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The effect of aspirations on agricultural innovations in rural Ethiopia

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Abstract

This paper identifies the effect of aspirations on the adoption of agricultural innovations in the context of rural Ethiopia. While most studies on agricultural innovations have focused on identifying observable and resource-related deprivations or 'external' constraints, a related stream of literature suggests that 'internal' constraints, such as the lack of aspirations, could reinforce external constraints and lead to self-sustaining poverty traps. Since both aspirations and the adoption of innovations are forward-looking, they are likely to be intimately linked. Aspirations are motivators that can enhance innovations or their adoption not only in their own right but also through their determinants, including self-efficacy, locus of control and other internal traits that may be unobserved. This implies that aspirations may affect innovations through multiple channels and hence may be endogenous. On the other hand, aspirations are also affected by a person's level of achievement, implying that aspirations and innovations are simultaneously determined. To identify the effect of aspirations on the adoption of agricultural innovations, we conducted both plot-level and household-level analysis using purposely collected data from households in rural Ethiopia. Using econometric strategies that account for the endogenous nature of aspirations, we found that a narrow or a very wide gap between aspirations and achievement in a farming household is strongly associated with low levels of innovativeness and low adoption rate of innovation products such as chemical fertilizers.

Keywords: Aspirations, innovations, agriculture, Ethiopia

JEL codes: D1, O1, Q1, Q12, Q16

1. Introduction

This paper studies the relationship between aspirations and innovation behavior in Ethiopian farmers. Previous studies on innovation have mainly focused on the adoption pattern of technologies, which have increased our understanding of why some technologies diffuse faster than others. Technology attributes, a farmer's perception of a technology (Adesina and Zinnah, 1993; Negatu and Parikh, 1999), land size, risk preferences, education, access to credit and extension services, wealth and labor endowment, roads, markets, tenure arrangement, and the availability of complementary inputs and networks are the main determinants identified in the literature studying innovations (for extensive reviews see Rogers, 1983; Feder et al., 1985; Feder and Umali, 1993; Foster and Rosenzweig, 2010).

However, these widely studied determinants of innovations have been mainly observable and resource-related, or, in other words, they are 'external' constraints. Any policies targeting purely at addressing them may not necessarily be able to bring about the desired change. This is because 'internal' constraints, such as the lack of self-efficacy or aspirations, which are difficult to measure and hence mainly ignored in existing studies, could reinforce external constraints, and this may lead to a self-sustaining poverty trap and low levels of proactivity (Appadurai, 2004, Ray, 2006; Dalton et al., 2014). For example, Guyon and Huillery (2014) found that in France students from a low social background – such as having parents with a low education level or living in a disadvantaged neighborhood – exhibited low aspirations for education despite having the same academic abilities as students from a higher social background. However, policies could be used to induce motivation or protect people from falling into the trap of low aspirations and poverty. For example, following Bandura's (1977) theoretical exposition of how perceived self-efficacy and behavioral changes might be related, Bandura et al. (1977) empirically tested and showed that behavioral changes can be effected by altering the level and strength of self-efficacy.

Further, notwithstanding the importance of policy interventions aimed at relaxing external constraints, for example, the provision of credit and extension services, Bertrand et al. (2004) argued that highly consequential behaviors are often triggered by situational factors, also known as "channel factors", which may include psychological factors as addressed in the context of this paper. Thus, it is essential to consider and factor in internal constraints when designing social policy initiatives (Bandura, 2009) because at the very minimum they can enhance the effectiveness of policies that address material deprivation (Dalton et al., 2014).

The main objective of this paper is to investigate whether low aspirations or very wide (or narrow) aspirations gap leads to a low adoption of agricultural innovations or a low degree of innovativeness in selected rural areas of Ethiopia. Aspirations are future-oriented, and they entail effort conditional on a person's belief in their own ability to change outcomes

which may also depend on a person's exposure to information and access to resources. This is also known as *self-efficacy*; having self-efficacy in turn implies a person has an *internal locus of control* – the belief that life outcomes are within their control (Bernard et al., 2011). Genicot and Ray (2014) argued that aspirations encourage a person to invest if they are moderately above their standard of living. In other words, the aspirations gap – the difference between aspirations and achievement – affects future-oriented behavior. According to Ray (2006), when the aspirations gap is either too narrow or too wide, we observe aspirations failure and people giving up (i.e., a lack of personal effort to raise their future living standards). This is because when the aspirations gap is too narrow, the reward is considered too small for the effort, and when it is too wide, the gap will remain large regardless of the amount of effort put in. Yet, Ray (2006) noted that policies could be used to moderately open up the aspirations window¹ (and hence the aspirations gap) or create a sense of possibilities (when the gap is wide) as long as people are not fatalistic or believe that their destiny is preordained.

Innovation is also future-oriented because it aims at bringing about change. Thus, we hypothesize that innovation is closely linked to aspirations and that low aspirations or very narrow/wide aspirations gap would lead to low innovation or low adoption rate of innovation products. The remainder of this paper is organized as follows: The next section contains the background and literature review. Section 3 introduces our theoretical model. Section 4 presents the data and empirical strategy. Results are discussed in section 5. And section 6 concludes the paper.

¹ According to Ray (2006, p.2), the aspirations window is a reference group, which is “an individual's cognitive world, her zone of ‘similar’, ‘attainable’ individuals (in terms of their life styles, their social and political norms, and their economic wellbeing); and from which the individual draws her aspirations.”

2. Background and literature review

The existing literature provides different theories and analytical tools that facilitate a better understanding of the circumstances of the poor and possible ways to help them out of the situation they are in.² Recent additions to the economics literature include a study of individual behavior using the aspirations-failure framework (see Bernard et al. (2011) for an extensive review, particularly in the Ethiopian context). On the other hand, innovation is regarded as an important avenue of bringing about change and sustaining development.³ In the systems approach, innovation is broadly defined as “the process by which individuals or organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country, or the world” (Ernst et al, 1998:pp.12-13). Agricultural innovations may involve use of agricultural technologies, improved practices, and institutional innovations and opportunities that can help facilitate interactions among different actors and improve efficiency and growth in the sector (World Bank, 2007).

The innovation systems concept (ISC) is particularly attractive because it gives attention to tacit knowledge, which is crucial in the case of developing countries (as opposed to codified knowledge) and yet “difficult to articulate or write down” and is “often embedded in skills, beliefs, or ways of doing things” (Mytelka, 1987; as cited in World Bank, 2007). An aspect that is closely related and highly relevant to this study is the attention the ISC gives to attitudes and practices, which are important to innovation processes. According to Hall et al. (2006), attitudes and practices such as mistrust, being closed to others’ ideas, secretiveness, lack of confidence, and limited scope and intensity of interaction are restrictive, while others such as trust, openness, transparency, confidence and proactive networking actually support innovation processes. This perspective could also offer a partial explanation to some “non-fully rational” behaviors that Duflo et al. (2011, 2008) observe in Kenya.

Unlike the widely held belief that low fertilizer adoption rates are due to low returns or credit constraints, Duflo et al. (2011, 2008) found that simple interventions (such as offering free delivery of fertilizer while selling them at full market price) just after harvest substantially increased the fertilizer adoption rate (the researchers found the effect comparable to that of a 50 percent reduction in the price of fertilizer later in the season). Surprisingly, Duflo et al. found that offering free delivery when fertilizer is actually needed had no significant impact on the fertilizer adoption rate. Findings like these motivate economists to explore alternative explanations by looking at other disciplines, substantiating

2 For example, Amartya Sen’s (1981) essay on entitlements and deprivation is considered the breakthrough in the analysis of poverty and famine that led to the development of related concepts that include the Human Development Index and many other multidimensional poverty measures.

3 For example, G20 2011 communiqué of Ministerial Meeting on Development put emphasis on innovation in the context of agricultural development.

the view that beliefs and/or internal factors, such as aspirations, could help in understanding individual decision-making.

Studying within the framework of the aspirations failure theory, Bernard et al. (2014) conducted a video-based experiment that featured success stories to test whether aspirations and future-oriented behavior can be altered. Using data collected six months after the video screening, Bernard et al. identified multiple treatment effects, including significant improvement in: aspirations, use of financial tools related to both savings and credit, the number of children enrolled in school, and the total spending on children's education. They also found a positive treatment effect on a hypothetical demand for loan – a result consistent with previous studies by Bernard et al. (2011), and Bernard and Taffesse (2012), which found evidence that low aspirations or external locus of control could be correlated with low demand for long-term loans and low use of such loans for long-term investments.

Other studies have also found strong correlation between the lack of aspirations and many factors, including the following: expenditures on agricultural inputs, yields, and savings (Kosec et al., 2012); savings choices and health-seeking behavior (Ghosal et al, 2013); career aspirations and educational attainment of adolescent girls (Beaman et al., 2012); private school enrollment (Galab, 2013); educational outcomes (Serneels and Dercon, 2013); and dropout behavior (Goux et al., 2014). In addition, Gorard et al. (2012) conducted a review on education, psychology and related social science literature that examine the importance of attitude and aspirations of young people and their parents on educational attainment and participation.

While existing studies have examined, mainly theoretically, the formation of aspirations and their role in various outcomes, the effect of aspirations on agricultural innovations remain largely unexplored. Related behavioral studies such as that by Kebede and Zizzo (2015) have shown the negative impact of social preferences, such as envy (which Kebede and Zizzo measured using a money burning experiment), on agricultural innovations. Other studies on innovation have focused on innovation adoption patterns mainly based on observable socio-economic characteristics (as described in the introduction of this paper). This study contributes to the literature by examining internal constraints, such as aspirations, as determinants of agricultural innovations.

3. Theoretical model

To understand the link between aspirations and the adoption of agricultural innovations, this paper adopts the theoretical model developed by Dalton et al. (2014).⁴ The two key premises of the model are as follows:

- I. aspirations are reference points that affect utility from achieving a particular status, but -
- II. aspirations are endogenous reference points in that they are affected by effort choices.

In this framework, an individual is assumed to have aspirations level (A) for their final wealth status (w_f), which is determined by their initial wealth (w_0) and the level of effort (e) they put in. This implies for the given initial status w_0 , the individual's utility derived from achieving a particular status w_f by choosing effort level e also depends on their aspirations level (A). The individual's utility function can be described as:

$$u(e, A, w_f) = b(w_f) + v\left(\frac{w_f - A}{w_f}\right) - c(e) \quad (1)$$

Where:

- $w_f = f(e, w_0)$ is assumed to be an increasing function of effort e , $\{e \in [0, 1]\}$, which comes with some cost $c(e)$, whereby the cost function is assumed to be smooth, increasing and convex with $c(0) = 0$;
- $b(w_f)$ is assumed to be a smooth, increasing, concave function over final status with $b(0) = 0$;
- $v(\cdot)$ is a continuously differentiable reference-dependent value function that captures the premise that individual aspiration level A is a reference point that affects the satisfaction experienced by achieving a final outcome w_f .

According to Dalton et al. (2014), poverty imposes external constraints (e.g., lack of access to information or credit to acquire skills), which effectively reduce the productivity of the poor. Consequently, for a given effort level, final wealth is proportional to initial wealth $\{w_f = f(e, w_0)\}$, which clearly puts the poor at a disadvantage since the marginal product of effort increases with initial wealth. This would subsequently cause the poor to limit their effort choice and thereby their aspirations level since agents would aspire only to achieve an outcome that is perceived as attainable. This gives rise to the model's second premise that

⁴ A detailed presentation and the corresponding proofs can be found in that paper.

aspirations are endogenous to an effort choice. Therefore, at a given effort level, aspirations level A can be defined as the final outcome attained⁵:

$$A = f(e, w_0) \quad (2)$$

The two premises of the model together imply a two-way feedback between aspirations and effort. Thus, to find an optimal level of status and utility, the rational solution would be to jointly choose an effort level and an aspirations level (\hat{e}, \hat{A}) such that:

$$\hat{e} \in \arg \max_e s(e, w_0) = u(e, f(e, w_0), f(e, w_0)) \quad (3)$$

where $e \in [0, 1]$ and,

$$\hat{A} = f(\hat{e}, w_0) \quad (4)$$

However, as the evidence presented in the literature review suggests, most individuals may lack the foresight to recognize the feedback effect and therefore may not make decisions in this manner. Such people are referred to as behavioral decision-makers. Hence, according to Dalton et al. (2014), a behavioral decision-maker regards their aspired status A as fixed (instead of endogenously evolving with effort and achieved status), thus imposing an externality on themselves that is not fully internalized. Hence, for a fixed initial wealth level, the behavioral solution is (\tilde{e}, \tilde{A}) , which is different from (or less than) the rational solution (\hat{e}, \hat{A}) , and the decision-maker is internally constrained. This implies that poverty and initial disadvantage interact to generate a behavioral poverty trap characterized by minimal effort-aspirations pair.

