reducing the fixed costs of accessing the high technology. Section four describes the data and presents summary statistics; the general identification strategy is also introduced, however, additional field work is necessary<sup>1</sup>.

## 2. Theoretical Framework

Here I present a household model where households derive their income from selling their production of an agricultural commodity (e.g., cocoa, rice, corn, coffee)  $Y_t$ . Inputs for the production of  $Y_t$  are labor  $l_t$  and capital  $k_t$ . While households are endowed with a fixed amount of labor each period  $\bar{L}$ , they can buy additional units of labor in the market at a wage  $w$ . Therefore the total labor employed in the production of their commodity is given by the units of their own labor  $l^{in}$ , plus the units of labor bought in the market  $l^{out}$  such that  $l = l^{in} + l^{out}$ . Households can also accumulate capital by investing each period such that  $i_t = k_{t+1} - (1 - \delta)k_t$ , where  $\delta$  is depreciation.

Suppose that each household has preferences over an infinite stream of consumption  $c = \{c_t\}_{t=0}^{\infty}$  and labor  $l^{in} = \{l_t^{in}\}_{t=0}^{\infty}$  given by a time-separable utility function of the form:

$$U(c, l) = \sum_{t=0}^{\infty} \beta^t u(c_t, l_t^{in})$$

where  $u$  is assumed to be continuous, positive monotonic and concave.  $\beta$  is the household discount factor and is assumed to be  $0 < \beta < 1$ . Its income is used to buy private goods  $c$ , capital  $k$ , and labor  $l^{out}$ . It derives utility from consumption on private goods and leisure.

The production process for agricultural goods can be described by  $F(k, l, A)$ , where  $k$  and  $l$  are the capital and labor devoted to the production of the agricultural good, and  $A$  is a production shifter. Each period the household decides its consumption level, and the units of labor and capital that it is going to allocate in the production of the agricultural good.

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<sup>1</sup>This additional field work is expected to take place this June in Ethiopia.

Under perfect certainty, the maximization problem is given by:

$$\begin{aligned}
Max \quad & u(c_t, l_t^{in}) \quad st \quad \forall t \\
P_t F_t(k_t, l_t, A) \quad & \geq \quad c_t + i_t + w l_t^{out} \\
i_t \quad & = \quad k_{t+1} - (1 - \delta)k_t \\
c_t \quad & \geq \quad 0 \\
l_t^{in} \quad & \leq \quad \bar{L} \\
l_t^{out} \quad & \geq \quad 0
\end{aligned}$$

I assume that preferences follow the functional form specified in (1). Where  $\gamma$  is the risk aversion of the household and  $\theta$  is the Frisch elasticity of labor supply.

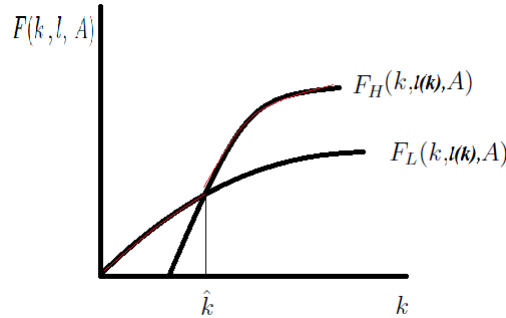
$$U(c, l^{in}) = \frac{1}{1-\gamma} \left( c - \frac{l^{in(1+\theta)}}{1+\theta} \right)^{1-\gamma} \quad (1)$$

Following Barrett et al. (2008), I assume that producers have access to two types of technologies described by the following functions:

$$F(k, l, A) = \begin{cases} F_L(k, l, A) & = A_L k^\alpha l^\zeta \\ F_H(k, l, A) & = A_H k^\alpha l^\zeta - E \end{cases} \quad (2)$$

Where  $A_L < A_H$ ,  $\alpha + \zeta < 1$ , and  $E > 0$  is the cost of employing  $F_H(k, l, A)$ . Each producer will choose the high technology when a given combination of inputs  $\hat{l}$  and  $\hat{k}$ , makes  $F_L(\hat{k}, \hat{l}, A_L) \leq F_H(\hat{k}, \hat{l}, A_H)$ . Therefore, the producer chooses his technology according to  $F(k, l, A) = \max \{F_L(k, l, A), F_H(k, l, A)\}$  which is the upper envelope of both technologies (Figure 1).

