Assessing the Role of Estates on Smallholder Household Labor Allocation in Sub-Saharan Africa: A Case Study of Malawi

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Abstract

Estate farming in Malawi Africa is a very important part of the agricultural landscape dating back to the colonial era. This is more so the case in Malawi where estates covering about 1.35 million hectares or about a quarter of the country's arable area. With large investments in agricultural land, the labor decisions of smallholder households will likely be altered. This study examined the role of estate farms on smallholders' allocation of labor between on-farm, and off-farm casual employment as well as their demand for casual labor using the *ganyu* system of Malawi as a case-study. Using the Malawi Integrated Household Panel survey (IHPS) covering the years 2020, 2013, 2016 and 2019 I estimated the effect of estates on the participation of smallholders on these labor decisions as well as the number of days spent in each activity. Linear probability model (LPM), as well as tobit-correlated random effects (CRE) regressions were estimated to test these effects. I also controlled for relevant household and community variables such as household size, landholdings, value of assets, precipitation etc. Both models showed that estates had a negative correlation on ganyu demand especially where they constituted 75% or more of the agricultural land.

The LPM showed that households in communities with 75% or more share of estates have about 6% less probability to demand ganyu labor. There was no marked effect of estates on the other labor variables. On average, the CRE regression showed that a 1%-point increase in the share of agricultural land occupied by estates was associated with a modest 0.02 to 0.04 percent ($p<0.1$) number of days of ganyu labor demanded by all households. Moreover, when estate shares are dummied, I also found that households in communities with 75% or more estate shares had 21 to 25% ($p<0.05$) less days of ganyu labor demand than those in estate-less communities. Conversely, households in these communities (with >=75% estate share) spent 19% more days ($p<0.1$) on their own crop farming activities. Households in communities with 50% estate share supplied 75% more days of ganyu labor ($p<0.1$) than households without estates.

Based on these findings, and anecdotal evidence, the presence of estates on labor outcomes (especially labor demand) in Malawi is mostly significant where they occupy 75% or more of the agricultural land owing to *tenancy* or squatter arrangements which limits ownership rights, and the opportunities for non-agricultural employment. This argument is supported by the positive significant role that variables such as asset ownership and land size also had. The current government's drive to engender a more liberal market for agricultural land holds very promising prospects and will benefit if complemented by other policies that will also enhance non-agricultural employment opportunities.

Keywords: Estate farming, Ganyu, Small holder household, Household labor allocation
JEL Classification: J22, Q12

1. Introduction

The debate on whether a smallholder or large farm led agriculture holds the most merit for agricultural development in sub-Saharan Africa has lingered for decades (Collier and Dercon, 2014, Hazell 2015; Hall et al., 2017). Having missed out on the well acclaimed successes of the smallholder dominant Asian green revolution, and witnessed the success of the large-farms model (e.g. the Brazilian Cerrado) in Latin America, most African countries have had the burden of exploring what agricultural development model works best for the region (Deininger and Byerlee, 2012). Irrespective of the favored development path, most SSA countries have made agricultural commercialization a major plank of their economic development policy while ensuring that smallholders are not deprived of crucial resources especially land (Yaro et al., 2017). Three models of agricultural commercialization have emerged as a result: estate (plantation) farms, contract farms and medium-scale commercial farming (Hall et al., 2017; Yaro et al., 2017). Estates are larger than the average holding, mostly grow one crop, requires large capital investment, are centrally managed and rely a lot on hired labor (Smalley, 2013). In Malawi, estate farming is a very important part of the agricultural landscape dating back to the colonial era. As of now, estate lands cover about 1.35 million hectares i.e., about a quarter of the country's arable area ((Deininger and Xia, 2018, Broms, 2020).

With such large investments in agricultural land, the labor decisions of smallholder households will be altered in a number of ways. First, where estate farms exist, they could be very important employers of hired labor especially in predominantly agrarian economies like Malawi with limited alternative employment opportunities (Dimova 2010; Lindsjo et al., 2020). The alienation of customary land from smallholders might make these households move them from household agricultural activities into alternative vocations of which hired employment in estates is most likely, in the context of limited employment opportunities (Smalley, 2013; Deininger and Xia,

2016). Another indirect way by which this might be the case is that smallholders may be outcompeted from access to casual labor markets which they depend on traditionally. Malawi has a very well established informal casual off-farm labor system known as *ganyu* which has been well documented as a coping strategy among Malawians in rural areas (Whiteside 2000, Bryceson 2006). Farm households in communities that have estate farms may also use ganyu labor as an income diversification strategy. However, it is also possible that the presence of estates in a community may attract agricultural opportunities such as input and output markets while will encourage more agricultural activity by smallholder farmers (Jayne et al., 2019b). In addition to the labor supply questions, there is also a corresponding equilibrium effect that estates could impose on the demand of ganyu labor by households. For example, estate farms could pay higher *ganyu* wage rates and by so doing, disenfranchise smallholder households from access to the ganyu labor market. However, the rent-seeking behavior of estate farms in employing cheap labor, offering exploitative working conditions and in most cases employing more migrant labor than locals may also have the very opposite effect (Yaro et al., 2017; Hall et al., 2017).

This study examined the role of estate farms on smallholders' allocation of labor between on-farm, and off-farm casual employment as well as their demand for casual labor using the ganyu system of Malawi as a case-study. The crucial research questions which the present study therefore addressed are: are estates in Malawi causing smallholder households to reduce household labor supply to their own farms? If yes, are these smallholder households therefore supplying more of their labor to off-farm *ganyu* work? Also, how is smallholders' household *ganyu* demand affected by estates in the community?

To answer these questions, I use data from four waves of the Malawi integrated household panel survey conducted between 2010 and 2019 to first determine the effect of community land allocated

for estate purposes on the smallholder households' decision to participate in own farm activities, *ganyu* supply and demand. Secondly, I estimate the effect of estates on the number of days that household members spend on own-farm agricultural activities, *ganyu* supply and demand. Malawi makes for a very interesting case considering the number of years that most of these lands have been under estate designation. This in addition to the multiple waves of panel data enables me to quantify the long-term impact of Malawi's estate policy on smallholder's labor decisions.

