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Rural Non-Farm Employment and Household Welfare

Evidence from Malawi

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Abstract

This paper uses nationally representative panel data and a combination of econometric approaches, to explore linkages between rural non-farm activities (wage and self-employment) and household welfare in rural Malawi. The paper analyzes the average treatment effects and distributional effects on participants' welfare indicators, such as households' per capita consumption expenditures. Then it investigates the effects of non-farm activities on the use of agricultural inputs, one channel through which non-farm employment might improve the welfare of rural households. Although participation in non-farm activities is not randomly assigned in the data, the identification strategy relies on fixed effects and correlated random effects estimation methods, dealing effectively with time invariant heterogeneity, coupled with geographical covariate adjustments, controlling for time varying differences in local market conditions and employment opportunities. The results suggest that non-farm wage employment and non-farm self-employment are welfare improving and poverty reducing. However, households at the lower tail of the wealth distribution benefit significantly less from participation than the wealthiest. Although the results support the promotion of the rural non-farm economy for poverty reduction purposes, they indicate that targeted interventions that improve poor households' access to high-return non-farm opportunities are likely to lead to bigger successes in curbing rural poverty.

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Rural Non-Farm Employment and Household Welfare: Evidence from Malawi

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1. Introduction

The contribution of non-farm activities (such as non-farm wage employment and non-farm enterprises) to household income in Sub-Saharan Africa (SSA) is substantial and has increased over time (Haggblade et al., 2010, Start, 2001, Lanjouw and Lanjouw, 2001, Lanjouw and Shariff, 2004, Reardon et al., 1998). Recent estimates indicate that 44 percent of rural African households (on average) participate in non-farm wage employment or self-employment. The average income share from non-farm sources is 23%, with an overall positive correlation between diversification and GDP per capita (Davis et al., 2014). Consequently, rural non-farm employment (RNFE) has become an essential part of discussions on poverty reduction in rural Africa, being a potential pathway out of poverty for many.

Despite the extent and growth in importance of the RNFE in SSA, there are still limited empirical analyses of the welfare effects of the subsector and how this varies across different kinds of rural households. Though evidence of positive correlations between RNFE participation and income exists, many studies are outdated while an ongoing debate still questions whether RNFE improves welfare or if indeed it is the wealthy who are able to engage in RNFE. Consequently, this paper uses nationally representative data and a combination of empirical approaches to examine links between RNFE participation and welfare. We explore a key mechanism through which welfare effects of RNFE are likely to operate in rural SSA and the heterogeneity of such effects across different types of rural households.

The paper significantly enriches the discussion on RNFE and rural development in SSA in three main ways. First, we use panel data methods to address time invariant sources of heterogeneity in the estimation of the welfare effects of non-farm employment participation. Bezu et al. (2012) also use panel data from Ethiopia to show positive linkages between RNFE and consumption expenditure growth. But most of the remaining literature on the subject uses cross sectional data, leaving open the important policy question of whether non-farm employment is really a route out of poverty for the millions of poor in rural Africa (Owusu et al., 2011, Ackah, 2013).[1] Using a rich nationally representative panel data set from Malawi,[2] we are able to use panel data estimation techniques to at least address the endogeneity of RNFE participation due to *time invariant* unobserved characteristics, such as innate ability. We include a rich set of household and geographical control variables to capture potential time varying confounding factors such as differences in labor market conditions.

Second, this paper goes beyond average effects and explores the heterogeneous effects of RNFE participation. Although the average treatment effects are useful measures of the link between participation in non-farm employment and welfare outcomes, they often provide an incomplete view of the relationship. Numerous studies on the determinants of household participation in non-farm activities (over the past two decades) have found evidence of entry barriers for marginalized socioeconomic groups such as women or the poor (Abdulai and CroleRees, 2001, Woldenhanna and Oskam, 2001, Barrett et al., 2001a, Smith et al., 2001, Lanjouw et al., 2001, Reardon et al., 2000). The marginalized groups are either totally excluded or restricted to the least lucrative non-farm activities, despite their relatively greater need for

[1] Kijima et al. (2006) would be another exception as they used panel data collected from 894 rural Ugandan households in 2003 and 2005; but they focused more on off-farm labor supply and its determinants, rather than welfare effects.

[2] https://www.malawi.gov.mw

diversification. These barriers that restrict the participation of marginalized groups in RNFE imply that the size of the welfare effects of participation in non-farm activities might be lower for marginalized groups compared to the more privileged groups with access to high return opportunities. Despite the widely recognized existence of entry barriers, studies that investigate the distributional effects of RNFE participation at different points of the wealth distribution are still very few. Such studies have very important implications in terms of informing the likely policies (and their targeting) that would be effective in maximizing potential benefits of RNFE for rural households. To explore such heterogeneity, Bezu et al. (2012) used subgroup analysis, comparing average consumption growth effects among the poor to the average effects among the non-poor. This paper goes a step further by using a quantile regression (QR) approach to test for heterogeneous welfare effects of RNFE participation on household consumption expenditure at different points of the conditional distribution of household consumption expenditure (Cameron and Trivedi, 2010). Applying the QR approach within a panel framework, we are able to still control for time invariant unobservable factors correlated with welfare and participation in RNFE.

Third, this paper revisits the relationship between RNFE participation and agricultural investments, given that rural households are likely to at least partially be involved in agriculture. In addition to the direct effects of income for consumption that RNFE provides for households, RNFE can also serve as a source of cash for investment in agriculture (Adjognon et al., 2016, Oseni and Winters, 2009), or rather take resources (such as family labor) away from agricultural activities (Smale et al., 2016). In rural Malawi, more than 90 percent of households are involved in agricultural crop production activities, which provide about 55 percent of total household income on average. Thus, we go a step further and explore if participation in RNFE has positive (or negative) effects on investments in agricultural inputs. Apart from Holden et al. (2004) who investigated the effects of off-farm income on household welfare and agricultural production, most previous studies have focused either solely on the effect of RNFE on agricultural investments (Oseni and Winters, 2009, Smale et al., 2016) or welfare directly (Ackah, 2013, Owusu et al., 2011, Matsumoto et al., 2006). We explore both in the context of Malawi and go a step beyond Holden et al. (2004) to consider the heterogeneous welfare effect of RNFE for different kinds of rural households.

We find that participation in RNFE is associated with higher household per capita consumption expenditure. However, the effects are larger for those at the top of the welfare distribution compared to those at the bottom. Moreover, we find that farm households involved in RNFE appear more likely to invest in inputs purchases.

The rest of the paper is organized as follows. Section 2 describes the data while section 3 discusses the econometric and empirical framework used for our analyses. Section 4 presents and discusses the study results. Section 5 concludes with suggestions for policy consideration and future research.

2. Data sources and definition of key concepts

Study context

This study was conducted in Malawi, a small country located in eastern Africa. Malawi is one of the poorest countries in the world, with an estimated 71 percent of its population living below $1.90 per day of purchasing power parity in 2010 (World Bank, 2016). It was ranked 173 of 188 countries by the 2015 United Nations Human Development Index (HDI). According to the

2016 World Development Indicators (WDI), the country had a GNI per capita of US$350 in 2015. It has a relatively young and growing population (17.2 million people in 2015); and is one of the most densely populated countries in the world, with 177 people per sq. km of land area. Similar to most poor countries, the Malawian economy relies primarily on the agricultural sector which contributes over 30 percent of its GDP and employs 85 percent of its workforce (World Bank, 2016). Given the low return from agriculture and the persistent poverty facing the farm households, policy makers in Malawi would find it useful to know whether facilitating households' movement into new, more productive, and more lucrative activities outside agriculture is a potential way for reducing poverty in Malawi.

Data sources

This study uses the panel component of the Malawi Third Integrated Households Survey (IHS3) and the Integrated Household Panel Survey (IHPS) implemented through a joint effort of the Government of Malawi through the National Statistical Office (NSO; www.nso.malawi.net), and the World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) initiative. These are multi-topic surveys with detailed information about households' characteristics, activities and livelihood, agricultural practices and community-level information. The full balanced panel sample includes 3,104 households successfully tracked and interviewed in both IHS3 in 2010 and IHPS in 2013. The sample frame includes all three geographical regions of Malawi: North, Centre and South. The survey stratified the country into rural and urban strata. The urban stratum includes the four major urban areas: Lilongwe, Blantyre, Mzuzu, and the Municipality of Zomba. All other areas including Bomas are considered as rural areas.

In this study, we are interested in livelihood diversification strategies among rural population. Therefore, our analysis uses only the rural subsample, which represents about 70 percent of the sample (2,766 households). The IHPS data are representative at the national, urban/rural and regional levels.

We also use auxiliary data such as the consumption aggregates developed by the World Bank poverty and LSMS teams for poverty analysis in Malawi.[3] The use of these pre-generated variables allows us to compare and link our analyses to other reports and studies based on the publicly available LSMS data, thereby contributing coherently to the large discussion about livelihoods in rural Malawi, and Africa more generally.

Definition of main concepts

As suggested by Barrett et al. (2001b), it is important to distinguish between various terminologies such as "off-farm", "non-agricultural" , and "non-farm" employment, often used synonymously in the literature to describe the RNFE. Using an adaptation of the sectoral classification in Barrett et al. (2011),[4] we define non-farm employment in this paper to mean, all

[3] The consumption aggregates data as well as a detailed discussion on how each component is calculated are in the dissemination documentation available for download along with the consumption aggregate data from the LSMS website.

[4] Barrett et al. (2011) exclude completely the primary sector from non-farm employments.

activities outside of crop and livestock production. Agricultural wage employment such as ganyu wage[5] is thus excluded from our non-farm employment definition. However, we include other activities of the primary sector such as forestry, hunting, fishing, mining and quarrying, etc. The main reason for excluding agricultural wage employment from our analysis is because it is a special category of employment that attracts generally the poorest, and has been shown to be of limited significance in household income (e.g. Matsumoto et al. (2006) in Eastern Africa). Following the functional classification, we distinguish between non-farm wage (involving a wage or salary contract) and non-farm self-employment (entrepreneurial activity).

In line with our definition and classification of RNFE, we consider a household to be participating in non-farm wage employment if at least one member of the household holds or held a non-agricultural job involving a wage or salary contract, in the 12-month period prior to the survey. For non-farm self-employment, participation implies at least one member of the household has owned a business or worked on their own-account during the 12-month period prior to the survey.[6] Note that by this definition we do not require the non-farm activity to be the primary activity of the household members. As mentioned by Winters et al. (2009), this avoids underreporting participation rates. However, our definition is not equivalent to the definition used in Winters et al, (2009) as we do not include transfers and remittances, and we keep non-farm wage employment and self-employment separate throughout our analyses. We lay out, in the later section of this paper, the main reasons for keeping both types of non-farm employment separate.

3. Conceptual framework and empirical strategy

Participation in rural non-farm activities: Push and pull factors

Observed patterns of participation in non-farm activities, such as wage employment and self-employment result from the combination of "*pull*" and "*push*" factors. *Push* factors relate to the need for ex-ante income smoothing strategies in the presence of binding financial constraints and limited risk mitigating solutions. This includes cases where households diversify in order to satisfy the need for cash to finance agricultural activities in the absence of rural financial services, or the need to feed a large household on a limited amount of land in case of crop failure. On the other hand, *pull* factors relate the desire by economically rational households to take advantage of opportunities generated by the transformation of the rural economy as a whole. Increased agricultural productivity from the use of modern production techniques, coupled with diminishing marginal return of labor in agricultural use, free labor for use in more productive non-farm alternatives. Also, increased urbanization, and income rise as part of the structural transformation underway in most developing countries, generates demand for non-agricultural goods and services, thereby offering remunerative opportunities in the non-agricultural sector for the surplus labor squeezed out from the agricultural sector (Barrett et al., 2001b, Haggblade et al., 2010). While in

[5] Ganyu labor is short-term labor hired on a daily or other short-term basis. Most commonly, piecework weeding or ridging on the fields of other smallholders or on agricultural estates.

[6] We have preferred using the binary participation variable instead of continuous participation variable (such as household income from non-farm activities, or number of hours spent in non-farm activities) mainly because the continuous forms are more prone to measurement errors. Also the household income from participation is available only for the participating households. Assuming zero for the non-participants is likely to lead to biases.

poor agrarian economies, and for poor households, push factors might trigger the need for diversification (Bardhan and Udry, 1999), resource constraints and entry barriers faced by the poor often restrict their participation in high-return non-farm activities (Bezu and Barrett, 2012). Whether it is by necessity or by opportunity, it is a widely held view that participation in non-farm activities is likely to have a positive effect on the welfare of a participant through the above described channels (Owusu et al., 2011, Ackah, 2013, Oseni and Winters, 2009), though strong empirical evidence of this seems to still be lacking in the currently available literature. However, because poor and non-poor may have differing motives for participating in RNFE (opportunity versus necessity), their benefits from participation are also likely to differ.

In this paper, we allow for non-farm wage employment and non-farm self-employment to affect household welfare differently. Assets that facilitate engagement in either type of non-farm employment, the timing of their availability, the returns from participation, and the costs imposed on participating households are likely to be different. For example, non-farm self-employment often comes from businesses owned and managed by the household and therefore may offer more flexibility for the household to manage them in parallel with other activities such as agricultural activities without creating too much competition for labor. Wage employment on the other hand may imply more competition with agricultural activities due to a less flexible schedule, but does not require households to make an upfront capital investment. While the data set does not allow us to fully investigate those differences between non-farm wage employment and non-farm self-employment, we still consider it important to maintain the separation between them in our analyses.

Following Bardhan and Udry (1999), adapted by Abdulai and CroleRees (2001) we formalize households' participation in non-farm self-employment and wage employment by assuming that households allocate resources such as time and land across various activities including farm and non-farm activities. Households choose consumption C_t to maximize the following lifetime expected utility function Max $U_t = E_t \sum_{t=\tau}^{T} \delta^{\tau-t} u(C_t)$ subject to the following constraints:

Inter temporal budget constraint: $\boldsymbol{A_{t+1} = (1 + r_t)(A_t - C_t + \sum_{k=1}^{K} g_k(l_{kt}, \varepsilon_{kt}; X))}$ **(1)**

Time endowment constraint: $\boldsymbol{\sum_{k=1}^{K} l_{kt} \leq L}$ **(2)**

Non-negativity constraint: $\boldsymbol{l_{kt} \geq 0}$, **k=1…K** **(3)**

Where T is life expectancy, and δ is the discount factor. l_{kt} is the amount of labor allocated to activity k at time t. $g_k(l_{kt}, \varepsilon_{kt}; \boldsymbol{X})$ is the technology constraint that characterizes the returns from investing l_{kt} units of labor in alternative k. X captures household's individual and location characteristics that influence the returns to labor use in each of the K uses.

The first-order conditions for the above maximization problem imply that households allocate labor between K activities in order to equate the marginal utility of allocating one unit of labor to each of them. Mathematically this implies:

$$\boldsymbol{E_t[U'(C_t).g'_k(l_{kt}, \varepsilon_{kt}; X)] = E_t[U'(C_t).g'_{-k}(l_{-kt}, \varepsilon_{-kt}; X)]} \quad \textbf{(4)}$$

where –k refers to activities other than k. The household labor allocation decision to activity k takes into account the expected return from that activity, and the maximum expected returns from all the other possible activities. If for any activity, the household's endowments in human, financial, and physical capitals imply a low expected return from that activity compared to the

others, then no labor would be allocated to that activity. This implies that low expected returns from participation in non-farm employment might justify, at least partly, the limited participation observed for the poor relative to the non-poor. Even though, for the poorest, expected marginal utility from investing labor in agriculture is low given their land constraint and limited access to other productive agricultural assets, the low expected returns from the best non-farm employment opportunity they have access to, given their resources, may still be very low. This illustrates why econometric estimations of the impacts of non-farm employment participation needs to take seriously the endogeneity of the participation decision.

A similar reasoning may apply when households are allocating labor between non-farm wage employment and non-farm self-employment. Different types of households' resources might matter for the non-farm self-employment compared to wage employment and therefore will affect households revealed preference for each of them. We investigate empirically, the main factors that determine households' participation in non-farm wage employment and non-farm self-employment in rural Malawi.

Determinants of participation in non-farm employment

Consider the following latent variables W_{itk}^{*} which characterize the differential benefit from participation in an activity k relative to the next best alternative. We drop the subscripts k for succinctness. As mentioned above, households' individual and location characteristics play an important role in determining this differential benefit. We allow for both observable and unobservable household characteristics to affect this decision. Therefore, the latent variable model is specified as follows (Green William, 2000, Wooldridge, 2010, Owusu et al., 2011):

$$\boldsymbol{W_{it}^{*} = 1[X_{it}'\beta + r_i + u_{it} > 0]} \quad \textbf{(5)}$$

where W_{it} is the observed participation decision of a household at time t. X_{it} is the vector of explanatory variables included in the model. Assuming a standard normal distribution for the error term u_{it} yields a Probit model for the participation decision. r_i captures unobservable characteristics of the households such as ability, networks and preferences, that may affect their employment choice and may also be correlated with some explanatory variables such as education. β is the vector of parameters of interest. The estimation of this model with pooled Ordinary Least Square (OLS) or Probit or Logit model without taking into account the unobserved parameter r_i will likely lead to inconsistent estimates due to omitted variables. If this was a linear model, we could use a fixed effects (FE) approach to get rid of the unobserved time invariant effects. But in our case, we have non-linear (binary decision) models. The use of the fixed effects method is, thus, problematic because of the incidental parameters problem (Wooldridge, 2010). Instead we use the Mundlak (1978) special case of (Chamberlain, 1982) correlated random effect (CRE) to model the relation between the unobserved time invariant heterogeneity parameter r_i and the explanatory variables X_{it}, and we get the following unobserved effects Probit response function (Green William, 2000, Wooldridge, 2010):

$$\boldsymbol{Prob(W_{it} = 1|X_{it}) = \Phi(X_{it}'\beta + r_i)} \quad \textbf{(6)}$$

$$\boldsymbol{r_i = \psi + \overline{X_i}\xi + a_i, \quad a_i|X_i \sim Normal(0, \sigma_a^2)} \quad \textbf{(7)}$$

The full model becomes:

$$\boldsymbol{Prob(W_{it} = 1|X_{it}, \overline{X_\iota}) = \Phi(X'_{it}\beta_a + \psi_a + \overline{X_\iota}\xi_a),} \quad \textbf{(8)}$$

with $\boldsymbol{\theta_a = \theta/(1 + \sigma_a^2)^{1/2}}$ **,** $\boldsymbol{\theta = (\beta, \psi, \xi)}$

Partial effects of variable x_j, from the model above, are defined as:

$$\boldsymbol{PE_{x_j} = \frac{\partial Prob(W_{it}=1|X_{it},\overline{X_\iota})}{\partial x_{jt}} = \beta_{aj} \cdot \phi(X'_{it}\beta_a + \psi_a + \overline{X_\iota}\xi_a)} \quad \textbf{(9)}$$

The parameters of equations (8) and (9) can be consistently and efficiently estimated using random effects conditional maximum likelihood (or full MLE). However, consistency of the full MLE relies on the conditional independence assumption, thereby ruling out serial correlation in the error terms. In our cases, there are reasons to believe that participation in non-farm employment in the current year is not totally independent from participation in previous years even after controlling for observable characteristics, creating a violation of the conditional independence assumption. An alternative approach uses the pooled binary model or partial (pooled) maximum likelihood estimation. Though such estimator is usually less efficient, it is consistent, even under the violation of the conditional independence assumption. A more efficient estimation is possible using the Generalized Estimating Equation (GEE) technique (Liang and Zeger, 1986). This estimator is also robust to violation of the conditional independence assumption, but panel-robust standard errors should be used for inference. Given its advantage over the full MLE and pooled probit approaches, we use mainly the GEE approach to estimate APEs. The GEE estimator is a more efficient version of the moment based GMM estimator, and is asymptotically equivalent to the Weighted Non Linear Square (WNLS) estimation approach (See Cameron and Trivedi (2005), p790 for a brief discussion).