Figure 1



After clarifying assumptions and general functional forms that represent production and

utility, I rewrite the model as a dynamic programming problem and proceed to solve it.

$$V(k) = \text{Max}_{A,c,l} \left\{ U(c, l^{in}) + \beta V(k') \right\} \quad \text{st :} \quad (3)$$

$$c + k' - (1 - \delta)k + w l^{out} = PF(k, l, A) \quad (4)$$

$$c \geq 0, l^{out} \geq 0, \quad \bar{L} \geq l^{in} \quad (5)$$

The maximization problem can be rewritten as:

$$V(k) = \text{Max}_{A,k',l} \left\{ U(c(k, k', l^{in}, l^{out}), l^{in}) + \beta V(k') \right\} \quad (6)$$

The first order conditions are given by equations (7)<sup>2</sup>, (8), and (9):

$$\frac{\partial V(k)}{\partial k'} : \frac{\partial U(c, l^{in})}{\partial c} = \beta \frac{\partial U(c', l^{in'})}{\partial c'} \left[ P' \frac{\partial F(k', l', A')}{\partial k'} + (1 - \delta) \right] \quad (7)$$

$$\frac{\partial V(k)}{\partial l^{in}} : \frac{\partial U(c, l)}{\partial c} P \frac{\partial F(k, l, A)}{\partial l^{in}} = - \frac{\partial U(c, l)}{\partial l^{in}} \quad (8)$$

$$\frac{\partial V(k)}{\partial l^{out}} : \frac{\partial U(c, l)}{\partial c} \left[ P \frac{\partial F(k, l, A)}{\partial l^{out}} - w \right] = 0 \quad (9)$$

The results in equations (7), (8), and (9) indicate that the marginal rate of substitution of labor and consumption has to be equal to the marginal productivity of labor, and that the inter-temporal rate of substitution of consumption has to be equal to the value of the marginal product of capital. Rewriting the first order conditions using the functional forms of utility and production, I get:

$$\frac{\partial V(k)}{\partial k'} : \left( c - \frac{l^{in(1+\theta)}}{1+\theta} \right)^{-\gamma} = \beta \left( c' - \frac{l^{in'(1+\theta')}}{1+\theta'} \right)^{-\gamma} \left[ P' \alpha A' k'^{\alpha-1} l'^{\zeta} + (1 - \delta) \right] \quad (10)$$

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$$2 \frac{\partial V(k)}{\partial k'} : \frac{\partial U(c, l^{in})}{\partial c} - \beta \frac{\partial V(k')}{\partial k'} = 0$$

Using the envelope theorem, I can get  $\frac{\partial V(k')}{\partial k'}$ :

$$\frac{\partial V(k)}{\partial k} : \frac{\partial U(c, l^{in})}{\partial c} \frac{\partial c}{\partial k} \\ \frac{\partial V(k)}{\partial k} : \frac{\partial U(c, l^{in})}{\partial c} \left[ P \frac{\partial F(k, l, A)}{\partial k} + (1 - \delta) \right]$$

Updating  $\frac{\partial V(k)}{\partial k}$  one period forward and using this in  $\frac{\partial V(k')}{\partial k'}$ , I get:

$$\frac{\partial V(k)}{\partial k'} : \frac{\partial U(c, l^{in})}{\partial c} = \beta \frac{\partial U(c', l^{in'})}{\partial c'} \left[ P' \frac{\partial F(k', l', A)}{\partial k'} + (1 - \delta) \right]$$

$$\frac{\partial V(k)}{\partial l^{in}} : P\zeta A k^\alpha l^{\zeta-1} = l^{in^\theta} \quad (11)$$

$$\frac{\partial V(k)}{\partial l^{out}} : P\zeta A k^\alpha l^{\zeta-1} = w \quad (12)$$

Let  $MRS = \frac{MU_c}{MU_{c'}}$ . Then, I can write (10) in terms of the inter-temporal marginal utility of consumption to get the rule of capital accumulation.

$$k' = \left( \frac{P' \alpha A' l'^\zeta}{\frac{MRS}{\beta} - (1 - \delta)} \right)^{\frac{1}{1-\alpha}} \quad (13)$$

From (11) and (12) I get the optimal decisions of labor such that  $l^{in}$  and  $l^{out}$  are given by:

$$l^{in} = w^{\frac{1}{\theta}} \quad (14)$$

$$\begin{aligned} P\zeta A k^\alpha (l^{in} + l^{out})^{\zeta-1} &= w \\ (l^{in} + l^{out})^{\zeta-1} &= \frac{w}{P\zeta A k^\alpha} \\ l &= \left( \frac{w}{P\zeta A k^\alpha} \right)^{\frac{1}{\zeta-1}} \end{aligned} \quad (15)$$

$$l^{out} = \left( \frac{w}{P\zeta A k^\alpha} \right)^{\frac{1}{\zeta-1}} - w^{\frac{1}{\theta}} \quad (16)$$