To my knowledge, very little has been done to quantify the impact of large-scale land acquisition on smallholder labor decisions in sub-Saharan Africa generally, and more specifically estate farms in Malawi. Ali *et al* (2019) studied the impact of large farms on smallholders' labor market participation in Ethiopia. Similarly, Deininger and Xia (2016) studied among other outcomes, the spillover effects of newly established large farms (mostly 10 to 50 ha) on smallholders' off-farm labor supply in Mozambique. While the former study found no evidence for paid or casual job creation for smallholders, the Deininger and Xia study found some evidence for job creation by farms that are in very close proximity with smallholders. A crucial gap in these studies is that they only look at labor supply in wage and casual employment without considering household farming activities. The reality is that most rural agricultural households are faced with making a choice as to how their labor will be supplied between their own farms and other farms (*ganyu*), and this should be considered together for a more complete analysis. The allocation of household labor across on and off farm agricultural activities therefore represents a more flexible short-term choice for rural households. Another peculiarity of the current study is in the tenure and nature of these estate farms with most of them allocated more than two decades or more ago (Deininger and Xia, 2018). Unlike recent large scale land investments examined in the aforementioned studies, estate farms are long entrenched parts of the Malawi agricultural landscape but there has been little or no

direct empirical assessment (at least in my review) of the relationship between them and *ganyu* another very crucial feature of Malawian agriculture. This study hopes to fill this gap. Finally, another contribution this study makes is in the empirical design. In the aforementioned studies, the authors use binary indicators to indicate rural labor market participation as their dependent variables. Binary indicators are noted to result in a loss of information, and a reduced power to quantify relationships while also resulting in inflated type 1 error rates (Schmitz *et al.*, 2012). In the present study I use a variety of specifications to better quantify the effects being studied. Considering the concurrent nature of the own-farm, and *ganyu* labor decisions, I estimate the impact of estate lands on own-farm labor supply as well as *ganyu* labor demand and supply using a systems of equation approach. Moreover, in addition to binary outcomes, I used continuous dependent variables i.e. the total days worked by all household members in each sector to evaluate the effect of these estates on smallholder household labor dynamics.

This study therefore contributes to an emerging body of literature that is concerned with studying the spillover effect of large agricultural and land investments on smallholder outcomes including labor. Smallholder farmers currently account for more than 80% of farmers in Africa (NEPAD, 2013; Hazell, 2015). More specifically, 84.7% of Malawian households are involved in agricultural activities, with 78.1% of individuals above 15 years being involved in *ganyu* activities (World Bank, 2020). Given this reality, a study such as this which elucidates on the labor livelihood dynamics will be very valuable to policy makers in the bid to reduce poverty in Sub-Saharan Africa. Given these realities, any study such as this which elucidates on the livelihood dynamics between the two will be very valuable to policy makers in their poverty reduction goals (Bhandari and Ghimire, 2016).

To achieve study objectives, I used the Integrated Household Panel Survey (IHPS) data conducted in Malawi over four waves-2010, 2013, 2016, 2019. I employed panel methods such as fixed effect and correlated random effect estimators helps to address time invariant-heterogeneities that may have affected the location of estate farms in specific communities and bias the results. Overall, I find very modest effect of estates on smallholder household labor allocation. When taken as an aggregate, estates had no effect on the probability of participation in any of the agricultural labor decision except *ganyu* demand. The LPM showed that households in communities with 75% or more share of estates have about 6% less probability to demand *ganyu* labor. There was no marked effect of estates on the other labor variables. On average, the CRE regression showed that a 1% point increase in the share of agricultural land occupied by estates was associated with a modest 0.02 to 0.04 percent ($p<0.1$) number of days of *ganyu* labor demanded by all households. Moreover, when estate shares are dummied, I also found that households in communities with 75% or more estate shares had 21 to 25% ($p<0.05$) less days of *ganyu* labor demand than those in estate-less communities. Conversely, households in these communities (with >=75% estate share) spent 19% more days ($p<0.1$) on their own crop farming activities. Households in communities with 50% estate share supplied 75% more days of *ganyu* labor ($p<0.1$) than households without estates.

The rest of this paper proceeds as follows. Section 2 gives a conceptual background to the present study. Section 3 covers the empirical strategy of the study, followed by the results and discussion in the fifth section. Conclusions and policy implications are presented in the last section.

2. Conceptual Framework

The theoretical underpinning of this study is the canonical agricultural household model (AHM) credited to Singh, Squire and Strauss (1985). In this model the household maximizes a quasi-concave utility $U(C, L;\ Z)$ function by choosing consumption C and leisure levels L , where Z is a vector of exogenous household characteristics e.g. household size, and value of assets that might affect marginal utilities of consumption and leisure (Benjamin 1992; Taylor and Adelman, 2003). U is well behaved and has positive partial directives with respect to C and L (Strauss, 1984). The utility maximization decision is defined within an income constraint that is defined by household production Q, returns from family labor and other non-production income I (e.g. remittances). Q is a quasi-convex function of T^f , hired labor H, and land cultivated A. Apart from the budget constraint faced by the household, it is also faced by a constraint on its time endowment T which is divided between farm work T^f , off-farm work T^{off}, and leisure L (Huffman and El-Osta, 1997). Considering that household labor-leisure margin is almost negligible in most rural households, the AHM in this case essentially reduces to a labor and consumption decision (Adhikari, 1996). T^f, T^{off} and H are therefore endogenous to the household. For simplicity, I assume a common price for agricultural and consumption goods. This makes sense in the case of maize which is the main consumption staple in Malawi, as well as the most commonly cultivated crop by smallholders (Ricker-Gilbert, 2014). Moreover, maize price is usually determined exogenously by government parastatals in Malawi (FAO, 2020). I also assume an exogenous uniform *ganyu* wage rate for hired and supplied labor as the scope of the current study is not to assess equilibrium impact of estate farms on the *ganyu* market.

Estates could play an implicit role in the labor choices of the household in a number of ways. The presence of large agricultural investments like estates could present positive spillovers such as

extension services, increased availability of farm inputs, bigger markets for commodities as well as machinery to local smallholders (Muyanga *et al.*, 2019). In this case smallholders' net income may be increased, and their budget constraint relaxed by spending more time on own-cropping activities. This should also result in higher demand for *ganyu* and less *ganyu* supply due to increased profitability of household farming activities. On the other hand, estates may alienate or outcompete smallholders by monopolizing from input and output market opportunities, thereby pushing them (smallholders) away from own farm activities (Ali *et al.*, 2019). In this scenario, to maximize or maintain previous utility, levels smallholders may allocate more time towards off-farm activities while reducing on-farm work and demand for labor. In the context of the current study, the most common off-farm opportunity will be *ganyu* labor supply.

The foregoing discourse suggests a reduced form model of the form:

$$Y = f(E, X, C) \qquad 1$$

Where Y is the dependent variable of interest- in this case a measure of T^f , T^{off} or H; E is a measure of estates in the community; X is a vector of household characteristics, while C is a vector of community characteristics. For simplicity, E, X and C are assumed to be exogenous.

