MARKET IMPERFECTIONS AND CLASS STRUCTURE: THE CASE OF SOUTH AFRICA

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Abstract

Land and market imperfections shape the organization of agricultural production and lead to different production regimes within rural farm households in South Africa. This paper presents a theoretical model to explain the presence of three main households groups (classes) determined on the basis of the labor regime adopted: small peasants (working both on and off farm), self cultivators (autarkic in labor) and hiring in households. Membership in the three categories is determined by the endogenous shadow wage and the effective market wages. A generalized ordered logit model is used to test the main predictions of the model. Market imperfections, which prevent household from accessing markets, are expected to have different impacts on heterogenous households; in this study, a Brant test on coefficient constancy helps to identify the household specific factors affecting market participation.

Key words: farm households, market imperfections, liquidity constraint.

1 Introduction

Land and market imperfections shape the organization of agricultural production and lead to different production regimes within rural farm households. There is a substantial differentiation across households engaged in agricultural activities which suggests the presence of quite distinct categories of households in the rural areas. Eswaran and Kotwal (1986)[1] use a farm household model in which such categories emerge as a result of differences in land endowment in a imperfect-markets scenario, where the amount of credit depends on land ownership and hiring in labor involves supervision costs. Saudolet et al. (1998) suggest a model which considers transaction costs in the labor market and lead to the identification of three labor regimes (sellers, employers and self-sufficient in labor). Departing from this model we incorporate an additional constraint showing that the lack of pre-harvesting liquidity also has an influence on the labor strategy adopted.

Empirical analysis conducted using data on rural South Africa suggest the presence of quite distinct household categories. Carter and May (1997) identify 8 classes on the basis of the livelihood strategies undertaken[2] by each group. Such categorization is the result of not only differences in both tangible (land and labor) and intangible assets (welfare rights, social reciprocity) but also of the constraints on the ability to effectively exploit such endowments. The usefulness of households categorization emerges also in Eastwood et al. (2006). The authors define the household categories on the basis of their specialization by income source and identify three groups within rural households in a former homeland area of the Limpopo Province (South Africa): factor-reliant, migrancy-dependent and pension-dependent households.

[0]The author would like to thank Robert Eastwood, Michael Lipton, Jeneesh Manga and Federico Perali for their invaluable contributions to this work.

[1]Their model follow the endogenous class formation framework of Roemer (1982) who first formalized household labor regime adoptions.

[2]These classes are: Marginalized households, Welfare dependent households, Remittance dependent households, Secondary wage dependent households, Primary wage dependent households, Mixed income households with secondary wages, Mixed income households with primary wages and entrepreneurial households.

Using the South Africa Rural Survey (1997) we have identified three main classes of landed farm households on the basis of the labor regime adopted: small peasant, self-cultivators and hiring in households. Transaction costs and the lack of liquidity which largely characterized the rural South Africa (Fenwick and Lyne, 1999) are expected to influence household decisions to participate in the labor market. A growing literature has focused on the role of transaction costs in the household supply decision process (Key et al. (2000) and Makhura (2001)) analyzing the relative importance of proportional and fixed transaction cost in the household market participation.

The aim of this study is to analyze the determinants of the class structure identified in rural South Africa; a theoretical framework, built on the classical agricultural household model literature (Singh et al., 1986), is developed to explain classes emergence and behavior. The model incorporates transactions costs in the labor market which lead to differences in the selling and buying prices of labor (wage band). A liquidity constraint is also included to represent the liquidity shortage faced by peasants during the pre-harvesting period which affects household decisions to sell and buy inputs (labor and non labor inputs) and is reflected in their respective shadow prices. The width of the wage bands, therefore, appears to be influenced not only by transactions costs but also by the liquidity status of the households.

In a farm household framework the labor strategy adopted depends on the on farm marginal productivity of labor and on the market wages, which are affected by transaction costs. Because household characteristics can have an influence on both aspects which cannot be distinguished on a theoretical basis, in the empirical estimation we employ an econometric procedure, called Brant test on coefficient constancy, to identify which household characteristics are determinants of household specific wage bands and which others affect on farm labor productivity. In particular, the gender of the household head, access to information (newspaper, magazines, radio), the level of development of the local labor market have been considered as be determinants of transaction costs.

The paper proceeds as follows: section 2 presents some descriptive statistics to provide a broad overview of household categories, in section 3 the theoretical framework is developed and the three household classes are analyzed separately. Section 4 describes the empirical specification adopted and section 5 reports and discusses the results, finally section 6 concludes.