## Steady State

Assume  $A' = A$ . Let  $\rho = \left( \frac{1}{\beta} - (1 - \delta) \right)$ . In steady state,  $\frac{\partial U(c, l^{in})}{\partial c} = \frac{\partial U(c', l^{in'})}{\partial c'}$ , which implies that the marginal rate of substitution of inter-temporal consumption is 1. Replacing this condition in (13), the levels of capital and labor in steady state are given by (17), and (18) below:

$$\begin{aligned} k_{ss}^* &= \left( \frac{P \alpha A l_{ss}^{*\zeta}}{\rho} \right)^{\frac{1}{1-\alpha}} \\ k_{ss}^* &= \left( \frac{1}{PA} \left( \frac{\rho}{\alpha} \right)^{1-\zeta} \left( \frac{w}{\zeta} \right)^\zeta \right)^{\frac{1}{\alpha+\zeta-1}} \end{aligned} \quad (17)$$

Finally, I replace the expression above in equation (15) to get the level of labor in the

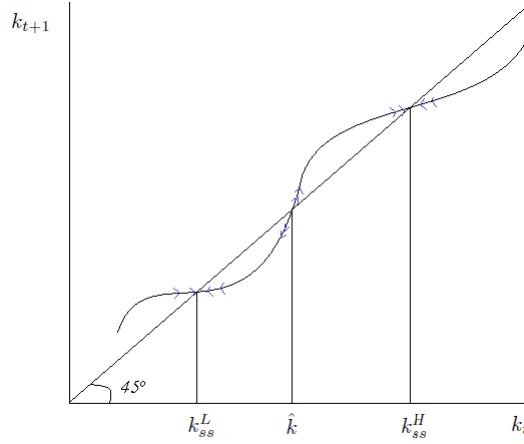


steady state:

$$\begin{aligned}
l_{ss}^* &= \left( \frac{w}{P\zeta A} \right)^{\frac{1}{\zeta-1}} k_{ss}^{*\frac{-\alpha}{\zeta-1}} \\
l_{ss}^* &= \left( \frac{w}{P\zeta A} \right)^{\frac{1}{\zeta-1}} \left[ \left( \frac{1}{PA} \left( \frac{\rho}{\alpha} \right)^{1-\zeta} \left( \frac{w}{\zeta} \right)^\zeta \right)^{\frac{1}{\alpha+\zeta-1}} \right]^{\frac{-\alpha}{\zeta-1}} \\
l_{ss}^* &= \left\{ \frac{1}{PA} \left( \frac{w}{\zeta} \right)^{1-\alpha} \left( \frac{\rho}{\alpha} \right)^\alpha \right\}^{\frac{1}{\zeta+\alpha-1}}
\end{aligned} \tag{18}$$

Note that  $k_{ss}^*$  and  $l_{ss}^*$  are increasing in the technology level. Therefore, I define the steady state levels of  $F_i(k, l, A)$  as  $k_{i_{ss}}^*$ , and  $l_{i_{ss}}^*$  where  $i = H, L$ .  $k_{H_{ss}}^* > k_{L_{ss}}^*$ , and  $l_{H_{ss}}^* > l_{L_{ss}}^*$ . In equilibrium, producers accumulate capital to one of the steady state levels  $(k_{H_{ss}}^*, l_{H_{ss}}^*; k_{L_{ss}}^*, l_{L_{ss}}^*)$  depending on the technology they use (dynamic behavior).

Figure 2



Denote  $\hat{k}$  and  $\hat{l}$  as the technology adoption frontier levels, that is the level of capital and labor that make producers indifferent between using high and low technology, such that  $F_L(\hat{k}, \hat{l}, A_L) = F_H(\hat{k}, \hat{l}, A_H)$ . If producers have an initial level of capital and labor such that  $(k_0, l_0) \geq (\hat{k}, \hat{l})$ , they will be able to use the high technology from period 0 and will end up at the high steady state  $(k_{H_{ss}}^*, l_{H_{ss}}^*)$ . Furthermore, if  $k_0 < \hat{k} \leq k_{L_{ss}}^*$ , producers start with the low technology, but eventually would switch to the high technology ending up at the high steady state. Conversely, if  $k_0 \leq k_{L_{ss}}^* < \hat{k}$  producers will end up at the low steady state  $(k_{L_{ss}}^*, l_{L_{ss}}^*)$ .

### 3. Evaluating Cooperatives as Policy Intervention

Following Carter and Ikegami (2007), producers can be classified in three different categories according to their dynamic behavior and poverty trajectories. Those who always converge to the poor steady state independently of their initial level of capital, those who are initially poor but accumulate capital over time, adopt high technology and eventually exit poverty, and those who, independently of their initial level of capital, always converge to the high steady state.