The implication is that interventions could be used to break behavioral poverty traps simply by raising the aspirations of the poor. Interventions can also be used with mechanisms that increase individual wealth or reduce the cost of effort (e.g., cost of innovations) faced by the poor. Hence, using agricultural innovations as a proxy for effort and as an avenue of improving rural livelihoods, this paper aims to find out whether aspirations actually determine agricultural innovations.

⁵ The basic assumption is that everyone can reach their aspirations; and, reaching aspirations does not necessarily imply aspiring optimally (Dalton et al., 2014)

4. Data and empirical strategy

4.1 Empirical model

Following the literature review and theoretical framework outlined in the previous sections, we now present our estimation strategy. Innovations are efforts to achieve a certain outcome, and they may require patience and risk-taking, which are central to the decision-making process. Aspirations, on the other hand, are motivators which can enhance innovation and effort allocation to facilitate innovation not only by themselves but also indirectly through other determinants such as risk preferences which may be unobserved. This again implies that aspirations may affect innovations through multiple channels and hence may be endogenous or simultaneously determined.

Since individuals with different level of aspirations (i.e., those with lower aspirations and those with higher aspirations, or between people with moderate aspirations-gap and narrow/large aspirations-gap) may generate data differently, a simple regression model may not capture variations both within a group and between groups of individuals. An alternative approach is to sort individuals into two groups, or 'positions', based on their aspirations status. However, as noted above, outcomes (or innovations) and aspirations are simultaneously determined, which can lead to selection bias as categorizing people into the two positions would not be random. Hence, among the estimation strategies that allow joint determination of endogenous discrete variables and the outcomes they affect, endogenous switching models are preferred (Mare and Winship, 1987; Adamchik and Bedi, 2000; Di Falco et al., 2011). According to Mare and Winship (1987), the main advantages of an endogenous switching model are that they allow us to model both the allocation of persons to various 'treatments' and the effects of treatment on other outcomes; estimate the degree to which common, unmeasured variables affect both the outcome and explanatory variables; take account of the potential selection bias; and estimate the impact of the classification regime by simulating how individuals would fare had they entered different 'treatment' groups.

Formally, the determination of household innovations can be expressed as the following function:

$$y_j = f(A, IN, HH, C, V) \quad (5)$$

Where y_j represents innovations implemented by the household, A represents the aspirations status, IN denotes other individual characteristics, HH and C respectively denote household and community level characteristics that may influence innovations, and V represents location- or village-fixed effects. But for the ease of presentation, let t_j denote the 'treatment' variable A , and X_j denote IN , HH , C and V . Following Wooldridge (2010), the above function can be expressed as an endogenous treatment-effect model with the regression form:

$$y_j = X_j\beta + \delta t_j + \varepsilon_j \quad (6)$$

where t_j is a binary-treatment variable that is assumed to stem from an unobservable latent variable:

$$t_j^* = w_j\gamma + v_j \text{ with } t_j = \begin{cases} 1, & \text{if } t_j^* > 0 \\ 0, & \text{otherwise} \end{cases} \quad (7)$$

where w_j are the covariates used to model aspirations status (or treatment), and the error terms ε_j and v_j are bivariate normals with mean zero and covariance matrix $\begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix}$. The covariates X_j and w_j are unrelated to the error terms, or they are exogenous.

The log-likelihood of observation j is given by:

$$\ln L_j = \begin{cases} \ln\Phi \left\{ \frac{w_j\gamma + \frac{(y_j - X_j\beta - \delta)\rho}{\sigma}}{\sqrt{1-\rho^2}} \right\} - \frac{1}{2} \left(\frac{(y_j - X_j\beta - \delta)}{\sigma} \right)^2 - \ln\sqrt{2\pi\sigma}, & t_j = 1 \\ \ln\Phi \left\{ \frac{-w_j\gamma - \frac{(y_j - X_j\beta)\rho/\sigma}{\sigma}}{\sqrt{1-\rho^2}} \right\} - \frac{1}{2} \left(\frac{(y_j - X_j\beta)}{\sigma} \right)^2 - \ln\sqrt{2\pi\sigma}, & t_j = 0 \end{cases} \quad (8)$$

Where $\Phi(\cdot)$ is the cumulative distribution function of a standard normal distribution.

The Stata program *etregress* (StataCorp, 2013) was used for the estimation of the endogenous treatment-effect model with maximum likelihood when the dependent variable is continuous. Binary dependent variables were estimated using the endogenous switching model with full-information maximum likelihood. To fit the model, a “wrapper” program, *ssm*, which calls for the *gllamm* Stata program (Miranda and Rabe-Hesketh, 2006) was used. Miranda and Rabe-Hesketh argued that the identification of the model does not require identifying restrictions, even though it would be a good practice to specify at least one exclusion restriction. A description of the model can be found in the paper by Miranda and Rabe-Hesketh (2006) and will not be presented here because it is similar to the treatment-effects model described above.

When the dependent variable is a count number, we followed Cameron and Trivedi (2010) and used a structural model, also known as the control function approach. Similar to the switching model, this approach also defines explicit models for both the dependent variable (y_j) and the endogenous regressor (t_j). The basic assumption is that the structural equation for the count variable y_j is a Poisson model with a mean that depends on an endogenous regressor:

$$y_j \sim \text{Poisson}(\mu_j) \text{ and} \\ \mu_j = E(y_j | t_j, X_j, v_j) = \exp(\beta_1 t_j + X_j' \beta_2 + v_j) \quad (9)$$

where the error term v_j can be interpreted as unobserved heterogeneity and is assumed to be uncorrelated with X_j but correlated with t_j , allowing for endogeneity. The addition of v_j also controls for overdispersion in the Poisson model. The interdependence between t_j and v_j is specified as:

$$t_j = X_j' \gamma_1 + w_j' \gamma_2 + \varepsilon_j \quad (10)$$

Where w_j is a vector of exogenous variables that affect t_j nontrivially but does not directly affect y_j , which is commonly known as an instrument or an exclusion restriction. Further, the errors v_j and ε_j are assumed to be related via:

$$v_j = \rho \varepsilon_j + \eta_j \quad (11)$$

where $\eta_j \sim [0, \sigma_\eta^2]$ is independent of $\varepsilon_j \sim [0, \sigma_\varepsilon^2]$. Consequently, this means that ε is a common latent factor that affects both y_j and t_j and is the only source of dependence between them after controlling for the influence of the observable variables X_j and w_j . If $\rho = 0$, then t_j can be treated as exogenous. Otherwise, t_j is endogenous since it is correlated with v_j in (10) because both t_j and v_j depend on ε .

Now, substituting (11) for v_j into (9) yields $\mu_j = \exp(\beta_1 t_j + X_j' \beta_2 + \rho \varepsilon_j) e^\eta$. Then, taking the expectation of μ_j with respect to η yields:

$$E_\eta(\mu) = \exp(\beta_1 t_j + X_j' \beta_2 + \rho \varepsilon) E(e^\eta) = \exp(\beta_1 t_j + \ln E(e^\eta) + X_j' \beta_2 + \rho \varepsilon) \quad (12)$$

The constant term $\ln E(e^\eta)$ can be absorbed in the coefficient of the intercept, a component of X_j . It follows that:

$$\mu_j | X_j, t_j, \varepsilon_j = \exp(\beta_1 t_j + X_j' \beta_2 + \rho \varepsilon_j) \quad (13)$$

Where ε_j is a new additional variable, and the intercept has absorbed $E(e^\eta)$. If ε were observable, including it as a regressor would control for the endogeneity of t_j . Given that it is unobservable, the estimation strategy is to replace it by a consistent estimate from a two-step estimation procedure as follows. First, equation (10) is estimated using OLS and the residuals $\hat{\varepsilon}_j$ are generated. Second, parameters of the Poisson model given in (13) are estimated after replacing ε_j by $\hat{\varepsilon}_j$. Finally, if $\rho = 0$ in the second stage, robust estimates can be drawn by adding the command `vce(robust)` option. But if $\rho \neq 0$, then the VCE needs to be estimated with the bootstrap method that controls for the estimation of ε_j by $\hat{\varepsilon}_j$ (Cameroon and Trivedi, 2010).

4.2 Sampling, data and measurement issues

The data was collected through a household survey carried out between January and March 2014 in Ethiopia. The survey revisited an existing sample of agricultural households surveyed in 2006 and again 2010 in Oromia region under an NGO project, which ended in 2010, aimed

at promoting agricultural innovations. The original survey used a mix of purposive and random sampling procedures to select 390 households from three study sites (Aredo et al., 2008). The primary sampling unit consisted of a pair of neighboring districts, or *woredas*, which were chosen based on the planting density of their major crop and whether they had active farmers' cooperatives. At the second stage, *kebeles* (subdistricts) with active farmers' cooperatives were selected. Using the number of participating households within a cooperative as the sampling frame, households were randomly selected. The major crop and total sample size at each research site are summarized in Table 1. As shown in Table 1, one to three households in each district dropped out of the survey for various reasons, including death, relocation to another area and unavailability for the survey interview. Nevertheless, when compared against the full sample, the households that dropped out of the survey did not show any statistically significant baseline difference with regards to key indicators such as income, wealth, and landholdings (results not reported but available upon request).

Table 1. Geographic distribution of the sample households

District	Bakko- Siree site (Maize crop)		Lume-Adaa site (Teff crop)		Hettosa-Tiyyo site (Wheat crop)		Sample size
	Bakko	Sibu Siree	Lume	Adaa	Hettosa	Tiyyo	Total
Sample size at baseline (2006)	65	65	65	65	65	65	390
Sample size (2014)	64	63	63	64	62	63	379

4.2.1. Psychosocial indicators

The new survey included a module that asked about aspirations and other internal features. The module was identical to the one used by Bernard and Taffesse (2014), and the instrument passed their test for validity and reliability based on a test-retest approach (for details, see Bernard and Taffesse (2014)).

To capture aspirations and expectations, the instrument asked the respondents about:

- First, their current level, aspired level, and expected level with regards to four dimensions (income, wealth, social status, and children’s education).⁶ Wealth (or current value of assets) and income (annual income from agriculture and non-agricultural activities) were reported in terms of Ethiopian Birr; children’s education

⁶ Since individuals aspire to achieve different things, depending on their experiences and the information set they have, relying on any single indicator may not suffice for measuring a person’s aspirations. Nonetheless, these four indicators are believed to be strongly correlated with many dimensions a person might want to achieve in their life. Hence, the aggregate index is comprehensive enough to use as a strong proxy for a person’s aspirations.

in terms of education level; and social status in terms of the percentage of the village population that had asked the individual for advice on important decisions.⁷

- Second, the weight or relative importance they place on each of the four aforementioned dimensions. The respondents were each given 20 beans and a piece of paper with four squares, each labeled with one of the four dimensions. Then the respondents were asked to distribute the beans in the four squares according to the importance of each dimension to them.

Following Beaman et al. (2012), Bernard and Taffesse (2012), and Kosec et al. (2012), a respondent's aspirations level was calculated using an aggregate index based on their answers to the questions about their aspirations for each of the four dimensions. The index is constructed by first normalizing each dimension (i.e., by removing the average level for individuals in the same district and then dividing this difference by the standard deviation for individuals in the same district) and then multiplying the result by the weight the respondent gave to the dimension. The aspiration index was derived by summing the weighted average of the four normalized outcomes.⁸

Mathematically, the aspirations index (A_i)⁹ can be represented as:

$$A_i = \sum_{n=1}^4 \left(\frac{a_n^i - \mu_n^d}{\sigma_n^d} \right) w_n^i \quad (14)$$

Where:

a_n^i is the aspired outcome of individual i on dimension n (income, assets, education, or social status).

μ_n^d is the average aspired outcome in district d for outcome n .

σ_n^d is the standard deviation of aspired outcomes in district d for outcome n .

7 Since attitudinal measures such as aspirations are likely to be measured with errors, normalization would help to smooth out errors at individual level. Further, normalization also makes individual indicators unit free, a prerequisite for aggregation as explained next.

