Are rural youth disengaging from agriculture? Empirical evidence from Ethiopia

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Abstract

This study investigates the trends, patterns and prospects of youth involvement in agriculture in Ethiopia, by gender. It also analyses the determinants of youth labor supply in agriculture using household and youth sample survey data collected during 2010/11 and 2014/15 main agricultural seasons in Oromia, one of the designated high agricultural potential area of Ethiopia. Labor supply is measured as the total annual working days (in adult equivalent) of male and female youth members of the household allocated to on-farm and off-farm work. Based on this data the marginal products (shadow wages) of youth workers of each gender and net income (shadow income) are estimated, using a structural time-allocation models. Then the estimated shadow wages and shadow income are used as regressors in a structural model of youth labor supply. The results indicate that trends and patterns of youth involvement in agriculture vary across gender and work locations, and so do their marginal products. Whilst the on-farm participation of youth is declining across time irrespective of gender, the participation in off-farm agricultural activities is increasing for both. There is statistically no significant decrease in the total agricultural labor supply of both male and female youths. Further, we find that the effect of own shadow wage on labor supply is positive for male youth members, suggesting an upward sloping labor supply. However, the effect of own marginal product of female youth labor is negative, suggesting that female youth agricultural labor supply is backward bending. The findings challenge the presumption that youth are abandoning agriculture, at least in the survey areas. Policy implications of the results would be that changes in economic incentives such as shadow wages and shadow income matter for youth involvement in agriculture and off-farm agricultural employment opportunities could help to reduce youth underemployment.

Key words: male youth, female youth, shadow wage, shadow income, agricultural labor supply

JEL codes: D13, J22, J23, Q12

1. Introduction

The composition of population and its distribution across the globe indicates that Africa South of the Sahara (SSA) has the world's youngest population and is home to over 200 million young people (aged between 15 and 24 years). This trend is expected to continue for the coming decades. Seventy percent of these youth reside in rural areas and are employed primarily in the agricultural sector (Omoti, 2012). On average 74% of youth population in Africa lives on less than 2USD per day, lacking the resources and skills to be productive. This poses a great challenge for youth unemployment and also an opportunity to encourage youth to be the engine behind the development of new agricultural enterprises-in farming, research, processing, packaging, and retailing food stuffs.

In Ethiopia, agriculture still plays an important role to the development of the economy. As in the case of most developing countries, agricultural labor is mainly composed of unpaid family work and self-employment (CSA, 2005). The working hours for different age cohort has been changing. Youth in the country are not homogenous group and not all young people across the regions have been benefited and/or affected to the same degree (Calves and Schoumaker, 2004).

Existing studies use the aggregated or homogenous approach of measuring labour supply of agricultural households (Benjamin and Kimli, 2006; Ahearn et al., 2006; Jacoby, 1993; Skoufias, 1994; Kien, 2009; Dupraz and Latruffe, 2015). There are no adequate empirical evidences that distinguish whether market and non-market time (labour) is spent on-farm or off-farm and for which household member and age category is the phenomenon refers to. Available evidences are also inconclusive as to what the patterns, trends and prospects of young people engagement in agriculture look like (Bezu and Holden, 2014; Ahaibw et al., 2013; Agwu et al., 2014). If we want to understand the behaviour of youth career choices (youth participation in agriculture, for instance) we need to comprehend how youth labour is allocated within or among households that involves both market and non-market economy.

The myths of youth participation in agricultural production do not necessarily emanated from the trend and evolution of participation in agriculture but also from the methods and models envisaged by the researcher. Limitation of data (especially the absence of panel data) and empirical inadequacy have also contributed to the inconclusive findings. Often the existing studies use youth intensions (such as to stay in or exit from agriculture, or having agriculture as a primary occupation) as an outcome variable than actual time spent in agriculture in analysing youth participation in agricultural activities. These studies also rely on the separability assumption to analyse youth participation in agriculture (Bezu and Holden, 2014; Ahaibw et al., 2013; Agwu et al., 2014). The main problem with this kind of analysis is its insufficiency to capture actual engagement of youth in agriculture across time and space. Evidence shows that actual engagement and intensions vary greatly (Omoti, 2012). In addition, such kind of analysis does not address adequately the question of whether youth are abandoning agriculture or if they are reducing the number days they work in the sector.

Our study goes beyond the previous studies in several ways. First, unlike the other studies on the topic, we obtain the plot level actual time spent by different members of the farming households. This is distinct from intentions or having agriculture as primary occupation because it provides a better and reliable analysis. This enable us to examine the intensity of youth participation in agriculture. Second, unlike those who used separability approach to analyse youth participation in agriculture, we use the non-separability approach such as shadow wages to estimate the labor supply of youth. This approach accounts for simultaneity between production and consumption decisions of the households and widespread labor market failure (Deolalikar and Vijverberg, 1983, 1987; Jacoby, 1993; Skoufias, 1994; Schultz, 1999; Benjamin and Kimber, 2006; and Chang et al., 2012). Allocation of labor among household members such as youth labor, are thought to depend upon current and future opportunity cost of time (shadow wages), hence use of such kind of approach provides better analysis and fit the Ethiopian rural setting. Third, we control for the possible sources of endogeneity- a common problem often unaddressed in the existing studies of youth employment in agriculture. Finally, we were able to track migrant youth who left the household to work elsewhere on others farm. This provides more accuracy in assessing youth involvement in agriculture across gender, space and time.

The objective of the study is thus, to analyse the trends, patterns and prospects of youth involvement in agriculture, by gender and labor type. We also examine the determinants of youth supply of farm labor. Taking into account intensity of youth involvement on family farm or own farm, off-farm as well as the work of youth at destination for youth migrating to other rural and per-urban areas, the results challenge the presumption that youth are abandoning agriculture, at least in the study areas.

2. Conceptual framework

We extend the notion a utility maximization approach based on the structural time-allocation models for agricultural household members' to estimate the labor supply of youth, disaggregated by gender (Becker, 1965; Manser and Brown, 1980). In this approach resource allocation decisions (including time) of household members is a constrained optimization problem. The model employed here is a version of Gronau's (1997) modified by Jacoby (1993) and employed by Skoufias (1994). Each type of labour inputs is specified as having different effect on agricultural output and change overtime differently.

We assume that a household consists of male mature members, male youth members, female mature members, female youth members and children. Households allocate each of their time endowment (T) among at least four main activities: Leisure (L_i), household production (H_i), market work (M_i) and farm work (F_i); where subscript i indexes male (m) and female (f) youth members, mature members and children. The time devoted to market yields wage income, which allows the purchase of market goods (G_m). The effective real wage for off-farm work, W_i is assumed to be constant. Time allocated to household production combined with other fixed inputs (denoted here by vector K) yields a household produced composite commodity described by the production function:

$$X = X(H_{my}, H_{fy}, H_{mm}\ , H_{fm}, H_c; K)$$

$$H = H_{mm} + H_{fy} + H_{mm} +\ H_{fm} + H_c$$

Where $_{my,\ fy,\ mm\ fm}$ *and* $_c$ denotes male youth household members, female youth household members, male mature household members, female mature household members and children, respectively.