From equation (2), the levels of capital and labor that make producers indifferent between technologies are given by  $\hat{k}$  and  $\hat{l}$  such that  $A_L \hat{k}^\alpha \hat{l}^\zeta = A_H \hat{k}^\alpha \hat{l}^\zeta - E$ . Furthermore, I can define the level of labor  $\hat{l}$  in terms of  $\hat{k}$  as in equation (18). Solving for  $\hat{k}$ , I get that the adoption frontier level of capital is given by equation (19) below.

$$\begin{aligned}
 A_L \hat{k}^\alpha \left( \left( \frac{w}{P\zeta A_L \hat{k}^\alpha} \right)^{\frac{1}{\zeta-1}} \right)^\zeta &= A_H \hat{k}^\alpha \left( \left( \frac{w}{P\zeta A_H \hat{k}^\alpha} \right)^{\frac{1}{\zeta-1}} \right)^\zeta - E \\
 \hat{k}^{\frac{\alpha}{1-\zeta}} \left( \frac{P\zeta}{w} \right)^{\frac{\zeta}{1-\zeta}} \left( A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}} \right) &= E \\
 \hat{k} &= \left( \frac{w}{P\zeta} \right)^{\frac{\zeta}{\alpha}} \left( \frac{E}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} \right)^{\frac{1-\zeta}{\alpha}}
 \end{aligned} \tag{19}$$

To examine if a policy intervention that promotes cooperatives is able to reach the poor and help them escape poverty, it is necessary to analyze if the cooperative benefits (i.e. increase in prices explained by the households' collective action, increase in the TFP if the cooperative offers technical assistance to its members, relaxation of credit constraints), are high enough so poor households are able to accumulate capital and move towards high technology. Along the lines of the model examined above, I will analyze separately if an increase in prices  $P$ , TFP  $A$ , or a decrease in the fixed costs  $E$  would facilitate producers to move towards the high technology. Furthermore, through comparative dynamics, I will analyze what policy would have the highest impact in facilitating access to high technology.

#### 3.1 Comparative Dynamics

According to equation (19), an increase in prices  $P$ , in the high technology  $A_H$ , or a decrease in the fixed costs of the high technology  $E$  will decrease the level of the technology adoption frontier. However, an increase in low technology  $A_L$ , will increase it. More specifically, the marginal effects are described by equations (20), (21), (22), and (23) below:

$$\frac{\partial \hat{k}}{\partial P} = -\frac{\zeta}{\alpha P} \left( \frac{w}{P\zeta} \right)^{\frac{\zeta}{\alpha}} \left( \frac{E}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} \right)^{\frac{1-\zeta}{\alpha}} < 0 \quad (20)$$

$$\frac{\partial \hat{k}}{\partial A_H} = -\frac{1}{\alpha} \left( \frac{w}{P\zeta} \right)^{\frac{\zeta}{\alpha}} \left( \frac{E}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} \right)^{\frac{1-\zeta}{\alpha}} \frac{A_H^{\frac{\zeta}{1-\zeta}}}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} < 0 \quad (21)$$

$$\frac{\partial \hat{k}}{\partial A_L} = \frac{1}{\alpha} \left( \frac{w}{P\zeta} \right)^{\frac{\zeta}{\alpha}} \left( \frac{E}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} \right)^{\frac{1-\zeta}{\alpha}} \frac{A_L^{\frac{\zeta}{1-\zeta}}}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} > 0 \quad (22)$$

$$\frac{\partial \hat{k}}{\partial E} = \frac{1-\zeta}{\alpha E} \left( \frac{w}{P\zeta} \right)^{\frac{\zeta}{\alpha}} \left( \frac{E}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} \right)^{\frac{1-\zeta}{\alpha}} > 0 \quad (23)$$

By definition  $\frac{\partial \hat{k}}{\partial A_H} > -\frac{\partial \hat{k}}{\partial A_L}$ . However, a comparison among the magnitude of the remaining marginal effects is not straightforward. Even so, I will establish the the following propositions:

Proposition 1: Assume that  $\zeta A_H > P$ . The marginal effect of an increase in the price  $P$  is greater than the marginal effect of an increase in high technology TFP  $A_H$  when the difference between technologies is high (i.e.,  $\frac{A_L}{A_H} \rightarrow 0$ ). Therefore,  $\frac{\partial \hat{k}}{\partial P} > \frac{\partial \hat{k}}{\partial A_H}$  if  $\left(1 - \frac{P}{\zeta A_H}\right)^{1-\zeta} \geq \frac{A_L}{A_H}$ . Note that  $A_H \gg P$  when the output elasticity of labor is small (i.e.,  $\zeta \rightarrow 0$ ).