8 The expectation index is constructed using the same method.

9 Relatedly, aspirations-gap is the difference between the aspired outcome and current level in terms of each of the four dimensions. The individual aspirations-gap index is calculated by dividing the aspirations gap with the aspired outcome of each dimension. The weighted sum of the individual aspirations-gap indices of the four dimensions gave the aggregate aspirations-gap index. A dummy for narrow/large aspirations gap was then constructed as follows. First, we classified individuals into three groups (i.e., narrow, moderate and very wide) according to their level of aspirations-gap index (or AG_i). To do this, we employed the formula used by Bandiera and Rasul (2006) to categorize individuals into three relative poverty statuses: poor, moderate and rich. Accordingly, the aspirations-gap of an individual was considered NARROW if AG_i was < 75% of sample average, MODERATE if AG_i was between 75% and 125% of sample average, and VERY WIDE if AG_i was > 125% of sample average. (Alternatively, the aggregate aspirations-gap index can be used to classify individuals into 5 quintiles. In this case, the bottom 1 and top 1 quintiles could represent narrow and verylarge aspirations-gap respectively). Since theory suggests both narrow and very large aspirations-gap are uncondusive for proactive behavior (or innovations), they were put together to form one category (taking the value of 1). The middle represents moderate aspirations-gap and form the second category (taking value of 0).

w_n^i is the weight individual i places on dimension n .

In addition, the survey instrument also asked several questions to capture factors that help shape aspirations. These include factors associated with cognitive processes, such as locus of control, perception on the causes of poverty, attitude towards change, self-esteem, envy, and trust. The psychosocial indicators are measured using Likert-type scales (see Table 2).

Table 2. Brief description of internal factors and measurement

Internal factor	Each of these factors was constructed from an individual's response to different statements read to them about their lives. Most of the responses were coded on a 4-point scale: <i>strongly disagree</i> , <i>disagree</i> , <i>agree</i> or <i>strongly agree</i> . Those marked with an asterisk had only 2 choices, and the rest are defined below.
Self-esteem	Standardized index constructed from 6 items. Responses were recoded to reflect higher self-esteem
Internal locus of control	A standardized index constructed from 14 items that reflect a respondent's perception of whether life outcomes are controlled by: (1) oneself (internality), (2) powerful people (powerful others), or (3) chance. Responses were recoded to reflect internal locus of control
Perception of cause of poverty as external	A standardized index constructed from 12 items which reflect the respondent's perception of whether the causes of poverty are (1) individual, (2) fate, or (3) structural. Responses were recoded to reflect that causes of poverty are external factors
Openness to change*	A standardized index constructed from 7 items which reflect the respondent's attitude to change and adherence to community norms. Responses were coded to reflect more openness to change.
Competition/envy*	A standardized index constructed from 3 items which reflect the respondent's sense of rivalry/envy/competition. Responses were coded to reflect more envy.
Trust in others	A standardized index constructed from 2 items which reflect the respondent's sense of trust in others. Responses were coded to reflect higher trust.
Subjective wellbeing	A standardized index constructed from 2 items which reflect the respondent's perception of own life condition. Respondents were asked to define (a) "best/worst life" and (b) "happy/miserable life" on a scale of 10. Responses were coded to reflect higher subjective wellbeing.
Time preference (impatience)	An index constructed from 4 choices. Respondents were asked to choose whether they prefer to receive a certain amount of money today or a higher amount at a later date. Responses were recoded to reflect impatience.
Risk aversion	An index constructed from results of two hypothetical decisions: (1) lottery choices with payouts determined by a coin toss, and (2) choices among selling price of a bag of maize with same structure as the lottery payouts x 100. Responses were recoded to reflect less risk aversion.

4.2.2. Innovation and adoption indicators

Innovation and adoption behavior of farmers were measured using different indicators. First, to elicit innovativeness, farmers were asked the following question with regards to 12 value chain innovations:

Question: *In the past 5 years, have you changed the way, or do you have a new or better way of [...]*¹⁰?

Using the twelve responses (1 yes, 0 otherwise), the innovation index (Y_j) was calculated as:

$$Y_j = \sum_{n=1}^{12} I_{ij} \quad (15)$$

¹⁰ This question asked about changes in the context of farming practices. For example, the farmers were asked questions about the changes in: the crops they grow in each season, the kind of seeds they used and the places they buy the seeds, the type and quantity of other inputs they use (e.g., fertilizer and chemicals), their use of improved agronomic practices (e.g., planting techniques and land preparation), in the adoption of soil and water conservation (e.g. mulching, zero or reduced tillage, use of crop residue, water harvesting and drip irrigation), marketing information, and credit and loans?

where I_{ij} refers to the type of innovation i individual j implemented, and $Y_j = [0, 12]$.

Innovation adoption was measured in two steps. First, respondents were asked if they had access to or used a certain innovation (i.e., the type of innovation). Second, conditional on adoption, respondents were asked to report the intensity of use (unit/ha) of the specific agricultural technologies (such as fertilizer, improved seeds, herbicides and pesticides) and other agronomic practices (such as improved planting methods) (see Table 5).

5. Results and discussion

5.1 Descriptive statistics

We begin by presenting a general overview of the study sites in terms of their household characteristics, such as demography, resources, and membership in groups. Table 3 indicates that, on average, the sample households in the three sites have similar characteristics. Only a few exceptions were found in the Bako-Sire site, where some indicators showed slight differences. According to the results, the household heads in Bako-Sire were on average slightly younger and more educated. The area also had slightly larger households and a marginally lower percentage of female-headed households.¹¹ Considering the full sample, the data suggest that about 9 percent of the households were headed by females. The average age and schooling attainment of household heads was about 50 years and 4.6 years, respectively. The average family size was about 6.8 people with a 0.39 dependency ratio. The average size of livestock and land holdings in the sample was about 8.2 tropical livestock units and 3 hectares, respectively. The average number of days households were in contact with agricultural extension agents was about 8 days. The number of social groups households belonged to was about 6.9, on average. About 70 percent of the households were project beneficiaries in the past.

Table 3. Descriptive statistics on demographics, endowment, membership in groups, and other factors

Variable	Bakko-Sire (N=115)		Hitossa-Tiyo (N=124)		Adda-Lume (N=124)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Sex of household head (1 if Female)	0.04	0.20	0.14	0.35	0.10	0.30
Age of household head (in years)	45.2	13.1	54.2	13.2	51.7	12.2
Number of years of schooling completed by household head	5.31	3.94	4.55	4.39	3.98	3.89
Household size (number of household members)	7.46	2.39	6.50	2.23	6.47	2.32
Dependency ratio (number of dependents divided by number of working adults)	0.45	0.20	0.38	0.20	0.33	0.21
Household head participates in business or wage labor (1 yes)	0.57	0.50	0.44	0.50	0.44	0.50
Livestock holdings (in Tropical livestock unit, TLU)	8.29	6.05	7.74	4.49	8.67	5.09
Total land size accessed by household (hectare)	2.92	2.20	3.18	1.96	2.98	1.66
Total land size used for main crop (hectare)	2.09	1.83	2.66	1.91	2.70	1.62
Number of days of contact with extension agent	7.62	8.11	8.19	9.22	10.54	12.46
Number of groups household belongs to	6.27	2.71	7.89	3.28	6.36	2.84
Household was project beneficiary in the past (1 yes)	0.69	0.47	0.71	0.46	0.70	0.46

Employing the formula described in equation (14) for the computation of aggregate aspirations and expectations indices results in only a marginally skewed (to the right) distribution of the aspirations and expectations scores (Fig. 1a and 1b); this indicates that the sample is a fair representation of the population. The aggregate indices were also used to classify individuals into the low and high groups according to the level of their aspirations

¹¹ These slight differences may have been occurred because households that did not cultivate any of the three main crops were omitted from the analysis. The households were omitted because the focus of this study is limited to the three main crops.

and expectations by comparing their scores to the district average. Table 4 indicates that about 33% and 41% of household heads had low aspirations and low expectations, respectively. Female household heads were also more likely than their male counterparts to have low aspirations and expectations. Further, wealthier and more highly educated individuals were less likely to have low aspirations and low expectations. Surprisingly, a higher percentage of household heads in the younger age groups showed low aspirations and low expectations. Perhaps, this could be because of their limited experience and information set and hence narrow aspirations window.

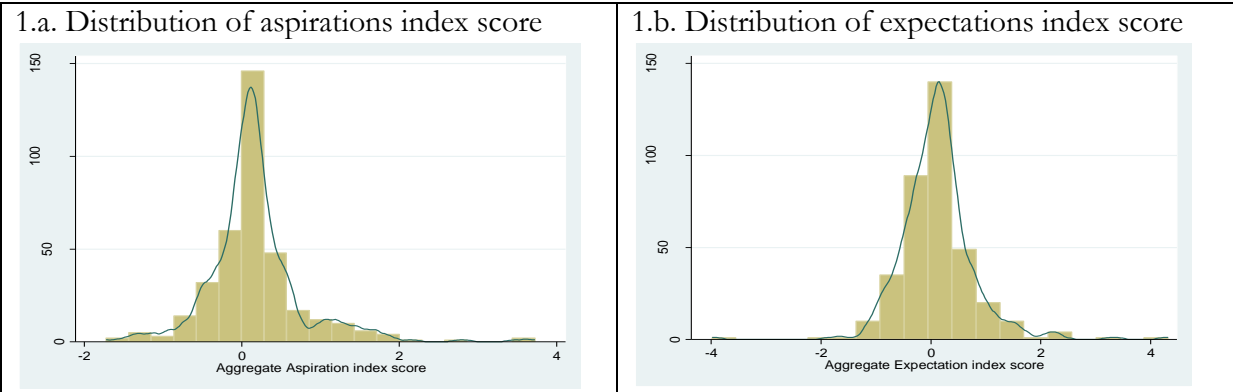


Fig. 1. Distribution of aspirations and expectations indices

Table 4. Share of household heads with low aspirations and low expectations

	Low Aspirations	Low Expectations		Low Aspirations	Low Expectations
All	0.33	0.41			
<i>By sex</i>			<i>By wealth quintile</i>		
Male	0.30	0.39	Q1 poorer	0.64	0.65
Female	0.56	0.65	Q2	0.34	0.53
<i>By age group</i>			Q3	0.31	0.37
age 15-30	0.55	0.50	Q4	0.23	0.33
age 31-50	0.27	0.35	Q5 richer	0.15	0.20
age 51+	0.36	0.47	<i>By per-capita expenditure quintile</i>		
<i>By education group</i>			Q1, poorer	0.56	0.59
education			Q2	0.33	0.52
none	0.47	0.61	Q3	0.23	0.36
0-4 grade	0.41	0.55	Q4	0.29	0.38
5-8 grade	0.19	0.29	Q5, richer	0.23	0.23
9+ grade	0.21	0.16			

Other cognitive processes might determine an individual’s level of aspirations. Figure 2 presents the mean standardized outcomes of some cognitive indicators by aspirations level. The mean comparison tests (Figure 2b) showed that people with higher aspirations exhibited higher internal locus of control, higher self-esteem, more trust in others, higher subjective wellbeing, and lower risk aversion. Further, the results suggested that, on average, people with high aspirations were less likely to perceive external factors as the cause of poverty. All these results were statistically significant. There was not much difference between the two groups in other cognitive indicators such as openness to change, envy (competitiveness) and patience.