2 A theoretical model to explain class structure

This model provides the theoretical explanation for the emergence of different household categories in a imperfect markets scenario. In particular we consider imperfections in the labor market, allowing for the presence of transaction costs which are directly translated into the *effective cost* of labor. The model departs from the one presented in Saudolet et al. (1998) including the presence of an additional liquidity constraint. The effective cost of hiring labor (h) is given by the market wage plus search and supervision costs and is defined as w_h. The effective off farm wage includes search and other transaction costs and is different between unskilled (w_o^1) and skilled labor (w_o^2). The imperfections in the labor market are therefore translated into the following relation $w_o^1 < w_h < w_o^2$. Family labor is also allocated to on farm (skilled and unskilled, f_q^1 f_q^2) and leisure (f_l^1 f_l^2). The lack of access to inputs such as seeds, fertilizer, pesticides as well as to technical knowledge is one of the major problems faced by South African farmers. This is partly due to the lack of liquidity in the pre - harvesting period and the transaction costs in the input market (the latter are incorporated into the effective price of non-labor production inputs p_x). As

reported by several authors[3], in rural South Africa, income from non-agricultural sources, such as wage employment, is important in providing working capital for the purchase of seeds, fertilizers, and other production inputs; to take this into account we include a liquidity constraint on pre-harvesting period transactions:

$$p_x x + w_h h + K \leq w_o^1 f_o^1 + w_o^2 f_o^2 + S$$

where x represents non-labor production inputs, K are fixed setup costs, and S is the pre-harvesting amount of exogenous transfers. The household maximizes utility which is a function of leisure and income, y. Maximization is subjected to the above liquidity constraint together with additional non-negativity constraints on labor demand and supply, inputs and leisure:

$$\max_{f_o^1, f_o^2, f_q^1, f_q^2, h, x} U(f_l^1, f_l^2, y)$$

where $y = pq(A, h + f_q^1 + f_q^2, x) - w_h h - p_x x - K + w_o^1 f_o^1 + w_o^2 f_o^2 + T$ and $f_l^1 = f^1 - f_q^1 - f_o^1$, $f_l^2 = f^2 - f_l^2 - f_o^2$. The lagrangian function for this problem and the respective first order conditions are reported below.

$$\begin{aligned} L = U(f_l^1, f_l^2, pq(A, h + f_q^1 + f_q^2, x) - w_h h + w_o^1 f_o^1 + w_o^2 f_o^2 + T) \\ +\lambda(w_o^1 f_o^1 + w_o^2 f_o^2 + S - p_x x - w_h h - K) + \mu_k^n f_k^n + \mu_h h + \mu_x x \end{aligned}$$

with $k = q, o, l$ and $n = 1, 2$.

$$\begin{aligned}
&1a) \quad h: && u_y(pq_L - w_h) + \mu_h - \lambda w_h = 0 \quad h \geq 0 \quad \mu_h h = 0 \\
&2a) \quad f_q^1: && u_y pq_L - u_1 + \mu_i^1 - \mu_l^1 = 0 \qquad f_q^1 \geq 0 \quad \mu_i^1 f_q^1 = 0 \\
&3a) \quad f_q^2: && u_y pq_L - u_2 + \mu_i^2 - \mu_l^2 = 0 \qquad f_q^2 \geq 0 \quad \mu_q^2 f_i^2 = 0 \\
&4a) \quad f_o^1: && u_y w_o^1 - u_1 + \mu_o^1 - \mu_l^1 + \lambda w_o^1 = 0 \quad f_o^1 \geq 0 \quad \mu_o^1 f_o^1 = 0 \\
&5a) \quad f_o^2: && u_y w_o^2 - u_2 + \mu_o^2 - \mu_l^2 + \lambda w_o^2 = 0 \quad f_o^2 \geq 0 \quad \mu_o^2 f_o^2 = 0 \\
&6a) \quad x: && u_y(pq_x - p_x) + \mu_x - \lambda p_x = 0 \qquad x \geq 0 \quad \mu_x x = 0 \\
&7a) \quad \lambda: && w_o^1 f_o^1 + w_o^2 f_o^2 + S - p_x x - w_h h - K \geq 0 \quad \lambda \geq 0 \\
& && \lambda(w_o^1 f_o^1 + w_o^2 f_o^2 + S - p_x x - w_h h - K) = 0 \\
&8a) \quad \mu_l^n: && f_l^n \geq 0 \quad \mu_l^n \geq 0 \quad \mu_l^n f_l^n = 0 \qquad n = 1, 2
\end{aligned}$$

where λ is the marginal value of liquidity, T are exogenous transfers mainly represented by pensions and remittances and A is the fixed amount of land cultivated by the household[4].

The inclusion of a liquidity constraint does not affect farm labor allocation of skilled household members. As in Saudolet et al. (1998) skilled members do not work on farm. This can be directly derived from the initial assumption $w_h < w_o^2$, which implies that there are no incentives for the household to employ their skilled members on farm since the foregone wage is higher than the cost of hiring labor. This is also consistent with the conditions derived above since substituting equations 1a and 5a into 2a we obtain $\mu_q^1 = u_y(w_o^2 - w_h) + \lambda(w_o^2 - w_h) + \mu_o^2 + \mu_h > 0$ which implies zero on farm skilled labor.

[3]The complete list of study suggesting such conclusions is reported in Van Zyl et al. (1995).

[4]Since land in South Africa is mainly assigned by local authority which provides only use rights, no market for land is assumed and agricultural land has no value as collateral (Fenwick and Lyne, 1999) as assumed instead in Eswaran and Kotwal (1986) model.