3. Empirical Specification and Strategy

Based on the foregoing discourse, the following general null hypothesis was tested:

H_0: *Estates do not have any effect on the amount of smallholder household labor allocated to household farming activity, nor household ganyu labor supply and demand.*

I model household labor allocation and demand as follows based on 1 above:

$$Y_{ijt} = \alpha + \beta_1 EF_{jt} + \gamma X_{ijt} + \rho C_{jt} + \theta_i + \sigma_t + \varepsilon_{ijt} \quad (2)$$

Where Y_{ijt} the variable of interest represents the labor allocation variable which could be one of (i) the total number of days that members of household *i* in community (or Enumeration Area- EA) *j* spends on own farm cropping activities in year *t*, (ii) the total number of days that the household member spends on *ganyu* activity in the year (iii) The total number of days that the household employed hired labor for agricultural activities in year *t*. In the LPM specification, Y_{ijt} is defined as a binary variable equal to 1, if the household participates in a given labor demand or supply activity. The specifications of Y_{ijt} are all in line with the literature on rural household labor dynamics. For example, Ricker-Gilbert (2014) used both number of days and the binary participation indicator when estimating the employment effects of Malawi's fertilizer subsidy program on household labor decisions. Deininger and Xia (2016) also used a binary indicator in their study of employment effects of large land-based investments in Mozambique.

EF_{jt} is the explanatory variable of interest i.e. a measure of the estates in the region. The Malawi LSMS-ISA data source used contains information on the share of agricultural land in the EA that is occupied by estates with responses given as 0%, 25%, 50%, 75% and 100% (See Table 1). Based on this scale of response, EF_{jt} was implemented as (i) a continuous variable and (ii) a set of dummies representing each of the first three levels, and communities with >= 75% estate share (due to the smaller number of observations). θ_i refers to household level time-invariant unobservables (which also absorbs EA effects) and σ_t refers to year dummies that may affect the labor and supply decisions of the households. β_1 is therefore a vector of the parameters of interest in the current study. The error term ε_{ijt} consists of a random component and other unobservables that may affect the labor supply and demand activities.

X_{ijt} is the vector of household variables such as age of household head, household size, number of working age individuals (i.e. 15 to 65 years), landholding, the monetary value of assets owned by the household, and the age and sex of the household head. Household size and number of working age individuals represent the household's work capacity and should have an implication on how much of labor the household can supply to either their own farm or as *ganyu*. Considering that non-agricultural employment opportunities and leisure are assumed to be negligible in this model, households with more working age members should also demand less *ganyu* as working-age family members would be able to deal more effectively with the drudgery of crop farming (Dimova *et al.,* 2010). Landholding and asset value are also very important indications of the wealth status of the household that may affect the tightness of their budgets and consequently their labor supply decisions. Interestingly, evidence from previous studies (e.g., Ricker-Gilbert, 2014) have showed that among poor households, those who demand for *ganyu* are not necessarily those with larger landholdings. The sex of the household head which is usually a time-invariant characteristic was included because within the study period, it varied for a number of households due to death. Moreover, previous studies (e.g. Dimova *et al.,* 2010) showed that female headed households are usually more resource constrained and may supply more *ganyu* to mitigate budget issues. Studies have documented the impact of different household level shocks such as weather (Lewin *et al.,* 2012*;* Xu *et al.,* 2019), price shocks (Danzer and Grundke, 2020), cost shocks (Grabrucker and Grimm, 2018), and personal shocks (Alwang and Siegel, 1999; Dimova *et al.,* 2010) on household's agricultural labor decision. Depending on the direction of impact, households that are affected by these shocks may intensify household farm activity or use *ganyu* demand or supply as a temporal coping mechanism. Therefore, a dummy representing shocks from

high cost of agricultural inputs, as well as experience with natural disaster the previous year were included in the regressions. The household variables are presented in Table 2.

C_{jt} is a vector of other community level variables that could affect household agricultural labor decisions. This includes the community *ganyu* wage rate which was computed as the median wage rate paid by households in each community per year. The same convention for proxying regional wage rates has been applied by previous studies such as those by Ricker-Gilbert (2014) and Dimova *et al* (2010) with the latter using mean rates. Like Ricker-Gilbert (2014), I use median rates here as a way to deal with the problem of data censoring that occurs with household data. Another very important variable included here is the planting season price of maize which is the major staple of Malawi. Maize is also an important wage crop in Malawi, as it is commonly used for *ganyu* remuneration by households (Dorward, 2006). Considering that maize supply is lowest, and prices higher in the planting and pre-harvest seasons, most households are usually forced to be involved in *ganyu* as a way to smooth consumption before harvest when prices are lowest (Ricker-Gilbert, 2014). Maize prices therefore have a serious implication on labor decisions. Since most planting occurs during the rainy season, the prices used in the present study were those of the current year's rainy season. The current year's price has also been used in previous studies (such as Ravallion, 1990; Ricker-Gilbert, 2014) for modelling effect on household labor decisions. C_{jt} also includes other variables such as the average distance to an ADMARC (Agricultural Development and Market Corporation) market, the presence of a MASAF (Malawi Social Action Fund) program which hires residents in need of work, the community population, and the presence of microfinance institutions. These variables were added as an indication of the exposure of the communities to markets which certainly has an implication on the agricultural labor supply and demand decisions of the households in the community per previous studies such as Anim (2011),

and Bedemo *et al* (2013). ADMARC markets play an important role in Malawi's agriculture buying farm output from smallholders. The importance of ADMARC markets to Malawian farmers has been a subject of contention in several studies with some studies suggesting that they underpay smallholders for their outputs (Chirwa *et al.,* 2005; Jayne *et al.,* 2010). They, however, represent smallholder proximity of markets and could play a role in the decision of smallholders to spend time on their own farms and/or demand *ganyu* (Jayne *et al.,* 2010). The inclusion of the presence of microfinance institutions is also very crucial as these institutions play a crucial role in relaxing household credit constraints, as well as help them deal with shocks. They are therefore important in household labor supply decisions-on-farm and *ganyu.* Finally, C_{jt} includes other weather variables such as the annual precipitation and temperature in the community. These weather variables could either incentivize or disincentivize households from crop farming, and *ganyu* supply (Lambert, 2014; Lee *et al.,* 2018). In the CRE estimation which allowed for time invariant variables, I included variables such as distance to a major road, distance to the district center (or *Boma*), year and region dummies. These variables are presented in Table 3

The decision to demand and supply labor will vary across different segments of the population. Considering the fact that *ganyu* cuts across both agricultural and non-agricultural labor, equation *(2)* is estimated for the entire population and for only agricultural households -in this case those who cultivated land all through the four waves. Considering the fact that these decisions are all made at the household level and are affected by the same factors I model the labor supply variables as a system of seemingly unrelated regressions to account for the possibility of cross-equation correlation of error terms (Cameron and Trivedi, 2010).