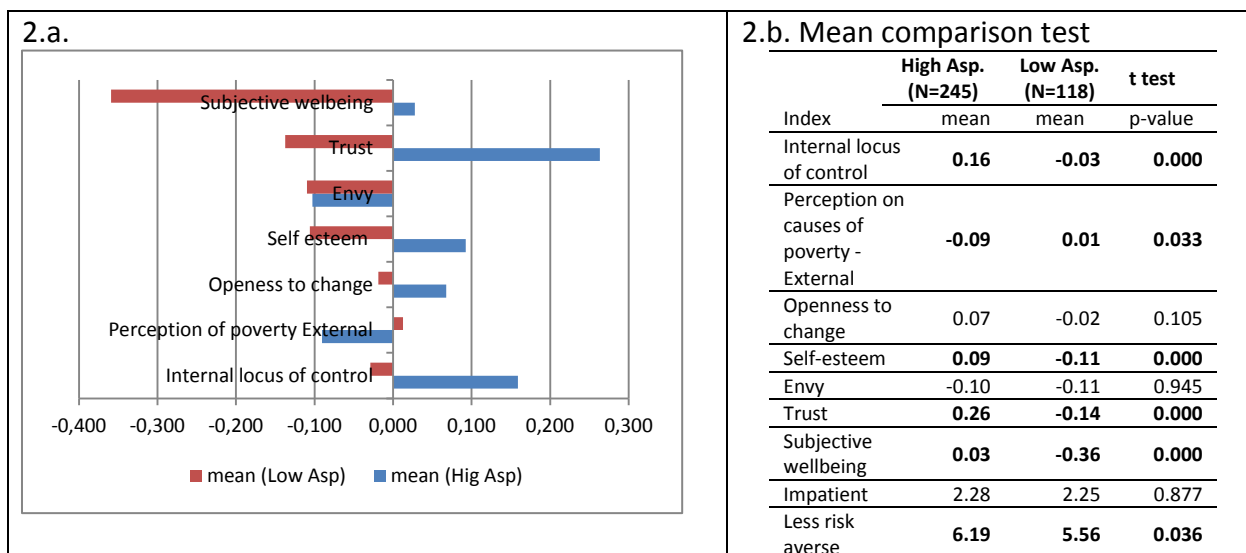


Fig. 2. Descriptive statistics on cognitive indicators

Several innovation and adoption indicators were examined in this study in terms of innovativeness (the use of innovations) and the intensity of use of the adopted innovations. The results (Table 5) suggested that on average male-headed households exhibited higher innovativeness and adopted row-planting techniques more frequently than female-headed households. They also displayed higher intensity of fertilizers use (kg/ha). However, there did not seem to be much difference between the sexes in terms of the following aspects: (1) access to fertilizers, herbicides and pesticides, and improved seeds; (2) the adoption of sustainable natural resource management practices (SNRMPs); (3) the intensity of use of herbicides and pesticides, and improved seeds; and (4) the intensity of general innovativeness (innovativeness index). This result, disregarding the role of other determinants of innovations, implies that gender may not play a statistically significant role in terms of access to and use of some of these innovations. This will be econometrically checked in the next section after controlling for other determinants.

Table 5. Comparison of innovation/adoption by sex of household head (M=329, F=34)

	Male (N=329)		Female (N=34)		t-test: mean difference
	Mean	Std. Dev.	Mean	Std. Dev.	p-value
<i>Innovation/adoption (1 Yes, 0 otherwise)</i>					
Innovativeness	0.92	0.27	0.82	0.39	0.069
Fertilizer use	0.98	0.13	0.94	0.24	0.126
Herbicides/Pesticides use	0.94	0.24	0.91	0.29	0.533
Improved seed use	0.57	0.50	0.47	0.51	0.246
<i>Conditional intensity of innovation/adoption (unit/ha)</i>					
Innovation index [1,12]	5.58	2.89	5.18	2.58	0.479
Fertilizer use (kg/ha)	176	87	145	70	0.051
Herbicides/Pesticides use (Lt/ha)	1.40	1.70	1.67	2.36	0.417
Share of land with improved seeds	0.66	0.29	0.61	0.33	0.555
<i>Plot level indicators (N=1595)</i>					
SNRMP (Index [0,9])	1.70	0.99	1.60	0.80	0.305
Planting method (1 row-planting, 0 otherwise)	0.31	0.46	0.21	0.41	0.033

SNRMP= composite index of sustainable natural resource management practices employed at each plot. These practices comprise of mulching, terraces, reduced tillage, use of crop residue, water harvesting, use of drip irrigation, compost, manure and crop rotation.

A comparison of innovations by aspirations and expectations status also revealed statistically significant differences. For example, individuals with high aspirations tended to have higher innovativeness and be more likely to adopt innovation products, including fertilizers and improved seed; the results were statistically significant (Table 6). However, people with high expectations seem to perform better only in terms of the innovativeness index. Further, when considering only the households that had actually innovated or adopted any of the given technologies, those with high aspirations used more fertilizers per hectare of land and had higher share of land planted with improved seeds. Similarly, people with high expectations seemed to be more innovative, have higher share of land planted with improved seeds, and adopted more SNRMPs, on average.

Table 6. Comparison of innovation/adoption by aspirations and expectations status

	N	High Asp.		Low Asp.		t-test (p-value)	High Exp.		Low Exp.		t-test (p-value)
		Mean	Std. Dev.	Mean	Std. Dev.		Mean	Std. Dev.	Mean	Std. Dev.	
<i>Innovation/adoption (1 Yes, 0 otherwise)</i>											
Innovativeness	363	0.93	0.25	0.86	0.35	0.014	0.95	0.21	0.85	0.36	0.001
Fertilizer use	363	1.00	0.06	0.94	0.24	0.001	0.98	0.14	0.97	0.16	0.615
Herbicides/Pesticides use	363	0.95	0.22	0.91	0.29	0.106	0.95	0.22	0.92	0.27	0.276
Improved seed use	363	0.62	0.49	0.45	0.50	0.002	0.60	0.49	0.52	0.50	0.150
<i>Conditional intensity of innovation/adoption (unit/ha)</i>											
Innovation index [1,12]	330	5.69	2.93	5.23	2.70	0.181	5.99	2.82	4.84	2.80	0.000
Fertilizer use (kg/ha)	355	180	87	160	82	0.040	179	89	166	82	0.164
Herbicides/Pesticides use (Lt/ha)	340	1.43	1.78	1.40	1.76	0.866	1.50	1.89	1.30	1.58	0.301
Share of land with improved seeds (%)	205	0.62	0.30	0.75	0.25	0.006	0.62	0.31	0.72	0.26	0.021
<i>Plot level indicators (N=1595)</i>											
SNRMP (Index [0,9])		1.68	0.98	1.73	0.96	0.389	1.73	0.97	1.61	0.97	0.014
Planting method (1 row-planting, 0 otherwise)		0.31	0.45	0.28	0.46	0.318	0.29	0.45	0.31	0.46	0.397

The bivariate analysis presented in this section clearly indicated that aspirations and expectations might be important determinants of agricultural innovation. The analysis further suggested that the sex of the household head could also matter for certain innovations. In the next section, econometric techniques are used to examine if the findings in this section hold after controlling for other determinants.

5.2 Econometric results

This section presents regression results from various specifications. Estimation techniques described in section 4, such as endogenous treatment effects, simultaneous equation with endogenous switching, and the control function approach were used. To improve identification, indicators of parental involvement in different local institutions – such as *kebele* committee, *iddir* (funeral organization), religious groups, cooperatives – and the ratio of own income growth to the average income growth in the same district between 2006 and 2010 were used as the main exclusion restrictions. In addition to satisfying the statistical

requirements of relevance and excludability from the first-step regressions, instruments also need to be theoretically valid. Next we explain why this is the case in this study.

Past active involvement or leadership experience in local institutions is likely to have exposed parents to new information that can be passed on to their own household members, including children. This in turn is likely to have broadened their children's *aspirations window*. Holding leadership positions would also give an individual a higher social status in their community, which would consequently influence their children's aspirations during the same period. Since present aspirations are linked to past aspirations, the instruments are relevant. On the other hand, since parents' past involvement in local institutions is not directly linked to innovation, it would most likely affect their children's present innovation behavior only through its effect on their aspirations. Hence, the instruments are excludable, satisfying the second requirement of a theoretically valid instrument.

The other instrumental variable is the ratio of a household's income growth to the average income growth in the community in the past. The actual income growth in the past may affect present innovation. However, since the relative position (i.e. the ratio) of the household's income growth is exogenously determined and not by the individual, it cannot directly affect innovation and hence is excludable. Further, since this outcome is measured in the past, present innovation could not have affected past income. On the other hand, since aspirations are formed by comparing own outcomes to other people's outcomes, the instrument is linked to aspirations and hence necessary, fulfilling the requirements of a theoretically valid instrument.

It should be noted that not all these indicators were able to pass formal statistical tests for a valid instrument in all specifications. Rather, each of the indicators were used only in specific regressions in which they satisfy the requirements.¹² Due to the highly endogenous nature of aspirations, more instruments were hard to come by with the existing data. Results are compared against those estimated under the exogeneity assumption of aspirations. Various innovation indicators were considered in the analysis, and the results are summarized below.

12 The Stock and Yogo (2005) test for weak instruments was used for various specifications. The null hypothesis of weak instrument was rejected using either a minimum value of 10 (a rule of thumb for F statistic), or the minimum eigenvalue statistic to tolerate distortion for a 5% Wald test based on the LIML estimators. Hansen's test of over identifying restriction was not rejected, therefore implying that the instruments were valid. Further, falsification tests were also conducted. Results are not reported here because of space constraints, but they are available upon request. Other parental characteristics such as education, their involvement in savings group, membership in a school's parent committee were also considered, but they did not pass the statistical tests for weak instrument.

Result 1: Effect of low aspirations (and narrow/large aspirations-gap) on innovativeness of farmers

Tables 7a and 7b present the estimated effect of aspirations on a farmer's innovativeness. After controlling for other factors, the results in Table 7a suggested that aspirations are important determinants of household innovativeness. For example, based on the exogeneity assumption, the results of the negative binomial regression (column 1) suggested that there was a statistically significant difference in innovation behavior between households with low aspirations and those with high aspirations. This result, however, is not robust because the estimated coefficient loses statistical significance when controlling for other determinants (column 2), possibly because aspirations are endogenous to innovativeness. Hence, we employed a control function estimation technique to account for the potential endogeneity bias. While the results (column 3) seemed to show that low aspirations are negatively associated with the innovation index, the estimated coefficient is not statistically significant.

According to Ray (2006), however, it is not aspirations per se but rather the aspirations-gap that non-linearly affects behavior. Hence, we employed a negative binomial estimations technique and controlled for other factors and two dummies representing aspirations-gap to reflect the hypothesized non-linear relationship between the aspirations-gap and innovation. Following Ray (2006), we hypothesized that narrow and large aspirations-gap are not conducive for innovation. The results shown in column 4 of Table 7a suggested that when compared to people with a moderate aspirations-gap, those with a narrow aspirations-gap were more likely to adopt more innovations. This did not seem to be in line with the theory that a narrow aspirations-gap offers very little motivation to innovate. While the coefficient for the dummy representing a large aspirations-gap had the expected negative sign, it is not statistically significant. We then re-ran the model after controlling for other determinants and only one of the two dummies representing aspirations-gap (i.e., either the narrow or large aspirations-gap), leaving out the remaining as the base category (columns 5 and 6). The results (column 5) again suggested that people with a narrow aspirations-gap were more likely to have a higher level of innovativeness by comparison with others. While it is possible that a narrow aspirations-gap may induce very little motivation to innovate, it may not induce frustrations, unlike what we would expect from very large aspirations-gap. It may also be the case that the method employed for the construction of the three aspirations-gap categories (i.e., narrow, moderate and large) may have erroneously categorized those with a moderate aspirations-gap as people with narrow aspirations-gap. The next specification (column 6), however, returned the expected results; by comparison with others, people with a very large aspirations-gap were more likely to demonstrate a low level of innovativeness. Based on Ray (2006) and Genicot and Ray (2014), this could be the result of frustration because the gap may appear too large to close.

Table 7a. Determinants of a farmer's innovativeness†

	(1)	(2)	(3)	(4)	(5)	(6)
	NEGBIN1	NEGBIN2	CONFUN1	NEGBIN3	NEGBIN4	NEGBIN5
Low aspirations	-0.22***	-0.10	-0.24			
	(0.07)	(0.08)	(0.41)			
Narrow asp. gap				0.35***	0.36***	
				(0.10)	(0.08)	
Large Asp-gap				-0.01		-0.31***
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	No	Yes	Yes	Yes	Yes	Yes
Observations	377	375	375	375	375	375
Wald chi2	91.81	107.94	123.55	131.69	131.25	122.05
Log likelihood	-949.76	-930.32	-959.26	-920.23	-920.23	-926.38

† Full results are presented in Table A.1. in the appendix. Robust standard errors in parentheses.

* p<0.10, ** p<0.05, *** p<0.01

The results in Table 7a, columns 4 to 6, may suffer from endogeneity bias, which we could not directly test because of a lack of strong instrumental variables for the two dummies representing aspirations-gaps. As an alternative, we employed matching estimators and tested if people with a large aspirations-gap were less likely to innovate by comparison with others. We used propensity score matching and covariate matching estimators, including kernel matching, nearest neighbor matching (Rosenbaum & Rubin, 1983; Smith & Todd, 2005), and bias-corrected covariate matching (Abadie and Imbens, 2011). The results (Table 7b) indicated that individuals with a very large aspirations-gap adopted $(1.15/5.01) = 23$ to $(1.42/5.01) = 28$ percent fewer innovations by comparison with the base category (i.e., people with a moderate or narrow aspirations gap). This result is consistent with the findings presented in Table 7a, confirming that people with a large aspirations-gap were less innovative.