The model cannot explain the presence of households which both hire in and out unskilled labor, however this category constitutes only a little percentage of our sample and will not be considered in this study. Given the initial assumption, $w_o^1 < w_h$, the cost of hiring in labor exceed the forgone wage off farm of unskilled labor, therefore the household has the incentive to replace hired workers with family labor. Substituting equations 1a and 2a into 4a and considering households with positive hired labor ($\mu_h = 0$) we obtain $\mu_o^1 = u_y(w_h - w_o^1) + \mu_q^1 + \lambda(w_h - w_o^1) \geq 0$ which implies that no unskilled labor works off farm[5].

Following the same assumptions of Saudolet et al. (1998) we focus on unskilled family labor assuming that once a skilled member is employed off farm little flexibility remains in the choice between time worked and leisure, therefore $f_o^2 = kf^2$. The model can be simplified and reduced to the following:

$$\max_{h,x,f_o^1,f_i^1,} U(f_l^1, f^2(1-k), y)$$
$$s.t \quad p_x x + w_h h + K \leq w_o^1 f_o^1 + w_o^2 k f^2 + S$$

where $y = pq(A, h + f_q^1, x) - w_h h - w_x x - K + w_o^1 f_o^1 + w_o^2 k f^2 + T$ and $f_l^1 = f^1 - f_q^1 - f_o^1$. The first order conditions for this problem are reported below:

$$1b) \quad h: \quad u_y(pq_L - w_h) + \mu_h - \lambda w_h = 0 \quad h \geq 0 \quad \mu_h h = 0$$
$$2b) \quad f_q^1: \quad u_y pq_L - u_1 + \mu_q^1 - \mu_l^1 = 0 \quad f_i^1 \geq= \quad \mu_q^1 f_i^1 = 0$$
$$3b) \quad f_o^1: \quad u_y w_o^1 - u_1 + \mu_o^1 - \mu_l^1 + \lambda w_o^1 = 0 \quad f_o^1 \geq= \quad \mu_o^1 f_o^1 = 0$$
$$4b) \quad x: \quad u_y(pq_x - p_x) + \mu_x - \lambda p_x = 0 \quad x \geq 0 \quad \mu_x x = 0$$
$$5b) \quad \lambda: \quad w_o^1 f_o^1 + w_o^2 f_o^2 + S - p_x x - w_h h - K \geq 0 \quad \lambda \geq 0$$
$$\lambda(w_o^1 f_o^1 + w_o^2 f_o^2 + S - p_x x - w_h h - K) = 0$$
$$6b) \quad \mu_l^1: \quad f_l^1 \geq 0 \quad \mu_l^1 \geq 0 \quad \mu_l^1 f_l^1 = 0$$

Landed workers. We now specify a lower bound on household assets (including land, human capital and agricultural capital) such that households below this threshold will consider cultivation unprofitable. This is explain by the presence of fixed set-up costs, K. As reported in Eswaran and Kotwal (1986), a household will engage in farming activities only if its maximized utility, U_a^*, obtainable from engaging in farming activities exceeds the utility of being a pure workers, U_w^*. We define Z_0 as the set of household characteristics such that:

$$U_a^*(f_l^1, f^2(1-k), w_o, y_a^*(f^1, f^2, A, w^*, K)) > U_w^*(f_l^1, f^2(1-k), y_w^*(f^1, f^2, w_o, A))$$

This conditions determines the emergence of a category of landed workers and should also address the issue of household preferences on working their own land. For households with $Z > Z_0$ we now analyze the characteristics of each separate category.

Self-cultivators. This category includes only households self sufficient in labor which do not hire

[5]On the other side, considering households which members work off farm, no hired labor is admitted.

labor and which members do not work off farm. The model reduces to the following 4 equations:

$$
\begin{aligned}
&1c) \quad pq_L = u_1/u_y = w^* \\
&2c) \quad pq_x = p_x(1+\lambda/u_y) = \widetilde{p_x} \\
&3c) \quad w_o^2 f_o^2 + T - p_x x - wh_h - K \geq 0 \quad \lambda \geq 0 \\
&\qquad\quad \lambda(w_o^2 f_o^2 + S - p_x x - K) = 0 \\
&4c) \quad y = pq(A, f_q^1, x) - p_x x + w_o^2 k f^2 + T - K
\end{aligned}
$$

The marginal productivity of labor in the autarkic case, from now either w^* or *mpla*, is a function of household characteristics and technology and will also be used as a comparison tool in the identification of following categories. The *mpla* is also influenced by the presence of a liquidity constraint which affects the shadow price of purchased inputs $\widetilde{p}_x$. When the liquidity constraint is binding, the price of inputs is given by the effective price, which includes transaction costs, plus an endogenous markup (λ/u_y) representing the marginal utility of liquidity. Therefore:

$$w^* = w^*(A, f^1, f^2, T, K, p, \widetilde{p}_x) = w^*(A, f^1, f^2, T, K, p, p_x, S) \tag{1}$$

Since $w_h > w_o$, self-cultivator shadow wage lays in between the two thresholds, $w_o^1 < w^* < w_h$. The proof of this result will emerge from following subsections.