The main approach described above uses single equations and models separately the determinants of participation in non-farm self-employment and non-farm wage employment. This assumes that both decisions are made in complete independence from each other, implying that the residuals terms in both equations have zero correlation (See Green William (2000), chapter 17.5 for a discussion of multivariate Probit models):

$$\boldsymbol{\rho = cov\left(u_{it}^{wage\ employment}, u_{it}^{Self-employment}\right) = 0} \quad \textbf{(10)}$$

This does not have to be the case. It is very plausible that farmers make decisions about labor allocation to various activities simultaneously. In which case, there is some efficiency gain in estimating simultaneously both non-farm employment equations. The jointness of the decisions can be justified by the fact that households have a limited amount of labor available, and labor markets are not fully functional. Alternatively, there are probably common unobserved factors that affect participation in both non-farm activities. In the same spirit as seemingly unrelated regressions, a system of binary response equations can be estimated that take into account the potentially positive correlation between the residuals from both equations. Multivariate probit models rely on the joint normal distribution of the errors. Maximum likelihood is applied based in the joint density function.

$$\boldsymbol{\begin{pmatrix} u_{it}^{wage\ employment} \\ u_{it}^{self-employment} \end{pmatrix} \left| X_{it}, \overline{X_\iota} \right. \sim Normal\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]} \quad \textbf{(11)}$$

While this method is expected to yield efficiency gains compared to the single equations, the joint normality of the residuals from both non-farm employment equations is a very restrictive assumption; because, joint normality is not always guaranteed even when each marginal distribution is normally distributed (Wooldridge, 2010). Under joint normality, bivariate Maximum Likelihood estimator algorithms are available in most statistical packages such as STATA. When we have several equations, simulation-based methods such as the Geweke–Hajivassiliou–Keane (GHK) smooth recursive conditioning simulator are recommended to go around the difficulty of managing a complex likelihood function (Cappellari and Jenkins, 2003). Because of the potential loss of consistency in case of violation of the joint distributional assumption, we maintain single equations as our main approach, but we estimate the bivariate Probit model using traditional bivariate probit Maximum Likelihood as well as the GHK Simulated Maximum Likelihood for robustness purposes.

Average treatment effects of participation in RNFE on participants

The core equation to be estimated, for each outcome of interest in this analysis, takes the form of the following unobserved effect model:[7]

$$\boldsymbol{Y_{it} = G(\beta_0 + \beta_1 SelfEmployment_{it} + \beta_2 WageEmployment_{it} + Z'_{it}\beta_3 + c_i + \varepsilon_{it})} \quad \textbf{(12)}$$

where ε_{it} is the vector of idiosyncratic errors, and Z_{it} is a vector of controls. We allow for an unobservable household heterogeneity effect c_i (in equation 1) to be correlated with the explanatory variables in the model. G(.) is a positive function that links the explanatory variables to the dependent variable Y_{it}. It could be a linear or non-linear function (for example: standard normal density, or Tobit function) depending on the dependent variable. β_k, k=0, 1, 2, 3 are the parameters to be estimated. Our estimation approach uses the fixed effects (FE) approach or the correlated random effects (CRE) approach, as appropriate. Indeed, some of our outcome variables are better represented using non-linear models (e.g. poverty incidence (1/0), poverty gap (0-1), input purchase (1/0), value of input purchases (pile up at zero due to corner solution), and therefore we estimate both the CRE model and the linear FE model and compare results.

A weakness of both the FE and the CRE approaches is that they only account for time invariant unobservable heterogeneity. Any remaining time-varying unobservable heterogeneity might still lead to inconsistent estimates unless they are effectively taken into account using appropriate instrumental variables. However, instrumental variable methods suffer the difficulty of finding a good instrument that satisfies both identification and rank conditions (See Wooldridge 2010): (i) they should have no partial effect on the outcome variables and should not be correlated with other factors that affect the outcomes variable; and (ii) they must be related, either positively or negatively, to the treatment indicator. Keeping in mind that "*the cure may be worse than the disease"* when a weak instrument is used (Baser, 2009), we use the FE and CRE approaches without instrumental variable, but we include a large set of time varying explanatory variables to hopefully capture and proxy for as many sources of heterogeneity as possible. In particular we control for geographical location using dummy variables thereby capturing local market conditions that may affect both the participation in RNFE and also the welfare outcome of interest.

Distributional effects of non-farm employment participation: Quantile regression

[7] See the list of outcome variables in table 1.

Though the average treatment effect is a useful way to summarize the link between participation in RNFE and welfare outcomes, it may hide a lot of heterogeneity in terms of how different groups benefit from non-farm employment participation. Quantile regression methods (Koenker, 2005) can address this limitation by informing about the relationship between non-farm employment participation and outcome variables at different points of the conditional distribution of the outcome (Cameron and Trivedi, 2010). As such, QR methods can inform the distributional effects of engaging in non-farm activities. This is usually overlooked in treatment effects estimation discussions and seems largely absent in the literature on RNFE and welfare effects. Distributional effects have very important implications for informing likely effective policies and the extent to which finer targeting might be necessary to improve effectiveness of policies. Another advantage of quantile regressions over conditional mean regressions is that the former is robust to outliers because quantiles are not sensitive to extreme values of the outcome while the mean is.

For values of q between 0 and 1, let's define the conditional quantile $Q_q(Y(.)|w,Z) = F^{-1}_{Y(.)|w,Z}(q)$, as the value of outcome Y (HHPCE in our case) that splits the data into the proportions q below, and 1-q above, where $F^{-1}(.)$ represents the cumulative distribution function CDF of potential outcome Y(.). As described by Imbens and Wooldridge (2008) as well as Cameron and Trivedi (2010) we specify the q-th quantile treatment effect as the average difference between quantiles of the two marginal potential outcome distributions:

$$\boldsymbol{\tau_q(Z) = F^{-1}_{Y(1)|Z}(q) - F^{-1}_{Y(0)|Z}(q)} \quad \textbf{(13)}$$

Assuming linearity, the following conditional quantile equation is estimated for various quantile of Household Consumption Expenditure Per Capita (Koenker, 2005):

$$\boldsymbol{Q_q(Y_{it}(.)|w,Z,c) = \tau_{q0} + \tau_{q1} w_{it} + Z'_{it}\tau_{q3} + Q_q(v_{it}|w,Z,c)} \quad \textbf{(14)}$$

where $v_{it} = c_i + u_{it}$ is the composite error. We use $\boldsymbol{w_{it}}$ to represent the vector of treatment variables $(SelfEmployment_{it}, WageEmployment_{it})$. Again, we model the unobserved household time invariant characteristics using the CRE. We then apply pooled quantile regression to the resulting equation.[8] Using a generalized version of the least absolute deviation (LAD) estimation approach (Wooldridge, 2010, Green William, 2000), we estimate and graphically present the quantile treatment effects for several quantiles (10^{th}, 20^{th}, 25^{th}, median, 75^{th}, 80^{th}, and 90^{th}) of household per capita consumption expenditures.

Estimation strategy and description of key variables

Table 1 presents the description and summary statistics of the main outcome variables analyzed in this paper, along with the methods used for estimating their equations.

[8] While this way of introducing time averages as regressors is a practical way of introducing CRE into quantile regressions, it is not totally consistent with the unobserved effects quantile model in equation 12. Because the quantile of a sum is different from the sum of quantiles, the independence assumption after including time averages of explanatory variable is still restrictive. We recognize this as a limitation of our estimates. We explore a model without the time averages to check consistency of the results (Wooldridge, 2010).

Beyond our two treatment variables describing participation in non-farm wage employment and non-farm self-employment, the first main outcome variable considered is household per capita consumption expenditure (HHPCE) as a direct measure of household welfare. It includes annual aggregate expenditures on food, non-food, durable goods and housing, deflated by spatial and temporal prices indices to adjust for cost of living differences, and adjusted for household size. We prefer this consumption-based measure as opposed to its main competitor (income-based), because consumption is considered less prone to seasonal variations in living standards, especially in rural areas of developing countries. Deaton and Zaidi (2002) mention that consumption aggregates, over a relatively short period of time such as annual, offer a practical advantage over income aggregates by informing more about longer-term living standards. As indicated in Table 1, average HHPCE over both survey years is 57,750MKW.[9] The conditional expectation model of HHPCE is a linear model that we estimate using the FE approach. We also estimate the treatment effects on Log HHPCE using the FE, which gives a sense of percentage effects of our treatment variable, and allows interpretation in relative terms. The conditional quantile model is also a linear model in which the quantiles of the conditional distribution of HHPCE are expressed as linear functions of the independent variables (see equation 14). This model includes the same explanatory variables as in the conditional expectation model, and is estimated using generalized least absolute deviation (LAD) approach. As suggested by equations 12 and 14, the independent variables in the estimating equations include primarily our two treatment variables, in addition to which we include the following set of control variables guided by on the basis of theory and the available literature:

- household characteristics (such as education, age of head, household composition);
- household ownership of productive capital (captured by normalized agricultural assets, normalized landholdings,[10] as well as normalized total livestock unit[11]);
- distance to infrastructures (road and markets to capture transaction costs faced by households);
- community level characteristics that may affect productive activities (prices of fertilizer in the EA, price of maize in the EA,[12] rainfall, temperature, etc.).

We also include a time dummy variable in the equation to account for time specific shocks that could affect welfare directly, but also affect RNFE participation. In the CRE model, the time averages of all the explanatory variables are included to capture time invariant unobserved heterogeneity. In order to reduce remaining unobserved characteristics that might affect our estimates of the treatment effects, we include a set of 26 dummy variables to capture district

[9] This is equivalent to about 346.5 USD given the prevailing exchange rate (0.006USD/MKW) during the survey period. See http://www.xe.com.

[10] An alternative specification includes also a dummy variable for landless households. But adding this variable does not change the results at all because the proportion of landless represents only 7 percent of the sample. So our reported results exclude this variable purposely.

[11] Households' wealth and productive capital indices such as wealth index and agricultural assets index are generated using factor analysis as in FILMER, D. & PRITCHETT, L. H. 2001. Estimating wealth effects without expenditure data—or tears: An application to educational enrollments in states of india*. *Demography,* 38**,** 115-132. The index was then normalized such that norm_index = ((index - min(index)) / (max(index)-min(index))).

[12] Fertilizer is a key modern input in agriculture production, and maize is the most popular food crop grown and consumed in Malawi.

specific factors that may affect welfare but also determine the economic opportunities available in the area and affect welfare. The description of all these variables, as well as the test of covariates balancing between treatment and control groups can be found in Appendices 1 through 3. Those balancing tests indicate significant differences in education, assets endowment, and resource constraints between participants and non-participants in non-farm wage employment and non-farm self-employment. We also notice significant differences between the poor and the non-poor in terms of household covariates (Appendix 4).

Second, we investigate whether participation in RNFE influences household consumption expenditure enough to affect poverty status. For the poverty analysis, the class of poverty metrics proposed by Foster, Greer and Thorbecke (FGT, 1984) is used. Poverty incidence is based on the HHPCE, relative to the 85,852 MKW (real 2013 prices) local poverty line per person per year in Malawi. As opposed to the $1.90/day international poverty line, this local poverty line indicates the cost of maintaining a reference welfare level (here defined as satisfying necessary energy and nutritional requirements to have a healthy and active life) to a given person, at a given time in the specific context of Malawi (Ravallion, 1998).[13] Household poverty incidence takes value 1 if household consumption falls below the poverty line, and 0 otherwise. The summary statistics presented in table 1 indicate that the proportion of rural households with consumption expenditure below the poverty line is 37 percent over the 2010-13 pooled sample, confirming that poverty is relatively widespread in rural Malawi.[14] The main specification used to explore the effect of the RNFE on poverty is a CRE Probit model, estimated using the Generalized Estimating Equation (GEE) approach.[15] Poverty gap (defined as the consumption shortfall relative to the poverty line, as a fraction of the poverty line) takes a value 0 for all non-poor households, creating a censoring at 0 and a continuous set of values between 0 and 1. The squared poverty gap (sensitive to extreme poverty) takes continuous values between 0 and 1 with a pile up at zero. On average, the poor in rural Malawi appear to be about 30 percent short of the poverty line, and the squared poverty gap is 0.13. We use the CRE fractional Probit approach to estimate responses of both poverty variables to RNFE participation. As demonstrated by Gallani et al. (2015), Fractional Response Model (FRM) is preferable since it overcomes the limitations of other approaches for the statistical analysis of dependent variables that are bounded in nature and present a significant number of observations at one of the boundary points. For all these three poverty measures, we also estimate the linear FE model to serve as benchmark for comparison as it requires fewer distributional assumptions and generally gives reasonable approximation of APEs (Wooldridge, 2010). The same set of covariates used in the estimation of the HHPCE response model are used for the poverty analyses.

Third, we explore effects of RNFE on subjective measures of food security, captured by self-reported measures of food insecurity and food consumption adequacy (see Table 1). The food

[13] More details about this can be found in the LSMS documentation for Malawi.

[14] This refers to the average proportion of poor rural households in the pooled sample. Over the period 2010 to 2013, the proportion of poor rural *households* dropped from 40% to 33%. Overall, the proportion of poor rural *people*, the rural poverty headcount, fell from 44% in 2010 to 41% in 2013.

[15] The GEE approach consistently identifies average partial effects (APE); it is robust to violation of the conditional independence assumption as opposed to the full maximum likelihood approach; it is more efficient than pooled Probit approach but clustered robust standard errors have to be used. (See Wooldridge (2002) for a full discussion.)

insecurity variable is a binary variable taking value one if the household head responded yes to the question "*Did you worry that your household would not have enough food in the past 7 days?*" This is modeled using the CRE Probit approach and estimated using GEE technique. The food consumption adequacy variable is an ordered response variable describing household food consumption over the past month on a scale of 1(less than adequate for household needs); to 3 (it was more than adequate for household needs). It is modeled using the CRE ordered Probit approach with maximum likelihood estimation approach. The ordered probit model enables us to account for the ordered nature of the food insecurity measure as well as time invariant unobserved household characteristics (See Wooldridge 2010 for details about ordered response models). For both these variables, we also estimate the linear FE for comparison purpose. Again, the same set of control variables are included in the model as in the HHPCE and poverty equations.

Finally, we turn our attention to agricultural investments. Several studies in the RNFE literature have explored agricultural investment as a pathway through which non-farm employment participation can increase welfare, and concluded a positive effect. For example, Oseni and Winters (2009) concluded a positive effect of both non-farm wage employment and non-farm self-employment participation on Nigerian farmers' agricultural investments (especially labor and fertilizer). Other studies such as Smale et al. (2016) found negative effects on fertilizer application (specifically nitrogen application on maize by Kenyan farmers), and concluded that engagement in the RNFE could be a distraction with trade-offs in labor allocation and farm investments. We investigate, in the case of Malawi, the effects of non-farm employment on agricultural investments. We focus on household purchases of fertilizer, and all inputs, as well as area of land cultivated. The effects of non-farm employment on the binary purchase decisions are first considered with a CRE Probit model and GEE estimation technique. Then, the effects on the quantity of inputs/fertilizer purchases per acre of land cultivated are modeled with a CRE Tobit approach and estimated using partial Maximum Likelihood. The linear FE estimation of partial effects is used for comparison purposes.

4. Results and discussion

4.1. The Rural Non-Farm Economy in Malawi

Like many other parts of the developing world, the rural economy in Malawi is transforming as its economy grows. A sign of such transformation is the increasingly important place that non-farm activities are occupying for households in rural Malawi. Though, agriculture remains the main source of income for most households, participation rates in non-farm wage and self-employment, as well as income shares from those activities, have reached non-negligible levels. Table 2 shows that the proportion of households earning income from non-farm self-employment was about 18 percent in 2010, and 27 percent in 2013. Meanwhile, average households' income share coming from non-farm self-employment was estimated at about 7 percent and 11 percent in 2010 and 2013 respectively. As for non-farm wage employment, participation rates sat around 17 percent and 15 percent, in 2010 and 2013 respectively, with associated income shares around 8 and 6 percent on average. These estimates are about average compared to other Sub-Saharan African (SSA) countries. The estimation by Davis et al. (2014) for a group of SSA countries, indicates on average 15 percent participation rate for non-farm wage employment and 34 percent for non-farm self-employment, with associated income shares of 8 percent and 15 percent.