Table 7b. Effect of large aspirations-gap on farmer innovativeness

	(1)	(2)	(3)
	Kernel	NN	Bias-corrected NN
ATT	-1.42*	-1.35***	-1.15**
	(0.75)	(0.45)	(0.46)
Average innovation index		5.01	
%change	(-)28	(-)27	(-)23
Observations	375	375	375

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Moving on to other results in Table 7a, we found that impatience (the preference for receiving rewards sooner), the use of credit¹³, and wealth status were all positively and statistically significantly correlated with the innovation index. This implies that eagerness and access to material resources are important to innovation. Household size is negatively associated with the innovation index, a result which we found surprising since most of the

13 Only one household in the entire reported credit constraints in the self-assessment. So we rather controlled for a dummy that represented credit use.

innovations that made up the index may actually require more labor to implement. The remoteness of a farmers' cooperative office was negatively correlated with innovativeness, which is in line with expectations because proximity to an office is likely to improve access to information and agricultural inputs.

Result 2: Effect of aspirations-gap on access to or use of fertilizers, improved seed, and herbicides and pesticides and adoption of row-planting techniques

Table 8 presents the determinants of access to or use of different technologies at plot level. Out of the four innovation indicators (i.e., the use of improved seed, herbicides/pesticides, fertilizers and the adoption of row planting techniques) that we examined in this part, we found that having a narrow/large aspirations-gap was negatively and strongly associated only with the adoption of chemical fertilizers. According to these results (Table 8, columns 7 and 8), having a narrow/large aspirations-gap decreased the probability of a person using inorganic fertilizers, and the results are robust across specifications. However, since the returns generated through adoption of technologies are quite dependent on the intensity of input use, it might be more meaningful to look at the effect of aspirations-gap on the intensity of innovation use. This is examined in the next section by studying the intensity of inorganic fertilizer use¹⁴ at household level and by crop type.

Table 8. Effect of narrow/large aspirations-gap on the use of improved seed, herbicides/pesticides, fertilizer, and row-planting techniques[†]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	i.seeds	i.seeds	Row-plant	Row-plant	Herbicides	Herbicides	Fertilizers	Fertilizers
Narrow/large asp.gap	0.45 (0.29)	0.47 (0.31)	0.30 (0.32)	0.22 (0.30)	-0.21 (0.30)	-0.18 (0.29)	-0.88*** (0.31)	-0.75** (0.32)
Plot characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crop type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dist. to services	No	Yes	No	Yes	No	Yes	No	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
rho	-0.39** (0.17)	-0.37** (0.18)	-0.26 (0.19)	-0.24 (0.17)	-0.01** (0.17)	0.02 (0.17)	0.49** (0.19)	0.42** (0.19)
Wald chi2	559***	596***	708***	734***	618***	656***	343***	375***
Observations	1595	1595	1595	1595	1595	1595	1595	1595

[†] Full results are presented in Table A.2. in the appendix. Robust standard errors in parentheses. * p<0.10, ** p<0.05, ***p<0.01

We found that plot size and asset holdings were positively and strongly associated with the use of all technology indicators, and the results are robust across various specifications (Table 8). This could be because when farmers are faced with new innovations, having larger land holdings may allow them to conduct experiments on at least a portion of their land. This is also true when they are wealthy because wealth serves as a cushion to protect them against innovation risks. Other plot-level characteristics, such as perceived soil quality and

¹⁴ We chose fertilizer use for further investigation only because of space constraints.

distance from residence, did not seem to be important determinants of the use of chemical fertilizers, improved seeds, herbicides and pesticides; and the adoption of row planting techniques. If any, those plots very close to residence, which are likely to be homesteads, are negatively associated with the use of chemical fertilizers. Perhaps, this is because farmers might opt to rather use inputs such as household refuse which are less costly to get but costly to transport to remotely located plots. Further, there was a statistically significant, albeit weak, evidence suggesting that plots which were perceived as having low soil fertility were positively associated with the use of chemical fertilizers, which is in line with expectations as fertilizers are added to improve soil fertility. As Table 8 also shows, female-headed households and the age of the household head were positively and negatively associated with use of herbicides/pesticides, respectively. The results also suggested that the household head's education level and household size were positively associated with the use of improved seeds and the adoption of row planting techniques. This is because education is likely to increase a farmer's openness to using new technologies and larger household is advantageous for labor-intensive farming methods, which are still prevalent in the country. The results also suggested that past involvement in technology promotion project seemed to increase a farmer's likelihood of adopting the use of herbicides, pesticides and inorganic fertilizers.

The type of crop also determined the use of inputs and improved practices. Both maize and wheat plots are more likely to be planted with improved seeds; row planting techniques are also more likely to be used in both maize and wheat plots than teff plots (Tables 8). This may be because both wheat and maize in general give higher yields and also are agronomically easier to manage than teff. Further, in the country, the supply of improved seeds for wheat and maize have always been better than the supply of improved seeds for teff (see Thijssen et al. (2008) for the volume of production of improved seeds over time and by type of crop in the country). Consequently, farmers may have gained better knowledge of improved varieties of wheat and maize, which might have encouraged their adoption decision. However, by comparison to teff plots, maize plots were found to be negatively and strongly associated with the use of fertilizers, herbicides and pesticides, while wheat plots in contrast were positively and statistically significantly associated with the use of fertilizers (Table 8). Indicators of distance (remoteness) between a household and the agricultural cooperative office, the nearest micro finance institution, and the farmer training center (FTC) were found to be negatively associated with either the use of improved seeds, herbicides and pesticides; or the adoption of row planting techniques. This is in line with expectations as access to inputs, and access to extension and advisory services are likely to be limited when farmers are located farther away from these service centers. However, the remoteness of the nearest input dealer is positively associated with the use of herbicides and pesticides, a result which seems less intuitive.

The results from the switch parts¹⁵ (where a dummy representing either a large or a narrow aspirations-gap is the dependent variable) of the endogenous switching regression suggested that father's past involvement in a cooperative, larger household size, having low risk aversion, and remoteness of the FTC and the nearest asphalt road were all negatively associated with a large or narrow aspirations-gap. Having a female household head, having larger livestock and asset holdings, participation in past technology interventions, and remoteness of the nearest microfinance institution are all positively and significantly associated with a large or narrow aspirations-gap (Table 8).

Result 3: Effect of aspirations-gap on the intensity of fertilizers use

The choice of adopting an innovation or technology involves a multistage decision-making process (or "hurdle"). Given all other constraints, it is essential to examine the effect of the main variable of interest at each stage. The first-stage analysis have already shown that a narrow or large aspirations-gap is an important determinant of adoption of inorganic fertilizers at plot level (Table 8). In this section, we examine if the result would hold for the intensity (kg/ha) of fertilizer use. We start by examining if the effect of aspirations-gap varies by type of crop planted.

Result 3.1. Effect of aspirations-gap on the intensity of fertilizer use: by crop type

As presented in Table 9, regressions were performed for each crop at household level separately. Except for teff (column 2), we did not find any evidence that suggests that the intensity of fertilizer use was strongly associated with a person's aspirations-gap. Perhaps this is because even though teff in general has a higher market value than wheat and maize, its output per hectare (or yield) is very low by comparison. Further, teff production cost is also higher because it requires more labor time and other complementary inputs. As a result, people who lack motivation in general or who have a narrow or large aspirations-gap may avoid investing too much on this crop. Other factors such as having a female household head and distance to input dealer were found to be negatively associated with the intensity of fertilizer use when the crop is teff (Table 9). The results for wheat indicated that farmers who had experienced some negative shocks in the previous 12 months tended to use less fertilizers per hectare of land. Further, having larger asset holdings also increased the intensity of fertilizer use on both teff and maize crops.

15 The switch part presents the key determinants of the aspirations status (and aspirations-gap) including those which also determine the adoption of technologies. But the results will not be discussed in detail because identifying determinants of aspirations is not the focus of this paper.

Table 9. Determinants of the intensity of fertilizers use by crop type, household level (aspirations gap as explanatory variable)[†]

	(1)	(2)	(3)	(4)	(5)	(6)
	Teff1	Teff2	Maize1	Maize2	Wheat1	Wheat2
	OLS	Endog.Te.	OLS	Endog.Te.	OLS	Endog.Te.
Narrow/large asp.gap	-3.03 (9.28)	-67.32** (30.25)	8.42 (10.02)	14.52 (36.65)	8.22 (14.56)	-13.07 (20.22)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Wald chi2		260.66***		1762.4***		102.46***
Log lik.	-1165.9	-1140.42	-1308.63	-1275.79	-1203.38	-1167.53
r2	0.53		0.8		0.3	
Observations	220	200	246	223	225	208

[†] Full results are presented in Table A.3. in the appendix. Robust standard errors in parentheses. * p<0.10, ** p<0.05, ***p<0.01

Result 3.2. Effect of aspirations-gap on the intensity of fertilizers use at household level

To get a general picture of the effect of aspirations-gap on total fertilizer use per hectare of land at household level, the data is further examined without taking into account plot characteristics and the types of crop cultivated. The results (Table 10) clearly indicate that households with a narrow or large aspirations-gap tended to have lower fertilizer use per hectare of land than households with a moderate aspirations-gap. According to these results, the average difference in fertilizer use between a household with a narrow or large aspirations-gap and that with a moderate aspirations-gap was 104-106 kg/ha (columns 2-4). This could also be interpreted as the estimated average treatment effect (ATE) of having a narrow or very large aspirations-gap. In addition, since the ‘treatment’ variable (i.e., having a narrow or very large aspirations gap) did not interact with other regressors, the average treatment effect on the treated (ATET) is the same as the ATE (StataCorp, 2013). Further, adding or excluding the households that did not use fertilizers from the analysis did not change the results qualitatively¹⁶, again confirming the robustness of the findings.

Table 10. Determinants of intensity of fertilizer use, household level[†]

	(1)	(2)	(3)	(4)
	Intensity	Intensity	Intensity	Intensity
	OLS	Endog.Te.	Endog.Te.	Endog.Te.
Narrow/large asp-gap	8.11 (10.81)	-104.79*** (23.86)	-105.35*** (22.09)	-106.43*** (22.26)
Other controls	Yes	Yes	Yes	Yes
Wald chi2		185.03***	187.64***	186.93***
Log lik.	-1983.62	-2102.51	-2100.63	-2100.91
r2	0.38			
Observations	352	352	352	352

[†] Full results are presented in Table A.4. in the appendix. The source of difference among Columns 2-4 is only the type of IVs used in each specification. Robust standard errors in parentheses. * p<0.10, ** p<0.05, ***p<0.01

¹⁶ Results not reported but available upon request

With regards to other determinants, livestock and total asset holdings were positively and strongly associated with the intensity of fertilizer use. This is in line with expectations because access to credit in rural settings is generally limited, and hence these wealth indicators may not only reflect a person's purchasing power but also serve as collateral when the person takes out a credit agreement. They also contribute to insurance against innovation risks. On the other hand, the amount of land holdings was negatively associated with the intensity of fertilizer use. This could be because the lower yield caused by a lack of intensification (since total output is also determined by the size of cultivated land) may not seem as important to farmers with larger land holdings than to those with smaller land holdings.

Result 4: Correlation of aspirations and other psychosocial indicators

Other internal factors or beliefs such as self-esteem, locus of control, attitude to change, competitiveness or envy, trust in others, subjective wellbeing, and the perception that poverty is caused by external factors are likely to affect innovation behavior. However, since they are very likely to be linked to each other, it is challenging to find credible identifying instruments to directly examine the potential effect of each of these factors on innovation. Nonetheless, the literature suggests that these factors are strongly correlated with aspirations and targeting them could be a useful policy strategy. This is because "correlation can sometimes provide...evidence of a causal relation" (Angrist and Pischke, 2009: p.197). In this context, an indirect approach was adopted to establish the importance of other psychosocial factors to innovation through their correlation with aspirations. Consequently, the aspirations index was separately regressed on each of these internal factors and other determinants of aspirations (Table 11). The results suggested that indicators of self-esteem, trust in others, and subjective wellbeing are positively and significantly correlated with the level of aspirations. This is consistent with the theory and the results from the descriptive statistics of this study as well as other studies, such as Kosec et al (2012).