To deal with endogeneity problems, I control for a number of time varying EA level variables that affects the labor allocation variables (Table 3). I also use a fixed effect or correlated random

estimator depending on the specification. By time-demeaning the data, the fixed effect estimator gets rid of any time-constant EA heterogeneity which could simultaneously affect the dependent variable and the estate variable (Wooldridge, 2015). The CRE approach also enables the inclusion of many time constant variables which could make the estate variable endogenous. Therefore, I included time constant dummies reflecting regionality, as well as average distance of the respective communities from a major district center (*Boma)* and road in my model specification. I believe the measures cited here should reduce any endogeneity biases that could arise otherwise.

Both the tobit-CRE and the LPM-FE models are estimated as systems of unrelated regressions considering the possibility of contemporaneous errors in the three decisions. The following exclusion restrictions were made for the *ganyu* supply and demand equations. For the *ganyu* supply equation, the presence of ADMARC market is excluded as output markets should not directly affect the supply of *ganyu* labor. Also, while the presence of microfinance institutions could directly affect labor supply on and off farm by relaxing household budget constraints, it should not directly affect *ganyu* demand. This variable is therefore excluded from all demand equations.

Data

The principal source of data for this study is the integrated household panel survey (IHPS) which represents a sub-sample of household who were surveyed in the Living Standards Measurement Study (LSMS) implemented in Malawi by the National Statistical Office of the Government of Malawi with technical assistance provided by the World Bank and International Food Policy Research Institute (IFPRI). The Malawi IHPS data set contains three waves of data collected in 2010, 2013, 2016 and 2019. The panel sample was increased in each wave by tracking individuals who split-off and new households that were formed from the original wave. Each wave contained household, community and agriculture modules.

The household module contained information on household characteristics such as the main economic activity of household members, the number of hours spent on various activities in the last year, household size etc. The agricultural module contains more information on the household's agricultural activities including plot size cultivated and the amount of time spent on household crop farming activity (land preparation, weeding and fertilization and harvesting) during the rainy and dry (*Dimba*) seasons. Finally, the community module contains information on community variables including share of the community's agricultural land under estate lease. Community level data were resolved at the Enumeration Area (EA), Traditional Authority (TA) and District levels.

The initial survey consisted of 1619 households sampled from 102 EAs. However, by the second wave in 2010, only 1388 original households were resurveyed (i.e. a 14.3% attrition). In the 2016 survey, the community module only contained data from 97 EAs out of the 102 surveyed in the previous waves. After careful assessment and matching, 1355 original households were recovered from the household module. However, since community module data only covered 97 EAs, matching both modules produced 1277 households implying a 8% attrition from the previous wave. By 2019, the number of original households recovered from the sample was 1234 implying a 3.37% attrition rate from the 2016 wave. However, after data cleaning and removal of missing variables, a balanced panel consisting of 1145 households per wave, covering 88 EAs making a total sample size of 4580 households. Out of these, I got a balanced panel subset of 865 agricultural households (who cultivated land all through the 4 waves) covering 85 EAs. To ensure that the results presented do not suffer from attrition bias, I estimate all models using the inverse probability weighted technique by applying sampling weights provided in the IHPS data (Wooldridge, 2002).

Data cleaning was done as follows: the number of days spent by households on own crop farming activities included times spent in the last 12 months on land preparation and planting; weeding, fertilization and non-harvest activities; and harvesting. For each household member, the number of weeks spent on these activities were capped at 12, 16, and 12 respectively. A similar study by Palacios-Lopez *et al* (2017) on agricultural labor use in Nigeria, Malawi, Tanzania and Uganda had capped these weeks at 13, 26 and 13 respectively. However, I follow Ricker-Gilbert (2014) who exclusively studied labor use in Malawi. According to that study, planting takes place in Malawi between October and December, while harvest takes place between May and July, leaving the 16 weeks from January and April for post planting, non-harvest activities. To calculate total household time endowment, hours spent daily for various activities were capped at 12 for all crop farming and fisheries activities (following Palacios-Lopez *et al.*, 2017), 8 hours for wage employment based on Malawi's law (Malawi Employment Act, 2000), and 15 hours for non-agricultural businesses (based on anecdotal evidence). Following Malawian law, days spent on wage employment was also capped at 6 days per week. Finally, based on precious studies such as Fink, Jack and Masiye (2017) an average of 4 hours per day was used to calculate time spent for ganyu activities.

4. Results and Discussion

Tables 4 and 5 presents the LPM-FE results showing the effect of estates (continuous and dummy specifications respectively) on smallholder participation in the three labor decisions. Considering that the probability of household member participation in household agricultural activities is equal to 1 except in a very trivial number of households (0.52%), I estimate only the *ganyu* related equations for agricultural households. Results of the continuous specification shown in table 4, show no evidence that the presence of estates significantly affected any of the dependent (participation) variables for the whole population and agricultural households. Column 5 show that the median community wage rates had a very modest negative effect on participation in ganyu supply among agricultural households. In other words, the probability of households' participation in *ganyu* supply tends to increase at lower wage rates ($p<0.1$). This seems to support the poverty trap claim by scholars like Whiteside (2000) that poor resource-constrained Malawian households supply more *ganyu* at lower wage rates. Ricker-Gilbert (2014) also reported similar results in their study of the effect of fertilizer subsidy on smallholder *ganyu* supply in Malawi. The results from all households showed a significant negative relationship between maize prices and the probability of a household demanding *ganyu* labor. While the household size did not have any implication on the labor decisions, the number of working age household members was found to have a significant effect on the *ganyu* supply. A household with a good number of working age members has more members that are capable of working, hence it makes sense that the higher the number of working age members the more the *ganyu* supply.

Households with higher landholdings tended to have a higher probability of participation in own crop activities as well as *ganyu* demand ($p<0.01$). The amount of assets owned by households, also had a significant positive relationship with ganyu demand. Conversely, the amount of assets

was negatively related with the supply of *ganyu.* These findings are quite intuitive considering that *ganyu* supply is a credit relaxing mechanism. Households with more assets would be expected to supply less *ganyu* and demand more (Ricker-Gilbert, 2014). In terms of the shocks experienced in the past year, the results showed that the probability of participation in household agricultural activities increased following cost shocks. Most small holders are input constrained, and it stands to reason that they would increase farm labor supply to be able to sustain pre-shock revenue levels. Table 5 shows the LPM-FE model when the dummy variable is used to show the heterogeneity in the effect of estates on the household labor decisions. The results show a significant negative effect on the probability of demanding *ganyu* labor for households in communities where 75% or more of agricultural land is being held in estates (-0.063 $p< 0.01$). This result is less significant for agricultural households (-0.064, $p<0.1$). As with the previous table, the distance to ADMARC markets had a modestly positive effect on probability that a household participates in crop farming. The unfair practices of ADMARC markets towards smallholder farmers have been criticized in previous studies (Chirwa *et al.*, 2005). This might explain why farm households that are farther away from these markets have higher likelihood of participating in own crop farming activities. Other results in Table 5 are robust to those in Table 4.