Consistently with the existing literature, the data from Malawi suggest a divide in participation in the non-farm economy along poverty line. Our descriptive statistics by poverty status indicate that, while participation in self-employment increased for both the poor and the non-poor between the two years, participation rates for the poor are significantly lower than for the non-poor households in both years. In 2013, about 20% of the poor were engaged in self-employment activities, up from 15% in 2010. Meanwhile the same statistic for the non-poor increased from 20% in 2010 to 30% in 2013. The difference between poor and non-poor is even sharper for wage employment, where the participation rates for the non-poor are more than double the participation rates among the poor in both survey years. The lower gap observed for non-farm self-employment compared to wage employment likely reflects differences in entry barriers between the two types of employment. Non-farm wage employment jobs require more education and better social networks. While the lower participation rates among the poor call for further attention to participation barriers, the fact that participation rates among the poor are still almost 20% justifies the need to understand if and how such households benefit from non-farm activities.

In a more detailed analysis, participation rates and returns by sectors of non-farm self-employment (Table 4) and non-farm wage employment (Table 5) for the poor and non-poor confirms further patterns of dualism. Our descriptive analyses indicate the existence of high and low return sectors of non-farm activities and the high return sectors are almost exclusively available to a handful of privileged, due to entry barriers that prevent the more marginalized groups (the poor and sometimes women) from accessing those opportunities. In the following paragraphs, we describe the main features and types of non-farm employment in which rural households in Malawi are involved, by poverty status.

Non-farm self-employment in rural Malawi

Table 3 summarizes the main traits of non-farm businesses observed in rural Malawi. As most rural non-farm enterprises in SSA, described by Nagler and Naude (2014), the characteristics of rural non-farm enterprises in Malawi are consistent with little potential for job creation as they are mostly informal, have low productivity, and short life spans. Almost half of all the non-farm businesses in rural Malawi are reportedly operated from home, with only 13 percent having access to electricity, and 6 to 8 percent with some formal registration. Business owners are relatively young (38 to 39 years old) and mostly uneducated (75% of business owners have no formal education). Businesses owned by poor household members are less likely to be registered formally compared to those owned by non-poor household members. Also poor business owners appear less educated on average compared to non-poor business owners. These differences might well affect productivity and returns to participation for the poor.

As for the types of household enterprises operated, participants in non-farm self-employment are involved in a variety of sectors or industries.[16] The distribution of non-farm self-

[16] The classification of non-farm enterprise activities into industry categories used here closely follows the 1992 United Nations International Standard Industrial Classification (ISIC) standards into 5 main groups. The groups include: (a) Primary sector, which comprises agriculture, livestock, hunting, fishing, and mining; (b) Food, Beverage, and Tobacco Manufacturing; (c) Non-food Manufacturing, (d) Commerce and Tourism (wholesale and retail, and restaurants and

employment by sector, as well as average profit[17] earned by participants, for the poor, and the non-poor are summarized in Table 4. The analysis of table 3 indicates that about half of household enterprises in rural Malawi are in the commerce and tourism sector (wholesale, retail trade, restaurants, and hotels). These are typically small businesses involving people selling or reselling a wide variety of products from groceries and food products to clothes, shoes, etc., and earning on average 6,000 to 7,000 MKW[18] (or 8 to 10USD) monthly. The second most prominent sector is the manufacturing sector (food and non-food combined), which accounts for approximately 40 percent of all household enterprises. The manufacturing sector is dominated by food, beverage, and tobacco manufacturing, which accounts for more than half of the manufacturing sector, represents more than 25 percent of all household enterprises, and includes primarily street vendors of various food and drinks and making a profit in the range of 4,000 to 6,000MKW (or 5.5 to 6USD) monthly.

In general, returns to non-farm self-employment are pretty low (around 6,000MKW ~ 8USD) in rural Malawi, and are lowest in the most popular sectors (Table 4). The commerce and tourism sector, which contains about half of the non-farm businesses, generates on average 6,000 to 7,000KW (8 to 10USD) monthly, as opposed to 9,000 to 12,000 KW (12 to 17USD) of profit reported in the construction and services sector, which represents only 9 to 10 percent of non-farm enterprises. The manufacturing sector, second most important sector generates even lower revenues. Returns from the Food, beverage, and tobacco manufacturing sector are about 3,000MKW monthly, and the non-food manufacturing sector generates about 5,000 to 6,000 KW monthly.

With the sectors of non-farm enterprises defined here, no evidence of dualism becomes particularly apparent from simply observing the distribution of non-farm enterprises by sectors, for the poor versus the non-poor. However, a Kolmogorov-Smirnov test of equality of distribution does indicate a significant difference (at 1%) between poor and non-poor. We do observe a large heterogeneity in returns to participation within each category of non-farm enterprises. And profits earned by the poor are significantly lower compared to the non-poor across all categories of self-employment. The t-test of mean difference in profit (Table 4) show p-values less than 1% for most categories of self-employment.

Non-farm wage employment in rural Malawi

Non-farm wage employment activities are also distributed across several sectors[19] presented in Table 5. The *service sector* appears to be the largest with about a third of all non-

hotel businesses); and (e) Other sectors, which include construction, electricity and utilities, transportation, and other services.

[17] This is a direct measure self-reported by the respondent. The reference period for profits is the latest month of operation prior to the interview. Might suffer measurement errors. Therefore, should serve only as rough estimation.

[18] Kwachas (MWK), local currency used in Malawi. 1 USD = 723.4319 MWK according to currency.me.uk.

[19] We follow the occupation codes used in the Malawi LSMS survey instruments, which includes: Relatively ***skilled*** labor jobs such as: (1) Professional, technical, & related workers; (2) Administration and managerial workers; (3) Clerical and related worker; (4) Sales workers. And

farm wage employment, closely followed by the category of *transport equipment operators, and laborers not elsewhere classified* which represents approximately a quarter of all wage employment. Then comes the sector of *Professional, technical, & related worker groups*, representing also about a quarter of the rural non-farm wage employment. Together, the remaining sectors represent each less than 7% of non-farm jobs in both 2010 and 2013. Notice that approximately 75% of all rural non-farm jobs are in sectors that do not require highly skilled labor. Wages in those sectors are significantly lower than wages in sectors that require more skilled labor. As a result, the average monthly wage across all non-farm jobs in rural Malawi is pretty low, around 8,000 Kwachas (~ 11USD).

Dualism in the categories of non-farm wage employment is obvious compared to non-farm self-employment. The skilled labor jobs, which generate the highest returns, are almost exclusively accessible to the non-poor while the non-skilled labor jobs appear available for all. Table 5 indicates that about 80 percent of the jobs taken by the poor are in the non-skilled labor sectors, compared to about 60% for the non-poor. In addition, and non-surprisingly, the poor earn significantly less than the non-poor in most sectors of non-farm wage employment. Monthly wage earned by participants in non-farm wage employment, and t-test of difference in wages between the poor and non-poor by category of employment, reveals significantly lower wage for the poor. The only sector in which we fail to reject the absence of a significant difference between wages earned by poor and non-poor is the service sector, which is the most popular sector for both poor and non-poor.

4.2. Determinants of participation in non-farm activities

Table 6 summarizes the estimation results of the determinants of participation in non-farm wage and self-employment in rural Malawi based on the unobserved effects Probit model presented in equation 8 and 9. Several important points emerge from those results.

Education is an important driver of non-farm wage employment participation, but not a significant determinant of non-farm self-employment participation. Table 5 shows that the average partial effect of household head education increases with the level of education until MSCE level, beyond which educational attainment level does not appear significant anymore, probably due to the low proportion (1.3%) of people in that education level category in the rural Malawi. This is consistent with several previous findings such as in Oseni and Winters (2009), Winters et al. (2007) as well as Lanjouw and Shariff (2004), and De Janvry and Sadoulet (2001), though they have often lumped non-farm wage employment and self-employment together in their analyses, thereby losing out on some nuances between the two types of activities. Indeed, education may play a double role, influencing households' participation in non-farm-self-employment and wage employment. On one hand, since returns to non-farm wage employment are higher in general than non-farm self-employment (See Table 4 and Table 5), the more educated may occupy the few non-farm wage employment, leaving the non-farm self-employment sector for the least educated. This would imply a negative effect of education on non-farm self-employment participation. On the other hand, those who are more educated also have higher expected returns from participation in non-farm self-employment due to skills acquired from their formal training.

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relatively ***unskilled*** labor jobs such as: (1) Service workers; (2) Agricultural, animal husbandry and forestry workers, fishermen and hunters; (3) Other sectors including production and related workers, transport equipment operators and laborers not elsewhere classified.

We find that access to credit is an important determinant of households' participation in non-farm self-employment. More precisely, access to credit for relevant households increases participation in non-farm self-employment by about 8 to 10 percentage points on average, ceteris paribus (see table 6). These results challenge the common view that rural household enterprises require little to no capital investment and thus can provide a source of cash for the poorest who are lacking access to financial services in presence of rural credit market failures (Poulton et al., 2006, Bardhan and Udry, 1999). From our analysis, it appears that viable household enterprises in the context of rural Malawi require some level of investments, significant enough to preclude the poorest from engaging in those activities.

Wealth of the household (captured by a normalized asset index) significantly increases participation in both non-farm wage employment and self-employment. This is consistent with the findings in Oseni and Winters (2009), and add to reasons why the poorest have a more restricted access than the non-poor to non-farm employment opportunities. Assets such as tables, sewing machine, TV, bicycle, etc., can be used to operate household enterprises, commute to a non-farm wage or business place, etc., thereby increasing households' likelihood (and may be expected returns) of participating in non-farm wage and self-employment. In addition, asset ownership is correlated with social status in most rural areas in Africa. So households with more assets may have stronger networks through which they can receive information about non-farm wage employment opportunities. Depending on the type of business, households with large networks may also have higher expected returns from non-farm enterprises, which increases participation.

Besides, our results reveal generally stronger evidence of a pull scenario explaining the participation in non-farm activities in rural Malawi. The participation rate in non-farm wage employment, among neighboring households of the same geographical area, affects, positively and significantly, each household's participation in both non-farm wage employment and non-farm self-employment. Similarly, the proportion of other households owning a business in the same geographical area significantly and positively affects each household's likelihood of participation in non-farm self-employment and non-farm wage employment. This is consistent with the pull scenario described in Haggblade et al. (2010), which stresses that the economic environment greatly determines access and participation in non-farm activities. Having a lot of households participating in non-farm wage employment or non-farm self-employment in the same locality may reflect a more vibrant economic environment with more jobs or business opportunities, which therefore increase participation in those employment categories. From a social network effects point of view, this also corresponds with what was dubbed correlated neighborhood effects by (Manski, 1993). People behave like one another when they face similar shocks or environment. However, the observed correlation might also suggest the existence of social effects (endogenous and contextual peer effects), which imply that households' decision to participate in non-farm wage activities depend on their peers' behaviors and characteristics. Disentangling these effects is beyond the scope of this paper. However, the findings that social network effects might influence participation in non-farm self-employment (similarly to peer effects in agricultural technology adoption) are intrinsically interesting and deserve further investigation. In the social network literature and technology adoption literature, Bramoulle et al. (2009) followed by Krishnan and Patnam (2014) addressed the Manski reflection problem inherent to the identification of peer effects by using average characteristics of neighbors as instruments for participation rates among neighbors.

On the estimation methods, we find large consistency between our linear model results and the CRE Probit estimation results. The APE estimates have usually similar magnitudes as well as

consistent signs and significance levels in both the non-farm wage employment and non-farm self-employment cases. More importantly, the results from the more efficient multivariate system estimates do not add any particular insight (see appendix 5). While the Simulated Maximum Likelihood (SML) estimates and the Bivariate Probit Maximum Likelihood (ML) estimates both do indicate a negative correlation (ρ=-0.15) and significant (at 1%) between the residuals of the non-farm wage employment and non-farm self-employment models, the coefficient estimates are remarkably consistent in signs and significance with the main Probit results described above. This robust consistency of our estimates across methods increases our confidence in these results, which indicates that policies geared to increase rural household participation in non-farm employment might want to focus on factors such as education and access to credit for the poor, in addition to improving infrastructure and growth motors.

4.3. Impacts of participation in the RNFE

Impact on HHPCE

Does participation in non-farm activities increase households' welfare, *ceteris paribus*? Are the poverty reduction motives of policies promoting the RNFE in developing countries justified? Our APE estimation results, summarized in Table 7, indicate a consistently positive response to both questions. Appendices 6 through 11 report the full set of results. We discuss below the main points that come out of those results.

First, non-farm wage employment participation increases households' per capita consumption expenditure by a margin of 4,500MKW, though only significant at 16%. The log linear model indicates a 10 percent increase effects, statistically significant at 5%. As for non-farm self-employment, the APE estimates on the levels of HHPCE is 7,000MKW corresponding approximately to a 13 percent increase in HHPCE, and statistically significant at 1%. These numbers are not directly comparable with previous studies such as Owusu et al. (2011) and Ackah (2013) since they lumped both types of non-farm activities together and also focused on different outcome variables (notably household income instead of consumption expenditure). However, they confirm the general conclusion of a positive effect of non-farm employment participation on direct measures of household welfare. Besides, the t-test of comparison of coefficients of non-farm self-employment and non-farm wage employment indicates, at 1% significance level, that the effect of non-farm self-employment on participants is higher on average than the effects of non-farm wage employment participation.

While we find positive effects of participation in both non-farm wage employment and non-farm self-employment, we also find significant heterogeneity of HHPCE response to participation in the RNFE. Everything else held constant, households at the bottom of the wealth distribution seem to benefit significantly less from participating in non-farm wage employment or in non-farm self-employment than households at the top of the distribution (Table 8 and Figure 1). Though the effects of engaging in non-farm wage employment or non-farm self-employment remain positive for all classes of the welfare distribution, there is a generally increasing trend in the size of the effect as we go from lower percentiles to the top of the distribution of HHPCE. The quantile effects of non-farm self-employment go from a low of about 2,300MKW for the 10^{th} percentile of HHPCE, and increases to a high of over 16,000MKW for the 90^{th} percentile (almost 10 times the effect on the lowest quantile). As for non-farm wage employment, the effect is not significant for the 10^{th} and 20^{th} percentiles. It starts being significant for the 25^{th} percentile, from

a low of 4,600MKW to a high of about 6,500 MKW for the 75th and 80th percentiles, before dropping again to a non-significant size of 2,000MKW at the 90th percentile. This indicates that, for non-farm wage employment, the middle segments of the population benefit the most; while, for non-farm self-employment, the upper segments benefit the most from participating. However, in both cases the poorest appear to benefit the least from participating, confirming the findings in (Bezu et al., 2012). This heterogeneity of effects also illustrates the fact that resource constraints faced by the poorest likely consign them to low return activities with less potential to increase their income considerably, potentially putting them into a poverty trap. Meanwhile the middle and upper segments earn significantly higher returns from participating in non-farm activities because they have access to the most lucrative employment opportunities. These results are largely consistent with our descriptive analysis, and also support the evidence in the existing literature on the existence of entry barriers that confine marginalized groups to low returns and non-lucrative employment categories (Abdulai and CroleRees, 2001, Woldenhanna and Oskam, 2001, Barrett et al., 2001a, Smith et al., 2001, Lanjouw et al., 2001, Reardon et al., 2000).

Impacts on poverty and food security

We extend beyond HHPCE to analyze several other welfare outcomes. Our results indicate that both non-farm wage employment and non-farm self-employment have a negative and significant effect on all three FGT poverty metrics. Both the fractional Probit model and the linear FE model show that, on average, a household's engagement in non-farm wage employment reduces the likelihood of its consumption expenditure falling below the poverty line by 7 percentage points. Similarly, self-employment reduces poverty incidence by a statistically significant margin of about 8.5 percentage points. This is an important margin relative to the pooled sample rural household poverty incidence of about 37 percent (see summary statistics in Table 1). For the depth and severity of poverty measured by poverty gap and squared poverty gap respectively, our CRE fractional Probit, and linear FE models produce consistent results indicating significant and negative effects of both non-farm wage employment and nonfarm self-employment. This implies that though the poorest seem to benefit less from engaging in non-farm activities, the size of the effect is still enough to reduce significantly the depth and severity of poverty confirming that the rural non-farm sector can well serve as a pathway out of poverty for poor rural households in Malawi.

The positive effect of non-farm activities persists in the analysis of household subjective perceptions of food security. In particular, estimates from the CRE Probit model and linear FE model consistently indicate that participation in non-farm wage employment reduces the likelihood that a household feels food insecure by about 5 to 6 percentage points. Similarly, the ordered Probit results show that households engaged in non-farm wage employment perceive their food consumption level to be more adequate for the needs of the household, compared to non-participating households. For non-farm self-employment, the estimated effect does not appear statistically significant.

RNFE and agricultural investment

Several studies in the RNFE literature have explored agricultural investment as a pathway through which non-farm employment increases welfare, and concluded a positive effect. For example, Oseni and Winters (2009) concluded a positive effect of both non-farm wage

employment and non-farm self-employment participation on Nigerian farmers' agricultural investments (especially labor and fertilizer). Other studies such as Smale et al. (2016) found negative effects on nitrogen application on maize by Kenyan farmers, and concluded that engagement in the RNFE could be a distraction with trade-offs in labor allocation and farm investments. Our results (at bottom panel of Table 7) indicate that participation in non-farm self-employment increases likelihood (but not intensity) of inputs use, especially inorganic fertilizer purchases among rural households in Malawi by about 5 percentage points. Though restricted to the purchase decision only, these findings tend to align more with the strand of existing literature finding evidence that RNFE reduces the cash constraint for rural households at least partially engaged in agriculture such as Owusu et al. (2011) and Ackah (2013) as well as Barrett et al. (2001b) on the subject. We do not find a statistically significant effect of wage employment on input purchases. The lack of significance of the effects of non-farm wage employment could imply that the negative effect on agriculture due to labor displacement counters the positive effect on financial constraints for agricultural investments. We also do not find any effects of RNFE on the area of land cultivated in the season.