The household produced commodity X is assumed to be perfectly substitute with the composite agriculture commodity that is either produced by household or purchased from the market. The production function for the composite agricultural commodity produced by the household is specified as:

$$\Gamma(F_i, h_i, childern; A)$$

Where Γ a concave function; F denotes family labour; h denotes hired labour; subscript i denotes male and female youth members and male and female mature members in the household; A is a vector of fixed factors such as land. Hired labours for the different groups are paid at the corresponding real wage rates W_i^h. Given, these specifications, households are assumed to choose G_M, H_i, F_i, M_i, h_i so as to maximise utility:

$$U[G_M + X(H_i; F, T - H_{my} - M_{my} - F_{my},\ T - H_{fy} - M_{fy} - F_{fy}, T - H_{mm} - M_{mm} - F_{mm},\ T - H_{fm} - M_{fm} - F_{fm},\ T - H_c - M_c - F_c); \text{B}] + \lambda\big[\Gamma(F_i, h_i, childern; A) - \sum_{i=1}^{5} W_i^H\, h_i + \sum_{i=1}^{5} W_i\, M_i + R\ - G_M\big] + \sum_{i=1}^{5} \mu_i\, M_i \qquad (1)$$

Where λ is the lagrangean multiplier associated with the income inequality constraint and μ is the lagrangean multiplier associated with the inequality constraint on the market work of each labour type (i.e. $M_i \geq 0$). Maximising the lagrangean with respect to G_m, F_i, M_i results the following FOC (using Sheppard's lemma):

$$\frac{\frac{\partial U}{\partial L_i}}{\frac{\partial U}{\partial C}} = W_i^* = W_i + \mu_i/\lambda \qquad (2)$$

$$\frac{\partial \Gamma}{\partial h_i} = W_i^H \qquad (3)$$

$$\frac{\partial \Gamma}{\partial F_i} = W_i^* \qquad (4)$$

$$\frac{\partial \Gamma}{\partial H_i} = W_i^* \qquad (5)$$

Where W_i^* is a "shadow wage rate" of labor type i $\in \{my, fy, mm, fm, c\}$. If a person is working in the market then his/her shadow wage rate will be equal to the respective market wage rate Wi for that gender and age category (i.e. $W_i^* = W_i$). In contrast, if a person is not working in the labor market, then the shadow wage rate, W_i^*will be in general greater than Wi (Skoufias, 1994). Linearizing the budget constraint at the optimum allows one to reformulate the leisure hours for each family labor type as the solution to a traditional model of family labor supply. Thus, the equilibrium solution can be expressed as:

$$Max\ U[G_M + X^*, L_i; \mathrm{B}] \quad (6)$$

Subject to the constraints

$$G_M + X^* + \sum_{i=1}^{5} W_i^* L_i = R^* + \sum_{i=1}^{5} W_i^* T_i \quad \mathrm{i} \in \{my, fy, mm, fm, c\} \quad (7)$$

$$X_M + Z^* + \sum_{i=1}^{5} W_i L_i = V^* + T \sum_{i=1}^{5} W_i^* \quad (8)$$

The left hand side of (8) is the value of total expenditure on goods and leisure with X* denoting the amount of X commodity produced at the optimum H_i^* , W_i^*, being the shadow values of time defined above. The right hand side of the equation (8) is the “shadow full income”.

After some mathematical computation, the solution to this simpler maximization problem results the structural demand for leisure and the corresponding structural labour supply functions respectively:

$$L_i^* = L_i(R_i^*; B) \quad (9)$$

$$D_i^* = D_i\left(W_{my}^*, W_{fy}^*, W_{mm}^*, W_{mf}^*, W_{ch}^*, R^*; B\right) \quad (10)$$

Where$D_i^* = T - Li = F_i^* + H_i^*$; if Mi*=0 (11)

$D_i^* = T - Li = F_i^* + H_i^* + M_i^*$; if Mi* >0 (12)

Where D_i^* is the total working days of family members of category *i* in an on-farm, off-farm and working X. For simplicity D_i^* farm production of crops in an on-farm and off-farm aggregated from each parcels and crops at household lever for the respective gender and age categories, and we assume Mi=0 in the analysis. Detail estimation method is presented under empirical analysis.

3. The data set

The study uses data from the Ethiopian Agricultural Growth Program (AGP) survey, a detailed agricultural panel survey carried out in 2010/11 in four major regions (Oromiya, Amhara, SNNP and Tigray) and in Oromiya region in 2014/15 on sub-sample of households and youths. AGP is a five year program aimed to increase smallholder productivity and value addition in the agricultural sector with increased participation of women and youth. The first wave of survey was implemented jointly by Central statistical agency (CSA) and the Ethiopian strategic support program (ESSP) of International Food Policy Research Institute (IFPRI) during July, 3-22, 2011. The second wave (follow up) was carried out by one of the authors (student) during the months of December 2014 and January 2015.

This study focuses on Oromiya and exclusively on youth members and youth headed households sub-sampled from the region. Multi-stage sampling techniques were employed to sub-sample households with youth members and youth headed households during the second wave. In the first stage, the fresh listing of sampled AGP woredas from Oromiya was prepared and clustered into three categories based on the youth population density: high, medium and low. All the 27 AGP woredas in the region were sorted in descending order based on youth population size, then randomization was applied to select the predetermined 12 woredas. Each woreda contains 3 enumeration areas, a total of 36 enumeration areas were covered during the second wave. In the second stage, a fresh listing of all the 12 sub-sampled woredas was prepared and grouped into mature headed households with youth members and youth headed households. Each woreda contains 78 households. Households who were without youth members were dropped from the fresh listing. Accordingly, total of 525 households with youth members and youth headed were randomly selected from the 12 selected woredas. Households who qualified the criteria but unavailable due to death or migration that made tracking difficult were replaced from the contingency list. Reappointment was made if member of the qualified households were not available at the time of appointment.

The final step was the selection of youth members and youth headed households from within each households. Following the random selection of households with youth members and youth headed residing within each woredas from each EAs, random selection of youths were carried out until the predetermined number is obtained. In this analysis youth has been defined over the age interval of 13 to 34.

Our analysis is based at two levels: household and individual. The empirical analysis at household level is based on a panel survey of all youth members (about 2026 individuals) from 525 households in 36 enumeration areas of Oromiya region. For robustness check and different study a subsample of 660 youths from the same household who were included during baseline were selected randomly during the second wave and used for individual labor analysis (a total of 1320 individuals from the two waves).

Two types of questionnaires were administered to one household: head questionnaire and youth questionnaire. The survey collected detail information on youth characteristics, household characteristics, wealth, agricultural production such as farms, production inputs with detail labor allocation of each household members categorized by age and gender, outputs, plot tenure, and other farm characteristics and off-farm activities.