Table 6 shows the Tobit-CRE results of regressions of the days spent on household crop farming, and *ganyu* decisions. The results showed that on average a 1%-point increase in the share of agricultural land occupied by estates implied a 0.02 (-0.022, $p<0.1$), and 0.04 percent point (-0.038, $p<0.05$) reduction in the number of days *ganyu* labor was demanded by all households and agricultural households respectively[1]. Conversely, households in these communities (with >=75% estate share) spent 19% more days ($p<0.1$) on their own crop farming activities. Households in

[1] Result was interpreted as elasticity at the mean. See Bellemare and Wichman, 2019.

communities with 50% estate share supplied 75% more days of *ganyu* labor ($p<0.1$) than households without estates.

The result also showed a modest negative relationship between median community wage rates and demand for *ganyu* labor among agricultural households thereby corroborating the results of the LPM-FE regressions. Maize price was negatively related with household *ganyu* demand ($p < 0.01$) . Distance from ADMARC markets was found to be negatively associated with the number of days spent by households in their farms. The presence of MASAF programs had a positive correlation with the number of days spent in own farm and *ganyu* activities among agricultural households. The effect on the latter is quite intuitive since MASAF programs are meant to provide short-term, labor-intensive employment opportunities to poor households (Beegle *et al.*, 2016). The results also showed that the presence of microfinance institutions had a negative effect on days spent by households on their own farm activities. Again, microfinance institutions help relax credit constraints, and may explain the reason why households will spend less time on their farms. They could also create other non-agricultural employment opportunities where they are present. Other results mostly corroborate the results from the LPM-FE specifications. Household size and the number of working age household members were both positively related to the days spent on household farming activities. Moreso, the number of working age household members was also positively correlated with the number of days *ganyu* was supplied ($p<0.01$). Households with larger landholdings spent more time in their farms and demanded more *ganyu* labor. Wealthier households (i.e. those with higher asset value) were less likely to supply *ganyu* as reported for the previous regressions. Male headed households also spent more time on their farms compared to Households with female heads. This could also be indicative of other extant realities where female heads are more resource constrained (Dimova *et al.*, 2010; Bryceson, 2006). Households who

experienced cost shocks also spent more time on their farms. Finally, households that were more remote from major roads demanded less *ganyu* labor.

As shown in Table 7, when the estate variable is decomposed into dummies, the negative relationship between household *ganyu* demand and the estate share was only significant where estates constituted 75% or more of the agricultural land ($p<0.05$). The number of days spent on ganyu activities, was found to be modestly higher ($p<0.1$) in communities where estates occupied half of the agricultural land, whereas the number of days spent on own-farm activities was higher where estates occupied 75% or more of the community's agricultural land. The other results were robust to those presented in Table 7. At this point a pattern is apparent- while households in communities covered with mostly estate lands (>=75%) demanded less *ganyu* labor, they seem to spend more time on their farms (albeit marginally and only when all households are considered).

5. Conclusions and policy recommendations

Estates have historically played an important role in Malawian agriculture. While they have a well-established history in Malawi dating back to colonial times, very little has been done empirically to assess their impact on smallholder outcomes. *Ganyu* is also a deeply entrenched feature of Malawi's agricultural landscape whose relationship with the estate phenomena merits empirical investigation. This study therefore investigated the impact of estate land allocation on smallholder labor decision including own-farm cropping activities, as well as *ganyu* demand and supply.

The key findings of this study are as follows: On average, households in communities that have estates demanded less days of *ganyu* especially where 75% or more of agricultural lands were under estates. Households in such communities (with 75% or more estate share) were about 6% less likely to demand *ganyu* labor, than households that did not have estates. I also found that the

number of working age household members, and size of landholding were very significant predictors of all labor variables albeit in different ways. Households with more working age members spent more time in their own crop farming activities and *ganyu* supply and demanded less *ganyu.* Landholding size had a positive correlation with time spent on own crop farming activities and *ganyu* demand, and a negative one with *ganyu* supply. The value of household assets was also an important correlate of *ganyu* demand and supply, with wealthier households more likely to demand *ganyu,* and less likely to supply it.

Overall, the role of estates in local smallholder labor decisions was quite modest. This is probably because estate labor dynamics is in itself not monolithic. Estate labor for example could come from different sources apart from local *ganyu* supply. There is copious evidence to show that estates generally rely a lot on immigrant labor. Moreover, estate labor dynamics takes a lot of forms including tenancy, as well as contract/outgrower schemes which are quite different from the traditional labor arrangements addressed in this paper (Prowse, 2013).

A major limitation in this study and perhaps a room for improvement is in the measure of estate land used. Having exact continuous measures of estates in the communities should provide better estimates. Deininger and Xia (2018) for example used cross-sectional georeferenced estate survey data from the Malawian National Census of Agriculture and Livestock (NACAL) conducted in 2006/2007 in their study, but considering that the current study uses a panel data paradigm, and only one wave of the NACAL data is available, it could not be used for the current study. The use of multiple panel waves of data covering estates would make a critical improvement to the current study. Finally, from a policy perspective the current government initiative to liberalize land tenure is a step in the right direction, but there is also a need to consider other alternative sectors. There is a need for Malawian rural dwellers to have other employment alternatives as a purely agrarian

land-based economy may only be reinforcing a seeming poverty trap for the more resource-constrained.

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Appendix

Table 1: Changes in estate share distribution from 2010 to 2019 (Balanced community data, N=380)

Estate share of agricultural land:	0%	25%	50%	>=75%
2010	80.00%	11.58%	1.05%	7.37%
2013	80.00%	12.63%	1.05%	6.31%
2016	77.89%	8.42%	6.32%	7.36%
2019	74.74%	10.53%	3.16%	11.58%
Total	78.16%	10.79%	2.89%	8.16%

Values represent the share of communities under each estate share regime in the study period. Source: Author's calculation from Malawi IHPS survey 2010-2019