It is possible that decisions to participate in non-farm employment and decision to use inputs are made simultaneously, and therefore a system estimation of non-farm employment participation and inputs use equations would improve the efficiency of the estimates; though identification relies on joint normality of the residuals from the equations in the system. As an additional robustness check, we estimate a series of recursive trivariate Probit models as an alternative way to explore the effects of non-farm employment participation on inputs purchase decisions (Appendix 11). In each system, we have one equation for each treatment variable (wage-employment and self-employment), and one equation for the outcome variable (fertilizer purchase, or inputs purchase), making a total of three equations. The equation for the outcome variable includes both treatment variables as explanatory variables, while the equations for the treatment variables do not include the outcome variable as explanatory variable. This recursive formulation (see equation 17-49 in Green William (2000)) implies a one-way causality between the treatments and outcome variables. A similar approach was used by (Smale et al., 2016) to investigate the same question in Kenya. We estimate this system, for input purchase and for fertilizer purchase decisions using GHK Simulated Maximum Likelihood (Cappellari and Jenkins, 2003). The estimated coefficients are consistent with the single equation results presented above suggesting a positive effect of non-farm employment participation on inputs purchase decision in general, and fertilizer purchase in particular. More interestingly while the effect of non-farm wage employment was not significant in the single equation models, the more efficient system estimations indicates a rather positive and significant effect of non-farm wage employment on inputs purchase decisions as well. The likelihood ratio tests of joint significance of the residuals from the equations are always significant at 1%, justifying the relevance of a system estimation approach to improve efficiency in our case.

Overall, the study results indicate positive welfare effects of RNFE on objective and subjective measures of household welfare and these findings are consistent across different estimation techniques. The results are also largely consistent with the existing literature. The magnitude of the welfare effects of self-employment is on average larger than that from wage-employment. One mechanism through which RNFE likely improves household welfare is through the provision of funds for investment in agricultural production; the mainstay of most rural households. Finally, the quantile regression analysis reveals considerable heterogeneity in the

welfare effects of RNFE, with the poor benefitting significantly less than the non-poor from both non-farm wage-employment and non-farm self-employment.

5. Conclusion

This paper makes several contributions to the debate about the poverty reduction potential of the rural non-farm employment sector.

The paper first revisits the determinants of participation in non-farm wage employment and non-farm self-employment, using recent and nationally representative panel data from Malawi. The results offer little support for the early view that the poor and least endowed households are more likely to participate in non-farm activities, in order to insure against production risks and meet capital constraints (Bardhan and Udry, 1999). Our results rather indicate the presence of significant barriers to participation, faced by the poorest. These barriers include human, financial, and physical constraints such as education, assets and credit. Different sets of resources seem to matter for participation in either type of non-farm activity. Educated and wealthy households are pulled into non-farm wage employment, while participation in non-farm self-employment is mostly driven by access to credit and wealth. Market access and proximity to better infrastructure and opportunities are important for both non-farm wage employment participation and non-farm-self-employment.

Then, using panel data estimation techniques, we find consistent evidence that the RNFE can serve as a potential mechanism to increase welfare and reduce poverty in rural Malawi. Our results are consistent across a wide range of econometric approaches and broad suite of objective and subjective welfare and poverty measures. We conclude that while any causal interpretation of the usually positive correlation between non-farm engagement and wealth requires some care, the context of rural Malawi offers consistent evidence of a positive welfare impact of participation in non-farm activities, and thus the RNFE can be considered as a pathway out of poverty for rural households.

However, our results suggest that more attention should be paid to improving not just access, but also the quality of the non-farm opportunities available for the poorest. Though on average, participation in non-farm wage-employment and non-farm self-employment has a consistently positive effect on welfare, we find strong evidence that even when the poor participate in the RNFE, they benefit significantly less than the non-poor. The existing literature and observations from our data indicate that human, physical, and financial capital are key factors that limit participation in non-farm employment for the poor in rural areas. Addressing dualism along poverty and gender lines as well as other dimensions, is of utmost importance if the RNFE is to be an effective tool for broad-based rural development. Failing to take this into consideration will likely lead to widening inequality instead of shared prosperity. Moreover, given the notable heterogeneity of activities within non-farm employment, future research should delve even deeper into these different types of activities and explore participation in and roles of various sub-categories of non-farm wage employment and non-farm self-employment for household welfare.

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TABLES & FIGURES

The Heterogeneous Welfare Effects of Rural Non-Farm Employment: Recent Evidence from Malawi

Table 1: Description and summary statistics of the main variables used in this paper, household level, 2010-2013, rural Malawi

Variables	Definition	Types of variables	Overall Mean	SD	N	Estimation approach
Treatment variables						
Non-farm wage employment (0/1)	A member of household is engaged in non-farm wage employment		15.11	35.82	5532	GEE CRE Probit
Non-farm self-employment (0/1)	A member of household is engaged in non-farm self-employment		21.58	41.14	5532	GEE CRE Probit
Outcome variables						
HHPCE	Household total real consumption expenditure per capita	Continuous	57,759.59	46,702.55	5532	FE, CRE, Quantile regression
Log of HHPCE	Log of Household total real consumption expenditure per capita	Continuous	10.75	0.64	5532	FE, CRE
Poverty incidence	1[HHPCE<=Poverty Line]	Binary (0/1)	37.20	48.34	5532	GEE CRE Probit, Linear FE
Poverty gap	Consumption shortfall relative to poverty line as a fraction of poverty line	Fractional [0, 1]	11.2	18.8	5532	GLM CRE FRM, Linear FE
Poverty severity	Squared poverty gap	Fractional [0, 1]	0.05	.11	5532	GLM CRE FRM, Linear FE
Food insecurity (0/1)	Did you worry that your household would not have enough food in the past 7 days	Binary (0/1)	32.57	46.87	5532	GEE CRE Probit, Linear FE
Food consumption adequacy	Which of the following describes best your food consumption over the past month	Categorical ordered {1,2,3}			5532	ML CRE Ordered Probit, Linear FE
1	1== less than adequate for household needs		41.45	49.27		
2	2== just adequate for household needs		51.93	49.97		
3	3== It was more than adequate for household needs		6.62	24.86		
Fertilizer purchase decision (0/1)	The household purchased fertilizer for agricultural production in the rainy season	Binary (0/1)	38.85	48.75	5305	GEE CRE Probit, Linear FE, system ML
Inputs purchase decision (0/1)	The household purchased seeds, fertilizer or other chemicals for agricultural production in the rainy season	Binary (0/1)	60.13	48.97	5305	GEE CRE Probit, Linear FE, system ML
Fertilizer purchase per acre (1000MKW)	Value of fertilizer purchased per acre of land cultivated	Corner solution [0, +)	3.59	9.79	5305	CRE Tobit, Linear FE
Inputs purchase per acre (1000MKW)	Total Value of seed, fertilizer, and chemicals purchased per acre of land cultivated	Corner solution [0, +)	4.10	10.01	5305	CRE Tobit, Linear FE
Land cultivated (acres)	Number of acres of cultivated land by household	Corner solution [0, +)	4.43	52.31	5305	CRE Tobit, Linear FE

Source: Generated by authors using LSMS data.

Table 2: Household participation in non-farm employment in rural Malawi, 2010/2013

	Malawi				Non Poor				Poor				P-value t-test poor vs. non poor			
	Participation rates (%)		Share of Households Income from Source (%)		Participation rates (%)		Share of Households Income from Source (%)		Participation rates (%)		Share of Households Income from Source (%)		Participation rates (%)		Share of Households Income from Source (%)	
	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013	2010	2013
Non-Agricultural wage	17.1	15.1	8	6.5	21.6	19	10.6	8.5	9.7	7.4	3.9	2.3	0.000	0.000	0.000	0.000
Self Employment	18.2	26.8	7.2	11.1	20.3	30.5	9	12.9	14.9	19.4	4.4	7.4	0.002	0.000	0.076	0.000

Source: Malawi IHS3 panel sample (2010) and IHPS (2013)

Table 3: Selected characteristics of household enterprises in rural Malawi

	Rural Malawi		Non Poor		Poor		p-value difference	
Characteristics of households' enterprises	2010	2013	2010	2013	2010	2013	2010	2013
Age of enterprises (years)	11.1	9.0	11.7	9.0	12.9	9.1	0.250	0.821
Outside partner (%)	3.4	3.2	4.5	3.0	0.7	3.7	0.008	0.727
Business operating premises (%)								
Home	47.0	43.3	48.1	44.4	44.6	39.8	0.592	0.356
Market place and commercial area shop	31.5	38.0	29.8	36.6	35.5	42.8	0.285	0.198
Roadside and other areas	21.4	18.6	22.1	19.0	19.9	17.4	0.671	0.712
Formal registration (%)	7.1	7.9	9.1	9.3	2.4	3.3	0.003	0.008
FBPE[a] (%)	14.3	14.3	10.1	13.4	23.7	17.5	0.001	0.282
Access to electricity (%)	8.0	13.6	13.8	15.8	0.0	0.0	0.141	0.069
Number of enterprises per household (1 to 4)	1.1	1.1	1.0	1.1	1.1	1.0	0.907	0.027
Owner if household head (%)	73.6	69.5	75.6	72.3	69.1	60.4	0.233	0.008
Age of owner (%)	38.3	38.5	37.4	38.4	40.4	39.0	0.056	0.651
Education of enterprise owner (%)								
None	77.2	74.1	74.7	70.3	82.8	86.6	0.116	0.000
PSLC[b]	10.2	12.7	9.6	14.2	11.5	8.0	0.673	0.009
JCE[c]	8.1	7.9	9.6	8.7	4.7	5.1	0.078	0.091
MSCE[d]	3.7	4.5	4.9	5.7	1.0	0.4	0.010	0.000
Non-university diploma	0.5	0.5	0.7	0.6	0.0	0.0	0.117	0.044
University diploma	0.4	0.4	0.5	0.5	0.0	0.0	0.311	0.135
Post-graduate degree	0.0	0.0	0.0	0.0	0.0	0.0		0.322

Source: Malawi IHS3 panel sample (2010) and IHPS (2013).
Note: a Forest Based Products Enterprise. b Primary School Leaving Certificate. c Junior Certificate Examination. d Malawi School Certificate of Education Examination

Table 4: Distribution of non-farm household enterprises and returns by Sector, by poverty status, in Rural Malawi, 2010/2013

Sector	Rural Malawi		Non Poor		Poor		p-value difference	
	2010	2013	2010	2013	2010	2013	2010	2013
Participation	Proportion of enterprises by sector of industry (%)							
Primary sector (mostly charcoal related activities and stone quarrying)	1.6	2.7	0.8	1.9	3.4	5.4	0.161	0.183
Food, beverage, tobacco manufacturing (mostly food and drinks street vendors)	26.1	25.6	22.3	25.3	34.8	26.6	0.036	0.81
Non-food manufacturing (mostly mats, baskets, and pottery, tailor, metal tinsmith)	16.2	13.6	15.9	12.7	16.9	16.7	0.786	0.248
Wholesale and retail trade + restaurant + hotels (include a wide range of commerce & tourism related activities)	46.4	49.2	50.4	50.9	37.3	43.4	0.016	0.121
Construction, services, and other sectors (mostly electrical and other repair shops, barber shop, hair salon)	9.7	8.9	10.7	9.1	7.6	8	0.329	0.674
Returns	Profit of enterprises by industry (1000 KW)							
Primary sector	4.6	3.2	6.1	3.4	3.8	3.1	-	0.651
Food, beverage, tobacco manufacturing	3.8	3.7	5.1	4.3	1.7	2.1	0.038	0.006
Non-food manufacturing	4.8	5.8	5.9	6.7	2.4	3.1	0.052	0.086
Wholesale and retail trade and restaurant & hotels	6.6	7	7.6	8	3.6	3.3	0	0
Construction, services, and other sectors	8.6	12.2	10	13.8	2.8	6.5	0.017	0.109
Overall	5.7	6.4	7	7.3	2.6	3.2	0.000	0.000

Source: Malawi IHS3 panel sample (2010) and IHPS (2013).
Note: The information in this table is at the enterprise level. Profit is the net profit generated by the enterprise over the month of operation prior to the interview, as reported by the enterprise owner. Kwachas (MWK), local currency used in Malawi.

Table 5: Distribution of non-farm wage employment and returns by Sector, by poverty status, in Rural Malawi, 2010/2013

Sector	Rural Malawi		Non Poor		Poor		p-value difference	
	2010	2013	2010	2013	2010	2013	2010	2013
Participation	Proportion of participants by non-farm wage employment sector (%)							
Professional, technical, & related workers	24.3	24.8	26.7	28	15.3	7.1	0.037	0.000
Administration and managerial workers	1.3	1.7	1.5	2	0.8	0	0.441	0.022
Clerical and related worker	5.7	4.6	7.2	5.4	0	0	0.000	0.000
Sales workers	4.8	5	4.9	4.6	4.3	7.4	0.848	0.496
Service workers	34.4	30.2	30.3	27.6	50.1	44.4	0.002	0.046
Forestry workers, fishermen and hunters	1.8	3.8	2.2	2.7	0.2	9.6	0.074	0.165
Transport equipment operators and laborers not elsewhere classified	27.6	30	27.2	29.6	29.3	31.5	0.745	0.785
Return	Average monthly wages of participants by Sector (1000 KW)							
Professional, technical, & related workers	16.3	16.8	16.8	17.3	12.8	6.2	0.281	0.000
Administration and managerial workers	10.6	2.9	11.5	2.9	4	-	0.012	-
Clerical and related worker	10.4	10.9	10.4	10.9	-	-	-	-
Sales workers	5.6	6.8	6.5	7.4	2	4.8	0.000	0.065
Service workers	4.7	4.9	4.6	5.2	4.9	4.1	0.659	0.131
Forestry workers, fishermen and hunters	14.6	3.3	14.8	5	4.4	0.7	0.072	-
Transport equipment operators and laborers not elsewhere classified	7.3	5.7	7.6	6.2	5.9	3	0.239	0.001
Overall	8.1	7.6	8.8	8.4	5.5	3.7	0.000	0.000

Source: Malawi IHS3 panel sample (2010) and IHPS (2013).
Note: Wage is the estimated monthly salary using the last payment reported by the participant member and the period of time covered by that payment. Kwachas (MWK), local currency used in Malawi.

Table 6: Average partial effects estimates of determinants of non-farm employment participation

VARIABLES	Non-farm wage employment		Non-farm self-employment	
	CRE Probit model	Linear FE model	CRE Probit model	Linear FE model
Age of the household head	-0.000	-0.000	0.000	0.001
	[0.863]	[0.751]	[0.988]	[0.631]
Male-headed household (0/1)	0.072***	0.072***	0.017	0.008
	[0.001]	[0.002]	[0.552]	[0.783]
Highest level of formal education acquired by household head				
PSLC	0.035	0.039	0.003	0.010
	[0.194]	[0.202]	[0.937]	[0.803]
JCE	0.130***	0.120***	0.046	0.055
	[0.007]	[0.008]	[0.365]	[0.290]
MSCE	0.236***	0.257***	0.033	0.029
	[0.004]	[0.000]	[0.651]	[0.697]
Non-University Diploma and above	0.198	0.222	0.286	0.249+
	[0.294]	[0.228]	[0.184]	[0.102]
Maximum level of formal education acquired in the household				
PSLC	0.017	0.016	0.017	0.014
	[0.478]	[0.495]	[0.578]	[0.680]
JCE	0.016	0.015	-0.041	-0.058
	[0.579]	[0.628]	[0.224]	[0.165]
MSCE	0.079+	0.102**	-0.052	-0.056
	[0.105]	[0.030]	[0.271]	[0.294]
Non-University Diploma and above	0.262	0.263+	-0.184***	-0.294*
	[0.167]	[0.127]	[0.000]	[0.095]
Number of infant (<5yo) in HH	0.001	0.006	0.022**	0.019+
	[0.903]	[0.535]	[0.036]	[0.128]
Number of children (5-14yo) in the household	0.015***	0.017**	0.001	-0.000
	[0.006]	[0.011]	[0.930]	[0.974]
Number of prime adults (15-60yo) in HH	-0.003	-0.002	0.022**	0.021*
	[0.669]	[0.793]	[0.022]	[0.065]
Number of elderly (60yo+) in HH	-0.019	-0.023+	-0.006	-0.004
	[0.383]	[0.149]	[0.844]	[0.872]
Household access to loan (0/1)	-0.006	-0.001	0.083***	0.105***
	[0.695]	[0.931]	[0.000]	[0.000]
Normalized wealth index	0.301***	0.519***	0.450***	0.567***
	[0.003]	[0.001]	[0.000]	[0.000]
Normalized TLU index	-0.432*	-0.268	0.503+	0.176
	[0.086]	[0.506]	[0.117]	[0.717]
Total land area owned by HH in Acres	0.006*	0.000	-0.000	-0.000
	[0.100]	[0.735]	[0.825]	[0.860]
Household was affected negatively by some income Shock During the last 12 months (0/1)	0.017	0.021	-0.018	-0.037+

	[0.297]	[0.195]	[0.420]	[0.118]
Household has a migrant network (0/1)	0.010	0.008	0.005	0.007
	[0.532]	[0.669]	[0.799]	[0.774]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	-0.886***		0.229	
	[0.006]		[0.526]	
Average 12-month total rainfall (mm)	-0.000	0.000	0.000	0.000
	[0.500]	[0.721]	[0.227]	[0.741]
Annual Mean Temperature (∞C * 10)	0.000	0.000	-0.000	-0.002
	[0.838]	[0.909]	[0.839]	[0.419]
HH Distance in (KMs) to Nearest Road	-0.002	-0.004	-0.002	0.000
	[0.326]	[0.263]	[0.589]	[0.948]
HH Distance in (KMs) to Nearest Population Center with +20,000	-0.000	-0.001	-0.000	0.001
	[0.953]	[0.542]	[0.851]	[0.574]
Value of daily *ganyu* wage salary in the EA	-0.000	-0.000	0.000	0.000**
	[0.465]	[0.282]	[0.301]	[0.023]
Price of fertilizer in the EA	-0.000+	-0.000	-0.000	-0.000*
	[0.106]	[0.233]	[0.638]	[0.090]
Price of maize grains in the EA	-0.000	-0.000	0.000	0.000*
	[0.449]	[0.457]	[0.299]	[0.070]
EA neighbor's wage employment participation	0.002***	0.003***	0.001*	0.002**
	[0.001]	[0.003]	[0.088]	[0.026]
EA neighbor's self-employment participation	0.001***	0.001**	0.004***	0.004***
	[0.010]	[0.016]	[0.000]	[0.000]
Time dummy (year 2010=1)	-0.002	-0.004	-0.008	-0.022
	[0.929]	[0.888]	[0.787]	[0.363]
District dummies (27 -1 dummies)	Included	Included	Included	Included
Time average of explanatory variables	Included		Included	
Constant		-0.856		0.805
		[0.276]		[0.369]
Number of observations	5,286	5,286	5,286	5,286
Number of households		2,751		2,751

Source: Generated by authors using LSMS data

Note: ***, **, *, and + indicate that the corresponding regression APE is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The CRE model is estimated using GEE approach with cluster robust standard errors. The linear FE results are presented for comparison. Pvalues between brackets.