4. Descriptive statistics

In this section we provide the descriptive statistics for main variables of interest. The patterns of youth participation in agriculture vary by gender. For instance, in 2010/11, 64 percent of male youth members' main occupation was farming (full-time farmer either on own-farm or family farm); while it was about 26 percent for female youth members. Main occupation here refers to the main activities (often called primary occupation) of the youth. Farming here includes herding. Non-farm includes tailor, weaver, crafts, food seller, and trader where as others include teacher, health worker, and cleric (table 1).

On-farm labor supply for both male and female youth members is declining. In 2010/11, on average, male youth spent 5.93 labor days and female youth spent 6.24 labor days per meher[1] season in off-farm[2] production activities. These figures have increased to 7.39 for male youth and 7.01 for female youth in 2014/15 (table 2). The summary of variables used in the estimation of agricultural production function are presented in table 3.

5. Empirical analysis

As stated earlier, our empirical estimation strategy relies on the use of shadow wages to estimate labor supply of youth in agricultural households. The shadow wage estimation method employed here consists of three main steps following Jacoby (1993), Skoufias (1994) and Chang (2012).

First, we obtain estimates of the marginal productivities of each labor type (family male and female youth labour, male and female mature labour, child labor, and hired labor) estimated from a Cobb-Douglas (C-D) production function. We replicated the analysis using the translog production function and using Kien (2008) estimation method- an alternative approach to estimate the shadow wages and shadow income without estimating production function (see Kien, 2008 for the details). The results from the estimations are not documented here and available upon request.

We specify the C-D production function as:

$$\ln Y_{(h,t)} = \sum_{j=1}^{n} \beta_j \ln X_j(ht) + \quad X_{it}\theta + \mu(h) + \tau(t) + \varepsilon(_{h,t}) \qquad (13)$$

Where $\ln Y_{(h,,t)}$ denotes the total value of agricultural outputs produced by farmer h in year t; $\beta_j's$ are parameters to be estimated, Xj (h,t) is the total quantity of input j used and/or contributed by members in household h in year t, and $\mu(h,k)$ is farmer fixed effect that captures the time invariant farmer-specific heterogeneity that can arise from the omission of some key variables such as farmer managerial or soil characteristics;X_{it} is household and youth observable characteristics in year t; $\tau(t,k)$ is a year effect common to all farmers such as rainfall and the last term $\varepsilon(_{h,t})$ is a random disturbance term.

Multiple crop outputs are aggregated into a single output measure using the medians of their reported prices within each village. We considered only crop output and didn't include livestock output. We checked the robustness of our results by including this output values for whom the data was reported and found similar conclusions. We included TLU as an input into the production of crops.

[1] Meher season is the main agricultural season linked to long rainy season from May to January. It accounts for about 90-95% of the annual crop production of Ethiopia.

All variables measured in monetary terms such as output, seed and other inputs are deflated to 2011 prices. District-level fixed effects are applied to all estimations in order to account for invariance within districts. Standard errors are clustered at household level in order to account for correlation individuals situated in the same household.

Second, based on coefficients estimated from equation 13, the shadow wage rates of male youth and female youth family members in household *h* in year *t* are derived using the following expressions:

$$\widehat{W}_{my}^{*}(h,t) = \frac{\hat{Y}_{(h,,t)}}{MYL(h,t)}\widehat{\beta_{MYL}} \quad \text{and} \tag{14}$$

$$\widehat{W}_{fy}^{*}(h,t) = \frac{\hat{Y}_{(h,t)}}{FYL(h,t)}\widehat{\beta_{FYL}} \tag{15}$$

Where $\hat{Y}_{(h,k,t)}$ denotes the fitted value of output by household *h* in year *t* derived from the estimated coefficients of $\widehat{\beta_J}$ for estimated labor type and household fixed effects. In the same way, we derive shadow wages for mature members and child labor.

Once, we estimated the shadow wages, the next step is the estimation of shadow income $\hat{I}(h,t)$ of the household, h, in year t, which could be derived from the expression:

$$\hat{I}(h,t) = \hat{Y}_{(h,,t)} - \widehat{W}_{my}^{*}(h,,t) * MYL(h,t) - \widehat{W}_{fy}^{*}(h,t) * FYL(h,t) - \widehat{W}_{am}^{*}(h,t) * MML(h,t) - \widehat{W}_{af}^{*}(h,t) * MFL(h,t) - W_{my}(h,t) * HMYL(h,t) - W_{fy}(h,t) * HFYL(h,t) - W_{am}(h,t) * HAML(h,t) - W_{af}(h,t) * HFYL(h,t) - W_{ox}(h,t) * OXEN(h,t) - SEEDVAL(h,t) \; - OTHERINP(ht) + \Pi\mathrm{p}(\mathrm{h,t}) + \mathrm{V}(\mathrm{h,t}) \tag{16}$$

Where W_{my}, W_{mm}, W_{fy}, W_{fm}, W_{ox} are the village average wage rates for male youth, male mature, female youth, and female mature and oxen labour services, for household h, in year t, respectively. $\Pi\mathrm{p}(\mathrm{h,t})$ is the sum of net returns from the sale of livestock products, livestock sales and off-farm income and $\mathrm{V}(\mathrm{h,t})$ is income from land rent, oxen rent, handicrafts, business (trade) and transfers received by household *h* in year *t.*

The third stage is the estimation of male and female youth members' labor supply. The shadow wages and shadow income in step two is inserted into labor supply for estimation. In computing our measure of youth labor supply in agriculture, we generally categorized time spent into: on-farm, off-farm and total (the sum of on-farm and off-farm).

The empirical representations of equation (10) for male youth and female youth in household *h* in year t, are specified in log-linear form as follows[3]:

[3] If the shadow income is negative, a value of 1 is assigned so that the observations will not be lost after talking logs. In doing so, 146 observations out of 1051 observations on I was negative.

$lnD^*_{my}(ht) = \gamma_{my0} + \ \gamma_{my} ln\widehat{W}^*_{my}(h,t) + \gamma_{mfy} ln\widehat{W}^*_{fy}(h,t) + \gamma_{mmm} ln\widehat{W}^*_{mm}(h,t) +$
$\gamma_{mfm} ln\widehat{W}^*_{fm}(h,t) + \ \gamma_{myI} ln\hat{\Gamma}(\mathrm{h,t}) + \delta_{my}\ \mathrm{T} + \gamma_{myx} B(\ h,t) + \mu_i + \mu_{it} + \epsilon_{my}(h,t)$
(17)