Table 2: Summary of household characteristics

	2010	**2013**	**2016**	**2019**
Household size	4.934 (2.286)	5.511 (2.329)	5.547 (2.343)	5.356 (2.410)
Number of working age HH members (15 to 65 years)	2.396 (1.271)	2.699 (1.411)	2.658 (1.507)	2.816 (1.537)
Number of adult children living elsewhere	0.869 (1.627)	1.009 (1.809)	1.220 (1.834)	1.528 (1.977)
Age of HH Head	42.115 (15.758)	45.014 (15.324)	47.517 (14.772)	49.535 (14.518)
Sex of HH Head (=1 if male)	0.780 (0.414)	0.773 (0.419)	0.742 (0.438)	0.725 (0.447)
Landholding (Acres)	1.550 (1.509)	1.527 (1.546)	1.705 (1.866)	1.699 (1.813)
Real Asset value (2010 MWK) (Inverse-sine transformed)	8.370 (3.598)	8.749 (3.746)	9.250 (2.835)	8.960 (3.433)
Crop-harvest value share of the Total HH income (%)	45.814 (37.29)	45.405 (36.144)	41.193 (33.957)	27.958 (28.703)
Ganyu wage share of Total HH income (%)	13.445 (25.864)	14.469 (25.626)	27.913 (32.070)	27.033 (32.536)
Share of total HH days spent on own-crop farming activities (%)	62.649 (37.865)	57.233 (37.704)	48.949 (34.572)	41.187 (34.156)
Share of total HH days spent on ganyu activities (%)	13.394 (24.007)	14.664 (24.563)	24.463 (27.741)	28.771 (31.577)

Total days spent by HH members on own-crop farming activities	112.566 (112.315)	133.581 (132.867)	131.562 (150.986)	100.438 (116.235)
Days spent by HH members on ganyu activities	30.060 (67.417)	41.077 (82.843)	74.683 (109.424)	89.751 (133.824)
Total number of days *ganyu* labor was employed on HH farm	6.755 (27.659)	5.758 (15.326)	1.439 (8.937)	0.271 (1.867)
Disaster shocks (=1 if yes)	0.418 (0.494)	0.599 (0.490)	0.814 (0.389)	0.599 (0.490)
Cost shocks (=1 if yes)	0.292 (0.455)	0.725 (0.447)	0.574 (0.495)	0.318 (0.466)

Averages are presented. Standard deviations are presented in parenthesis.

Table 3: Comparison of time-varying community variables based on share of estate

	None	25%	50%	>=75%	All estate containing communities	T-Statistic (none vs estate Containing)	F-Statistic
Population	8032.21 (25467.39)	11268.41 (31540.59)	6471.30 (4858.23)	5905.28 (5647.62)	8695.65 (22868.33)	0.76	4.06***
Average distance to road (km)	6.92 (8.09)	11.44 (13.94)	17.67 (9.80)	10.68 (10.18)	12.10 (12.39)	15.93***	108.76***
Average distance to ADMARC market (km)	7.23 (5.12)	7.85 (4.46)	8.63 (5.39)	11.19 (8.25)	9.13 (6.35)	9.99***	62.42***
Average Annual Precipitation (mm)	1047.59 (228.95)	1015.04 (196.68)	988.31 (114.04)	1179.38 (303.51)	1068.26 (245.10)	2.53***	46.84***
Average Distance to District Boma (km)	30.00 (26.12)	39.99 (24.30)	41.82 (18.16)	30.09 (22.56)	36.82 (23.39)	7.62***	32.90***
Presence of Micro-finance institutions (1= Yes)	0.19 (0.39)	0.15 (0.36)	0.20 (0.40)	0.11 (0.31)	0.15 (0.35)	-3.08**	5.40***
Presence of MASAF program (1= Yes)	0.56 (0.50)	0.46 (0.50)	0.63 (0.48)	0.61 (0.49)	0.54 (0.50)	-1.06	8.70***

Real community g*anyu* wage rates (2010 MWK[±])	391.96 (541.11)	288.26 (145.20)	218.86 (43.17)	230.55 (80.99)	257.95 (118.88)	-8.00***	22.80***
Maize Price (2010 MWK[±])	43.26 (16.57)	42.67 (15.38)	49.41 (18.81)	38.98 (15.49)	42.38 (16.30)	-1.72*	15.76***

[±] MWK = Malawian Kwacha the official currency of Malawi. 1 MWK is approximately 1.200E-3 USD in 2021. * Yearly breakdowns presented in Appendix B

Table 4: LPM Regression showing effect of estates on HH participation in different labor allocation decisions (Estate Variable is Continuous)

	All Households			Agricultural Households	
	Participation in own farm activities	**Participation in ganyu supply**	**Participation in ganyu demand**	**Participation in ganyu supply**	**Participation in ganyu demand**
Share of estates (%)	1.760E-4 (1.267E-4)	-3.900E-5 (5.417E-4)	-5.123E-4 (3.421E-4)	-1.571E-4 (5.652E-4)	-5.082E-4 (3.798E-4)
Median community wage rate (in 2010 MWK) *(log)*	-1.946E-4 (0.015)	-0.025 (0.018)	2.703E-5 (0.022)	-0.039* (0.022)	0.006 (0.030)
Maize price (2010 MWK)	-5.000E-5 (3.294E-4)	1.336E-4 (0.001)	-0.001** (0.001)	1.170 (0.001)	-0.001 (0.001)
Average distance to ADMARC market	0.007* (0.004)		-0.003 (0.008)		-0.005 (0.009)
Presence of MASAF program	-8.814E-4 (0.013)	0.017 (0.018)	0.026 (0.018)	0.028 (0.020)	0.023 (0.019)
Presence of microfinance institutions	-0.008 (0.013)	-0.012 (0.024)		-0.021 (0.022)	

Community population *(log)*	0.003 (0.004)	-0.002 (0.010)	0.015 (0.009)	4.247E-4 (0.012)	0.018 (0.011)
Precipitation *(log)*	-0.452 (0.507)	-0.310 (1.230)	1.250 (1.042)	-0.549 (1.268)	1.330 (1.171)
Household size	0.004 (0.004)	-9.613E-4 (0.008)	0.008 (0.007)	-0.007 (0.009)	0.006 (0.008)
Number of working age HH members (15 to 65 years)	-5.703E-4 (0.006)	0.043*** (0.010)	-0.016 (0.010)	0.046*** (0.010)	-0.011 (0.011)
Sex of Household head	-4.969E-4 (0.014)	-0.028 (0.034)	-0.015 (0.030)	-0.026 (0.036)	-0.023 (0.035)
Landholding (acres)	0.034*** (0.007)	0.004 (0.010)	0.027*** (0.009)	0.002 (0.011)	0.026*** (0.010)
Log of total value of assets (2010MWK)	-6.073E-4 (0.002)	-0.011*** (0.004)	0.006*** (0.002)	-0.010** (0.004)	0.007*** (0.002)
Cost shock (= 1 if shock was experienced in the last year)	0.042*** (0.009)	0.013 (0.019)	0.005 (0.019)	0.017 (0.021)	-0.012 (0.020)
Disaster shock (= 1 if shock was experienced in the last year)	0.008	0.017	0.004	0.019	-0.017

	(0.008)	(0.020)	(0.015)	(0.023)	(0.018)
HH Effect	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Constant	4.016 (3.623)	2.362 (8.853)	-9.134 (7.489)	4.191 (9.123)	-9.728 (8.391)