Table 11. Correlation between aspirations and various psychosocial indicators[†]

	(1) SE	(2) LC	(3) OC	(4) E	(5) T	(6) SW	(7) PP	(8) ALL
Self-esteem	0.17** (0.08)							0.12 (0.09)
Locus of control		0.07 (0.11)						-0.10 (0.12)
Openness to change			0.08 (0.06)					0.06 (0.07)
Envy				-0.00 (0.03)				-0.01 (0.03)
Trust					0.09*** (0.03)			0.09*** (0.03)
Subjective wellbeing						0.08*** (0.03)		0.09*** (0.03)
Poverty caused by external factors							-0.13 (0.10)	-0.12 (0.09)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	375	375	375	375	375	375	375	375
R-squared	0.31	0.29	0.30	0.29	0.31	0.30	0.30	0.33

[†]Full results are presented in Table A.5. in the appendix as. Robust standard errors in parentheses. * p<0.10, ** p<0.05, ***p<0.01

We also made a similar attempt to see the correlation of future expectations with each of the internal traits after controlling for other determinants. As shown in Table 12, future expectations were strongly and positively correlated with self-esteem, internal locus of control, trust in others, and subjective wellbeing, whereas the perception that poverty is caused by external factors was found to be negatively correlated with future expectations.

Table 12. Correlation between expectations and various psychosocial indicators[†]

	(1) SE	(2) LC	(3) OC	(4) E	(5) T	(6) SW	(7) PP	(8) ALL
Self-esteem	0.22*** (0.07)							0.11 (0.09)
Locus of control		0.26*** (0.08)						0.20** (0.10)
Openness to change			-0.05 (0.05)					-0.09 (0.06)
Envy				-0.03 (0.03)				-0.01 (0.03)
Trust					0.12*** (0.04)			0.10** (0.04)
Subjective wellbeing						0.08** (0.04)		0.10*** (0.04)
Perception on causes of poverty as external							-0.17** (0.07)	0.01 (0.09)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	375	375	375	375	375	375	375	375
R-squared	0.38	0.39	0.36	0.36	0.38	0.37	0.37	0.42

[†]Full results are presented in Table A.6. in the appendix. Robust standard errors in parentheses. * p<0.10, ** p<0.05, ***p<0.01

6. Conclusion

Beliefs or the sense of control individuals have over their life shape their preferences. An internally constrained person may have low aspirations and hence may not put too much effort into improving their situation. In this study, we used an aggregated index constructed from four indicators that measure aspirations with regards to income, wealth, social status and children's education as a proxy for aspirations. Descriptive statistics suggested that individuals in the poorest income and wealth group and those with less education exhibited low aspirations, strengthening the notion that the poor may lack the resources or the 'capacity' to aspire (Appadurai, 2004). These results were confirmed by regression analyses that controlled for indicators of wealth and other potential determinants of aspirations. We examined whether a narrow or large aspirations-gap determines innovation behavior. We used the adoption of agricultural technologies – such as improved seeds, chemical fertilizers, and herbicides/pesticides – and the adoption of improved planting method (i.e., row planting) as indicators of innovation. We conducted plot-level and household-level analyses and found that having a narrow or very large aspirations-gap was strongly associated with a low level of innovativeness or low adoption of inorganic fertilizers. For example, our estimates suggested that, on average, a household with a narrow or very large aspirations-gap used about 105kg/ha less fertilizers than an average household with a moderate aspirations-gap.

Results of this study, however, should be interpreted with caution for the following reasons. First, aspirations and other cognitive indicators are likely to be measured with error. Yet, attempts were made to minimize the influence of the error through standardization of the data. Secondly, the method employed for the construction of the three aspirations-gap categories (i.e., narrow, moderate and large) may have erroneously put people in 'wrong' categories. Various specifications were tried to find robust results and thus accounting for this issue. Further, the data was collected from study sites which have high agricultural potential. This may limit the external validity of the study. However, most of the findings in this study are in line with the theory which suggests that moderate aspirations motivate future-oriented behavior. Our findings are also in line with a few other empirical studies such as Bernard et al. (2014) and Ghosal et al. (2013), which found that aspirations have strong impact on savings, increased demand for credit and other forward-looking behavior. Despite the highly endogenous nature of aspirations – our main variable of interest – and hence the corresponding challenges of finding powerful instrumental variables in observational studies, this study, to our knowledge, is the first attempt at providing empirical evidence using multiple innovations in the context of agriculture. Our findings clearly demonstrated that beyond access to material resources, psychological factors such as aspirations may also play a role in the adoption of agricultural innovations in rural Ethiopia.

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Appendix

Table A.1. Determinants of farmer innovativeness

(Dependent variable: Innovation index, count outcome)

	(1)	(3)	(5)	(6)	(7)	(8)
	NEGBIN1	NEGBIN2	CONFUN1	NEGBIN3	NEGBIN4	NEGBIN5
Low aspirations ⁺	-0.22*** (0.07)	-0.10 (0.08)	-0.24 (0.41)			
Narrow asp. gap ⁺				0.35*** (0.10)	0.36*** (0.08)	
Large Asp-gap ⁺				-0.01 (0.13)		-0.31*** (0.11)
Female hh head ⁺		-0.10 (0.14)	-0.10 (0.14)	-0.16 (0.14)	-0.16 (0.14)	-0.12 (0.14)
Age of hh head		-0.00 (0.02)	0.00 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)
Square of age		0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Education hh head		0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
HH size		-0.03* (0.02)	-0.04** (0.02)	-0.03* (0.02)	-0.03* (0.02)	-0.03* (0.02)
Total land holdings (ha)		0.02 (0.02)	0.02 (0.02)	0.03 (0.02)	0.03 (0.02)	0.03 (0.02)
Past beneficiary ⁺		0.04 (0.07)	0.03 (0.06)	0.04 (0.06)	0.04 (0.06)	0.06 (0.07)
Negative shock ⁺		-0.04 (0.07)	-0.01 (0.07)	-0.03 (0.07)	-0.03 (0.07)	-0.03 (0.07)
Impatience		0.03 (0.02)	0.02 (0.02)	0.04** (0.02)	0.04** (0.02)	0.03* (0.02)
Risk aversion		0.00 (0.01)	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Credit use ⁺		0.12* (0.07)	0.13* (0.07)	0.13* (0.07)	0.13* (0.07)	0.12* (0.07)
Value of assets(ln)		0.10** (0.05)	0.08 (0.07)	0.11** (0.04)	0.11** (0.04)	0.11** (0.04)
Market (minutes)(ln)		0.05 (0.04)	0.05 (0.05)	0.07* (0.04)	0.07* (0.04)	0.06 (0.04)
Coop office (minutes)(ln)		-0.09** (0.04)	-0.09** (0.04)	-0.08* (0.04)	-0.08** (0.04)	-0.08* (0.04)
Input dealer (minutes)(ln)		-0.06 (0.04)	-0.06 (0.04)	-0.04 (0.03)	-0.04 (0.03)	-0.05 (0.04)
FTC (minutes) (ln)		0.02 (0.05)	0.02 (0.05)	0.02 (0.05)	0.02 (0.05)	0.01 (0.05)
Road (minutes)(ln)		-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Bako-Sire ⁺	-0.17 (0.19)	-0.15 (0.19)	-0.16 (0.20)	-0.08 (0.19)	-0.08 (0.19)	-0.13 (0.19)
Hitossa-Tiyo ⁺	0.07 (0.14)	0.07 (0.15)	0.10 (0.16)	0.04 (0.15)	0.04 (0.15)	0.04 (0.15)
Error			0.15 (0.42)			
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.60*** (0.12)	0.78 (0.69)	0.94 (1.06)	0.32 (0.65)	0.31 (0.65)	0.61*** (0.66)
Inalpha	-1.52*** (0.19)	-1.73*** (0.22)		-1.89*** (0.25)	-1.89*** (0.25)	-1.79*** (0.23)
Observations	377	375	375	375	375	375
Wald chi2	91.81	107.94	123.55	131.69	131.25	122.05
Log likelihood	-949.76	-930.32	-959.26	-920.23	-920.23	-926.38

Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. ⁺Dummy variable

Table A.2. Effect of narrow/large aspirations-gap on the use of improved seed, herbicides/pesticides, fertilizer, and row-planting.

(Dependent variables: Binary outcome variables)

(Endogenous switching model with full information maximum likelihood)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	i.seeds	i.seeds	Row-plant	Row-plant	Herbicides	Herbicides	Fertilizers	Fertilizers
Narrow/large-gap	0.45 (0.29)	0.47 (0.31)	0.30 (0.32)	0.22 (0.30)	-0.21 (0.30)	-0.18 (0.29)	-0.88*** (0.31)	-0.75** (0.32)
Female hh head ⁺	0.20 (0.16)	0.16 (0.16)	0.04 (0.19)	0.08 (0.19)	0.53*** (0.20)	0.49** (0.21)	-0.03 (0.21)	-0.01 (0.22)
Age hh head	-0.02 (0.02)	-0.02 (0.02)	0.01 (0.03)	0.01 (0.03)	-0.06** (0.03)	-0.04 (0.03)	0.04 (0.03)	0.04 (0.03)
Square of age	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00* (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00* (0.00)
Education of hh head	0.04*** (0.01)	0.04*** (0.01)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.00 (0.02)	0.00 (0.02)
HH size	0.05** (0.02)	0.05** (0.02)	0.04* (0.02)	0.04* (0.02)	0.01 (0.02)	0.00 (0.02)	-0.05 (0.03)	-0.05 (0.03)
Livestock holdings(TLU)	-0.01* (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Value of assets (ln)	0.15*** (0.04)	0.13*** (0.04)	0.09* (0.05)	0.08 (0.05)	0.12*** (0.05)	0.11** (0.05)	0.12** (0.05)	0.08 (0.06)
Plot size (ha)	0.53*** (0.10)	0.55*** (0.10)	0.41*** (0.12)	0.39*** (0.12)	0.74*** (0.14)	0.76*** (0.14)	1.14*** (0.22)	1.21*** (0.22)
Past beneficiary ⁺	0.04 (0.09)	0.09 (0.09)	0.09 (0.11)	0.12 (0.11)	0.24** (0.10)	0.27** (0.10)	0.23* (0.12)	0.24** (0.12)
Negative shock ⁺	0.13 (0.08)	0.14* (0.09)	0.13 (0.10)	0.17 (0.10)	0.06 (0.10)	0.08 (0.10)	0.12 (0.11)	0.09 (0.12)
Impatience	0.03 (0.02)	0.03 (0.02)	0.02 (0.03)	0.02 (0.03)	0.09*** (0.03)	0.10*** (0.03)	0.02 (0.03)	0.03 (0.03)
Risk aversion	-0.00 (0.02)	-0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.02 (0.02)	0.01 (0.02)	-0.03 (0.02)	-0.03 (0.02)
Low fertile ⁺	0.05 (0.13)	0.07 (0.13)	-0.19 (0.16)	-0.18 (0.17)	-0.06 (0.15)	-0.03 (0.15)	0.29* (0.17)	0.33* (0.18)
Med. fertile ⁺	-0.06 (0.09)	-0.03 (0.09)	-0.17 (0.10)	-0.18* (0.11)	-0.19* (0.11)	-0.19* (0.11)	0.16 (0.12)	0.16 (0.12)
Dist.<(1 minute) ⁺	-0.29 (0.30)	-0.25 (0.31)	0.25 (0.47)	0.25 (0.48)	-0.34 (0.40)	-0.43 (0.41)	-0.84 (0.53)	-0.96* (0.54)
Dist.(1-30 min) ⁺	0.19 (0.27)	0.22 (0.28)	0.72 (0.45)	0.76* (0.46)	-0.21 (0.38)	-0.29 (0.38)	-0.08 (0.51)	-0.13 (0.52)
Dist.(31-60 min) ⁺	0.17 (0.29)	0.20 (0.29)	0.69 (0.46)	0.74 (0.47)	-0.24 (0.39)	-0.26 (0.40)	0.03 (0.54)	-0.02 (0.54)
Maize ⁺	1.34*** (0.11)	1.34*** (0.11)	2.52*** (0.14)	2.57*** (0.15)	-2.26*** (0.16)	-2.29*** (0.16)	-0.53*** (0.13)	-0.54*** (0.14)
Wheat ⁺	0.37*** (0.12)	0.37*** (0.12)	0.63*** (0.14)	0.66*** (0.15)	-0.00 (0.15)	0.01 (0.15)	0.33* (0.17)	0.34* (0.18)
Micro-financ (minutes)(ln)		-0.07 (0.07)		-0.07 (0.08)		-0.28*** (0.09)		-0.27** (0.11)
Market (minutes)(ln)		-0.01 (0.05)		0.04 (0.06)		0.07 (0.06)		-0.05 (0.07)
Coop office (minutes)(ln)		-0.21*** (0.05)		0.01 (0.06)		-0.04 (0.06)		0.04 (0.07)
Input dealer (minutes)(ln)		0.06 (0.05)		-0.14** (0.06)		0.16*** (0.06)		0.03 (0.07)
FTC (minutes)(ln)		0.23*** (0.06)		-0.13* (0.07)		0.03 (0.07)		-0.08 (0.08)
Road (minutes)(ln)		-0.00 (0.02)		-0.00 (0.03)		0.02 (0.02)		-0.00 (0.03)
Bako-Sire ⁺	0.51*** (0.13)	0.48*** (0.16)	0.96*** (0.16)	0.86*** (0.18)	0.82*** (0.17)	0.76*** (0.19)	0.07 (0.16)	-0.15 (0.20)
Hitossa-Tiyo ⁺	-0.35*** (0.12)	-0.36*** (0.13)	-0.00 (0.14)	-0.01 (0.15)	0.24* (0.15)	0.27* (0.15)	0.39** (0.17)	0.30* (0.18)