$lnD^*_{fy}(ht) = \gamma_{fy0} + \ \gamma_{fy} ln\widehat{W}^*_{fy}(h,t) + \gamma_{fmy} ln\widehat{W}^*_{my}(h,t) + \gamma_{fmm} ln\widehat{W}^*_{mm}(h,t) +$
$\gamma_{ffm} ln\widehat{W}^*_{fm}(h,t) + \gamma_{fyI} ln\hat{\Gamma}(\mathrm{h,t}) + \delta_{fy}\ \mathrm{T} + \gamma_{fyx} B(j,h,t) + \mu_i + \mu_{it} + +\epsilon_{fy}(\ h,t)$
(18)

where the $\gamma's \quad and\ \delta$ are parameters to be estimated, $D^*\ (ht)$, $\widehat{W}^*_{my}$ (h,t), $\widehat{W}^*_{fy}$ (h,t), W_{my} W_{fy}, and $\hat{\Gamma}(\mathrm{h,t})$ are as described above; $\widehat{W}^*_{mm}$ (h,t) and $\widehat{W}^*_{mf}$ (h,t) denotes shadow wages for male and female mature members, respectively; $B(h,t)$ denotes a vector of youth and household specific observable characteristics in household h in year t; μi is the standard time invariant unobserved characteristics, (μit) is unobserved time variant and $\epsilon \quad (h,t)$ is error term representing unobservable factors. The coefficient (δ) of year dummy (T) is one of our interest as it indicates trend. For individual estimation, the outcome variables in the labor supply model is the average working days for each labor type per gender of the youth. On-farm and off-farm labor in adult equivalent labor days (AELD)[4] is aggregated from each parcels and specific crops at household level for the respective age and gender categories. Then we matched these working days (aggregated per sex and per age category per labor type per household) with the shadow wages and income estimated in the second stage of the analysis together with youth and household head demographic and asset information.

Since, the shadow wage and shadow income depends on on-farm labor (Fi) which is part of the labor supply (Di) they will therefore be endogenous. Following (Murtazashvili and Wooldridge, 2008), when endogenous explanatory variables are continuous and when we have endogeneity that arises from both time invariant and time variant unobservables, the better way to estimate the parameters in equations 17 and 18 is to use the fixed effects instrumental variables (FE-IV) estimators. It enable us to remove unobserved individual heterogeneity and control for the simultaneity between labour supply, and shadow wages and income (Verbeek and Nijman, 1992). In this estimation, we assume that all youth farm labor are of equal quality other than for gender differences. To control for within correlation, we use cluster-robust covariance.

Table 4 summarizes the statistics of the variables used in the estimation of labour supply functions. In the next sections we present the results of the regression models described earlier.

6. Results and discussions

[4] One AELD represents 8 hours. Adult equivalent labor days were obtained as a weighted sum of labor days reported for adult males (weight=1), adult females (weight=0.84) and children below the age of 14 (weight=0.48.

Table 5 presents the OLS, random-effects and fixed-effects estimates of the coefficients of the production technology specified in equation (13). The Hausman test of the random versus fixed-effects specification fail to reject the random-effects specification at the 5% significance level. The use of random effects estimates indicate that the use of family labours such as male youth, female youth, mature male and female as well as child labor has a larger significant effect on output than the use of hired labor. In addition, the results of both FE and RE estimates indicate that the use of male youth members seem to have bigger effect on output compared to female youth members. We also note that the use of mature female members have higher effect on output compared to other family members. The contribution of child labor in output is also significant.

Based on the random-effects estimates in column (3) of table 5 the shadow wage rates (or marginal products) of male and female youth members' derived using the expressions in equations (17) and (18) are presented in table 6. Most of our discussion will concentrate on the estimated effect of shadow wages and incomes (mainly the results of FE estimates). The first column, third, fifth, seventh, ninth and eleventh reports the FE estimates of male and female youth members on-farm and off-farm labor supply, while the results from the IV counterpart of these models (FE-IV) are given in columns two, four, six, eight, ten and twelve.

After controlling for unobserved heterogeneity, FE estimate estimator in column 1, column 5 and column 9, we find positive and significant shadow wage elasticities (0.40, 0.11 and 0.40 for on-farm, off-farm and total labor supply of male youth members, respectively); suggesting an upward slopping labor supply. The magnitude of the estimates (own shadow wage elasticity and shadow income) for male youth members are similar to the pervious empirical findings of Skoufias (1994), Jacoby (1993) and Kien (2009), though on-farm wage elasticity is a bit higher in this study. An important notable difference observed between the coefficients for male youth members working on-farm with that of male youth members working off-farm is that the effect of shadow wage is higher in an on-farm labor supply compared to off-farm (0.399 vs 0.105). This suggests that family members have stronger work incentives of working on-farm compared to off-farm work.

The negative effect of higher female youth members marginal productivity on male youth member suggest that, male and female youth labours are gross substitutes, except for mature female members. The significance of this cross-wage effect is "consistent with family utility maximization" (Skoufias, 1994: 224). The less substitutability of labor between male youth members and mature female members, given the agricultural production system in Ethiopia, is as expected.

The coefficients on year dummies describe how average time spent on an activity has changed over time, controlling for changes in key demographics. Using the 2010/11 main agricultural production season as a base year, male youth members' on-farm labor supply is decreasing whereas the off-farm supply is increasing. There is a decreasing trend in total labor supply since the on-farm labor supply decrease is greater than the off-farm labor increment. However, none of them are statistically significant, an indicator that youth are not disengaging from agriculture, rather working less hours and to some extent changing work locations.

Off-farm labor supply of male youth members increases with number of male student members in the household. On the other hand, on-farm labor supply of youth male members decreases significantly with the number of male mature labourers in the household since the two labor types are substitutes.

The effect of shadow wage of female youth labor is negative and strongly significant at 1% level, suggesting that female youth agricultural labor supply is backward bending. The effect of shadow income on female youth labor supply is partly realized through the reallocation of labor from on-farm to other activities such as schooling and domestic work. This is reflected in backward slopping labor supply and a recent increasing trend in school participation of female youth, which is also consistent with the marginal role female youth play in agricultural production. As the sign of wage elasticities is theoretically unpredictable, this result is not unusual considering the agricultural production system of farm households in rural Ethiopia. Female youth members' on-farm and off-farm labor supply is decreasing over time though none of them are statistically significant, again an indicator that cast doubt that youth are exiting agriculture. An important difference observed is the effect of shadow income on both types of female labor: an increase in shadow income induces a decrease in an on-farm labor supply where as it induces an increase in off-farm labor supply.

Similar to the findings of Skoufias (1994) female youth members' labor supply appears to exhibit the usual concave pattern in age with adult female members working less. The supply (on-farm and off-farm) of female youth members' decreases with total number of female mature members. Unlike the case for male youth members, the effect of education of the household head on on-farm female youth members is positive and significant at 5% level where as the effect is negative on off-farm labor supply.

So far we have focused on results of the fixed effects estimators without instrumenting the endogeneity of key variables of interest such as shadow wages and shadow income. In columns 2, 4, 6, 8, 10 and 12, we present FE-IV estimators of the different labor supply models. As instruments for the shadow wages and shadow income, we have used exogenous income (remittances, gifts and transfers), market wages for male, female and children, housing facilities (roof type, floor type, bed type), ownership of mobile phones and radios, jewellery, ownership of cart and youth population density. In addition, ownership of stove, sources of drinking water during rainy and dry seasons are used in female youth members.