Table 7: Effect of participation in the non-farm activities on various outcomes in rural Malawi

VARIABLES	Effects of non-farm wage employment participation			Effects of non-farm self-employment participation		
	CRE Probit/fractional Probit / ordered Probit	CRE Tobit	Linear FE	CRE Probit/fractional Probit / ordered Probit	CRE Tobit	Linear FE
Objective welfare outcomes (N=5321)						
HHPCE (1000 MKW)			4.476			7.003***
			[0.158]			[0.000]
Log HHPCE			0.102**			0.129***
			[0.022]			[0.000]
Poverty incidence	-0.074**	.	-0.072**	-0.085***		-0.083***
	[0.012]		[0.022]	[0.000]		[0.000]
Poverty gap	-0.034***	-0.033**	-0.034**	-0.035***	-0.035***	-0.030***
	[0.007]	[0.011]	[0.018]	[0.000]	[0.000]	[0.002]
Squared poverty gap	-0.018**	-0.017**	-0.019**	-0.018***	-0.017***	-0.014**
	[0.021]	[0.017]	[0.045]	[0.000]	[0.000]	[0.011]
Subjective welfare outcomes (N=5321)						
Food insecurity (0/1)	-0.047+		-0.065**	-0.034+		-0.027
	[0.125]		[0.041]	[0.140]		[0.281]
Food consumption adequacy (1-3)	0.177**		0.104**	0.057		0.025
	[0.037]		[0.021]	[0.379]		[0.482]
Agricultural outcomes (N=5038)						
Fertilizer purchase decision (0/1)	0.039		0.037	0.045**		0.055**
	[0.190]		[0.303]	[0.043]		[0.036]
Inputs purchase decision (0/1)	0.046		0.037	0.053**		0.060**
	[0.160]		[0.260]	[0.031]		[0.039]
Value of fertilizer purchase (1000 MKW)		0.156	-0.638		0.388	0.136
		[0.745]	[0.419]		[0.225]	[0.786]
Value of inputs purchase (1000 MKW)		-0.124	-0.874		0.234	0.085
		[0.802]	[0.305]		[0.495]	[0.870]
Land cultivated (1000 acres)		-0.292	0.274		0.710	-0.576
		[0.699]	[0.800]		[0.561]	[0.893]

Source: Generated by authors using LSMS data

Note: ***, **, *, and + indicate that the corresponding regression APE is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The table presents only APEs on our main treatment variables. The APEs from the CRE Probit models are estimated using GEE approach. The CRE fractional Probit APEs are from GLM estimation. The unconditional APEs from CRE Tobit are estimated using pooled Tobit regression methods. The linear FE results are presented for comparison purpose. The full results tables are in appendices 2, 4, 5, and 6. P-values between brackets are based on cluster robust standard errors.

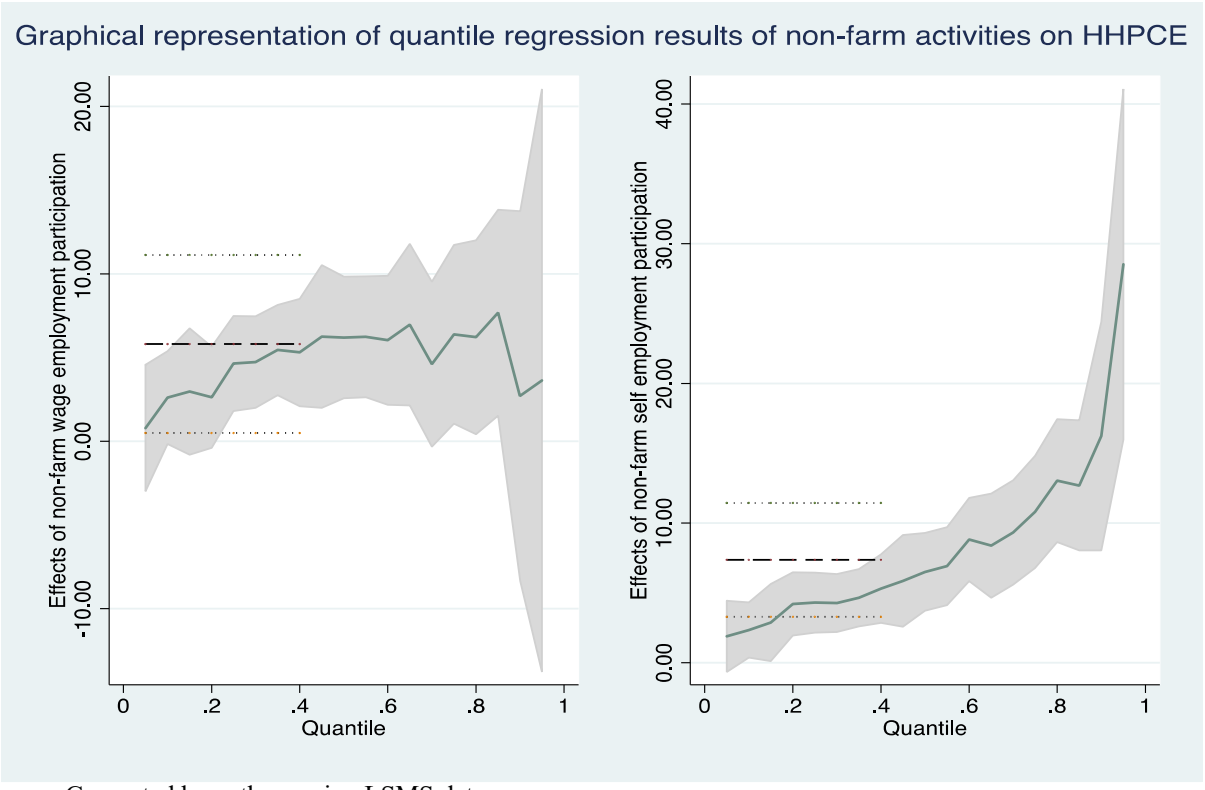
Table 8: Distributional effects of participation in the non-farm activities on HHPCE in Malawi (Quantile regression results)

VARIABLES	p10	p20	p25	p50	p75	p80	p90
Effects of non-farm wage employment participation	2.611+	2.634+	4.639***	6.198***	6.386**	6.214*	2.709
	[0.114]	[0.138]	[0.006]	[0.005]	[0.016]	[0.086]	[0.714]
Effects of non-farm self-employment participation	2.347**	4.209***	4.303***	6.503***	10.804***	13.041***	16.227**
	[0.018]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.016]
Other controls included	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time averages included	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5321	5321	5321	5321	5321	5321	5321

Source: Generated by authors using LSMS data

Note: ***, **, *, and + indicate that the corresponding regression coefficient is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The table presents quantile partial effects of our main treatment variables from 10th to the 90th percentile. The full results tables are in appendix 3. P-values between. Also the results without inclusion of time averages of explanatory variables yields the same conclusions. For the sake of conciseness, they are not presented here, but are available from authors upon request.

Figure 1: Quantile effects of non-farm wage and self-employment on HHPCE in rural Malawi



Source: Generated by authors using LSMS data

Note: The graph presents quantile partial effects of our main treatment variables. Other controls were included in the estimation

Appendix 1: Description and summary statistics of the covariates used in this paper, household level, 2010-2013, rural Malawi

Variables	Definition	Overall Mean	SD
Age of the household head	Age of the household head	44.04	16.52
Male headed-household	Male headed-household	76.16	42.62
Highest level of formal education acquired by household head			
None	The household head never attended formal school	77.17	41.98
PSLC	PSLC is the highest formal level of education of household head	10.03	30.05
JCE	JCE is the highest formal level of education of household head	6.87	25.30
MSCE	MSCE is the highest formal level of education of household head	4.68	21.13
Non-Univ Diploma and above	Non-Univ Diploma and above	1.25	11.10
Highest level of formal education acquired in the household			
None	No member of the household ever attended formal school	63.41	48.17
PSLC	PSLC is the highest formal level of education of the most educated household member	15.20	35.91
JCE	JCE is the highest formal level of education of the most educated household member	12.22	32.75
MSCE	MSCE is the highest formal level of education of the most educated household member	7.66	26.61
Non-Univ Diploma and above	Non-Univ Diploma and above	1.50	12.16
Size of the household	Number of people living in the household at the time of the interview	5.22	2.42
Number of infant (<5yo) in HH	Number of infant living in the household at the time of the interview	0.84	0.85
Number of children (5-14yo) in the household	Number of children living in the household at the time of the interview	1.62	1.41
Number of prime adults (15-60yo) in HH	Number of prime adults living in the household at the time of the interview	2.46	1.39
Number of elderly (60yo+) in HH	Number of elderly living in the household at the time of the interview	0.29	0.57
Household access to loan (0/1)	A member of the household received a loan in the year prior to the interview	16.63	37.24
Normalized wealth index	Principal component analysis estimate of asset index	0.05	0.08
Normalized TLU index	Total livestock unit index tlu=cattle*0.5+pigs*0.2+sheep*0.1+goats*0.1	0.01	0.03
Total land area owned by HH in Acres	Total land area owned by HH in Acres	3.35	49.13
Household was affected negatively by some income Shock During the last 12 months (0/1)	Household was affected negatively by some income Shock During the last 12 months (0/1)	86.37	34.31
Household has a migrant network (0/1)	A member of the household is living outside of the EA	35.65	47.90
Rain variability	Rain - EA level Coefficient of Variation of Dec-Jan rainfall from 1983/84 - 2012/13	0.25	0.04
Rainfall (mm)	Average 12-month total rainfall (mm)	850.32	89.24
Temperature (∞C * 10)	Annual Mean Temperature (∞C * 10)	216.31	19.12

HH Distance to Nearest Road	Household Distance in (KMs) to Nearest Road	9.84	9.85
HH Distance to Population Center	Household Distance in (KMs) to Nearest Population Center with +20,000	37.67	17.95
ganyu wage salary in the EA (MKW)	Value of daily *ganyu* wage salary in the EA (MKW)	566.22	599.87
Price of maize grains in the EA (MKW)	Price of maize grains in the EA (MKW)	198.59	112.66
Price of fertilizer in the EA (MKW)	Price of fertilizer in the EA (MKW)	62.27	39.34
EA neighbor's wage employment participation	Participation rate in non-farm wage employment by other household in the same EA	15.11	14.90
EA neighbor's self-employment participation	Participation rate in non-farm self-employment by other household in the same EA	21.58	15.27
Share of total land cultivated in crops (crop mix)			
Grains	Share of total land cultivated in grains	64.53	26.22
Legumes	Share of total land cultivated in legumes	23.00	22.86
Tubers	Share of total land cultivated in tubers	1.55	7.75
Oils crops	Share of total land cultivated in oil crops	0.43	3.86
Horticulture crops	Share of total land cultivated in horticulture crops	4.03	11.10
Cotton	Share of total land cultivated in cotton	1.29	7.29
Tobacco	Share of total land cultivated in tobacco	4.19	11.79

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.

Appendix 2: Test of balancing of covariates between non-farm wage employment participants and non-participants households, 2010-2013, rural Malawi

	Wage employment Non participants		Wage employment participants		t-test difference
Variables	Mean	SD	Mean	SD	pvalue
Treatment variables					
Non-farm wage employment (0/1)	0.00	0.00	100.00	0.00	
Non-farm self-employment (0/1)	21.53	41.11	21.89	41.37	0.668
Outcome variables					
HHPCE	53,903.41	40,631.58	79,420.64	67,908.37	0.000
Log of HHPCE	10.70	0.62	11.04	0.67	0.000
Poverty incidence	40.03	49.00	21.29	40.96	0.000
Poverty gap					
Poverty severity					
Food insecurity (0/1)	34.01	47.38	24.52	43.05	0.001
Food consumption adequacy					
1	43.51	49.58	29.90	45.81	0.000
2	50.45	50.00	60.29	48.96	0.002
3	6.05	23.84	9.81	29.76	0.003
Seeds purchase decision (0/1)	39.52	48.89	50.07	50.03	0.000
Fertilizer purchase decision (0/1)	36.71	48.21	51.79	50.00	0.000
Inputs purchase decision (0/1)	58.35	49.30	70.92	45.45	0.000
Seed purchase per acre (1000MKW)	0.46	1.56	0.91	2.26	0.000
Fertilizer purchase per acre (1000MKW)	3.10	8.51	6.57	15.06	0.001
Inputs purchase per acre (1000MKW)	3.57	8.92	7.31	14.60	0.000
Land cultivated (acres)	4.63	55.98	3.20	18.04	0.194
Covariates					
Age of the household head	44.53	17.00	41.30	13.22	0.000
Male headed-household	74.25	43.73	86.84	33.82	0.000
Highest level of formal education acquired by household head					
None	82.54	37.97	47.01	49.94	0.000
PSLC	9.71	29.61	11.84	32.33	0.012

JCE	5.64	23.08	13.76	34.46	0.000
MSCE	1.96	13.86	19.98	40.01	0.000
Non-Univ Diploma and above	0.15	3.86	7.42	26.22	0.000
Highest level of formal education acquired in the household					
None	68.70	46.38	33.73	47.31	0.000
PSLC	15.63	36.32	12.80	33.43	0.926
JCE	11.07	31.38	18.66	38.98	0.000
MSCE	4.34	20.39	26.32	44.06	0.000
Non-Univ Diploma and above	0.26	5.05	8.49	27.89	0.000
Size of the household	5.17	2.40	5.47	2.55	0.701
Number of infant (<5yo) in HH	0.85	0.85	0.82	0.82	0.027
Number of children (5-14yo) in the household	1.62	1.41	1.66	1.41	0.826
Number of prime adults (15-60yo) in HH	2.39	1.36	2.84	1.50	0.000
Number of elderly (60yo+) in HH	0.32	0.59	0.16	0.45	0.000
Household access to loan (0/1)	15.48	36.18	23.09	42.16	0.010
Normalized wealth index	0.04	0.06	0.11	0.13	0.000
Normalized TLU index	0.01	0.03	0.01	0.02	0.901
Total land area owned by HH in Acres	3.55	52.84	2.26	16.94	0.202
Household was affected negatively by some income Shock During the last 12 months (0/1)	86.71	33.95	84.45	36.26	0.104
Household has a migrant network (0/1)	36.52	48.15	30.74	46.17	0.028
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	0.25	0.04	0.26	0.04	0.017
Average 12-month total rainfall (mm)	850.57	87.09	848.91	100.55	0.017
Annual Mean Temperature (∞C * 10)	215.97	18.97	218.22	19.84	0.587
HH Distance in (KMs) to Nearest Road	10.43	10.05	6.53	7.89	0.000
HH Distance in (KMs) to Nearest Population Center with +20,000	38.11	17.87	35.17	18.26	0.012
Value of daily *ganyu* wage salary in the EA (MKW)	561.67	599.41	592.09	602.18	0.820
Price of maize grains in the EA (MKW)	201.75	112.90	180.81	109.70	0.001
Price of fertilizer in the EA (MKW)	62.12	38.98	63.14	41.31	0.731
EA neighbor's wage employment participation	13.26	13.52	25.50	17.79	0.000
EA neighbor's self-employment participation	20.74	14.92	26.32	16.28	0.000

Share of total land cultivated in crops (crop mix)					
Grains	64.31	26.17	65.90	26.52	0.370
Legumes	22.81	22.73	24.16	23.63	0.173
Tubers	1.55	7.65	1.55	8.33	0.035
Oils crops	0.48	4.09	0.13	1.90	0.107
Horticulture crops	4.14	11.28	3.38	9.93	0.271
Cotton	1.29	7.29	1.34	7.31	0.900
Tobacco	4.48	12.20	2.41	8.64	0.000

Source: Generated by authors using LSMS data

Notes: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.