Proposition 2: Assume that  $E \geq P$ . The marginal effect of an increase in the price  $P$  is greater than the marginal effect of a decrease in the fixed costs of accessing the high technology  $E$  if  $\frac{E}{P} \geq \left(\frac{1-\zeta}{\zeta}\right)$  or always that the output elasticity of labor is greater than  $\frac{1}{2}$ , such that  $\frac{\partial \hat{k}}{\partial P} > \frac{\partial \hat{k}}{\partial E}$  if  $\zeta \geq \frac{1}{2}$ . Note that  $E \gg P$  when the output elasticity of labor is small (i.e.,  $\zeta \rightarrow 0$ ).

Proposition 3: The marginal effect of an increase in the high technology TFP  $A_H$  is greater than the marginal effect of a decrease in the fixed costs of accessing the high technology  $E$ , if  $\frac{A_L}{A_H} \geq \left(1 - \frac{E}{A_H(1-\zeta)}\right)^{1-\zeta}$  or always that the fixed cost of accessing the technology is greater or equal to the value of the high technology such that  $\frac{\partial \hat{k}}{\partial A_H} > \frac{\partial \hat{k}}{\partial E}$  if  $E \geq A_H$ .

It is important to note that the marginal effect of an increase in prices is increasing in the high technology TFP  $A_H$ , and decreasing on both low technology TFP  $A_L$  and the fixed cost of high technology  $E$ . Furthermore, the marginal effect of an increase in high technology TFP  $A_H$  is increasing in the price  $P$  and decreasing on both the low technology TFP  $A_L$  and

the fixed cost of high technology  $E$ . Finally, the marginal effect of a decrease in the fixed costs  $E$ , increases on both the price  $P$  and the high technology TFP  $A_H$ , and decreases on low technology TFP  $A_L$ .

By taking the logarithm of equation (19), I can express  $\hat{k}$  in terms of its percentage changes  $\frac{\dot{\hat{k}}}{\hat{k}} = \frac{\hat{k}_{t+1} - \hat{k}_t}{\hat{k}_t}$  as in the equation below:

$$\frac{\dot{\hat{k}}}{\hat{k}} = -\frac{\zeta}{\alpha} \frac{\dot{P}}{P} + \frac{1-\zeta}{\alpha} \frac{\dot{E}}{E} - \frac{1}{\alpha} \frac{1}{A_H^{\frac{1}{1-\zeta}} - A_L^{\frac{1}{1-\zeta}}} \left( \frac{\dot{A}_H}{A_H} A_H^{\frac{1}{1-\zeta}} - \frac{\dot{A}_L}{A_L} A_L^{\frac{1}{1-\zeta}} \right) \quad (24)$$

From equation (24), the impact on  $\frac{\dot{\hat{k}}}{\hat{k}}$  from a percentage increase in prices  $\frac{\dot{P}}{P}$  is higher than the impact of a decrease in the fixed costs  $\frac{\dot{E}}{E}$  of the same percentage when the output elasticity of labor is higher than  $\frac{1}{2}$  (i.e.,  $\frac{\partial \hat{k}/\hat{k}}{\partial P/P} > -\frac{\partial \hat{k}/\hat{k}}{\partial E/E}$  if  $\zeta > \frac{1}{2}$ ).

Therefore, cooperatives would facilitate access to the high technology through increases in prices, high technology TFP, or decreases in the fixed costs of accessing the high technology (e.g., relaxation of credit constraints). Although the marginal effect of each policy depends on the values of the parameters, a policy that increases prices would have the highest impact if  $A_H \gg P$ , and  $E \gg P$  (i.e.,  $\frac{P}{A_H} > \zeta$  and  $\frac{P}{E} > \zeta$ ). If this is the case, the second best policy would be to increase the high technology TFP always that  $E \geq A_H$ . Note that when the output elasticity of labor is low (i.e.,  $\zeta \rightarrow 0$ ), the difference between the price and the other two variables has to be significantly high for  $P$  to be the best policy. This is because a low output elasticity of labor, implies a low elasticity of supply which leads to market power in an oligopsonic industry. On the other side, a policy that promotes an increase in  $A_L$ , would increase the technology adoption frontier delaying the access to the high technology. In this case, the magnitude of the reduction in long term poverty is the lowest.

The comparative dynamics analyzed above are limited to the analysis of how changes in prices  $P$ , TFPs  $A$  or fixed costs of the high technology  $E$  impact the technology adoption frontier ( $\hat{k}$ ) thresholds. Even so, changes in wages  $w$ , output elasticity of labor  $\zeta$ , or output elasticity of capital  $\alpha$ , also affect the variables of interest.