Focusing on the total labor supply FE-IV estimators, we find that the effect of shadow wage elasticities are higher and strongly significant in all the models than that reported by the FE estimators. In the male youth members' labor supply model, three are no dramatic changes in the sign of the estimated coefficients. However, there are dramatic changes in the size and significance of some of the estimated coefficients. For instance variables such as education of female, shadow wage for female youths, and age of female become insignificant and the only variable that become significant is number of female youth students in the household. In the female youth members' labor supply model, there are not only dramatic changes in the sign but also in the magnitude of the coefficients estimated. For instance, the negative shadow wage of female youth members disappear, and turns to positive while its magnitude has increased dramatically (1.16). The effect of male mature members' shadow wage on female youth members' labor supply becomes significant, with change of sign from positive to negative. Though decreasing trend is observed in both male and female members total labor supply, none of them are significant. Other explanatory variables in the female youth members' total labor supply model that show increase in magnitude and significance include education of female, age of female, total number of female youth students and total number of male full-time youths in the household. The negative effect of female education on female youth labor supply remains negative and strongly significant. In general, all the results indicate that the trends and patterns of youth involvement in agriculture vary across gender and across different categories of work; so do their marginal products.

For comparison, the labor supply functions in equations 17 and 18 were re-estimated for the sub-sample at individual level. Over all similar trend, pattern and magnitude in the estimated coefficients has been observed, results are available upon request.

7. Testing for separability: equality of marginal productivities and market wages

In order to test further whether the labor market functions efficiently, we examined the relationship between the estimated shadow wages and market wages. Assuming that farm households maximize utility, the marginal productivity of work on the family farm should be equal to the market wage received by family members working on the off-farm, if separability exists. We report the results in table 7 which is obtained from the regression of the form:

$$lnW_{it}^{*} = \propto + \beta lnW_{it} + \varepsilon_{it}$$

Where W_{it}^{*} is the estimated shadow wage of labor type i = male youth members, female youth members in year t; W_{it} is the wage received by working in the off-farm labor market in year t and ε_{it} is a random term. The observed market wage are instrumented for possible measurement errors using the variables age, education and their squares. The results strongly rejected the existence of separability.

8. Conclusions and policy implications

In this study, we investigate the trends, patterns and analyse the determinants of youth labor supply in agriculture, by gender using household and youth sample survey data collected during 2010/11 and 2014/15 agricultural seasons. We find that trends and patterns of youth involvement in agriculture vary across gender and work locations; so do their marginal products. Whilst the participation of youth in on-farm for both sex is declining across time (though insignificant for male youth), the participation in off-farm is increasing for both. There is statistically no decrease in the total agricultural labor supply of both male and female youth. The effect of own shadow wage is positive for male youth, suggesting an upward sloping labor supply. However, own shadow wage of female youth labor is negative and strongly significant at 1% level, suggesting that female youth agricultural labor supply is backward bending (using FE). Our estimation results also indicate that the magnitude of shadow wage elasticities and shadow income depends on the estimators chosen. The shadow wage elasticities are especially higher when instrumenting for shadow wages. Taking into account intensity of youth involvement on family farm or own farm, off-farm as well as their work at destination for youth migrating to other rural and per-urban areas, the results challenge the presumption that youth are exiting agriculture, at least in agricultural potential areas of Ethiopia.

Our estimation approach tests the existence of separability-the hypothesis strongly rejected in the estimation in favour of a non-separation model. A policy implications of the results would be that changes in economic incentives such as shadow wages matter for youth involvement in agriculture, but the impact of it induces different outcomes for male and female youth labor supply. In addition, the results indicate that increasing trend of off-farm employment opportunities can help to reduce youth unemployment and underemployment. Furthermore, attributes related to youth female members such as education and age of female youth members, composition of family structures and education of the household head also matters for youth involvement in agriculture. In line with this, we conclude that the myths of youth participation in agriculture over the last decade does not necessarily emanated from the trend and evolution of participation in agriculture but also from the methodological drawbacks. Limitation of data regarding youth labour allocation in agricultural production has also contributed to this inconclusive findings in the literature, especially the absence of panel data. This study tries to fill these gaps

References

Aguiar, M. and Hurst, E., 2006. Measuring Trends in Leisure: The Allocation of Time over Five Decades." Federal Reserve Bank of Boston Working Paper.

Barnum, H.N. and Squire, L., 1979. *A model of an agricultural household: theory and evidence [Malaysia]*. Published for the World Bank [by] Johns Hopkins University Press.

Becker, G.S., 1965. A Theory of the Allocation of Time. *The economic journal*, *75*(299), pp.493-517.

Benjamin, D., 1992. Household composition, labor markets, and labor demand: testing for separation in agricultural household models. *Econometrica: Journal of the Econometric Society*, pp.287-322.

Bezu S, Holden S., 2014. Are rural youth in Ethiopia abandoning agriculture? World Development. 2014 Dec 31; 64:259-72.

Calvès, A.E. and Schoumaker, B., 2004. Deteriorating economic context and changing patterns of youth employment in urban Burkina Faso: 1980–2000.*World Development*, *32*(8), pp.1341-1354.

Chang, Y.M., Huang, B.W. and Chen, Y.J., 2012. Labor supply, income, and welfare of the farm household. *Labour Economics*, *19*(3), pp.427-437.

C.S.A. 2013. Statistical Report on the 1999 National Labor Force Survey (Statistical Bulletin No.225), Addis Ababa, Ethiopia.

Deolalikar, A.B., Vijverberg, W.P., 1983. The test for heterogeneity of family and hired labor in agricultural production: A test using direct-level data from India, *Journal of Development Economics*, 8(2), pp. 45-89.

Dessing, M., 2002. Labor supply, the family and poverty: the S-shaped labor supply curve. *Journal of Economic Behavior & Organization*, *49*(4), pp.433-458.

FAO (2014), General and equity implications of land-related investments for access to land, employment and other income opportunities: Selected studies in Sierra Leone FAO (2014), Youth and agriculture: Key challenges and concrete solutions. Rome.

Juhn, C. and Murphy, K.M., 1996. *Wage inequality and family labor supply* (No. w5459). National Bureau of Economic Research.

Jacoby, H.G., 1993. Shadow wages and peasant family labour supply: an econometric application to the Peruvian Sierra. *The Review of Economic Studies*, *60*(4), pp.903-921.

ILO (2013) Global employment trends for youth 2013: a generation at risk. International Labour Office (ILO), Geneva

Le, K.T., 2009. Shadow wages and shadow income in farmers' labor supply functions. *American Journal of Agricultural Economics*, *91*(3), pp.685-696.

Macurdy, T. E. and Pencavel, J. H. (1986), Testing between Competing Models of Wage and Employment Determination in Unionized Markets, *Journal of Political Economy*, 94, S3-39

Manser, M. and Brown, M., 1980. Marriage and household decision-making: A bargaining analysis. *International economic review*, pp.31-44.