Appendix 3: Test of balancing of covariates between non-farm self-employment participants and non-participants, 2010-2013, rural Malawi

	Self-employment Non participants		Self-employment participants		t-test difference
Variables	Mean	SD	Mean	SD	p-value
Treatment variables					
Non-farm wage employment (0/1)	15.05	35.76	15.33	36.04	0.668
Non-farm self-employment (0/1)	0.00	0.00	100.00	0.00	
Outcome variables					
HHPCE	54,741.65	43,462.77	68,724.30	55,600.92	0.000
Log of HHPCE	10.70	0.63	10.91	0.66	0.000
Poverty incidence	39.81	48.96	27.72	44.78	0.000
Poverty gap					
Poverty severity					
Food insecurity (0/1)	33.24	47.11	30.15	45.91	0.213
Food consumption adequacy					
1	42.81	49.49	36.52	48.17	0.063
2	50.90	50.00	55.70	49.70	0.369
3	6.29	24.29	7.79	26.81	0.094
Seeds purchase decision (0/1)	39.27	48.84	47.51	49.96	0.000
Fertilizer purchase decision (0/1)	36.73	48.21	46.71	49.91	0.000
Inputs purchase decision (0/1)	57.48	49.44	69.98	45.85	0.000
Seed purchase per acre (1000MKW)	0.49	1.66	0.65	1.78	0.011
Fertilizer purchase per acre (1000MKW)	3.48	9.62	4.00	10.38	0.215
Inputs purchase per acre (1000MKW)	3.96	9.96	4.60	10.16	0.078
Land cultivated (acres)	4.09	51.38	5.67	55.60	0.903
Covariates					
Age of the household head	44.72	17.01	41.58	14.37	0.000
Male headed-household	74.92	43.35	80.65	39.52	0.014
Highest level of formal education acquired by household head					
None	78.33	41.20	72.95	44.44	0.010
PSLC	9.70	29.61	11.22	31.58	0.194

JCE	6.27	24.25	9.05	28.69	0.106
MSCE	4.52	20.77	5.28	22.37	0.354
Non-Univ Diploma and above	1.18	10.78	1.51	12.19	0.126
Highest level of formal education acquired in the household					
None	65.42	47.57	56.11	49.65	0.000
PSLC	14.29	35.00	18.51	38.85	0.000
JCE	11.60	32.02	14.49	35.21	0.246
MSCE	7.26	25.95	9.13	28.81	0.248
Non-Univ Diploma and above	1.43	11.87	1.76	13.15	0.211
Size of the household	5.12	2.39	5.56	2.50	0.000
Number of infant (<5yo) in HH	0.82	0.83	0.94	0.89	0.004
Number of children (5-14yo) in the household	1.59	1.41	1.75	1.41	0.001
Number of prime adults (15-60yo) in HH	2.40	1.39	2.67	1.38	0.000
Number of elderly (60yo+) in HH	0.32	0.59	0.19	0.48	0.000
Household access to loan (0/1)	13.53	34.21	27.89	44.86	0.000
Normalized wealth index	0.05	0.07	0.08	0.11	0.000
Normalized TLU index	0.01	0.02	0.01	0.06	0.097
Total land area owned by HH in Acres	3.19	49.77	3.97	46.75	0.598
Household was affected negatively by some income Shock During the last 12 months (0/1)	85.75	34.96	88.61	31.78	0.027
Household has a migrant network (0/1)	36.75	48.22	31.66	46.53	0.070
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	0.25	0.04	0.26	0.04	0.002
Average 12-month total rainfall (mm)	853.06	89.51	840.36	87.59	0.012
Annual Mean Temperature (∞C * 10)	215.84	19.15	218.01	18.92	0.026
HH Distance in (KMs) to Nearest Road	10.11	9.92	8.87	9.54	0.013
HH Distance in (KMs) to Nearest Population Center with +20,000	38.05	18.05	36.28	17.55	0.343
Value of daily *ganyu* wage salary in the EA (MKW)	548.59	564.61	630.35	710.21	0.005
Price of maize grains in the EA (MKW)	196.70	111.45	205.43	116.73	0.014
Price of fertilizer in the EA (MKW)	60.87	39.22	67.36	39.37	0.000
EA neighbor's wage employment participation	14.20	14.52	18.43	15.76	0.000
EA neighbor's self employment participation	19.74	14.32	28.28	16.68	0.000
Share of total land cultivated in crops (crop					

mix)					
Grains	65.45	26.17	61.15	26.15	0.001
Legumes	22.18	22.64	26.00	23.42	0.007
Tubers	1.51	7.71	1.68	7.88	0.758
Oils crops	0.47	4.01	0.28	3.26	0.589
Horticulture crops	3.92	10.98	4.42	11.53	0.183
Cotton	1.22	7.23	1.57	7.52	0.149
Tobacco	4.36	12.04	3.57	10.79	0.078

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.

Appendix 4: Test of balancing of covariates between poor and non-poor households, 2010-2013, rural Malawi

	NON POOR		POOR		t-test difference
Variables	Mean	SD	Mean	SD	p-value
Treatment variables					
Non-farm wage employment (0/1)	18.94	39.19	8.65	28.12	0.000
Non-farm self-employment (0/1)	24.84	43.22	16.08	36.75	0.000
Outcome variables					
HHPCE	76,672.85	49,807.94	25,833.13	7,228.67	0.000
Log of HHPCE	11.13	0.45	10.11	0.33	0.000
Poverty incidence	0.00	0.00	100.00	0.00	
Poverty gap					
Poverty severity					
Food insecurity (0/1)	25.07	43.35	45.24	49.78	0.000
Food consumption adequacy					
1	33.02	47.03	55.69	49.69	0.000
2	58.29	49.32	41.21	49.23	0.000
3	8.69	28.18	3.11	17.36	0.000
Seeds purchase decision (0/1)	42.10	49.38	39.26	48.84	0.177
Fertilizer purchase decision (0/1)	45.93	49.84	27.30	44.56	0.000
Inputs purchase decision (0/1)	63.68	48.10	54.34	49.82	0.000
Seed purchase per acre (1000MKW)	0.61	1.94	0.39	1.16	0.000
Fertilizer purchase per acre (1000MKW)	4.57	11.40	1.99	6.00	0.000
Inputs purchase per acre (1000MKW)	5.15	11.59	2.38	6.28	0.000
Land cultivated (acres)	4.93	62.06	3.60	30.21	0.599
Covariates					
Age of the household head	43.51	16.88	44.93	15.87	0.025
Male headed-household	77.49	41.77	73.91	43.93	0.026
Highest level of formal education acquired by household head					
None	71.53	45.13	86.69	33.98	0.000
PSLC	11.34	31.71	7.82	26.86	0.000
JCE	8.72	28.22	3.74	18.98	0.000

MSCE	6.51	24.67	1.60	12.56	0.000
Non-Univ Diploma and above	1.90	13.65	0.15	3.82	0.000
Highest level of formal education acquired in the household					
None	57.11	49.50	74.05	43.85	0.000
PSLC	16.41	37.04	13.17	33.82	0.001
JCE	14.16	34.87	8.94	28.54	0.000
MSCE	10.02	30.03	3.69	18.86	0.000
Non-Univ Diploma and above	2.30	15.00	0.15	3.82	0.000
Size of the household	4.68	2.35	6.12	2.27	0.000
Number of infant (<5yo) in HH	0.73	0.80	1.03	0.89	0.000
Number of children (5-14yo) in the household	1.32	1.33	2.12	1.40	0.000
Number of prime adults (15-60yo) in HH	2.34	1.37	2.65	1.41	0.000
Number of elderly (60yo+) in HH	0.28	0.56	0.31	0.59	0.141
Household access to loan (0/1)	18.42	38.77	13.61	34.29	0.003
Normalized wealth index	0.07	0.10	0.02	0.03	0.000
Normalized TLU index	0.01	0.04	0.00	0.01	0.000
Total land area owned by HH in Acres	3.88	59.96	2.46	20.45	0.448
Household was affected negatively by some income Shock During the last 12 months (0/1)	86.41	34.27	86.30	34.40	0.640
Household has a migrant network (0/1)	36.30	48.09	34.55	47.56	0.737
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	0.25	0.04	0.26	0.04	0.706
Average 12-month total rainfall (mm)	846.63	83.60	856.55	97.75	0.158
Annual Mean Temperature (∞C * 10)	215.16	18.38	218.25	20.17	0.030
HH Distance in (KMs) to Nearest Road	9.05	9.26	11.19	10.65	0.000
HH Distance in (KMs) to Nearest Population Center with +20,000	37.05	17.71	38.70	18.31	0.121
Value of daily *ganyu* wage salary in the EA (MKW)	596.44	628.35	515.51	545.18	0.042
Price of maize grains in the EA (MKW)	204.00	113.01	189.44	111.50	0.006
Price of fertilizer in the EA (MKW)	64.59	39.75	58.36	38.34	0.000
EA neighbor's wage employment participation	16.49	15.74	12.79	13.04	0.000
EA neighbor's self-employment	22.60	15.62	19.87	14.49	0.000

participation					
Share of total land cultivated in crops (crop mix)					
Grains	63.34	26.30	66.47	25.99	0.000
Legumes	23.73	22.88	21.82	22.79	0.004
Tubers	1.69	8.23	1.31	6.89	0.577
Oils crops	0.41	3.85	0.47	3.88	0.403
Horticulture crops	3.95	10.95	4.17	11.35	0.862
Cotton	1.21	7.18	1.44	7.47	0.493
Tobacco	4.76	12.69	3.26	10.08	0.004

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.

Appendix 5: Seemingly unrelated system equation estimates of non-farm wage employment and non-farm self-employment participation model

VARIABLES	GHK Simulated bivariate ML estimates		Seemingly unrelated bivariate ML Probit estimates	
	Wage employment	Self employment	Wage employment	Self employment
Age of the household head	-0.000	-0.000	-0.000	-0.000
	[0.982]	[0.977]	[0.984]	[0.983]
Male-headed household (0/1)	0.423***	0.061	0.423***	0.061
	[0.003]	[0.599]	[0.003]	[0.596]
Highest level of formal education acquired by household head				
PSLC	0.192	0.003	0.192	0.001
	[0.270]	[0.984]	[0.270]	[0.993]
JCE	0.621***	0.158	0.622***	0.156
	[0.004]	[0.425]	[0.004]	[0.430]
MSCE	0.991***	0.117	0.991***	0.118
	[0.001]	[0.685]	[0.001]	[0.683]
Non-University Diploma and above	0.894	0.942+	0.896	0.934+
	[0.169]	[0.127]	[0.169]	[0.130]
Maximum level of formal education acquired in the household				
PSLC	0.097	0.071	0.098	0.072
	[0.525]	[0.568]	[0.524]	[0.565]
JCE	0.102	-0.157	0.102	-0.154
	[0.579]	[0.332]	[0.580]	[0.341]
MSCE	0.408*	-0.211	0.408*	-0.211
	[0.094]	[0.360]	[0.094]	[0.360]
Non-University Diploma and above	1.099*	-1.195**	1.098*	-1.192**
	[0.066]	[0.037]	[0.067]	[0.038]
Number of infant (<5yo) in HH	0.007	0.086*	0.007	0.087*
	[0.906]	[0.064]	[0.904]	[0.062]
Number of children (5-14yo) in the household	0.087**	0.003	0.087**	0.003

	[0.024]	[0.925]	[0.024]	[0.923]
Number of prime adults (15-60yo) in HH	-0.022	0.087**	-0.022	0.087**
	[0.604]	[0.015]	[0.602]	[0.015]
Number of elderly (60yo+) in HH	-0.103	-0.016	-0.102	-0.015
	[0.499]	[0.897]	[0.502]	[0.905]
Household access to loan (0/1)	-0.042	0.329***	-0.042	0.329***
	[0.674]	[0.000]	[0.671]	[0.000]
Normalized wealth index	1.813***	1.776***	1.810***	1.771***
	[0.005]	[0.002]	[0.005]	[0.002]
Normalized TLU index	-2.788+	1.882	-2.791+	1.873
	[0.117]	[0.192]	[0.117]	[0.194]
Total land area owned by HH in Acres	0.042**	-0.000	0.042**	-0.000
	[0.011]	[0.794]	[0.011]	[0.788]
Household was affected negatively by some income Shock During the last 12 months (0/1)	0.104	-0.064	0.104	-0.063
	[0.364]	[0.501]	[0.364]	[0.510]
Household has a migrant network (0/1)	0.042	0.021	0.042	0.021
	[0.711]	[0.819]	[0.713]	[0.821]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13			-5.370***	1.022
			[0.002]	[0.454]
Average 12-month total rainfall (mm)	-0.001	0.002	-0.001	0.002
	[0.571]	[0.265]	[0.570]	[0.266]
Annual Mean Temperature (∞C * 10)	0.002	-0.002	0.002	-0.002
	[0.828]	[0.814]	[0.825]	[0.816]
HH Distance in (KMs) to Nearest Road	-0.014	-0.008	-0.014	-0.008
	[0.318]	[0.544]	[0.316]	[0.548]
HH Distance in (KMs) to Nearest Population Center with +20,000	0.001	-0.001	0.001	-0.001
	[0.936]	[0.860]	[0.938]	[0.871]
Value of daily *ganyu* wage salary in the EA	-0.000	0.000	-0.000	0.000
	[0.544]	[0.329]	[0.544]	[0.322]
Price of fertilizer in the EA	-0.001+	-0.000	-0.001+	-0.000
	[0.120]	[0.764]	[0.120]	[0.754]
Price of maize grains in the EA	-0.001	0.001	-0.001	0.001
	[0.445]	[0.404]	[0.446]	[0.398]
EA neighbor's wage employment participation	0.012***	0.006*	0.012***	0.006*
	[0.003]	[0.091]	[0.003]	[0.087]
EA neighbor's self employment participation	0.007**	0.016***	0.007**	0.016***
	[0.028]	[0.000]	[0.028]	[0.000]
Time dummy (year 2010=1)	-0.029	-0.020	-0.029	-0.019
	[0.852]	[0.878]	[0.852]	[0.883]

District dummies (27 -1 dummies)	Included	Included	Included	Included
Time average of explanatory variables	Included	Included	Included	Included
rho		-0.145***		-0.150***
		[0.000]		[0.000]
Constant	-0.885	-2.354**	-0.890	-2.358**
	[0.437]	[0.013]	[0.434]	[0.012]
Observations	5,286	5,286	5,286	5,286

Source: Generated by authors using LSMS data

Note: The symbols ***, **, *, and + indicate that the corresponding regression coefficient is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. P-values between brackets. The GHK estimates are generated using the mvprobit command with 100 draws in STATA. The bivariate ML estimates are generated using the biprobit command in STATA. The parameters in the table are coefficients and not APEs.

Appendix 6: Effect of participation in the non-farm activities on HHPCE in Malawi, FE estimates

VARIABLES	(2) HHPCE FE	(4) Log HHPCE FE
Wage employment participation	4.476	0.102**
	[0.158]	[0.022]
Self-employment participation	7.003***	0.129***
	[0.000]	[0.000]
Age of the household head	-0.053	-0.002
	[0.633]	[0.232]
Male-headed household (0/1)	2.895	0.063+
	[0.269]	[0.101]
Highest level of formal education acquired by household head		
PSLC	6.198**	0.036
	[0.048]	[0.401]
JCE	15.719***	0.187***
	[0.005]	[0.005]
MSCE	20.869*	0.197**
	[0.054]	[0.049]
Maximum level of formal education acquired in the household		
PSLC	-2.228	-0.011
	[0.350]	[0.765]
JCE	-0.755	0.020
	[0.814]	[0.667]
MSCE	-1.458	0.004
	[0.774]	[0.950]
Number of infant (<5yo) in HH	-9.266***	-0.139***
	[0.000]	[0.000]
Number of children (5-14yo) in the household	-8.872***	-0.136***
	[0.000]	[0.000]
Number of prime adults (15-60yo) in HH	-6.768***	-0.094***
	[0.000]	[0.000]
Number of elderly (60yo+) in HH	-7.836***	-0.118***
	[0.002]	[0.001]
Household access to loan (0/1)	1.635	0.034
	[0.436]	[0.221]
Normalized TLU index	140.889**	1.326**
	[0.045]	[0.032]
Normalized agricultural asset index + Normalized land holdings	41.423***	0.689***
	[0.000]	[0.000]
Household was affected negatively by some income Shock During the last 12 months (0/1)	1.644	0.027
	[0.473]	[0.446]
Household has a migrant network (0/1)	-1.124	-0.004
	[0.585]	[0.906]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13		
Average 12-month total rainfall (mm)	0.064	0.001+

	[0.228]	[0.134]
Annual Mean Temperature (∞C * 10)	0.413	0.000
	[0.261]	[0.931]
HH Distance in (KMs) to Nearest Road	0.006	-0.001
	[0.987]	[0.784]
HH Distance in (KMs) to Nearest Population Center with +20,000	-0.085	-0.003
	[0.689]	[0.160]
Price of fertilizer in the EA	-0.013	-0.000
	[0.403]	[0.604]
Price of maize grains in the EA	0.083**	0.001**
	[0.024]	[0.029]
Time dummy (year 2010=1)	-2.343	-0.037
	[0.567]	[0.623]
District dummies	Included	Included
Time average of explanatory variables		
Constant	-100.016	9.223***
	[0.354]	[0.000]
Observations	5,321	5,321
Number of households	2,764	2,764

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.

The dependent variable in column 1 and 2 are levels of HHPCE. In column 3 and 4, the dependent variable is Log (HHPCE). The symbols ***, **, *, and + indicate that the corresponding regression coefficients are statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. P-values based on clustered robust standard errors between brackets.