_cons	-3.35***	-3.19***	-4.24***	-2.97***	1.33	1.63	0.06	1.57
	(0.69)	(0.83)	(0.93)	(1.07)	(0.83)	(1.00)	(0.95)	(1.14)
Switch part (dep var: Narrow/large-Asp.gap)								
Father's involvement in coop	-0.26***	-0.27***	-0.26***	-0.28***	-0.26***	-0.28***	-0.27***	-0.29***
	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)
Female hh head ⁺	0.48**	0.58**	0.51**	0.57**	0.46*	0.54**	0.44*	0.52**
	(0.24)	(0.24)	(0.25)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)
Age hh head	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Square of age	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education of hh head	-0.01	0.01	-0.00	0.01	-0.01	0.01	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
HH size	-0.08***	-0.07***	-0.08***	-0.07***	-0.09***	-0.07***	-0.09***	-0.07***
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Livestock holdings(TLU)	0.03***	0.04***	0.03**	0.04***	0.03**	0.04***	0.03**	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Value of assets (ln)	0.17***	0.13**	0.18***	0.13**	0.18***	0.13**	0.18***	0.13**
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Plot size (ha)	0.05	0.03	0.05	0.02	0.06	0.02	0.06	0.01
	(0.14)	(0.15)	(0.14)	(0.14)	(0.14)	(0.14)	(0.13)	(0.14)
Past beneficiary ⁺	0.41***	0.31***	0.43***	0.33***	0.44***	0.33***	0.46***	0.34***
	(0.10)	(0.11)	(0.10)	(0.11)	(0.10)	(0.11)	(0.10)	(0.11)
Negative shock ⁺	0.15	0.07	0.15	0.08	0.15	0.08	0.15	0.09
	(0.10)	(0.11)	(0.10)	(0.11)	(0.10)	(0.11)	(0.10)	(0.11)
Impatience	-0.04	-0.04	-0.03	-0.04	-0.04	-0.04	-0.03	-0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Risk aversion	-0.09***	-0.08***	-0.10***	-0.08***	-0.10***	-0.08***	-0.10***	-0.08***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Low fertile ⁺	-0.13	-0.19	-0.14	-0.20	-0.13	-0.19	-0.12	-0.17
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Med. fertile ⁺	0.13	0.05	0.12	0.04	0.12	0.04	0.13	0.06
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Dist.<1 minute) ⁺	0.55*	0.59*	0.60*	0.64**	0.61*	0.65**	0.59*	0.63*
	(0.32)	(0.32)	(0.32)	(0.33)	(0.32)	(0.33)	(0.32)	(0.32)
Dist.(1-30 min) ⁺	0.50*	0.58**	0.55**	0.63**	0.56**	0.65**	0.54**	0.63**
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
Dist.(31-60 min) ⁺	0.64**	0.75**	0.66**	0.78**	0.67**	0.79***	0.65**	0.75**
	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)
Maize ⁺	-0.23	-0.22	-0.22	-0.22	-0.20	-0.19	-0.16	-0.16
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.13)	(0.14)
Wheat ⁺	0.12	0.10	0.12	0.10	0.12	0.11	0.13	0.11
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Micro-financ (minutes)(ln)		0.21**		0.21**		0.21**		0.21**
		(0.09)		(0.09)		(0.09)		(0.09)
Market (minutes)(ln)		0.01		0.03		0.03		0.02
		(0.07)		(0.07)		(0.07)		(0.07)
Coop office (minutes)(ln)		0.12		0.11		0.11		0.12*
		(0.07)		(0.07)		(0.07)		(0.07)
Input dealer (minutes)(ln)		-0.09		-0.11		-0.11		-0.11
		(0.07)		(0.07)		(0.07)		(0.07)
FTC (minutes)(ln)		-0.36***		-0.38***		-0.38***		-0.38***
		(0.08)		(0.08)		(0.08)		(0.08)
Road (minutes)(ln)		-0.12***		-0.11***		-0.11***		-0.10***
		(0.04)		(0.04)		(0.04)		(0.04)
Bako-Sire ⁺	0.59***	0.75***	0.57***	0.72***	0.56***	0.70***	0.53***	0.66***
	(0.16)	(0.18)	(0.16)	(0.18)	(0.16)	(0.18)	(0.15)	(0.18)
Hitossa-Tiyo ⁺	0.49***	0.53***	0.53***	0.56***	0.52***	0.55***	0.54***	0.57***
	(0.15)	(0.16)	(0.14)	(0.16)	(0.15)	(0.16)	(0.15)	(0.16)
_cons	0.37	0.90	0.22	0.82	0.20	0.77	0.28	0.82
	(0.91)	(1.09)	(0.90)	(1.10)	(0.91)	(1.10)	(0.90)	(1.10)
rho	-0.39**	-0.37**	-0.26	-0.24	-0.01**	0.02	0.49**	0.42**
	(0.17)	(0.18)	(0.19)	(0.17)	(0.17)	(0.17)	(0.19)	(0.19)

Wald chi2	559***	596***	708***	734***	618***	656***	343***	375***
Observations	1595	1595	1595	1595	1595	1595	1595	1595

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. +Dummy

Table A.3. Determinants of the intensity of fertilizer use (by crop type)

(Endogenous treatment-effects model with maximum likelihood)

	(1)	(2)	(3)	(4)	(5)	(6)
	Teff1	Teff2	Maize1	Maize2	Wheat1	Wheat2
	OLS	Endog.Te.	OLS	Endog.Te.	OLS	Endog.Te.
Narrow/large asp.gap ⁺	-3.03 (9.28)	-67.32** (30.25)	8.42 (10.02)	14.52 (36.65)	8.22 (14.56)	-13.07 (20.22)
Female hh head ⁺	-23.06* (13.36)	-0.39 (16.76)	-6.22 (11.66)	2.23 (13.00)	15.90 (14.83)	16.27 (15.76)
Age of hh head	-2.52 (1.97)	-0.48 (0.06)	0.08 (1.61)	0.09 (1.60)	-0.21 (2.19)	-0.05 (2.11)
Square of age	0.02 (0.02)	-0.00 (0.00)	-0.00 (0.01)	0.00 (0.01)	0.00 (0.02)	0.00 (0.02)
Education hh head	0.64 (1.13)	0.37 (0.03)	0.82 (1.31)	0.02 (1.33)	1.65 (1.21)	1.87 (1.22)
HH size	1.76 (2.09)	-0.08 (0.06)	0.10 (1.62)	0.03 (1.69)	0.48 (1.92)	0.49 (1.94)
Livestock(TLU)	-0.81 (0.88)	-1.03 (0.84)	1.53 (0.97)	1.61 (0.99)	1.62 (1.00)	1.89** (0.96)
Value of assets(ln)	8.63** (3.41)	9.18** (3.75)	11.16** (5.03)	11.39** (0.11)	1.43 (3.64)	1.45 (3.37)
Past beneficiary ⁺	1.08 (7.91)	0.38* (8.93)	5.94 (7.35)	5.44 (7.66)	3.05 (8.90)	2.65 (9.13)
Negative shock ⁺	-3.19 (7.32)	0.28 (8.53)	1.02 (6.92)	3.30 (0.26)	-13.51* (7.90)	-8.22 (7.71)
Impatience	0.00 (1.91)	-1.18 (0.06)	1.04 (2.22)	-0.03 (0.07)	-2.06 (2.13)	-2.69 (2.11)
Risk aversion	1.20 (1.48)	-0.90 (0.04)	1.29 (1.33)	-0.03 (1.45)	1.15 (1.49)	1.25 (1.52)
Land size with Teff (ha)	-2.88 (4.70)	-4.26 (5.73)				
Land size with Maize (ha)			-11.23*** (3.69)	-11.17*** (3.57)		
Land size with Wheat (ha)					-0.98 (2.87)	-0.69 (2.89)
Micro-financ (minutes)(ln)	13.85** (5.61)	0.04 (0.18)	-1.79 (5.11)	0.32 (0.22)	7.85 (7.50)	8.75 (7.58)
Market (minutes)(ln)	3.17 (4.22)	0.11 (0.14)	-1.09 (3.86)	-1.86 (4.11)	-5.44 (4.82)	-6.72 (4.63)
Coop office (minutes)(ln)	2.04 (4.36)	0.19 (4.99)	-4.48 (4.33)	-4.45 (0.16)	0.65 (4.25)	-2.30 (3.92)
Input dealer (minutes)(ln)	-11.46** (5.35)	-0.08 (0.15)	-4.33 (5.66)	-5.37 (0.16)	2.35 (5.30)	2.15 (5.27)
FTC (minutes) (ln)	-2.34 (4.76)	-0.39** (6.20)	13.00*** (4.86)	13.59** (0.17)	3.30 (5.29)	5.48 (5.15)
Road (minutes)(ln)	3.09 (1.90)	2.77 (1.83)	0.35 (1.74)	-0.13** (0.06)	-2.62 (2.13)	-3.23 (2.09)
Bako-Sire ⁺	-106.24*** (11.56)	0.10 (12.46)	231.50*** (12.67)	0.10 (13.17)	-117.09*** (24.39)	-110.84*** (25.42)
Hitossa-Tiyo ⁺	-74.76*** (15.21)	-68.69*** (0.53)	45.44*** (10.71)	0.42 (0.34)	-52.91*** (10.76)	-50.64*** (10.30)
Constant	108.66* (63.33)	140.94** (67.83)	-107.02* (63.54)	-107.51* (61.67)	113.62 (73.78)	121.71* (73.30)
<i>Switch part (dep var: Narrow/large-Asp.gap)</i>						
Mother's involvement in Kebele		0.46*** (0.13)				0.44** (0.23)
Father's involvement in Coop				-0.38*** (0.14)		
Female hh head ⁺		-17.95 (0.42)		0.59 (0.58)		0.17 (0.51)
Age of hh head		0.01 (1.93)		-0.03 (0.06)		-0.10 (0.08)
Square of age		0.00		0.00		0.00

	(0.02)		(0.00)		(0.00)	
Education hh head	-0.01		0.50		-0.01	
	(1.20)		(0.04)		(0.04)	
HH size	0.45		-0.24		-0.18***	
	(2.47)		(0.06)		(0.07)	
Livestock(TLU)	0.00		-0.00		0.01	
	(0.02)		(0.03)		(0.03)	
Value of assets(ln)	0.13		0.13		0.13	
	(0.10)		(5.39)		(0.11)	
Past beneficiary ⁺	8.38		0.12		0.48*	
	(0.23)		(0.27)		(0.29)	
Negative shock ⁺	4.39		0.20		-0.10	
	(0.24)		(7.42)		(0.28)	
Impatience	-0.04		0.90		0.03	
	(2.11)		(2.33)		(0.08)	
Risk aversion	-0.09**		1.17		-0.05	
	(1.83)		(0.05)		(0.06)	
Land size with Teff (ha)	-0.05					
	(0.15)					
Land size with Maize (ha)			0.37			
			(0.26)			
Land size with Wheat (ha)					0.28	
					(0.21)	
Micro-finance (minutes) (ln)	13.59**		-1.79		0.36*	
	(5.89)		(5.79)		(0.20)	
Market (minutes)(ln)	4.86		0.03		0.03	
	(4.96)		(0.17)		(0.16)	
Coop office (minutes)(ln)	4.74		0.01		0.03	
	(0.17)		(4.42)		(0.13)	
Input dealer (minutes)(ln)	-13.24**		-0.23		-0.17	
	(5.71)		(6.08)		(0.16)	
FTC (minutes) (ln)	-8.80		-0.16		-0.48***	
	(0.18)		(5.47)		(0.17)	
Road (minutes)(ln)	-0.08		0.61		-0.25	
	(0.06)		(1.78)		(0.16)	
Bako-Sire ⁺	-102.30***		228.97***		6.50***	
	(0.45)		(0.45)		(0.67)	
Hitossa-Tiyo ⁺	0.20		45.26***		0.05	
	(17.79)		(11.43)		(0.43)	
Constant	0.39		0.58		3.32	
	(1.88)		(2.06)		(2.42)	
athrho(Constant)	0.86**		-0.05		0.30**	
	(0.44)		(0.34)		(0.15)	
Insigma(Constant)	3.99***		3.93***		3.92***	
	(0.11)		(0.09)		(0.06)	
Wald chi2		260.66	1762.43		102.46	
Log lik.	-1165.9	-1140.42	-1308.63	-1275.79	-1203.38	-1167.53
r2	0.53		0.8		0.3	
Observations	220	200	246	223	225	208