Small peasant. Households belonging to this category allocate labor both on and off farm while no hired labor is required. Considering equations 2b and 3b, appropriately adapted to this specific case ($\mu_q^1 = 0$ and $\mu_o^1 = 0$), we obtain the following expression:

$$pq_L = \frac{u_1 + \mu_l^1}{u_y} = w_o^1 \left(1 + \frac{\lambda}{u_y}\right) = \widetilde{w}_o^1 \tag{2}$$

The marginal productivity of family labor, which we define $w_s^* = w_s^*(A, f^1 - f_q^o, f^2, T, K, p, \widetilde{p}_x)$, equals the shadow price of off farm labor ($\widetilde{w}_o^1$) given by the effective price of labor plus an endogenous markup caused by the presence of a liquidity constraint. Since the marginal productivity of labor is a decreasing function of labor it is expected to be higher then the *mpla*, $w_s^* > w^*$, then:

$$w^* < \widetilde{w}_o^1$$

The household will sell labor off farm if the effective wage gained off farm, markup by the presence of an liquidity constraint is greater than the remuneration they would get if all family members worked on farm (*mpla*). The presence of a binding liquidity constraint lower the opportunity cost of being self-cultivator while increases the shadow off farm wage, therefore shifting the thresholds delimiting this category (Figure 1).

Hiring in household Households belonging to this category hires in labor in addition to their family labor. As reported above, there is no off farm labor and considering equations 1b and 2b, with opportune adjustments ($\mu_h = 0$ and $\mu_q^1 = 0$) it follows that:

$$pq_L = \frac{u_1 + \mu_l^1}{u_y} = w_h \left(1 + \frac{\lambda}{u_y}\right) = \widetilde{w}_h \tag{3}$$

Since the marginal productivity of labor is a decreasing function of labor, $w^* > \widetilde{w}_h$, that is if the opportunity cost of being completely self sufficient in labor is higher than the shadow cost of employing external workers, the household will hire in labor. The presence of a binding liquidity constraint higher the shadow price of hiring in labor therefore shifting the thresholds delimiting this category (Figure 1).

The roles played by household characteristics, lack of liquidity and transaction costs in determining the agrarian class structure are illustrated in Figure 1. To simplify the graphical representation, leisure has been considered fixed, and the total amount of household unskilled labor is denoted by the vertical line; changes in household composition are represented by movements in the line. The off farm wage, w_o, lies below the hiring in wage, w_h, and the *mpla* (w^*) corresponds to the intersection between farm labor demand and supply: three cases have been considered. In the first case, w_A^* lies between the two external wages and all family labor is employed on farm at price w_A^*, the household is autarkic in labor. In the second case, a lower demand for labor intercepts the supply curve below the off farm wage (w_B^*), the household will employ part of its family labor on farm at price w_o, selling the rest on the market, f_o^1. The third case is associated to higher labor demands such that the *mpla*, w_C^*, exceeds the hiring in wage. The household will hire in workers (h) at price w_h.

Household characteristics influence the demand and supply of labor as well as the effective external wages. First, transaction costs (C_o, C_h) which depend both on household specific characteristics and other factors exogenous to the households, determine the effective market wages, variations in such costs are depicted by shifts of the horizontal lines. An increase in the transaction costs in the hiring in labor market, for example, will shift upward the correspondent wage line. At the same time, because both hired and off farm labor can affect the household liquidity constraint, also this effect is represented by movements in the wage bands. For a liquidity constrained household, the price of hiring out family labor has an additional value given by the marginal utility of liquidity and summarized by λ. Second, the demand for labor is influenced by changes in land and skilled labor endowments, non-labor income and inputs prices which cause shifts of the curve. An increase in farming land, for example, will shift the demand curve and the interception upward. Depending on the initial conditions, such increase could cause the switch from small peasants to self-cultivator or from self-cultivators to the hiring in category. Finally, given the assumption of an inelastic labor supply curve[6], only changes in household composition cause movements in the line. The graph shows how liquidly and household characteristics (indirectly through their effect on transaction costs) determine the location of the external wage bands. At the same time, both factors may affect directly and indirectly, through the effect of liquidity on the non-labor input shadow price, the position of the demand and supply curve. Which characteristics cannot be identified from a theoretical point of view and; this issue has to be addressed with the support of econometric instruments during the empirical estimation.

The same effects, illustrated with the graph, can be depicted through a comparative statics exercise which, in addition, permits to identify the direction of the effects and offers a set of conditions that can be empirically tested. Table 1 summarizes the expected signs that have been derived from the comparative statics reported in Appendix A. Larger endowments of land and higher income transfers are expected to

[6]This assumption has been introduced only to simplify the graphical representation, it has not been employed in the theoretical household model.