Appendix 7: Effects of participation in the RNFE on quintiles of HHPCE

VARIABLES	p10	p20	p25	p50	p75	p80	p90
Wage employment participation	2.611+	2.634+	4.639***	6.198***	6.386**	6.214*	2.709
	[0.114]	[0.138]	[0.006]	[0.005]	[0.016]	[0.086]	[0.714]
Self-employment participation	2.347**	4.209***	4.303***	6.503***	10.804***	13.041***	16.227**
	[0.018]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.016]
Age of the household head	-0.042	0.005	-0.013	-0.079	-0.161	-0.192+	-0.392*
	[0.524]	[0.939]	[0.829]	[0.341]	[0.198]	[0.144]	[0.057]
Male-headed household (0/1)	1.870	2.858*	1.598	2.211	6.659*	6.856*	2.388
	[0.268]	[0.063]	[0.335]	[0.399]	[0.060]	[0.091]	[0.740]
Highest level of formal education acquired by household head							
PSLC	-0.349	-1.262	-0.916	0.929	9.709*	10.191*	6.786
	[0.828]	[0.423]	[0.658]	[0.717]	[0.055]	[0.070]	[0.466]
JCE	5.945**	8.658***	7.995**	9.316**	21.622***	18.744**	20.544
	[0.011]	[0.004]	[0.011]	[0.033]	[0.006]	[0.034]	[0.210]
MSCE	2.274	4.883	5.615	16.777**	36.827***	43.716**	28.356
	[0.479]	[0.444]	[0.348]	[0.014]	[0.009]	[0.016]	[0.424]
Maximum level of formal education acquired in the household							
PSLC	0.626	0.779	0.259	-0.171	-4.342	-6.652	-1.599
	[0.734]	[0.693]	[0.915]	[0.943]	[0.316]	[0.223]	[0.829]
JCE	0.325	1.269	0.372	1.340	-5.894	-4.363	-1.536
	[0.887]	[0.539]	[0.885]	[0.703]	[0.265]	[0.521]	[0.881]
MSCE	2.153	1.823	-0.258	-0.767	-15.890+	-10.826	-0.373
	[0.397]	[0.678]	[0.957]	[0.896]	[0.135]	[0.405]	[0.983]
Number of infant (<5yo) in HH	-2.766***	-4.092***	-4.592***	-6.785***	-9.154***	-10.031***	-9.751***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of children (5-14yo) in the household	-3.433***	-4.063***	-4.556***	-5.737***	-6.848***	-7.026***	-8.640***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of prime adults (15-60yo) in HH	-2.939***	-3.856***	-4.221***	-4.003***	-4.337***	-5.659***	-8.076***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of elderly (60yo+) in HH	-3.744**	-7.800***	-6.678***	-4.867**	-7.138*	-6.759	-1.831
	[0.022]	[0.000]	[0.001]	[0.024]	[0.086]	[0.199]	[0.780]
Household access to loan (0/1)	2.727**	1.593	1.089	0.723	0.871	0.757	2.754
	[0.048]	[0.318]	[0.452]	[0.728]	[0.632]	[0.784]	[0.549]
Normalized TLU index	32.917	12.544	48.236	89.698*	99.853+	19.958	13.738

	[0.242]	[0.790]	[0.281]	[0.097]	[0.138]	[0.759]	[0.912]
Normalized agricultural asset index + Normalized land holdings	19.665***	22.493***	23.349***	27.503***	32.530***	32.966***	46.026***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.002]	[0.006]
Household was affected negatively by some income Shock During the last 12 months (0/1)	0.662	0.474	1.783	0.960	4.360+	6.643+	5.915+
	[0.593]	[0.644]	[0.167]	[0.647]	[0.131]	[0.115]	[0.110]
Household has a migrant network (0/1)	-0.970	-1.881+	-1.215	0.127	0.220	2.956	2.504
	[0.340]	[0.121]	[0.396]	[0.948]	[0.938]	[0.361]	[0.583]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	-13.093	-22.098	-28.994	-39.669*	-60.347+	-71.742	34.300
	[0.515]	[0.348]	[0.247]	[0.087]	[0.141]	[0.187]	[0.677]
Average 12-month total rainfall (mm)	0.019	0.013	0.011	0.019	0.026	0.025	0.014
	[0.443]	[0.634]	[0.733]	[0.561]	[0.508]	[0.566]	[0.857]
Annual Mean Temperature (∞C * 10)	-0.096	-0.076	-0.022	-0.003	0.201	0.528	1.146*
	[0.406]	[0.537]	[0.886]	[0.988]	[0.683]	[0.244]	[0.077]
HH Distance in (KMs) to Nearest Road	-0.100	-0.151	-0.148	-0.034	-0.189	-0.365	-0.212
	[0.640]	[0.382]	[0.437]	[0.859]	[0.694]	[0.483]	[0.772]
HH Distance in (KMs) to Nearest Population Center with +20,000	0.052	0.062	0.026	-0.109	-0.045	-0.043	-0.555+
	[0.635]	[0.642]	[0.817]	[0.431]	[0.758]	[0.870]	[0.116]
Price of fertilizer in the EA	-0.006	-0.012**	-0.011*	-0.014*	-0.018	-0.017	-0.010
	[0.390]	[0.038]	[0.064]	[0.086]	[0.173]	[0.295]	[0.731]
Price of maize grains in the EA	0.056**	0.033	0.026	0.073***	0.082***	0.097**	0.195**
	[0.024]	[0.154]	[0.323]	[0.009]	[0.003]	[0.011]	[0.010]
Time dummy (year 2010=1)	0.005	-3.124+	-3.459*	-2.524	-3.625	-2.797	4.653
	[0.998]	[0.138]	[0.075]	[0.341]	[0.297]	[0.388]	[0.571]
							[.]
Time average of explanatory variables							
District dummies							
Constant	36.094**	33.481**	30.597**	44.849***	62.689*	65.833+	34.729
	[0.011]	[0.016]	[0.028]	[0.002]	[0.079]	[0.100]	[0.489]
	5,321	5,321	5,321	5,321	5,321	5,321	5,321

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.

***, **, *, and + indicate that the corresponding regression coefficient is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The table presents quantile partial effects of explanatory variables from 10th to the 90th percentile. P-values between.

Appendix 8: Effects of participation in the non-farm activities on poverty incidence, gap and severity in rural Malawi

VARIABLES	Poverty incidence			Poverty gap			Poverty severity			
	CRE Probit	Linear FE	CRE Probit	Fractional CRE Probit	CRE Tobit	Linear FE	CRE Probit	Fractional CRE Probit	CRE Tobit	Linear FE
Wage employment participation	-0.074**	-0.072**	-0.034***	-0.034**	-0.033**	-0.034**	-0.018**	-0.018*	-0.017**	-0.019**
	[0.012]	[0.022]	[0.007]	[0.019]	[0.011]	[0.018]	[0.021]	[0.056]	[0.017]	[0.045]
Self-employment participation	-0.085***	-0.083***	-0.035***	-0.035***	-0.035***	-0.030***	-0.018***	-0.018***	-0.017***	-0.014**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.002]	[0.000]	[0.001]	[0.000]	[0.011]
Age of the household head	0.003**	0.002*	0.001+	0.001	0.001*	0.001	0.000+	0.000	0.000*	0.000
	[0.027]	[0.069]	[0.110]	[0.154]	[0.064]	[0.279]	[0.142]	[0.195]	[0.058]	[0.301]
Male-headed household (0/1)	-0.044+	-0.045	-0.025**	-0.026**	-0.023**	-0.022+	-0.010*	-0.011*	-0.010*	-0.008
	[0.120]	[0.206]	[0.020]	[0.020]	[0.035]	[0.103]	[0.091]	[0.077]	[0.076]	[0.315]
Highest level of formal education acquired by household head										
PSLC	0.043	0.060+	0.005	0.003	0.008	0.016	-0.000	-0.001	0.003	0.007
	[0.288]	[0.142]	[0.775]	[0.849]	[0.611]	[0.272]	[0.990]	[0.939]	[0.676]	[0.392]
JCE	-0.096*	-0.061	-0.044***	-0.046**	-0.042**	-0.015	-0.019**	-0.020**	-0.018**	-0.001
	[0.051]	[0.282]	[0.004]	[0.012]	[0.017]	[0.431]	[0.013]	[0.030]	[0.031]	[0.954]
MSCE	-0.075	-0.010	-0.037	-0.040	-0.035	0.004	-0.014	-0.015	-0.013	0.008
	[0.347]	[0.888]	[0.185]	[0.176]	[0.217]	[0.869]	[0.376]	[0.342]	[0.318]	[0.576]
Maximum level of formal education acquired in the household										
PSLC	-0.002	-0.016	0.008	0.008	0.004	-0.004	0.004	0.004	0.002	-0.003
	[0.949]	[0.644]	[0.554]	[0.565]	[0.729]	[0.750]	[0.577]	[0.598]	[0.783]	[0.694]
JCE	-0.070*	-0.069+	-0.014	-0.015	-0.020	-0.015	-0.009	-0.009	-0.011+	-0.009
	[0.077]	[0.119]	[0.328]	[0.345]	[0.162]	[0.347]	[0.280]	[0.312]	[0.113]	[0.331]
MSCE	-0.090+	-0.077	-0.026	-0.026	-0.030	-0.026	-0.012	-0.012	-0.015	-0.012
	[0.122]	[0.201]	[0.227]	[0.299]	[0.166]	[0.304]	[0.377]	[0.422]	[0.174]	[0.394]
Number of infant (<5yo) in HH	0.074***	0.078***	0.028***	0.028***	0.030***	0.030***	0.013***	0.013***	0.015***	0.014***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of children (5-14yo) in the household	0.074***	0.081***	0.029***	0.029***	0.030***	0.030***	0.014***	0.014***	0.015***	0.014***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of prime adults (15-60yo) in HH	0.052***	0.047***	0.024***	0.024***	0.024***	0.021***	0.012***	0.012***	0.012***	0.010***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Number of elderly (60yo+) in HH	0.104***	0.103***	0.040***	0.040***	0.042***	0.034***	0.019***	0.019***	0.020***	0.015**
	[0.001]	[0.003]	[0.000]	[0.000]	[0.000]	[0.010]	[0.001]	[0.002]	[0.000]	[0.048]
Household access to loan (0/1)	-0.000	-0.003	-0.015*	-0.015*	-0.010	-0.019**	-0.013***	-0.013***	-0.008*	-0.016***
	[0.984]	[0.921]	[0.091]	[0.091]	[0.277]	[0.030]	[0.008]	[0.006]	[0.066]	[0.001]
Normalized TLU index	-1.535**	-0.921*	-0.426	-0.434	-0.537*	-0.102	-0.224	-0.222	-0.262*	-0.018
	[0.045]	[0.086]	[0.181]	[0.201]	[0.056]	[0.554]	[0.217]	[0.256]	[0.057]	[0.835]
Normalized agricultural asset index + Normalized land holdings	-0.478***	-0.465***	-0.195***	-0.197***	-0.198***	-0.194***	-0.102***	-0.103***	-0.101***	-0.100***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Household was affected negatively by some income Shock	-0.015	-0.023	-0.006	-0.005	-0.005	-0.003	0.001	0.001	-0.000	0.004

During the last 12 months (0/1)										
	[0.541]	[0.477]	[0.523]	[0.608]	[0.613]	[0.818]	[0.844]	[0.856]	[1.000]	[0.593]
Household has a migrant network (0/1)	0.007	0.016	-0.006	-0.006	-0.001	-0.007	-0.004	-0.005	-0.001	-0.006
	[0.769]	[0.551]	[0.517]	[0.528]	[0.875]	[0.519]	[0.367]	[0.375]	[0.787]	[0.368]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	0.900**		0.171	0.164	0.239		0.057	0.056	0.098	
	[0.018]		[0.223]	[0.431]	[0.249]		[0.448]	[0.603]	[0.317]	
Average 12-month total rainfall (mm)	-0.000	-0.001	-0.000**	-0.000*	-0.000	-0.000*	-0.000**	-0.000*	-0.000	-0.000+
	[0.745]	[0.209]	[0.020]	[0.061]	[0.201]	[0.100]	[0.013]	[0.055]	[0.190]	[0.130]
Annual Mean Temperature (∞C * 10)	0.001	-0.000	0.001	0.001	0.001	0.001	0.000	-0.000	0.000	-0.000
	[0.659]	[0.919]	[0.515]	[0.554]	[0.494]	[0.632]	[0.975]	[0.988]	[0.667]	[0.968]
HH Distance in (KMs) to Nearest Road	-0.001	-0.000	-0.001	-0.001	-0.000	-0.002	-0.001	-0.001	-0.000	-0.001
	[0.835]	[0.949]	[0.466]	[0.502]	[0.787]	[0.249]	[0.355]	[0.360]	[0.660]	[0.246]
HH Distance in (KMs) to Nearest Population Center with +20,000	-0.001	0.000	0.000	0.000	-0.000	0.001+	0.000	0.000	0.000	0.000
	[0.510]	[0.897]	[0.890]	[0.885]	[0.863]	[0.128]	[0.539]	[0.527]	[0.959]	[0.193]
Price of fertilizer in the EA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	[0.632]	[0.892]	[0.341]	[0.413]	[0.486]	[0.792]	[0.450]	[0.520]	[0.484]	[0.767]
Price of maize grains in the EA	-0.001**	-0.001+	-0.000***	-0.000*	-0.000*	-0.000*	-0.000***	-0.000*	-0.000*	-0.000*
	[0.022]	[0.112]	[0.003]	[0.055]	[0.054]	[0.059]	[0.008]	[0.083]	[0.063]	[0.084]
Time dummy (year 2010=1)	0.010	0.011	0.015	0.015	0.013	0.012	0.010	0.011	0.008	0.010
	[0.786]	[0.857]	[0.273]	[0.436]	[0.513]	[0.586]	[0.177]	[0.332]	[0.409]	[0.462]
Time average included	Included		Included	Included	Included		Included	Included	Included	
District dummies included	Included		Included	Included	Included		Included	Included	Included	
Constant		1.578+				0.629+				0.388*
		[0.137]				[0.131]				[0.099]
Observations	5,317	5,321	5,317	5,321	5,321	5,321	5,317	5,321	5,321	5,321
R-squared		0.130				0.141				0.107
Number of households		2,764				2,764				2,764

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination. ***, **, *, and + indicate that the corresponding regression APE is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The table presents APEs on all explanatory variables. The APEs from the CRE Probit models are estimated using GEE approach. The CRE fractional Probit APEs are from GLM estimation. The unconditional APEs from CRE Tobit are estimated using pooled Tobit regression methods. The linear FE results are presented for comparison purpose. P-values between brackets are based on cluster robust standard errors

Appendix 9: Effects of participation in the non-farm activities on food security and subjective well being

VARIABLES	Food insecure		Adequacy of food consumption	
	CRE Probit	Linear FE	CRE ordered Probit	Linear FE
Wage employment participation	-0.047+	-0.065**	0.177**	0.104**
	[0.125]	[0.041]	[0.037]	[0.021]
Self-employment participation	-0.034+	-0.027	0.057	0.025
	[0.140]	[0.281]	[0.379]	[0.482]
Age of the household head	0.000	-0.000	-0.002	-0.000
	[0.743]	[0.952]	[0.591]	[0.793]
Male-headed household (0/1)	0.016	0.009	0.103	0.045
	[0.596]	[0.792]	[0.268]	[0.372]
Highest level of formal education acquired by household head				
PSLC	0.071+	0.074+	-0.068	-0.027
	[0.121]	[0.146]	[0.576]	[0.691]
JCE	-0.053	-0.067	0.055	0.038
	[0.355]	[0.252]	[0.730]	[0.607]
MSCE	-0.141**	-0.119	0.344+	0.180+
	[0.036]	[0.151]	[0.116]	[0.108]
Maximum level of formal education acquired in the household				
PSLC	-0.029	-0.029	0.107	0.042
	[0.385]	[0.430]	[0.290]	[0.442]
JCE	0.087*	0.095*	0.177	0.083
	[0.072]	[0.055]	[0.169]	[0.236]
MSCE	0.092	0.113+	-0.069	-0.066
	[0.188]	[0.137]	[0.698]	[0.504]
Number of infant (<5yo) in HH	0.023*	0.026*	-0.063*	-0.032+
	[0.073]	[0.056]	[0.093]	[0.102]
Number of children (5-14yo) in the household	0.019**	0.024***	-0.057**	-0.031**
	[0.029]	[0.007]	[0.025]	[0.032]
Number of prime adults (15-60yo) in HH	0.008	0.010	-0.073**	-0.034*
	[0.461]	[0.506]	[0.011]	[0.089]
Number of elderly (60yo+) in HH	0.035	0.021	-0.157*	-0.073+
	[0.301]	[0.613]	[0.095]	[0.117]
Household access to loan (0/1)	0.022	0.024	-0.135*	-0.067*
	[0.377]	[0.403]	[0.052]	[0.087]
Normalized TLU index	-1.001+	-0.904*	1.198	1.257
	[0.103]	[0.068]	[0.295]	[0.163]
Normalized agricultural asset index + Normalized land holdings	-0.179***	-0.173**	0.876***	0.414***

	[0.006]	[0.022]	[0.000]	[0.000]
Household was affected negatively by some income Shock During the last 12 months (0/1)	0.112***	0.107***	-0.274***	-0.147***
	[0.000]	[0.000]	[0.000]	[0.002]
Household has a migrant network (0/1)	0.019	0.030	0.023	-0.001
	[0.465]	[0.296]	[0.754]	[0.977]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	0.425		-0.531	
	[0.270]		[0.616]	
Average 12-month total rainfall (mm)	0.001	0.001	-0.001	-0.001
	[0.291]	[0.184]	[0.613]	[0.399]
Annual Mean Temperature (∞C * 10)	-0.000	0.001	0.006	0.003
	[0.832]	[0.784]	[0.330]	[0.450]
HH Distance in (KMs) to Nearest Road	0.006+	0.004	0.001	0.005
	[0.123]	[0.293]	[0.919]	[0.331]
HH Distance in (KMs) to Nearest Population Center with +20,000	0.002	0.000	-0.004	-0.003
	[0.337]	[0.909]	[0.404]	[0.444]
Price of fertilizer in the EA	0.000	0.000	0.000	0.000
	[0.222]	[0.203]	[0.740]	[0.895]
Price of maize grains in the EA	0.002***	0.002***	-0.002**	-0.001*
	[0.000]	[0.002]	[0.026]	[0.078]
year_2011	0.101***	0.122**	-0.114	-0.066
	[0.009]	[0.036]	[0.263]	[0.335]
Constant		-2.209*		2.298+
		[0.061]		[0.115]
Observations	5,317	5,321	5,321	5,321
R-squared		0.058		0.044
Number of Households		2,764	2,764	2,764

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination. ***, **, *, and + indicate that the corresponding regression APE is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The table presents APEs except in the ordered Probit cases. The APEs from the CRE Probit models are estimated using GEE approach. The coefficients form the CRE ordered Probit are from pooled ordered Probit. The linear FE results are presented for comparison purpose. P-values between brackets are based on cluster robust standard errors.