I considered exogenous changes on different variables of the production side of the household. However, when farmers participate in a cooperative that sells their product to an oligopsonic industry, one would expect the farmers' bargaining power to increase with the number of farmers participating in that cooperative. If the industry is oligopsonic, in equilibrium the price that farmers receive for their product is lower than the price they would receive in a competitive market. Therefore, if forming a cooperative increases the farmers' market power in the industry, the price that farmers receive when a cooperative exists would

be higher than the price in the purely oligopsonic case. This price would be something in between the oligopsonic and the competitive equilibrium prices (i.e.,  $P^{PC} \geq P^{Coop} > P^O$ ). If this is the case, the price that farmers receive when selling their output should not be treated as exogenous. Actually, it would depend on the elasticity of supply of the farmers' output, their aggregate supply, and the market power of the oligopsony. Comparative dynamics suggest that when the elasticity of supply is low, an increase in prices would not be the best policy to facilitate access to high technology. Having mentioned this, future work will estimate the elasticity of supply of the farmers' output, the degree of market power in the oligopsony along with the minimum proportion of farmers that are required to participate in the cooperative to gain some bargaining power<sup>3</sup>. In addition, I will be able to measure if cooperatives have had a greater impact in prices or technology.

Nonetheless, the goal of this paper is to understand how cooperatives may reduce poverty though facilitating access to high technology. In this case, I assume that cooperatives benefit their members through increases in prices, provision of technical assistance and relaxation of credit constraints. Some limitations of this model are the assumption of an exogenous price, the exclusion of a labor market for producers, the assumption of homogeneity between labor hired and own labor and the exogeneity of the benefits provided by the cooperative. Furthermore, this model relies on the long run dynamic behavior and poverty trajectories of households. Therefore, further analysis about the short run impacts on poverty cannot be done. However, from a policy making perspective, allocating resources overlooking long run effects could result more inefficient than overlooking short run effects.

## 4. Data and Summary Statistics

### 4.1 Data

The data set used to test the implications of the model described in the previous section is the result of five rounds of the Ethiopian Rural Household Survey (ERHS) during 1994, 1997, 1999, 2004 and 2009. This data set was collected by the Economics Department, Addis Ababa University (Economics/AAU), the Centre for the Study of African Economies (CSAE), University of Oxford and the International Food Policy Research Institute (IFPRI), Washington DC. It covers information of 1,477 rural households in 15 villages from Ethiopia. Although, it is not nationally representative, it could be considered broadly representative of households in non-pastoralist farming systems. The advantage of this data set is that it provides a rich and unique set of variables about household characteristics, agriculture infor-

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<sup>3</sup>According to Bernard et al. (2008), in average only 20% of smallholders producers participated in cooperatives or producer associations in 2005.

mation (inputs and outputs), as well as community level data on NGO activity, production and marketing (Dercon and Hoddinott, 2011). Because the goal of this paper is to measure the impact of agricultural cooperatives on poverty, it is important to mention the variables that are relevant for this topic in the data set. At the household level, the surveys provide information of households that sell output, buy input, or access to credit in cooperatives. This information will be the proxy for cooperative membership/participation. On the other side, the community level data provides information about the number of agricultural cooperatives per village. It also provides information about the closest cooperative outside the village and qualitative information about the quality of services of the agricultural cooperatives in each village in the last 5 years.

## 4.2 Ethiopian Cooperatives and Summary Statistics

Cooperatives in Ethiopia were established in the 1950's. However, before 1991 they were based on "Marxist" principles whose goal was to end the capitalist "exploitation". During this period, the repressive Derg regime abused cooperatives and created prejudice against them (Kodama, 2007). In 1991 cooperative activities came to decline with the collapse of the Derg regime. Nonetheless, few years after the collapse cooperatives were promoted and supported by the government and other non governmental agencies.

In 1998, the new government issued the "Cooperative Societies Proclamation" encouraging smallholders to organize into agricultural cooperatives based on the principles of a free-market economy. The goal was to improve living conditions of farmers through production and productivity, promoting self reliance, improving technology and increasing income. However, the lack of training and literacy of smallholders restricted the creation of cooperatives (Emana, 2009). According to Francesconi (2009), membership is a voluntary decision depending on farm resources and farmer's preferences. Therefore, large farmers appear to have easier access to cooperatives.

With the new cooperatives proclamation, the government created six coffee farmers cooperative unions to manage coffee exports with the decline of international prices of coffee. At the same time, the Agricultural Cooperative Development International (ACDI) and Volunteers in Overseas Cooperative Assistance (VOCA) began implementing the USAID-funded five-year Agricultural Cooperatives in Ethiopia (ACE) project (Dorsey and Assefa, 2005). Most of the participants were drawn from the Oromia region due to its agricultural potential. The rest of the participants were drawn from Amhara, Tigray and the Southern regions (Assefa, 2005). The first ACDI/VOCA program (Cooperative Union Project - CUP) was implemented during 1998 and 1999 with the goal to enhance food security and rural income.