***, **,** and *** indicates significance at the 10%, 5%, and 1% respectively. Robust standard errors in parentheses

Table 5: LPM-FE Regression showing heterogeneity in effect of estates on HH participation in different labor allocation decisions

	All Households			**Agricultural Households**	
	Participation in own farm activities	**Participation in ganyu supply**	**Participation in ganyu demand**	**Participation in ganyu supply**	**Participation in ganyu demand**
Share of agricultural land under estates (Base = 0% estates)	0.001	0.019	0.017	0.029	0.025
25% estates	(0.010)	(0.037)	(0.027)	(0.041)	(0.028)
50%	-9.456E-4	0.080	0.071	0.043	0.075
	(0.017)	(0.071)	(0.058)	(0.072)	(0.065)
75% and more	0.017	-0.014	**-0.063*** **	-0.023	**-0.064***
	(0.012)	(0.045)	**(0.029)**	(0.049)	**(0.033)**
Median community wage rate (in 2010 MWK) *(log)*	-3.731E-4	-0.024	0.002	-0.039*	0.006
	(0.015)	(0.018)	(0.022)	(0.023)	(0.030)
Maize price (2010 MWK)	3.420E-5	7.010E-5	-0.002**	-1.123E-4	-0.001
	(3.423E-4)	(0.001)	(0.001)	(0.001)	(0.001)
Average distance to ADMARC market	0.007*		-0.001		-0.004
	(0.004)		(0.007)		(0.008)
Presence of MASAF program	-9.754E-4	0.017	0.026	0.028	0.023

	(0.013)	(0.018)	(0.018)	(0.019)	(0.018)
Presence of microfinance institutions	-0.007 (0.014)	-0.015 (0.025)		-0.025 (0.022)	
Community population *(log)*	0.003 (0.005)	-0.004 (0.011)	0.012 (0.008)	-0.002 (0.013)	0.014 (0.010)
Precipitation *(log)*	-0.461 (0.502)	-0.275 (1.271)	1.304 (1.033)	-0.492 (1.286)	1.396 (1.160)
Household size	0.004 (0.004)	-9.705E-4 (0.008)	0.008 (0.007)	-0.007 (0.009)	0.006 (0.008)
Number of working age HH members (15 to 65 years)	-5.266E-4 (0.006)	0.043*** (0.010)	-0.016* (0.010)	0.046*** (0.010)	-0.012 (0.010)
Sex of Household head	-5.192E-4 (0.014)	-0.028 (0.034)	-0.015 (0.030)	-0.026 (0.036)	-0.024 (0.035)
Landholding (acres)	0.034*** (0.007)	0.004 (0.010)	0.027*** (0.009)	0.003 (0.010)	0.026*** (0.009)
Log of total value of assets (2010MWK)	-6.466E-4 (0.002)	-0.011*** (0.004)	0.006*** (0.002)	-0.009** (0.004)	0.008*** (0.003)
Cost shock (= 1 if shock was experienced in the last year)	0.042*** (0.009)	0.013 (0.020)	0.005 (0.018)	0.018 (0.021)	-0.012 (0.020)

Disaster shock (= 1 if shock was experienced in the last year)	0.008 (0.008)	0.018 (0.020)	0.005 (0.015)	0.020 (0.023)	0.017 (0.017)
HH Effect	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Constant	4.084 (3.585)	2.111 (9.170)	-9.517 (7.422)	3.798 (9.257)	-10.186 (8.318)

***, **,** and *** indicates significance at the 10%, 5%, and 1% respectively. Robust standard errors in parentheses

Table 6: Tobit-CRE Regression showing effect of estates on number of days spent by households on different labor allocation decisions (Estate variable is continuous, and all dependent variables inverse hyperbolic sine transformed)

	All Households			**Ag Households**		
	Number of days spent in own farm activities	**Number of days spent in ganyu activities**	**Total Number of days labor was hired**	**Number of days spent in own farm activities**	**Number of days spent on ganyu activities**	**Total Number of days labor was hired**
Presence of Estates (% share)	0.002 (0.001)	0.001 (0.002)	-0.002* (0.001)	4.349E-4 (0.001)	7.604E-4 (0.003)	-0.003** (0.001)
Median community wage rate (in 2010 MWK)	0.027 (0.076)	-0.158 (0.118)	0.004 (0.053)	0.010 (0.044)	-0.285* (0.145)	0.017 (0.065)
Maize price (2010 MWK)	-0.002 (0.003)	-1.811E-4 (0.006)	-0.005*** (0.002)	-0.001 (0.002)	-0.002 (0.006)	-0.005** (0.002)
Distance to ADMARC market	-0.028 (0.026)		-0.006 (0.035)	-0.044** (0.017)		-0.011 (0.040)
Presence of MASAF program (=1 if program is present)	0.074 (0.075)	0.147 (0.104)	0.066 (0.053)	0.080* (0.045)	0.192* (0.111)	0.055 (0.064)
Presence of microfinance	-0.188*** (0.074)	-0.113 (0.147)		-0.063 (0.043)	-0.158 (0.130)	

institutions (=1 if institution is present)						
Community population (*log*)	0.033 (0.033)	-0.021 (0.056)	0.023 (0.024)	0.009 (0.019)	-0.015 (0.071)	0.029 (0.028)
Precipitation (*log*)	0.046 (4.168)	-6.448 (6.862)	8.351** (4.038)	3.481 (2.833)	-5.558 (7.214)	8.536* (4.797)
Household size	0.070*** (0.025)	0.005 (0.046)	-0.007 (0.024)	0.046*** (0.017)	-0.025 (0.050)	-0.019 (0.026)
Number of working age HH members (15 to 65 years)	0.106*** (0.039)	0.283*** (0.060)	-0.025 (0.032)	0.125*** (0.025)	0.324*** (0.058)	-0.008 (0.035)
Sex of Household head	0.216** (0.101)	-0.165 (0.182)	-0.056 (0.098)	0.297*** (0.090)	-0.165 (0.195)	-0.072 (0.110)
Landholding (acres)	0.337*** (0.050)	0.008 (0.056)	0.121*** (0.022)	0.160*** (0.020)	-0.004 (0.061)	0.104*** (0.024)
Log of total value of assets (2010MWK)	-0.004 (0.011)	-0.061*** (0.018)	0.012 (0.009)	0.002 (0.007)	-0.055** (0.021)	0.019* (0.010)
Cost shock (= 1 if shock was experienced in the last year)	0.231*** (0.058)	0.074 (0.119)	0.021 (0.057)	0.025 (0.039)	0.099 (0.129)	-0.012 (0.063)