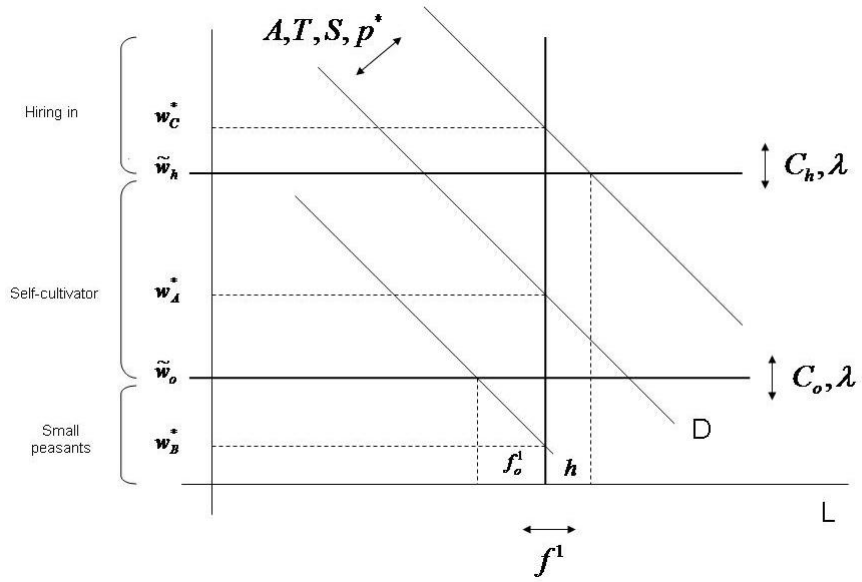

Figure 1: Wage bands and class structure

have a positive impact on the *mpla* therefore, *ceteris paribus*, lowering the probability of selling labor and increasing the probability of hiring in agricultural workers.

Table 1: Results of the comparative statics exercise

Effect	Sign	Effect	Sign
$\frac{\partial w^*}{\partial f^1}$	$-$	$\frac{\partial w^*}{\partial f^2}$	$\pm$
$\frac{\partial w^*}{\partial T}$	$+$	$\frac{\partial w^*}{\partial \widetilde{p}}$	$-$
$\frac{\partial w^*}{\partial A}$	$+$		

In this exercise the shadow price of inputs, $\widetilde{p}$, which has been fixed to simplify the mathematical derivation, negatively affects the *mpla*. It follows that, factors affecting positively the liquidity level of the households, through their negative effect on the non-labor input shadow price, are expected to affect positively w^*. Moreover, larger endowments of unskilled family labor are expected to lower the shadow price of labor causing the switch from the hiring in labor category to self-cultivators and to small peasants category (depending on the initial conditions). Finally, the effect of skilled labor is ambiguous. These predictions will be tested using a generalized ordered logit as described in the following section.

3 Data and empirical specification

The membership in one of the three household categories is determined by the endogenous shadow wage, function of the household characteristics and technology, and the effective wages (for off farm and hired labor) which are influenced by household specific transaction costs. The three household groups can be ordered in accordance with the underlying latent shadow wage and the probability of belonging to one

of the three categories can be estimated considering the framework reported below:

$$P(d_i = 0) = P(i \in \text{Small peasant}) = P(w_i^* + \varepsilon < w_{oi}^1(C_{oi}, \lambda_i)$$
$$P(d_i = 1) = P(i \in \text{Self sufficient}) = P(w_{oi}^1(C_{oi}, \lambda_i) < w_i^* + \varepsilon < w_{hi}(C_{hj}, \lambda_i)$$
$$P(d_i = 2) = P(i \in \text{Hiring in households}) = P(w_i^* + \varepsilon > w_{hi}(C_{hi}, \lambda_i)$$

Where i indicates the i-th household, C_{hj} and C_{oj} are the determinants of transaction costs associated with hiring in and out labor and λ_i represents the household specific liquidity status. The model will be tested using a generalized ordered logit which allows for household specific thresholds. This procedure relaxes the assumption underlying the classical ordered logit model in which the relationship between the explanatory variables and the response one does not vary across categories (parallel equations assumption). The standard order logit model estimates common thresholds, which in this model correspond to equal effective external wages across categories. It is widely recognized in the literature (de Janvry et al., 1991) that households are not affected by market imperfections with the same intensity and many environmental, social and cultural factors affect their specific ability to participate in the markets, therefore households with different characteristics are expected to face different transaction costs, i.e. different effective market wages. The used of a generalized ordered logit allows for household specific thresholds, however does not completely address the issue. It is not always possible *a priori* to correctly discriminate between household characteristics determining the endogenous shadow wage (shifting the demand and supply curve in Figure 1) and factors affecting, instead, the effective market wages (establishing the width of wage bands in Figure 1), i.e. the thresholds. The presence of uneducated family labor, for example, may affect the shadow wage but also the ability of the household to negotiate and avoid transaction costs. Starting from a classical ordered logit, a coefficient constancy test (Brant test[7]) is a useful instrument to determine which variables are determinants of the thresholds, that are those failing the test. Once the test is performed, the independent variables are allocated either to the thresholds or to the latent response regression.

The *mpla* is assumed to be a linear function[8] of the shadow price of inputs $\widetilde{p}_i$ and of those household characteristics, X_i^w which the Brant test have identified as determinants of the latent variable:

$$w_i^* = X_i^w \alpha_w + \widetilde{p}_i \theta + \varepsilon_{wi} \tag{4}$$

where α is a vector of coefficients and the error ε_w has a standard logistic distribution. In this specification the shadow wage, w^*, can be also interpreted as an index of the endowment position of the household. The shadow price of inputs, such as seeds, fertilizers and chemicals can be also linearly approximated by:

$$\widetilde{p}_i = \gamma_p + X_i^p \alpha_p + \varepsilon_{pi} \tag{5}$$

where the explanatory variables, X_i^p, are representative of both the demand and the supply of inputs. Given the relationship reported in equation 1, we can substitute 5 into 4 to obtain the reduced form expression for the shadow wage:

$$w_i^* = X_i^w \alpha_w + (X_i^p \alpha_p + \varepsilon_{pi})\theta + \varepsilon_{wi}$$

[7] An alternative method to test threshold constancy is presented in Pudney and Shield (2000).