Murtazashvili, I. and Wooldridge, J.M., 2008. Fixed effects instrumental variables estimation in correlated random coefficient panel data models. *Journal of Econometrics*, *142*(1), pp.539-552.

Nijman, T. and Verbeek, M., 1992. Nonresponse in panel data: The impact on estimates of a life cycle consumption function. *Journal of Applied Econometrics*, *7*(3), pp.243-257.

Rosenzweig, M.R., 1980. Neoclassical theory and the optimizing peasant: An econometric analysis of market family labor supply in a developing country. *The Quarterly Journal of Economics*, pp.31-55.

Semykina, A. and Wooldridge, J.M., 2010. Estimating panel data models in the presence of endogeneity and selection. *Journal of Econometrics*, *157*(2), pp.375-380.

Skoufias, E., 1994. Using shadow wages to estimate labor supply of agricultural households. *American Journal of Agricultural Economics*, *76*(2), pp.215-227.

Tables

Table 1: Main occupation, by gender and year

Year	Category	Farming (own or family farm)	Domestic work	Non-farm	Student	Unemployed	Others
2010/2011	Male	64.4	3.4	0.7	29.1	0.2	1.4
	Female	26.2	13.5	4.9	50.0	0.8	3.3
2014/2015	Male	62	1	0	35	1	0.3
	Female	19	18	1	58	1	1

Source: own computation.

Table 2: Average youth and household labor supply and demand (in adult equivalent labor days-AELD) for main agricultural season

	Male youth		Female youth		Household	
Year	On-farm	Off-farm	On-farm	Off-farm	Total demand	Total supply
2010/11	29.05	5.93	18.84	6.24	95.92	109.67
2014/15	27.55	7.39	15.04	7.01	94.62	112.41
Total	28.14	6.66	16.91	6.77	95.26	111.07
Mean diff	-1.50	1.45	-3.80	0.77	-1.29	3.74
P-value	0.25	0.43	0.05	0.51	0.41	0.34
N	1159	1159	1022	1022	1022	1022

Source: own computation

Table 3: Definition, Mean and standard deviation of other variables used in the estimation of the agricultural production: main agricultural season

Variable	Variable descriptions	2010/11 Mean	2010/11 Standard deviation	2014/15 Mean	2014/15 Standard deviation
Totoutput	Total output value in 2011 prices-crop only	10812.89	24909.85	13431.54	24650.95
MYL	Total working days of family labour contributed by male youth members (in AELD)	57.22	58.19	51.98	84.75
FYL	Total working days of family labor contributed by female youth members (in AELD)	20.31	31.73	15.28	28.34
MML	Total working days of mature family labor contributed by male members (in AELD)	29.92	43.25	22.98	39.44
MFL	Total working days of mature family labor contributed by female members (in AELD)	10.17	16.43	16.72	25.78
CHL	Total working days of family child labor (in AELD)	5.82	12.62		
THL	Total hired labor days	6.06	20.94	14.37	78.75
OXEN	Total oxen owned (TLU)	1.78	2.49	2.18	2.62
AREA	Total cropped areas in hectares	2.08	3.18	1.66	2.165
SEEDVAL	Value of seeds (2010/11 birr)	277.00	734.37	309.59	834.31
FERRVAL	Value of fertilizer (2011 birr)	740.96	1164.15	802.84	1344.83
WEEDVAL	Value of seeds	46.55	193.411	53.49	220.80
Extension	Frequency of extension visits	0.88	1.88	0.86	1.87
Age head	Age of household head in years	41.71	15.18	43.09	15.30
sexhead	Sex of head of the household. 1=male; 2=female	1.27	0.44	1.30	0.45
educhead	Education of the household head in completed years	1.63	2.67	1.96	2.94
Age_youth	Average age of the youth in completed years	9.37	6.63	22.22	6.07
Educ_youth	Average education of youth in completed years	0.51	2.58	3.86	3.24
Other variables in the model includes:					
Marital status of head, marital status of youth, sex of youth, woreda dummies, shock dummies such as input prices, pests; total number of children, total number of male and female youth members, total number of male and female mature members, farm assets, land size, plot characteristics-slope, soil quality, farm distance.					
Number of households		521		511	

Source: Own compilation.

Table 4: Definition, Mean and standard deviation of variables used in the estimation of youth labor supply

Variable name	Description of key variables used in labor supply models	2010/11		2014/15	
		Mean	Standard deviation	Mean	Standard deviation
$\hat{I}$	Shadow income estimated for the household	4,708	5,743	6,760	8,872
W_{my}	Shadow wage estimated for male youth members	7.268	8.761	18.61	40.67
W_{fy}	Shadow wage estimated for female youth members	6.764	25.14	9.804	24.32
W_{mm}	Shadow wage estimated for male mature members	4.134	6.556	19.86	25.91
W_{mf}	Shadow wage estimated for female mature members	26.38	31.86	34.00	33.54
Wm	Market wage earned by male youth	16.82	4.041	39.27	12.73
Wf	Market wage earned by female youth	14.09	3.085	20.95	16.36
ToT_On	Total on-farm family labour days(AELD)	90.86	84.58	99.35	102.5
off_MYL_ha	Total off-farm male youth labour days(AELD)	6.73	54.12	10.70	101.38
off_MYL_ha	Total off-farm female youth labour days(AELD)	6.42	43.44	7.01	51.23
ToT_Off	Total off-farm labour days (in AELD)	11.17	36.51		28.37
ToT_Lss	Total supply of household labour (in AELD)	130.5	99.04	119.6	125.8
MYL	Total male youth members labour contribution (AELD, on-farm)	57.10	58.57	52.38	84.78
FYL	Total female youth members labour contribution (AELD,on-farm)	20.69	31.17	16.71	27.77
MML	Total male mature members labour days (in AELD, on-farm)	30.58	43.35	23.40	39.45
MFL	Total female mature labor days (in AELD, on-farm)	10.55	16.39	17.04	25.68
CHL	Child labour (in AELD, on-farm)	5.759	14.05	5.249	11.21
THL	Total hired labour days (in AELD)	6.130	21.02	14.43	78.91
Farm_Dist	Farm distance from the household home(in minutes)	0.207	0.295	0.198	0.283
Childern_tot	# of children under 14 years	1.427	1.122	1.362	1.159
Student_m	# of male student youth 13-34 years	0.733	0.942	0.703	0.925
Student_f	# of female student youth 13-34 years	0.702	0.932	0.717	0.922
Full_timeyou_m	# of full-time male youth 13-34 years	0.722	0.701	0.730	0.716
Full_timeyou_f	# of full-time female youth 13-34 years	0.310	0.548	0.262	0.482
TLU	Number of livestock owned in TLU	8.204	8.530	8.523	8.733
Educ_male	Average education of male youth	2.844	2.976	2.895	3.061
Age_male	Average age of male youth members	17.60	9.893	17.99	10.01
Educ_female	Average education of female youth members	2.558	3.279	2.365	3.008
Age_female	Average age of female youth members	18.12	9.403	19.16	9.026
Headtype	Head type(1=youth headed, 0 otherwise)	0.34		0.39	
Sexhead	Sex of household head (1=female, 0 otherwise)	0.28		0.30	
educhead	Education of the household head(years)	1.640	2.66	1.94	2.9
marithead	Marital status of the household head(1=married, 0 otherwise)	0.72	0.44	0.71	0.45
Assetprod	Value of assets for agricultural production (in 2011 prices)	5,363	3849	7518	5420
Youth_male	# of male youth in the household 13-34 years	1.22		1.15	
Youth_female	# of male youth in the household 13-34 years	1.17		1.08	
Mature_male	# of male mature in the household >35 years	1.0		0.86	
Mature_fem	# of female mature in the household >35 years	0.70		0.54	
	Number of observations(households)	511		506	