The second program (Agricultural Cooperatives in Ethiopia - ACE) was implemented from 2000 to 2004, with goals similar to the CUP program but also included to increase women's participation in cooperatives, diversification of cooperative businesses, natural resource management and HIV/AIDS intervention. Among the benefits of these programs are increased bargaining power in marketing of outputs, access to credit and inputs at cheaper prices (Assefa, 2005).

In 2002, the Federal Cooperative Commission was established to reinforce the cooperative movement. The goal was to provide at least a cooperative in 70 percent of the Ethiopian municipalities (kebeles) by 2010. As of 2005, the share of cooperatives in municipalities increased from 10 percent in 1991 to 35 percent (Francesconi, 2009). Evidence of this is found in the data from the ERHS. According to the community level data in the 15 villages surveyed, the number of agricultural cooperatives increased from 5 in 1997 to 19 in 2009 (Figure 3). Furthermore, the number of households participating in a of cooperative also increased between 1994 and 2009. Figure 4, shows the evolution of farmers participation in cooperatives between 1994 and 2009 for the major Ethiopian argi-commodities (i.e., teff, barley, wheat, maize and coffee).

Figure 3

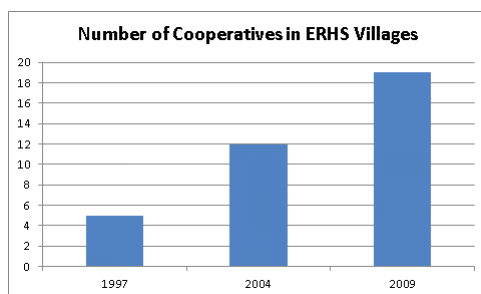
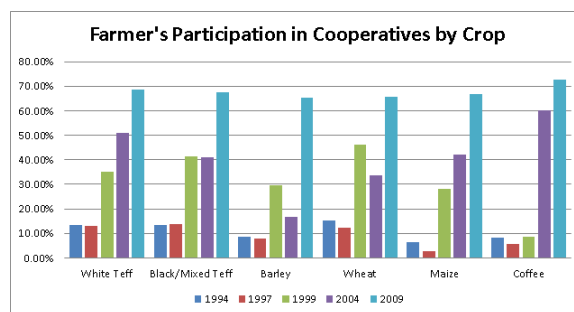


Figure 4



In 2008, IFPRI created the Ethiopian Commodity Exchange in 2008 to reduce uncertainty in agricultural markets and promote commercialization of the major Ethiopian agri-commodities. Membership to this markets is encouraged for cooperatives. This may explain the incidence of cooperatives in the major agri-commodity production sites in Ethiopia. Nowadays “agricultural cooperatives are the pillar of agricultural development” in Ethiopia. However, cooperatives still appear to be dependent on public support and in most of the cases they lack of managerial practices (Francesconi, 2009). Nonetheless, the government has promoted the involvement of cooperatives in the established commodity exchange, cooperative membership has had an insignificant impact on agri-commodity commercialization. In fact, only the minority of cooperatives engage activities of output marketing (i.e., marketing cooperatives). Although, these cooperatives provide better prices for farmers output, these are not enough incentives for all farmers to ensure greater participation. Actually, poorer farmers tend to sell less and consume more cereals. It may be the case that cooperatives fail to provide marketing services to their members because they operate in the context of rural communities where they are subject to social norms and social inclusion and solidarity (Francesconi, 2009). Evidence of the low participation in marketing cooperatives is found in the ERHS. The number of households selling their output to cooperatives was 1.29 percent in 1994 and declined to 1.13 percent in 1999. On the other hand, the number of households buying fertilizer from cooperatives increased from 37.89 percent to 53.59 percent in the same period (Table 1). In most cases cooperatives provide access to subsidized agricultural inputs (e.g., fertilizer, improved seeds, technical assistance, pesticides). According to Veerakumaran (2007), cooperatives import a considerable portion of fertilizer. In 2005 they imported 70% of the total fertilizer demanded in the country. In the Tigray region all the fertilizer was supplied by a cooperative in 2007. Evidence of this is also found in the data from the ERHS. The correlation between participation in cooperatives and inputs purchases, specifically fertilizer and pesticides, is not only positive but has increased between 1994 and 2009 (Table 2). Although, these cooperatives are the major channels for aid they provide no incentives to small-scale entrepreneurship that would move households towards more profitable markets. In fact, even if improved technology was made available in Africa, a large number of smallholder farmers could neither access nor sustain it (Francesconi, 2009).