[8] The *mpla* and the external wages have been expressed as linear functions of observable also in Bedi and Tunali (2005).

Collecting terms and setting the intercept to zero, the expression reduces to the following:

$$w^* = \mathbf{X}\beta + v$$

The two thresholds are assumed to be a linear function of the household specific determinants of transaction costs and liquidity status:

$$w_n = \delta_0 + \mathbf{Z}\delta_n + \varphi_n$$

where $n = o, h$ which indicates the off farm and hiring in wage respectively[9]. First a standard ordered logit is estimated, meaning that thresholds are considered equal across classes (parallel equation assumption). Then a Brant is performed to assess whether or not the coefficient are the same across categories. For those variable presenting a significant test statistic the constancy assumption has to be rejected. Once the variables have been allocated either to the thresholds or to the response regression, a generalized order logit is estimated to characterize the membership to the three household categories. The log likelihood function is therefore the following:

$$\begin{aligned} l_i(\beta, \delta) \quad = \quad & 1[d_i = 0] \log[\Lambda(w_o - \mathbf{X}\beta - \mathbf{Z}\delta_1)] + 1[d_i = 1] \log[\Lambda(w_h - \mathbf{X}\beta - \mathbf{Z}\delta_2) \\ & -\Lambda(w_o - \mathbf{X}\beta - \mathbf{Z}\delta_1)] + 1[d_i = 2] \log[1 - \Lambda(w_h - \mathbf{X}\beta - \mathbf{Z}\delta_2)] \end{aligned}$$

where β is the vector of coefficients satisfying the parallel regression assumption and δ_n are the vector of coefficient which varies across household categories[10].

The estimation is based on data collected by the Rural Survey in the 1997. Households engaged in both hiring in and out of labor have been excluded and constitute the 3% of the entire sample. The sample has been additionally restricted to those household only involved in maize production (75%). Three classes have been identified on the basis of the allocation of unskilled family labor[11] and on the presence of hired labor. Households with members working both on and off farm are defined "small peasants" while "self-cultivators" devote all family labor to the own farming activities and constitute the largest category in the sample (54 %). Hiring in households, besides family labor, employ additional hired workers and correspond to the 13% of the sample. Category characteristics are summarized in Table 2.

Agricultural assets are represented by the hectares of land used for growing field crops[12], the household human capital (proxied by the age of the household head[13]) and by the presence of structures or buildings on the farm or homestead. An index of land quality is derived from the average productivity of land (in terms of maize) by district. Exogenous transfers are represented by pensions and remittances and

[9]For identification purpose each variable has to be excluded at least from one of the three equations (the shadow wage and the two thresholds equations), using the Brant test it is also possible to address this issue.

[10]The model has been estimated using the stat command gologit2 (Williams, 2006).

[11]Skilled labor includes those household members with a level of eduction higher than the compulsory *general education and training* which runs from grade 0 to grade 9 (Department of Education, Republic of South Africa). In the South Africa education system there are other two educational bands: *further education and training* (from grade 10 to 12) and the *higher education and training* which includes undergraduate and postgraduate degrees, certificates and diplomas

[12]Grazing land is mainly communal and no information is available on the disposal size.

[13]If the head of the household belongs to the skilled labor forces employed off farm than the oldest member working on farm is considered.

Table 2: Descriptive statistics

Variables	Small peasants (33.65 %)	Self-cultivators (53.75 %)	hiring in hhs (12.6 %)
Land hectares (mean)	1.77	2.14	2.60
Unskilled members (male - mean)	2.76	2.11	2.08
Unskilled members (female - mean)	3.00	2.59	2.47
Skilled members (mean)	1.16	1.21	1.25
Access to pensions (% of hhs)	15.72	29.19	27.11
Migrants	47.11	66.86	68.87
Age of the head (mean)	51.93	55.62	56.14

are measured by the number of retired members[14] and employed migrants in the household. Additional variables are included and concern the access to information (through media and contacts with the agricultural extension officers) the length of residency in the area and an index of labor market development constructed as the average number of employed and unemployed members in the household by district.

4 Results

The results of the coefficient constancy test (Brant test), reported in Table 3, determine the allocation of each variable either to the thresholds or to the response regressions. Variables presenting a high Chi-square statistics do not satisfy the parallel regression assumption, their coefficients differ significantly across categories and have been classified as regressors in the threshold equations. Land, labor (skilled and unskilled) and human capital endowments are determinants of the marginal productivity of labor (*mpla*). The length of residency in the area also does not fail the test and will be included in the response equation. In contrast with the empirical specification of Saudolet et al. (1998), the Brant test suggests that pensions and remittances have to be included as regressors in the threshold equation. While this does not alter the overall interpretation of their impact on class structure, which remains in line with previous findings, it suggests that the lack of liquidity is affecting the household labor strategy adopted. In a unconstrained scenario, pensions and remittances would not have any effects on the thresholds (as in Saudolet et al. (1998)), however, in the South Africa context the inclusion of a liquidity constraint seems to be more appropriate as it captures the effect of the marginal utility of liquidity on the effective market wages. The access to information and the level of development of the local labor market also affect the effective wages.