Source: own computation

Table 5: Cobb-Douglass agricultural production function: OLS, FE and RE estimates

Dependent variable: Log(total value of output)			
	(1)	(2)	(3)
Variables	OLS	Fixed Effects	Random Effects
Head of the household (1=female, 0 otherwise)	-0.168*	-	-0.1518*
	(0.0925)	-	0.0935
Age of household head	0.0215*	0.0254	0.0234**
	(0.0120)	(0.0200)	(0.0116)
Age of head (squared)	-0.000185*	-0.000152	-0.000197*
	(0.000112)	(0.000162)	(0.000105)
Head type (1=mature head, 0 otherwise)	-0.0655	-	-0.176
	(0.132)	-	(0.215)
Education of household head(years)	0.00177	-0.00883	0.00157
	(0.0130)	(0.0352)	(0.0120)
Marital status of head(1=married, 0 otherwise)	0.0671	-	(0.0352)
	(0.0707)	-	0.0316
Log(MYL)	0.0590***	0.0463*	0.0579***
	(0.0224)	(0.0214)	(0.0224)
Log(FYL)	0.00786	0.0234	0.00740
	(0.0370)	(0.0482)**	(0.0383)*
Log(MML)	0.0333	0.0284	0.0214*
	(0.0285)	(0.0325)	(0.0302)
Log(MFL)	0.0693**	0.0661**	0.0653**
	(0.0271)	(0.0306)	(0.0260)
Log(CHL)	0.0441	0.0382	0.0492*
	(0.0271)	(0.108)	(0.0281)
Log(THL)	0.0256	0.0119	0.0239
	(0.0242)	(0.0314)	(0.0241)
Log(OXEN)	0.254***	0.173**	0.254***
	(0.0456)	(0.0734)	(0.0459)
Log(land)	0.446***	0.347***	0.432***
	(0.0736)	(0.0740)	(0.0698)
Log(FERRVAL)	0.0356***	-0.0286	0.0335***
	(0.0109)	(0.0303)	(0.0110)
Log(SEEDVAL)	-0.00341	-0.146	-0.00323
	(0.0115)	(0.732)	(0.0116)
Log(WEEDVAL)	0.0745***	-0.0591	0.0762***
	(0.0180)	(0.757)	(0.0182)
Average education of male youth members (years)	-0.00572	-0.0131	-0.00584
	(0.0126)	(0.0221)	(0.0129)
Average age of male youth members (years)	0.00447	0.00412	0.00500
	(0.00456)	(0.00746)	(0.00483)
Average education of female youth members	-0.00342	-0.00301	-0.00386
	(0.00982)	(0.0161)	(0.00976)
Average age of female youth members	-0.00280	-0.0104*	-0.00346
	(0.00321)	(0.00551)	(0.00322)
Much rain and floods at harvest(1=yes, 0 otherwise)	-0.209***	-0.0770	-.1812**
Constant	6.517***	8.106	6.523***
	(0.342)	(6.300)	(0.340)
Observations	1,022	1,022	1,022
Household FE		YES	YES
Year FE		Yes	Yes
Fixed vs Random Hausman	Prob>chi2	=	0.2378

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: own computation

Table 6: Determinants of on-farm, off-farm and total male and female youth labor supply (FE and FE-IV estimation result): at household level

(Dependent variable: Log (total working days of male or female members')