Disaster shock (= 1 if shock was experienced in the last year)	0.018 (0.056)	0.167 (0.117)	-0.059 (0.047)	-0.020 (0.040)	0.218 (0.144)	-0.089* (0.052)
Distance to major road (km)	0.004 (0.006)	0.009 (0.011)	-0.013*** (0.003)	0.006** (0.003)	0.011 (0.012)	-0.014*** (0.004)
Distance to district center (*Boma) in km*	7.932E-4 (0.003)	-0.004 (0.003)	0.001 (0.001)	-4.179E-4 (0.001)	-0.003 (0.004)	0.001 (0.001)
Regions (Base=South)						
Central	-3.352*** (0.405)	0.153 (2.228)	-0.077 (0.211)	0.045 (0.142)	-0.256 (0.510)	-0.679*** (0.211)
North	-3.202*** (0.393)	0.229 (2.205)	0.099 (0.211)	-0.045 (0.145)	-0.073 (0.400)	-0.547** (0.227)
Year (Base = 2010)						
2013	-0.082 (0.131)	-0.101 (0.223)	-0.038 (0.090)	0.148 (0.091)	-0.146 (0.245)	-0.026 (0.105)
2016	-0.157 (0.153)	1.446*** (0.265)	-0.836*** (0.110)	0.087 (0.103)	1.501*** (0.301)	-0.866*** (0.129)
2019	-0.606*** (0.095)	1.409*** (0.181)	-1.303*** (0.100)	-0.328*** (0.068)	1.482*** (0.204)	-1.346*** (0.107)

***, **,** and *** indicates significance at the 10%, 5%, and 1% respectively. Values reported are average partial effects. Robust standard errors in parentheses

Table 7: Tobit-CRE Regression showing effect of estates on number of days spent by households on different labor allocation decisions (Estate variables are dummies, and all dependent variables inverse hyperbolic sine transformed)

	All Households			**Ag Households**		
	Number of days spent in own farm activities	**Number of days spent in ganyu activities**	**Total Number of days labor was hired**	**Number of days spent in own farm activities**	**Number of days spent in ganyu activities**	**Total Number of days labor was hired**
Share of agricultural land under estates (Base = 0% estates)	0.010	0.088	0.052	0.043	0.139	0.097
	(0.096)	(0.227)	(0.074)	(0.069)	(0.254)	(0.081)
25% estates						
50%	-0.075	0.559*	0.218	0.049	0.500*	0.250
	(0.139)	(0.333)	(0.166)	(0.098)	(0.294)	(0.180)
75% and more	0.178*	0.051	-0.236**	0.038	0.012	-0.290**
	(0.096)	(0.248)	(0.110)	(0.066)	(0.281)	(0.118)
Median community wage rate (in 2010 MWK)	0.024	-0.153	-9.235E-4	0.009	-0.282*	0.019
	(0.075)	(0.121)	(0.053)	(0.044)	(0.149)	(0.067)
Maize price (2010 MWK)	-0.002	-3.176E-4	-0.006***	-0.001	-0.002	-0.006***
	(0.003)	(0.006)	(0.002)	(0.002)	(0.007)	(0.002)
Distance to ADMARC market	-0.035		0.007	-**0.044****		0.002
	(0.026)		(0.033)	(0.017)		(0.037)

Presence of MASAF program (=1 if program is present)	0.068 (0.075)	0.153 (0.102)	0.069 (0.051)	0.079* (0.046)	0.200* (0.111)	0.061 (0.061)
Presence of microfinance institutions (=1 if institution is present)	-0.183** (0.074)	-0.154 (0.151)		-0.065 (0.042)	-0.202 (0.131)	
Community population (*log*)	0.039 (0.034)	-0.026 (0.059)	0.017 (0.023)	0.006 (0.019)	-0.027 (0.077)	0.018 (0.027)
Precipitation (*log*)	0.101 (4.093)	-5.811 (7.600)	8.251** (3.970)	3.492 (2.812)	-4.658 (7.933)	8.375* (4.684)
Household size	0.069*** (0.025)	0.007 (0.046)	-0.006 (0.023)	0.046*** (0.017)	-0.020 (0.050)	-0.018 (0.025)
Number of working age HH members (15 to 65 years)	0.106*** (0.039)	0.283*** (0.061)	-0.026 (0.032)	0.125*** (0.025)	0.323*** (0.058)	-0.010 (0.034)
Sex of Household head	0.213** (0.101)	-0.155 (0.184)	-0.058 (0.100)	0.296*** (0.090)	-0.155 (0.197)	-0.074 (0.113)
Landholding (acres)	0.336*** (0.049)	0.008 (0.057)	0.121*** (0.022)	0.160*** (0.020)	-0.008 (0.063)	0.103*** (0.023)
Log of total value of assets (2010MWK)	-0.004 (0.011)	-0.061*** (0.018)	0.013 (0.009)	0.002 (0.007)	-0.054*** (0.021)	0.020* (0.010)

Cost shock (= 1 if shock was experienced in the last year)	0.225*** (0.058)	0.078 (0.116)	0.028 (0.055)	0.025 (0.039)	0.101 (0.125)	-0.003 (0.062)
Disaster shock (= 1 if shock was experienced in the last year)	0.016 (0.056)	0.176 (0.118)	-0.055 (0.047)	-0.019 (0.040)	0.226 (0.145)	-0.084 (0.052)
Distance to major road (km)	0.007 (0.006)	-0.014 (0.010)	-0.012*** (0.003)	0.006** (0.003)	0.015 (0.011)	-0.013*** (0.004)
Distance to district center (*Boma) in km*	0.002 (0.003)	-0.003 (0.002)	0.002 (0.001)	-4.933E-4 (0.001)	-0.003 (0.003)	9.594E-4 (0.001)
Regions (Base=South)						
Center	-3.519*** (0.418)	0.198 (2.148)	-0.044 (0.195)	-0.031 (0.130)	-0.222 (0.480)	0.294** (0.131)
North	-3.351*** (0.398)	0.277 (2.135)	-0.121 (0.193)	-0.127 (0.121)	0.053 (0.372)	0.403*** (0.132)
Year (Base = 2010)						
2013	-0.061 (0.134)	-0.087 (0.226)	-0.021 (0.084)	0.149 (0.093)	-0.136 (0.249)	-0.004 (0.097)
2016	-0.134 (0.158)	1.442*** (0.271)	-0.829*** (0.110)	0.089 (0.105)	1.502*** (0.309)	-0.854*** (0.127)
2019	-0.579	1.425***	-1.298***	-0.327***	1.493***	-1.338***

	(0.098)	(0.187)	(0.100)	(0.067)	(0.203)	(0.106)

***, **,** and *** indicates significance at the 10%, 5%, and 1% respectively. Values reported are average partial effects. Robust standard errors in parentheses