Table 3 shows summary statistics of the data reported by households’ participation in cooperatives. Participation is one if a household sells output, buys inputs, or access to credit from a cooperative. Note that most of the household characteristics are significantly different between participants and non-participants. Along with the findings of Bernard et al. (2008), it seems that participants are wealthier and more educated than non-participants.



### 4.3 Identification Strategy

This paper aims to analyze if cooperatives are effective in reducing poverty in rural Ethiopia. Some evidence from recent research in Africa (Bernard et al., 2008) suggests that better-off households are more likely to participate in cooperatives. However, it is not clear if structurally poor households who participate can exit poverty through cooperatives. If this is the case, cooperatives may be an effective policy reducing poverty. Otherwise, cooperatives should be accompanied with other policy interventions (e.g., saving programs) to enhance capital accumulation amongst the persistently poor. It may be the case that cooperatives have delayed the access to the adoption frontier level of capital by creating incentives to invest in the low technology.

Some evidence from the ERHS indicates that the number of cooperatives and participants has increased between 1994 and 2009. Furthermore, it exists a positive correlation between technology choices (i.e., fertilizer and pesticides) and participation in cooperatives. However, as Bernard and Spielman (2009) suggest, it seems that participants are wealthier than non participants. In this sense, one may think that wealthier households are more likely to participate in cooperatives. Therefore, the treatment (participants) and control (non participants) groups are not necessarily comparable in observable characteristics. For this reason, it is not likely that the treatment group would have had the same poverty trajectories without cooperatives (counter-factual) as the control group. A second challenge for the identification strategy is the bias due to unobservables (selection bias). It may be the case that some unobservables jointly influence the poverty trajectories of households and their participation decision conditional on some observables. It is possible that more “motivated” households are more likely to participate in cooperatives. As a result, a simple regression may overestimate the impact of cooperatives. As a first approach I could use the propensity scores method under the assumption that outcomes (likelihood of being poor) are independent of treatment conditioning over a vector of observables (Angrist and Pischke, 2008). However, a second approach would take advantage of the panel data and the natural experiments allowed by the establishments of the cooperatives in different regions between 1994 and 2009. To identify the instruments that will be used for this approach additional field work is necessary<sup>4</sup>. A second version of this paper will include the identification strategy and its results<sup>5</sup>.

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<sup>4</sup>This additional field work is expected to take place this June in Ethiopia.

<sup>5</sup>The second version of this paper is expected to be completed at the end of July.

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## 6. Appendix

Table 1

Percentage of households using services from a cooperative

Service	1994	1997	1999
Marketing	1.29%	1.56%	1.13%
Fertilizer	37.89%	50.82%	53.59%
Pesticides	45.79%	15.72%	27.63%
Credit		5.2%	

Table 2

Correlation between technology choices (inputs) and cooperative participation

Input bought	1994	1997	1999	2004	2009
Fertilizer	0.1994	0.1285	0.4625	0.442	0.4472
Tractor		0.0226	0.0039	0.0275	0.0161
Pesticides	0.1183	0.1838	0.2272	0.2544	0.2412
Transport		0.0138	0.1433	0.0379	0.0181
Seeds			0.0239	0.1095	0.0386

Table 3

Summary Statistics					
	Coops =0 (N=5,085)		Coops =1 (1,423)		
	Mean	Std. Dev.	Mean	Std. Dev.	t-stat ( $H_0 : \mu_1 = \mu_2$ )
Value of livestock in HH	3239.20	6094.53	5075.62	7862.16	-8.17***
Units of livestock in HH	3.24	3.97	4.06	4.28	-6.55***
Units of tropical oxen in HH	0.69	1.10	1.11	1.33	-7.83***
HH has any oxen	0.38	0.49	0.53	0.50	-6.95***
Total food consumption in HH	425.54	416.25	681.82	632.74	-14.43***
Total consumption in HH	538.51	524.02	865.00	791.99	-14.67***
Real consumption pcp in HH	78.84	83.87	84.36	82.59	-2.22***
HH size	5.81	2.74	6.13	2.53	-4.03***
HH is poor	0.42	0.49	0.38	0.49	2.65***
Plot area	1.42	1.45	1.78	0.81	-4.55***
Kgs purchased fertilizer	11.82	40.13	31.25	87.18	-5.3***
Expenses in fertilizer	33.05	110.58	116.9	250.55	-7.98***
Sex of Head	1.23	0.42	1.13	0.34	6.24***
Age of Head	45.05	15.52	46.48	15.37	-1.37
Literacy of Head	3.63	0.59	3.47	0.64	3.75***
Head Attended School	0.19	0.39	0.25	0.43	-3.31***
Years of School of Head	4.5	5.13	4.57	5.21	-0.19

\*\*\*p&lt;0.01, \*\*p&lt;0.05, \*p&lt;0.1