Appendix 10: Effects of participation in non-farm activities on inputs purchases for farm households only

	Fertilizer purchase decision (0/1		Inputs purchase decision (0/1)		Value of fertilizer purchase per acre of land cultivated		Value of inputs purchase per acre of land cultivated		Land cultivated in acre	
VARIABLES	CRE Probit	Linear FE	CRE Probit	Linear FE	CRE Tobit	Linear FE	CRE Tobit	Linear FE	CRE Tobit	Linear FE
Wage employment participation	0.039	0.037	0.046	0.037	0.156	-0.638	-0.124	-0.874	-0.292	0.274
	[0.190]	[0.303]	[0.160]	[0.260]	[0.745]	[0.419]	[0.802]	[0.305]	[0.699]	[0.800]
Self-employment participation	0.045**	0.055**	0.053**	0.060**	0.388	0.136	0.234	0.085	0.710	-0.576
	[0.043]	[0.036]	[0.031]	[0.039]	[0.225]	[0.786]	[0.495]	[0.870]	[0.561]	[0.893]
Age of the household head	-0.004***	-0.003**	-0.001	-0.000	-0.034+	-0.001	-0.007	-0.011	0.031	0.303
	[0.003]	[0.015]	[0.654]	[0.777]	[0.111]	[0.961]	[0.714]	[0.639]	[0.241]	[0.312]
Male-headed household (0/1)	-0.013	-0.003	-0.035	-0.027	-0.707	-1.346**	-1.105**	-1.417**	-1.272	3.526
	[0.689]	[0.942]	[0.311]	[0.535]	[0.211]	[0.026]	[0.030]	[0.023]	[0.179]	[0.623]
Highest level of formal education acquired by household head										
PSLC	-0.006	-0.017	0.022	0.017	-0.395	-0.887	-0.226	-0.764	0.895+	13.556
	[0.882]	[0.693]	[0.620]	[0.708]	[0.458]	[0.291]	[0.702]	[0.392]	[0.138]	[0.270]
JCE	0.075	0.077	-0.026	-0.061	0.976	1.177	0.496	1.481	1.209	6.053
	[0.182]	[0.165]	[0.684]	[0.287]	[0.260]	[0.423]	[0.602]	[0.339]	[0.270]	[0.264]
MSCE	0.062	0.065	-0.033	-0.028	0.755	2.555	0.489	3.071	1.690	8.861
	[0.442]	[0.385]	[0.712]	[0.719]	[0.590]	[0.346]	[0.760]	[0.279]	[0.273]	[0.158]
Maximum level of formal education acquired in the household										
PSLC	0.015	0.017	-0.003	-0.010	0.243	0.151	0.058	0.199	-1.708*	-17.457
	[0.644]	[0.644]	[0.931]	[0.806]	[0.647]	[0.803]	[0.909]	[0.756]	[0.065]	[0.267]
JCE	-0.032	-0.002	0.059	0.067	-1.003*	-1.702**	-0.428	-1.653*	-1.362	-9.212
	[0.457]	[0.973]	[0.221]	[0.171]	[0.079]	[0.046]	[0.506]	[0.074]	[0.159]	[0.299]
MSCE	-0.013	0.038	0.092+	0.122*	0.288	1.060	1.623	1.620	-2.040*	-11.930
	[0.822]	[0.550]	[0.148]	[0.078]	[0.819]	[0.617]	[0.310]	[0.472]	[0.096]	[0.217]
Number of infant (<5yo) in HH	-0.024*	-0.022*	-0.001	0.003	-0.214	-0.023	-0.047	-0.039	2.165	9.402
	[0.054]	[0.090]	[0.953]	[0.849]	[0.319]	[0.938]	[0.818]	[0.904]	[0.296]	[0.304]
Number of children (5-14yo) in the household	0.006	0.003	0.004	0.006	-0.095	-0.314+	-0.149	-0.301	0.525	2.975
	[0.529]	[0.765]	[0.664]	[0.549]	[0.505]	[0.125]	[0.345]	[0.194]	[0.460]	[0.477]
Number of prime adults (15-60yo) in HH	0.027***	0.021**	0.014	0.011	0.189	-0.109	0.040	-0.106	0.243	-0.202
	[0.008]	[0.049]	[0.221]	[0.326]	[0.232]	[0.642]	[0.809]	[0.665]	[0.248]	[0.776]
Number of elderly (60yo+) in HH	-0.003	-0.011	-0.007	-0.014	-0.161	-0.376	-0.312	-0.365	-0.151	-6.750
	[0.927]	[0.734]	[0.837]	[0.687]	[0.743]	[0.549]	[0.555]	[0.604]	[0.777]	[0.340]
Household access to loan (0/1)	0.013	0.017	0.030	0.046+	0.833**	1.291*	0.918**	1.170*	-0.166	1.353
	[0.566]	[0.504]	[0.263]	[0.111]	[0.035]	[0.065]	[0.025]	[0.080]	[0.896]	[0.702]
Normalized TLU index	0.519	0.941*	0.552	0.436	16.426**	47.688***	14.816*	45.936***	1.380	13.952
	[0.278]	[0.067]	[0.473]	[0.433]	[0.013]	[0.005]	[0.075]	[0.008]	[0.678]	[0.549]
Normalized agricultural asset index + Normalized land holdings	0.260***	0.252***	0.210***	0.219***	2.757***	1.438	2.326**	1.643	2.436	-7.698

	[0.000]	[0.000]	[0.001]	[0.000]	[0.001]	[0.286]	[0.013]	[0.263]	[0.198]	[0.321]
Household was affected negatively by some income Shock During the last 12 months (0/1)	-0.006	0.000	-0.008	-0.005	0.030	0.712	0.194	0.588	1.490+	4.532+
	[0.815]	[0.989]	[0.765]	[0.873]	[0.940]	[0.211]	[0.653]	[0.294]	[0.131]	[0.123]
Household has a migrant network (0/1)	0.027	0.013	-0.035	-0.046+	-0.180	-0.794+	-0.622+	-0.692	0.555	4.839
	[0.281]	[0.639]	[0.204]	[0.129]	[0.662]	[0.104]	[0.135]	[0.175]	[0.363]	[0.174]
Rain - EA level CoV of Dec-Jan rainfall from 1983/84 - 2012/13	-1.141***		0.253		-13.870+		2.814		-25.396	
	[0.005]		[0.559]		[0.147]		[0.749]		[0.483]	
Average 12-month total rainfall (mm)	-0.001	0.000	-0.001	-0.000	-0.020**	-0.035	-0.026**	-0.042+	-0.009	-0.081
	[0.150]	[0.899]	[0.203]	[0.938]	[0.036]	[0.154]	[0.045]	[0.145]	[0.474]	[0.175]
Annual Mean Temperature (∞C * 10)	-0.007***	-0.002	-0.006**	-0.004+	-0.095***	-0.110+	-0.113***	-0.138**	0.026	0.278
	[0.004]	[0.479]	[0.025]	[0.102]	[0.001]	[0.107]	[0.000]	[0.035]	[0.609]	[0.212]
HH Distance in (KMs) to Nearest Road	-0.001	-0.003	-0.002	-0.005	-0.115*	-0.266**	-0.156**	-0.302**	0.165	0.034
	[0.764]	[0.644]	[0.691]	[0.308]	[0.057]	[0.024]	[0.011]	[0.014]	[0.279]	[0.860]
HH Distance in (KMs) to Nearest Population Center with +20,000	-0.003	-0.003	-0.003	-0.001	-0.000	0.067	0.023	0.095	-0.037	0.114
	[0.171]	[0.244]	[0.217]	[0.768]	[0.994]	[0.609]	[0.669]	[0.550]	[0.267]	[0.532]
Price of fertilizer in the EA	-0.000+	-0.000	-0.000	-0.000	-0.004*	-0.002	-0.001	-0.002	0.003	0.072
	[0.109]	[0.162]	[0.437]	[0.442]	[0.058]	[0.416]	[0.634]	[0.428]	[0.327]	[0.231]
Price of maize grains in the EA	-0.000	0.000	0.000	0.000	0.006	0.011	0.010	0.013	-0.007	0.022
	[0.982]	[0.950]	[0.541]	[0.969]	[0.371]	[0.181]	[0.211]	[0.151]	[0.669]	[0.768]
Share of total land cultivated in crops										
grains crops	0.001	-0.006**	-0.004**	-0.004	0.027	0.081*	-0.001	0.088*	0.012	-0.124
	[0.348]	[0.045]	[0.016]	[0.189]	[0.281]	[0.083]	[0.923]	[0.065]	[0.600]	[0.371]
legumes crops	0.001	-0.006**	-0.003*	-0.004	-0.003	0.032	-0.026*	0.037	0.018	-0.121
	[0.650]	[0.029]	[0.053]	[0.294]	[0.916]	[0.514]	[0.096]	[0.452]	[0.460]	[0.431]
tubers crops	-0.001	-0.008***	-0.005**	-0.005+	-0.014	0.040	-0.030	0.054	-0.027+	-0.243
	[0.647]	[0.009]	[0.013]	[0.148]	[0.654]	[0.415]	[0.207]	[0.297]	[0.108]	[0.162]
oil crops	0.007***		0.001		0.044		-0.010		0.026	
	[0.007]		[0.811]		[0.372]		[0.828]		[0.497]	
Horticulture crops	0.001	-0.006**	-0.002	-0.002	-0.004	0.033	-0.019	0.037	0.010	-0.210
	[0.472]	[0.038]	[0.336]	[0.503]	[0.875]	[0.493]	[0.320]	[0.450]	[0.434]	[0.371]
cotton crops	-0.002	-0.009***	-0.003	-0.004	-0.060*	-0.020	-0.049***	-0.013	0.003	-0.149
	[0.346]	[0.006]	[0.227]	[0.313]	[0.092]	[0.690]	[0.010]	[0.789]	[0.927]	[0.290]
tobacco crops	0.007***	0.000	0.002	0.001	0.095***	0.158***	0.065***	0.159***	0.110	0.089
	[0.000]	[0.999]	[0.366]	[0.866]	[0.001]	[0.002]	[0.000]	[0.002]	[0.294]	[0.295]
Other crops		-0.007**		-0.001		0.044		0.046		-0.475
		[0.032]		[0.820]		[0.384]		[0.372]		[0.376]
Total value of crop sales (MKW)	0.000	0.000	-0.000	-0.000	0.000***	0.000***	0.000***	0.000***	-0.000	-0.000
	[0.793]	[0.891]	[0.787]	[0.409]	[0.001]	[0.000]	[0.000]	[0.000]	[0.532]	[0.621]
Time dummy (year 2010=1)	-0.045	-0.028	0.001	-0.015	-1.800***	-2.110***	-1.294**	-2.397***	0.088	15.212
	[0.206]	[0.490]	[0.989]	[0.741]	[0.002]	[0.002]	[0.046]	[0.002]	[0.964]	[0.339]
District dummies included										
Constant		0.873		1.835+		43.646+		55.424*		-46.400
		[0.455]		[0.105]		[0.117]		[0.076]		[0.430]

Observations	5,038	5,038	5,038	5,038	5,038	5,038	5,038	5,038	5,038	5,038
R-squared		0.073		0.049		0.119		0.131		0.033
Number of households		2,675		2,675		2,675		2,675		2,675

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination. ***, **, *, and + indicate that the corresponding regression APE is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively. The table presents APEs on all explanatory variables. The APEs from the CRE Probit models are estimated using GEE approach. The unconditional APEs from CRE Tobit are estimated using pooled Tobit regression methods. The linear FE results are presented for comparison purpose. P-values between brackets are based on cluster robust standard errors.

Appendix 11: Multivariate recursive Probit estimation of effects of non-farm employment participation on activities on inputs purchases for farm households only.

	Fertilizer purchase			Inputs purchase		
VARIABLES	(1) Wage employment	(2) Self-employment	(3) Fertilizer purchased	Wage employment	Self-employment	Inputs purchased
Wage employment participation	.		0.437***	.		0.271*
			[0.002]			[0.053]
Self-employment participation		.	0.339***		.	0.237*
			[0.007]			[0.051]
Age of the household head	0.002	0.002	-0.013***	0.002	0.001	-0.002
	[0.722]	[0.743]	[0.008]	[0.761]	[0.775]	[0.679]
Male-headed household (0/1)	0.445***	0.031	-0.062	0.447***	0.026	-0.107
	[0.003]	[0.795]	[0.585]	[0.003]	[0.826]	[0.315]
Highest level of formal education acquired by household head						
PSLC	0.199	0.075	-0.039	0.208	0.077	0.053
	[0.274]	[0.629]	[0.793]	[0.255]	[0.623]	[0.717]
JCE	0.700***	0.208	0.189	0.698***	0.211	-0.085
	[0.002]	[0.305]	[0.333]	[0.002]	[0.297]	[0.666]
MSCE	1.172***	0.272	0.077	1.169***	0.277	-0.140
	[0.000]	[0.334]	[0.782]	[0.000]	[0.324]	[0.624]
Maximum level of formal education acquired in the household						
PSLC	0.127	0.044	0.038	0.122	0.041	-0.016
	[0.427]	[0.733]	[0.760]	[0.446]	[0.749]	[0.897]
JCE	0.064	-0.219	-0.133	0.068	-0.219	0.168
	[0.736]	[0.188]	[0.393]	[0.724]	[0.187]	[0.275]
MSCE	0.335	-0.365+	-0.074	0.343	-0.361+	0.275
	[0.175]	[0.115]	[0.737]	[0.166]	[0.119]	[0.213]
Number of infant (<5yo) in HH	0.030	0.087*	-0.083*	0.031	0.089*	-0.004
	[0.607]	[0.067]	[0.070]	[0.590]	[0.063]	[0.932]
Number of children (5-14yo) in the household	0.094**	0.001	0.012	0.094**	0.002	0.011
	[0.018]	[0.975]	[0.699]	[0.018]	[0.953]	[0.719]

Number of prime adults (15-60yo) in HH	-0.023	0.085**	0.084**	-0.019	0.085**	0.041
	[0.605]	[0.021]	[0.019]	[0.671]	[0.021]	[0.239]
Number of elderly (60yo+) in HH	-0.079	-0.023	-0.004	-0.082	-0.019	-0.027
	[0.612]	[0.855]	[0.969]	[0.600]	[0.880]	[0.804]
Household access to loan (0/1)	-0.030	0.346***	0.016	-0.025	0.346***	0.076
	[0.769]	[0.000]	[0.852]	[0.812]	[0.000]	[0.369]
Normalized TLU index	-2.637+	1.632	2.046	-2.536+	1.661	1.912
	[0.130]	[0.252]	[0.201]	[0.149]	[0.241]	[0.354]
Normalized agricultural asset index + Normalized land holdings			0.846***			0.614***
			[0.000]			[0.003]
Household was affected negatively by some income Shock During the last 12 months (0/1)	0.158	-0.052	-0.036	0.163	-0.052	-0.027
	[0.191]	[0.594]	[0.683]	[0.178]	[0.596]	[0.760]
Household has a migrant network (0/1)	0.066	-0.017	0.083	0.076	-0.016	-0.103
	[0.573]	[0.855]	[0.358]	[0.517]	[0.868]	[0.230]
Average 12-month total rainfall (mm)	-0.002	0.001	-0.002	-0.001	0.001	-0.002
	[0.416]	[0.444]	[0.199]	[0.469]	[0.426]	[0.207]
Annual Mean Temperature (∞C * 10)	0.007	-0.002	-0.022***	0.006	-0.002	-0.017**
	[0.478]	[0.843]	[0.007]	[0.498]	[0.815]	[0.036]
HH Distance in (KMs) to Nearest Road	-0.014	-0.006	-0.003	-0.015	-0.006	-0.006
	[0.334]	[0.643]	[0.831]	[0.303]	[0.635]	[0.626]
HH Distance in (KMs) to Nearest Population Center with +20,000	0.004	-0.000	-0.011*	0.004	-0.000	-0.008
	[0.561]	[0.965]	[0.070]	[0.547]	[0.957]	[0.208]
Price of fertilizer in the EA	-0.001*	-0.000	-0.001	-0.001*	-0.000	-0.000
	[0.085]	[0.473]	[0.251]	[0.084]	[0.460]	[0.513]
Price of maize grains in the EA	-0.002	0.002	0.000	-0.002	0.002	0.001
	[0.229]	[0.317]	[0.893]	[0.246]	[0.290]	[0.614]
Total land area owned by HH in Acres	-0.000	0.000		-0.000	0.000	
	[0.746]	[0.755]		[0.733]	[0.804]	
value of ganyu salary in the area	0.000	0.000		0.000	0.000	
	[0.538]	[0.373]		[0.501]	[0.370]	
EA neighbor's wage employment participation	0.010***	0.005***		0.010***	0.005***	
	[0.000]	[0.005]		[0.000]	[0.005]	
EA neighbor's self-employment participation	0.006***	0.013***		0.006***	0.013***	
	[0.004]	[0.000]		[0.006]	[0.000]	
Share of total land cultivated in crops						

grains crops			0.005			-0.011**
			[0.364]			[0.033]
legumes crops			0.003			-0.009*
			[0.638]			[0.088]
tubers crops			-0.003			-0.014**
			[0.714]			[0.039]
oil crops			0.024**			0.002
			[0.023]			[0.829]
Horticulture crops			0.004			-0.005
			[0.498]			[0.386]
cotton crops			-0.007			-0.010
			[0.343]			[0.163]
tobacco crops			0.022***			0.005
			[0.000]			[0.377]
Total value of crop sales (MKW)			0.000			-0.000
			[0.439]			[0.665]
Time dummy (year 2010=1)	-0.048	-0.050	-0.128	-0.048	-0.048	0.000
	[0.763]	[0.700]	[0.339]	[0.765]	[0.714]	[1.000]
Normalized wealth index	2.175***	2.298***		2.082***	2.207***	
	[0.000]	[0.000]		[0.000]	[0.000]	
District dummies	included	included	included	included	included	included
Time average of explanatory variables	included	included	included	included	included	included
atrho21			-0.107***			-0.111***
			[0.000]			[0.000]
atrho31			-0.157***			-0.068
			[0.004]			[0.191]
atrho32			-0.100*			-0.037
			[0.089]			[0.513]
Likelihood ratio test of joint significance of rhos: Chi2(3)			28.09***			16.13***
			[0.000]			[0.001]
Constant	-0.796	-2.522**	2.460**	-0.816	-2.553**	0.558
	[0.564]	[0.025]	[0.022]	[0.555]	[0.023]	[0.583]
Observations	5,018	5,018	5,018	5,018	5,018	5,018

Source: Generated by authors using LSMS data

Note: PSLC=Primary School Leaving Certificate. JCE=Junior Certificate Examination. MSCE=Malawi School Certificate of Education Examination.
The symbols ***, **, *, and + indicate that the corresponding regression coefficient is statistically significant at the 1%, 5%, 10%, and 15% levels, respectively.
P-values between brackets. The GHK estimates are generated using the mvprobit command with 100 draws in STATA. The parameters in the table are coefficients and not APEs.