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. +Dummy

Table A.4. Determinants of intensity of fertilizer use (household level)

(Endogenous treatment-effects model with maximum likelihood)

	(1)	(2)	(3)	(4)
	Intensity	Intensity	Intensity	Intensity
	OLS	Endog.Te.	Endog.Te.	Endog.Te.
Narrow/large asp.gap ⁺	8.11 (10.81)	-104.79*** (23.86)	-105.35*** (22.09)	-106.43*** (22.26)
Female hh head ⁺	-6.59 (12.58)	2.44 (0.31)	2.49 (12.78)	2.57 (12.80)
Age of hh head	2.74 (2.06)	3.06 (2.30)	3.06 (2.30)	3.06 (0.04)
Square of age	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.00)
Education of hh head	1.55 (1.26)	1.45 (1.42)	1.45 (1.42)	1.44 (0.03)
HH size	-1.23 (2.09)	-2.65 (2.29)	-2.65 (2.29)	-2.67 (0.04)
Total land holdings (ha)	-9.76*** (2.83)	-9.33*** (3.14)	-9.33*** (3.15)	0.00 (3.15)
Livestock holdings (TLU)	3.71*** (1.17)	3.93*** (1.22)	3.94*** (1.22)	3.94*** (0.02)
Value of assets(ln)	12.70*** (3.68)	0.15* (0.08)	16.61*** (4.18)	0.15* (4.19)
Past beneficiary ⁺	4.18 (8.01)	0.34* (9.65)	12.37 (9.59)	0.38** (0.17)
Negative shock ⁺	0.82 (8.51)	0.20 (10.08)	5.13 (10.07)	5.17 (10.09)
Impatience	-2.12 (2.29)	-0.11** (0.05)	-3.27 (2.57)	-0.11** (2.58)
Risk aversion	0.06 (1.49)	-1.16 (0.03)	-1.17 (1.78)	-0.07** (1.79)
Micro-finance (minutes)(ln)	-2.45 (7.48)	0.04 (7.89)	0.83 (7.92)	0.02 (7.93)
Market (minutes)(ln)	-1.75 (4.43)	-1.85 (4.93)	-1.85 (4.93)	0.06 (4.94)
Coop office (minutes)(ln)	4.59 (4.17)	7.32 (4.69)	7.34 (4.69)	0.06 (0.11)
Input dealer (minutes)(ln)	1.00 (4.39)	-2.04 (0.11)	-2.05 (4.81)	-2.08 (0.11)
FTC (minutes) (ln)	1.65 (4.84)	-0.10 (0.11)	-2.34 (5.50)	-0.12 (5.52)
Road (minutes)(ln)	-0.11 (1.67)	-2.06 (1.66)	-2.07 (1.66)	-0.14** (1.66)
Bako-Sire ⁺	80.21*** (13.30)	0.45* (0.26)	87.90*** (14.42)	0.48* (0.26)
Hitossa-Tiyo ⁺	-36.60*** (7.82)	0.26 (0.23)	-26.22*** (9.68)	-26.12*** (0.22)
Constant	-38.48 (72.99)	20.13 (77.54)	20.42 (77.56)	20.98 (77.72)
Father's involvement in coop		-0.12 (0.09)	-0.15* (0.08)	-0.16* (0.09)
Father's involvement in religious group			0.38** (0.16)	0.37** (0.16)
Ratio of inc. growth(2006/2010)		-0.00 (0.00)	-0.00 (0.00)	
Female hh head ⁺		0.49 (12.74)	0.53* (0.32)	0.54* (0.32)
Age of hh head		0.05 (0.04)	0.05 (0.04)	0.05 (2.30)
Square of age		-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.02)
Education hh head		0.02	0.01	0.01

	(0.03)	(0.03)	(1.42)
HH size	-0.04	-0.05	-0.05
	(0.04)	(0.04)	(2.30)
Total land holdings (ha)	0.00	-0.00	-9.33***
	(0.06)	(0.06)	(0.06)
Livestock holdings (TLU)	0.01	0.01	0.01
	(0.02)	(0.02)	(1.22)
Value of assets(ln)	16.59***	0.15*	16.65***
	(4.17)	(0.08)	(0.08)
Past beneficiary ⁺	12.33	0.37**	12.45
	(0.18)	(0.17)	(9.62)
Negative shock ⁺	5.11	0.19	0.19
	(0.19)	(0.19)	(0.19)
Impatience	-3.26	-0.11**	-3.28
	(2.57)	(0.05)	(0.05)
Risk aversion	-0.05	-0.07**	-1.18
	(1.79)	(0.03)	(0.03)
Micro-finance (minutes)(ln)	0.81	0.02	0.86
	(0.15)	(0.15)	(0.15)
Market (minutes)(ln)	0.06	0.06	-1.85
	(0.10)	(0.10)	(0.10)
Coop office (minutes)(ln)	0.06	0.06	7.36
	(0.11)	(0.11)	(4.70)
Input dealer (minutes)(ln)	-0.08	-0.08	-0.08
	(4.81)	(0.11)	(4.81)
FTC (minutes)(ln)	-2.32	-0.12	-2.38
	(5.52)	(0.10)	(0.10)
Road (minutes)(ln)	-0.16**	-0.13**	-2.09
	(0.07)	(0.06)	(0.06)
Bako-Sire ⁺	87.86***	0.46*	87.98***
	(14.44)	(0.27)	(14.45)
Hitossa-Tiyo ⁺	-26.27***	0.25	0.27
	(9.69)	(0.23)	(9.71)
Constatnt	-1.06	-1.11	-1.09
	(1.49)	(1.48)	(1.48)
athrho (constant)	1.21***	1.24***	1.25***
	(0.28)	(0.27)	(0.27)
Insigma (constatnt)	4.35***	4.36***	4.36***
	(0.11)	(0.11)	(0.11)
Observations	352	352	352
Wald chi2		185.03	186.92
Log lik.	-1983.62	-2102.51	-2100.63
r2	0.38		

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. +Dummy

Table A.5. Correlation of aspirations and psychosocial indicators

(Dependent variable: Aspirations index)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SE	LC	OC	E	T	SW	PP	ALL
Self-esteem	0.17** (0.08)							0.12 (0.09)
Locus of control		0.07 (0.11)						-0.10 (0.12)
Openness to change			0.08 (0.06)					0.06 (0.07)
Envy				-0.00 (0.03)				-0.01 (0.03)
Trust					0.09*** (0.03)			0.09*** (0.03)
Subjective wellbeing						0.08*** (0.03)		0.09*** (0.03)
Poverty caused by external factors							-0.13 (0.10)	-0.12 (0.09)
Female hh head [†]	0.03 (0.09)	0.02 (0.09)	0.02 (0.09)	0.01 (0.09)	0.06 (0.09)	0.01 (0.09)	0.01 (0.09)	0.06 (0.09)
Age of hh head	-0.00 (0.02)	0.00 (0.02)	-0.00 (0.02)	-0.00 (0.02)	-0.01 (0.02)	0.00 (0.02)	-0.00 (0.02)	-0.01 (0.02)
Square of age	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Education hh head	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)
HH size	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.03*** (0.01)	0.03* (0.01)	0.03** (0.01)	0.03** (0.01)
Total land holdings (ha)	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.08*** (0.02)	0.08*** (0.02)	0.08*** (0.02)	0.07*** (0.02)	0.07*** (0.02)
Livestock holdings (TLU)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)
Value of assets(ln)	0.07** (0.03)	0.07** (0.03)	0.08*** (0.03)	0.07*** (0.03)	0.08*** (0.03)	0.06** (0.03)	0.07*** (0.03)	0.07** (0.03)
Negative shock [†]	-0.06 (0.07)	-0.07 (0.07)	-0.07 (0.07)	-0.07 (0.07)	-0.05 (0.07)	-0.06 (0.07)	-0.08 (0.07)	-0.05 (0.07)
Mean of others' asset holdings (ln)	-2.49 (4.87)	-2.75 (4.52)	-3.26 (4.70)	-3.14 (4.67)	-2.57 (4.44)	-2.90 (4.61)	-2.62 (4.72)	-2.10 (5.00)
Mean of others' income growth (2010-2014)	0.59 (0.90)	0.77 (0.94)	0.82 (0.95)	0.74 (0.94)	0.49 (0.91)	1.00 (0.93)	0.94 (0.96)	0.92 (0.94)
Village dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	39.67 (79.03)	43.88 (73.41)	52.31 (76.34)	50.28 (75.79)	40.98 (72.01)	46.59 (74.76)	41.87 (76.56)	33.65 (81.09)
Observations	375	375	375	375	375	375	375	375
R-squared	0.31	0.29	0.30	0.29	0.31	0.30	0.30	0.33

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. [†]Dummy

Table A.6. Correlation of expectations and psychosocial indicators

(Dependent variable: Aspirations index)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SE	LC	OC	E	T	SW	PP	ALL
Self-esteem	0.22*** (0.07)							0.11 (0.09)
Locus of control		0.26*** (0.08)						0.20** (0.10)
Openness to change			-0.05 (0.05)					-0.09 (0.06)
Envy				-0.03 (0.03)				-0.01 (0.03)
Trust					0.12*** (0.04)			0.10** (0.04)
Subjective wellbeing						0.08** (0.04)		0.10*** (0.04)
Perception on causes of poverty as external							-0.17** (0.07)	0.01 (0.09)
Female hh head [†]	0.00 (0.10)	0.01 (0.10)	-0.01 (0.10)	-0.01 (0.10)	0.06 (0.10)	-0.01 (0.09)	-0.01 (0.10)	0.06 (0.10)
Age of hh head	-0.00 (0.02)	0.00 (0.02)	0.00 (0.02)	0.00 (0.02)	-0.01 (0.02)	0.00 (0.02)	-0.00 (0.02)	0.00 (0.02)
Square of age	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Education hh head	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)
HH size	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.03 (0.02)	0.02 (0.02)	0.02 (0.02)	0.03 (0.02)
Total land holdings (ha)	0.12*** (0.03)	0.11*** (0.03)	0.12*** (0.03)	0.12*** (0.03)	0.12*** (0.03)	0.12*** (0.03)	0.11*** (0.03)	0.11*** (0.03)
Livestock holdings (TLU)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Value of assets (ln)	0.03 (0.03)	0.03 (0.03)	0.04 (0.03)	0.03 (0.03)	0.05 (0.03)	0.02 (0.03)	0.04 (0.03)	0.02 (0.03)
Negative shock [†]	-0.10* (0.06)	-0.12* (0.06)	-0.11* (0.06)	-0.11* (0.06)	-0.09 (0.06)	-0.10* (0.06)	-0.13** (0.06)	-0.08 (0.06)
Mean of others' asset holdings (ln)	-6.54 (9.99)	-5.88 (9.44)	-7.29 (9.52)	-7.76 (9.46)	-6.61 (9.24)	-7.12 (9.59)	-6.71 (9.79)	-4.88 (9.30)
Mean of others' income growth (2010-2014)	-2.94* (0.06)	-2.64* (0.06)	-2.80* (0.06)	-2.61* (0.06)	-3.09** (0.06)	-2.48 (0.06)	-2.51 (0.06)	-2.75* (0.06)
Constant	104.28 (162.02)	93.62 (153.16)	116.37 (154.39)	124.11 (153.45)	105.40 (149.92)	113.91 (155.50)	107.24 (158.75)	77.46 (150.86)
Observations	375	375	375	375	375	375	375	375
R-squared	0.38	0.39	0.36	0.36	0.38	0.37	0.37	0.42

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. [†]Dummy