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	On-farm				Off-farm				Total			
	Male FE	Male FE-IV	Female FE	Female FE-IV	Male FE	Male FE-IV	Female FE	Female FE-IV	Male FE	Male FE-IV	Female FE	Female FE-IV
$\ln(\widehat{W_{my}})$	0.399***	1.639***	-0.0850*	0.0737	0.105**	0.147**	-0.0266	-0.0760	0.404***	1.575***	-0.122***	-0.0295
	(0.0666)	(0.0740)	(0.0451)	(0.0634)	(0.0469)	(0.0703)	(0.0427)	(0.0835)	(0.0669)	(0.0784)	(0.0450)	(0.0699)
$\ln(\widehat{W_{fy}})$	-0.208***	0.133	-0.293***	1.535***	0.0178	-0.00685	0.0503	0.237**	-0.211***	0.0573	-0.264***	1.162***
	(0.0564)	(0.109)	(0.0595)	(0.105)	(0.0487)	(0.133)	(0.0477)	(0.107)	(0.0566)	(0.111)	(0.0585)	(0.110)
$\ln(\widehat{W_{mm}})$	-0.227***	-0.921***	-0.0195	-0.714***	0.0283	-0.0184	0.0341	-0.118	-0.208***	-0.840***	0.0188	-0.502***
	(0.0519)	(0.158)	(0.0453)	(0.154)	(0.0452)	(0.166)	(0.0413)	(0.143)	(0.0515)	(0.159)	(0.0461)	(0.165)
$\ln(\widehat{W_{mf}})$	0.133***	0.927***	0.0310	0.527**	0.0273	-0.190	0.0366	-0.144	0.130***	0.836***	0.0269	0.450*
	(0.0422)	(0.236)	(0.0400)	(0.227)	(0.0399)	(0.265)	(0.0424)	(0.216)	(0.0429)	(0.248)	(0.0430)	(0.239)
$\ln(\widehat{W_{ch}})$	-0.0925*	-0.136	-0.0170	0.149	-0.0674	-0.273*	-0.00835	-0.0394	-0.110*	-0.165	-0.00525	0.00749
	(0.0550)	(0.111)	(0.0591)	(0.109)	(0.0634)	(0.144)	(0.0565)	(0.135)	(0.0568)	(0.121)	(0.0567)	(0.122)
$\ln(\hat{I})$	-0.0436	-0.129	-0.0158	-0.0915	0.0198	0.132	0.0639**	0.256**	-0.0415	-0.0828	0.00165	0.0656
	(0.0294)	(0.0896)	(0.0220)	(0.0980)	(0.0267)	(0.125)	(0.0265)	(0.125)	(0.0306)	(0.0956)	(0.0222)	(0.105)
Trend	-0.0676	-0.226*	0.0175	-0.0579	0.0283	0.160	-0.104	0.101	-0.0310	-0.175	-0.0761	-0.175
	(0.127)	(0.117)	(0.120)	(0.127)	(0.117)	(0.153)	(0.104)	(0.144)	(0.126)	(0.129)	(0.119)	(0.137)
educ_male	0.0375	0.0339	0.0553	0.0983	-0.0913	-0.101	-0.0503	-0.0600	-0.0206	-0.0258	-0.0351	-0.00406
	(0.0864)	(0.0595)	(0.0739)	(0.0598)	(0.0697)	(0.0693)	(0.0666)	(0.0679)	(0.0877)	(0.0658)	(0.0743)	(0.0672)
edu_male2	-0.000286	-0.00317	-0.00885	-0.0129**	0.00804	0.00815	0.00293	0.00351	0.00412	0.00131	-0.000635	-0.00403
	(0.00901)	(0.00662)	(0.00660)	(0.00544)	(0.00763)	(0.00790)	(0.00542)	(0.00615)	(0.00952)	(0.00746)	(0.00623)	(0.00610)
age_male	-0.00192	-0.00845	0.0202	-0.0129	0.0281	0.0384*	-0.00740	-0.00492	0.0116	0.00726	0.0230	-0.00374
	(0.0291)	(0.0198)	(0.0241)	(0.0210)	(0.0218)	(0.0217)	(0.0240)	(0.0247)	(0.0296)	(0.0205)	(0.0239)	(0.0225)
educ_female	-0.128	-0.0332	-0.129**	-0.172***	-0.0678	-0.0649	-0.0727	-0.0830	-0.141*	-0.0503	-0.141**	-0.189***
	(0.0794)	(0.0555)	(0.0646)	(0.0499)	(0.0506)	(0.0495)	(0.0530)	(0.0553)	(0.0797)	(0.0565)	(0.0607)	(0.0535)
edu_femal2	0.00390	-0.000370	0.00572	0.00888***	0.00237	0.00243	0.00239	0.00331	0.00466	0.000552	0.00621*	0.00944***
	(0.00656)	(0.00417)	(0.00394)	(0.00320)	(0.00363)	(0.00341)	(0.00393)	(0.00391)	(0.00662)	(0.00430)	(0.00372)	(0.00344)
age_female	0.0771***	0.0187	0.0547	0.0386*	0.0327	0.0239	0.0560**	0.0514**	0.0836***	0.0273	0.0522*	0.0440**
	(0.0271)	(0.0192)	(0.0333)	(0.0201)	(0.0229)	(0.0216)	(0.0236)	(0.0238)	(0.0255)	(0.0194)	(0.0307)	(0.0221)
Childern_tot	-0.00514	-0.0304	0.0840	0.0588	-0.0700	-0.0735	-0.0290	-0.0277	-0.00138	-0.0212	0.112	0.0989
	(0.0772)	(0.0545)	(0.0657)	(0.0578)	(0.0607)	(0.0621)	(0.0546)	(0.0547)	(0.0786)	(0.0564)	(0.0683)	(0.0658)
Student_m	0.122	0.0442	0.0716	0.0302	0.130**	0.125**	0.108*	0.118**	0.110	0.0334	0.110	0.0726

	(0.0984)	(0.0695)	(0.0787)	(0.0645)	(0.0611)	(0.0608)	(0.0598)	(0.0598)	(0.0935)	(0.0702)	(0.0765)	(0.0696)
Student_f	-0.0515	-0.112*	-0.0583	-0.0906	-0.0568	-0.0652	-0.0368	-0.0441	-0.0523	-0.111*	-0.125	-0.156**
	(0.105)	(0.0658)	(0.0817)	(0.0647)	(0.0664)	(0.0673)	(0.0660)	(0.0653)	(0.105)	(0.0659)	(0.0814)	(0.0702)
Full_timeyou_m	0.0605	0.0761	0.0786	0.154**	0.102	0.0946	0.0779	0.0867	0.0461	0.0605	0.0838	0.156*
	(0.108)	(0.0788)	(0.0924)	(0.0785)	(0.0973)	(0.0997)	(0.0813)	(0.0793)	(0.110)	(0.0845)	(0.0907)	(0.0831)
Full_timeyou_f	0.0478	-0.0301	0.102	0.0607	-0.0280	-0.00637	-0.0324	-0.0354	0.0850	0.0152	0.0956	0.0668
	(0.126)	(0.0848)	(0.0926)	(0.106)	(0.0919)	(0.0949)	(0.0984)	(0.0985)	(0.122)	(0.0884)	(0.0992)	(0.111)
Mature_male	-0.576***	-0.407***	-0.0107	0.00677	-0.0943	-0.0352	-0.0197	-0.00731	-0.592***	-0.424***	-0.0361	-0.0292
	(0.106)	(0.0732)	(0.0845)	(0.0838)	(0.0827)	(0.0825)	(0.0751)	(0.0747)	(0.104)	(0.0745)	(0.0866)	(0.0883)
mature_fem	-0.0340	0.0364	-0.478***	-0.278***	-0.0322	-0.0276	-0.163**	-0.109	0.00347	0.0645	-0.399***	-0.248***
	(0.109)	(0.0756)	(0.0931)	(0.0727)	(0.0816)	(0.0749)	(0.0760)	(0.0727)	(0.110)	(0.0785)	(0.0989)	(0.0826)
agehead	0.00421	0.0129	-0.0508*	-0.0324	-0.00991	-0.00630	-0.0332	-0.0226	0.0111	0.0193	-0.0476	-0.0305
	(0.0354)	(0.0208)	(0.0307)	(0.0235)	(0.0218)	(0.0223)	(0.0236)	(0.0233)	(0.0347)	(0.0214)	(0.0313)	(0.0290)
educhead	0.0143	0.0171	0.0990**	0.0459	-0.0808**	-0.0907**	-0.098***	-0.116***	-0.000269	0.00489	0.0509	0.00846
	(0.0525)	(0.0358)	(0.0428)	(0.0498)	(0.0348)	(0.0362)	(0.0355)	(0.0374)	(0.0498)	(0.0359)	(0.0417)	(0.0473)
Constant	3.020***	0.651	3.378***	1.121	0.669	0.595	1.322	0.0693	2.930***	0.555	4.177***	1.508
	(0.996)	(0.921)	(0.921)	(1.146)	(0.773)	(1.409)	(0.803)	(1.313)	(1.003)	(1.020)	(0.920)	(1.228)
Observations	1,015	1,011	1,015	1,011	1,015	1,011	1,015	1,011	1,015	1,011	1,015	1,011
R-squared	0.267	0.643	0.198	0.389	0.068	0.069	0.084	0.088	0.273	0.606	0.185	0.277

Source: survey results   Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Test for separability

Variables	Jacoby Test (Ho:β=1 & α=0)
Log (predicted market wage)	2.117***
	(0.198)
Constant	-1.757***
	(0.616)
Observations	1,220
F-test for joint significance:	0.000

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: Own computation