The results of the generalized ordered logit are reported in Table 4. Variables with a positive sign are expected to have a positive effect on the marginal productivity of labor (w^*) increasing the probability of belonging to a higher category. Results referred to the first set of variables, those determining the *mpla*, confirm the predictions of the comparative static exercise; larger land size, for example, has a positive impact on w^*, therefore lowers the probability of working off farm and increases the probability of hiring in labor.

[14] In the 1997 the South Africa pension system provides a maximum benefit of 370 rand a month (around half of household average income) to all women over the age of 60 and men over the age of 65 which can be reduced on the basis of individual incomes including income from assets (Case and Deaton, 1998).

Table 3: Brant Test of Parallel Regression Assumption

Variable	chi2	p>chi2
Land (ha)	3.20	0.074
Buildings (dummy)	0.13	0.718
Index of land quality (by district)	0.15	0.698
Unskilled labor - male	1.76	0.185
Unskilled labor - female	2.15	0.143
Skilled labor	0.05	0.819
Age of household head	3.19	0.074
Length of residency	2.42	0.120
Gender of household head	10.16	0.001
Labor market dev. index (by district)	7.86	0.005
Access to information (dummy)	10.93	0.001
Contact with extension officer (dummy)	8.17	0.004
Members receiving pensions	8.23	0.004
Migrants	8.84	0.003

Table 4: Results of the generalized ordered logit

Variable	Coefficient	Small peasants	Self-cultivators
Land (ha)	0.054***		
	(0.017)		
Buildings	-0.085		
	(0.127)		
Unskilled labor - female	-0.173***		
	(0.030)		
Unskilled labor - male	-0.188***		
	(0.029)		
Skilled labor	0.056		
	(0.035)		
Age of household head	0.003		
	(0.003)		
Length of residency	0.006***		
	(0.001)		
Labor market dev. index		-0.615***	-0.384
		(0.174)	(0.205)
Gender of household head		-0.783***	-0.290**
		(0.111)	(0.134)
Access to information		0.007	0.715***
		(0.124)	(0.188)
Contact with extension officer		0.086	0.724***
		(0.176)	(0.177)
Members receiving pensions		0.713***	0.217*
		(0.117)	(0.118)
Migrants		0.271***	0.077
		(0.055)	(0.057)

Province and area dummies omitted. Numbers reported in parentheses are the standard errors; *, ** and *** indicates a significance at the 10%, 5%, and 1% level respectively.

Results can be also related to those from two binary logit models in which the first category (small peasants) is related to the other two and, in the second one, the first two classes are compared to the highest (hiring in households). In this way, the coefficients referred to the small peasants category only, can be interpreted as affecting the probability of being in a higher class through their effect on the

effective off farm market wage ($\widetilde{w}_o$). Exogenous transfers lower the marginal value of liquidity (λ) and decrease $\widetilde{w}_o$ (equation 2); as expected, households receiving pensions and remittances are less likely to work off farm and can rely on their family activity. On the other hand, a higher degree of development of the local labor market also affects the threshold ($\widetilde{w}_o$) as it implies lower transaction costs; households headed by a male member also face lower transaction costs in the labor market. These two latter factors have a positive impact on the effective market wage off farm and increases the probability of being small peasants. Looking at the third column of results, access to information through media and contacts with extension officers has a positive impact on the probability of hiring in labor. This may be due to the reduction in searching and supervision costs related to improved farmer knowledge. The gender of the head affect the membership of this category; male headed household are less likely to be in the highest category this can be interpret also as a liquidity related factor since in South Africa rural area male heads tend to migrate to the urban centers (Makhura, 2001), therefore their presence in the household may signal a liquidity shortage, this interpretation can also explain the loss of significance of the remittances variable coefficient.

5 Conclusions

This paper has explored how, in an imperfect markets context, asset endowments and liquidity status can affect the labor allocation strategy chosen by the household. Market imperfections are translated into wage differential where transactions costs and the marginal value of liquidity determine the difference between the hiring in and out wage; a brant test on coefficient constancy has help to empirically identify the determinants of such wage gap. Access to land has a positive impact on the ability of the household to rely on own activity and become employer of labor. The lack of liquidity induces household members to work off farm and restricts the ability of acquiring farm inputs including hired labor. This confirms what has been previously found in the literature (Van Zyl et al. (1995) and Fenwick and Lyne (1999)) and suggests the need for policy reforms in the rural credit and land sectors. On the other hand, promoting the development of the labor market and improving local infrastructures can help farmers to gain alternative income sources and cope with liquidity shortage.

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Appendix

A Comparative statics

The shadow wage, w^* in the case of labor-autarkic households will be implicitly estimated and used as a latent decision variable in the empirical section of this study. To analyze how household characteristics and exogenous factors affects household membership in the three categories, we need first to analyze the shadow price response to changes in its determinants. To simplify this analysis we first consider the shadow price of inputs, $\widetilde{p}$ as exogenously given and later we examine the factors affecting the endogenous price of non - labor inputs and how they impact the shadow wage.

For the first part we considered the following four equation which are sufficient to determine f_i^1, w^*, x, y:

$$\begin{aligned} u_1 &= u_y pq_L \\ pq_L &= u_1/u_y = w^* \\ pq_x &= \widetilde{p}_x \\ y &= pq(A, f_q^1, x) - p_x x + w_o^2 k f^2 + T - K \end{aligned}$$

Following Singh et al. (1986) we totally differentiate these first order conditions arranging them in a matrix framework:

$$\begin{pmatrix} a & -u_y pq_{Lx} & 0 & u_{1y} \\ -pq_{LL} & -pq_{Lx} & 1 & 0 \\ -pq_L & 0 & 0 & 1 \\ -pqLx & -pq_{xx} & 0 & 0 \end{pmatrix} \qquad \begin{pmatrix} df^2 \\ dx \\ dw \\ dy \end{pmatrix} =$$

$$\begin{pmatrix} u_{11}df^1 & bdf^2 & cdA & (u_{1y} - u_{yy}pq_L)dT & (-u_{1y}x - u_{yy}pq_L x)d\widetilde{p} \\ 0 & 0 & pq_{LA}dA & 0 & 0 \\ 0 & w_o^2 df^2 & pq_A dA & 1 & xd\widetilde{p} \\ 0 & 0 & pq_{xA} & 0 & d\widetilde{p} \end{pmatrix}$$

where: $a = -u_{11} + u_{1y}pq_L - u_{yy}pq_L pq_L - u_y pq_{LL}$, $b = u_{12}(1-k) + u_{1y}w_o^2 k - u_{yy}pq_L w_o^2$ and $c = u_{1y}pq_A - u_y pq_{LA} - u_{yy}pq_A$. Recalling Cramer's rule, the marginal effect of the k-th exogenous variables, z_k, on the shadow wage can be determined as follow:

$$\frac{\partial w^*}{\partial z_k} = \frac{1}{D} D_{wk}$$

where D is the determinant of the first matrix reported above and D_{wk} is the determinant of the matrix obtained substituting the k-th column in the last matrix into the third column of the first. Applying this rule to the above system of equations we obtain:

$$D = u_y(pq_{LL}pq_{xx} - pq_{Lx}pq_{Lx}) - u_{1y}pq_L pq_{xx} + u_{11}pqxx - u_{1y}pq_L pq_{xx} + u_{yy}pq_L pq_L pq_{xx}$$

In order to guarantee the existence of a maximum in the case of multiple inputs production function, the following condition need to be satisfied : $q_{LL}pq_{xx} - pq_{Lx}pq_{Lx} > 0$[15], therefore the overall sign of the determinant is positive.

[15]This condition is be used also to determined the sign of derivatives.

Now it is possible to derive the sign of the arguments in the shadow wage function as reported below:

$$
\begin{aligned}
\frac{\partial w^*}{\partial f^1} &= \frac{1}{D} - u_{11}(pq_{Lx}pq_{Lx} - q_{LL}pq_{xx}) < 0 \\
\frac{\partial w^*}{\partial f^2} &= \frac{1}{D}[u_{1y}(pq_{Lx}w_o^2 kpq_{Lx} - pq_{LL}w_o^2 pq_{xx}) - (pq_{LL}pq_{xx} - pq_{Lx}pq_{Lx})] \lesseqgtr 0 \\
\frac{\partial w^*}{\partial T} &= \frac{1}{D}(pq_{LL}pq_{xx} - pq_{Lx}pq_{Lx})u_{1y} + u_{1y}pq_{LL}pq_{xx} - u_{yy}pq_Lpq_{LL}pq_{xx}) > 0 \\
\frac{\partial w^*}{\partial \widetilde{p}} &= \frac{1}{D}u_{11}pq_{Lx} + u_{yy}pq_{Lx}(pq_Lpq_L + pq_{LL}pq_{xx} + pq_{Lx}pq_{Lx}) \\
&\qquad -u_{1y}pq_{Lx}(pq_{Lx}x + pq_{Lx}pq_{Lx}) < 0 \\
\frac{\partial w^*}{\partial A} &= \frac{1}{D}[u_{1y}pq_L(pq_{Lx}pq_{Lx} - pq_{LA}pq_{xx} + pq_{Lx}pq_{xA}) + u_{11}(pq_{LA}pq_{xx} - pq_{Lx}pq_{xA}x) \\
&\quad +u_{yy}pq_Lpq_L(pq_{LA}pq_{xx} - pq_{Lx}pq_{LA}) - 2u_ypq_Lpq_xpq_{LL}) - u_{1y}pq_{LA}pq_{xx}] > 0
\end{aligned}
$$

Given the negative relationship between non-labor input price and the shadow wage, factors relaxing the household liquidity constraint and, consequently, negatively affecting the shadow price of inputs are expected to have a positive impact on the endogenous shadow price.