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22 June 2015

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June 22, 2015

Abstract

The paper develops a regression based model of exit time from poverty. The model provides an integrated framework for analysing how policy interventions which target the growth rate of consumption, household and community characteristics, the poverty line, and inequality would affect the average exit time from poverty. The method is then illustrated using Malawian data from the Third Integrated Household Survey. The empirical results indicate that reduction in vertical inequalities relative to horizontal inequalities in Malawi would lead to a larger reduction in the length of time poor people stay poor. In both rural and urban areas, increases in the education of females have a larger effect on the exit time, and increases in employment in the tertiary industry reduce the exit time by a larger amount than employment in the primary or the secondary industries.

Keywords: Exit time; Poverty; Malawi

1 Introduction

Reducing poverty is a key development goal. A clear understanding of what factors determine the poverty status of individuals and households is crucial to achieving this goal. A number of studies have looked at factors which influence the likelihood of poverty (e.g. Mukherjee and Benson, 2003; Datt and Jollife, 2005, Cruces and Wodon, 2007), and vulnerability to poverty (e.g. Zhang and Wan, 2006; Gunther and Harttgen, 2009; Echevin, 2012). All these studies provide different facets for a deeper understanding of the potential of policy measures to reduce poverty and vulnerability to poverty. Another dimension of poverty which is also important is an understanding of how long poor individuals or households would take to exit from poverty.

As noted by Haughton and Khandker (2009), when thinking about poverty reduction strategies, it may also be useful to show how long it would take for the average poor person to exit poverty. This average exit time is meaningful in the sense that it describes an interesting "if-then" relationship (Morduch, 1998). Although methods for identifying

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correlates of poverty and vulnerability to poverty exist, there is no paper which has provided an integrated framework for quantifying how the exit time from poverty responds to changes in consumption growth, household and community characteristics, the cost of living of the poor, and welfare inequality.

The average exit time as developed by Morduch (1998) is essentially an aggregate measure, as such, it only gives summary information about how long on average poor people stay poor. This can be at the national level or it can be disaggregated by population subgroups. For policy purposes, one might be interested in knowing what policy measures to implement in order to shorten the exit time. For instance, poor households face various binding constraints which once identified can be relaxed to reduce the time that they stay poor through deliberate policy interventions. Furthermore, it may also be interesting to explore how redistribution and structural transformation can be combined with growth to reduce the exit time.

The contributions of this paper to the poverty literature are twofold. First, the paper extends the average exit time proposed by Morduch (1998) by developing a regression based model of exit time from poverty. This is done while controlling for spatial random effects. This model provides a toolbox for conducting an integrated analysis of how policy interventions which target the growth rate of consumption, exogenous household and community characteristics, the poverty line, and inequality would affect the average exit time from poverty. Second, the proposed method is then applied to Malawi using data from the Third Integrated Household Survey.

The rest of the paper arranged as follows. Section 2 presents a regression based model of exit time from poverty and associated marginal variations. Section 3 provides a description of the Malawian context and data used in the empirical application. Results of the application are reported in Section 4. Finally, Section 5 provides concluding remarks.

2 A Regression Based Model of Exit from Poverty

The proposed regression based average exit time from poverty uses a linear random effects regression which captures the determinants of poverty. Most if not all of the household data used in poverty analysis is hierarchical/multilevel in the sense that households are nested in communities. Higher level nesting is also possible. Households in the same cluster/community are likely to be dependent because they are exposed to a wide range of common community factors such as the same traditional norms regarding the roles of men and women. This dependency means that standard errors from a standard linear regression model are downward biased, and inferences about the effects of the covariates may lead to many spurious significant results (Hox, 2010; Cameron and Miller, 2015).

I model these common community traits as random effects. An extended discussion of multilevel or hierchical models can be found in for example Rabe-Hesketh and Skrondal

(2008) and McCulloch et al. (2008). Consider the following two level linear additive poverty regression for household i $(i = 1....M_j)$ in community j $(j = 1....J)$.

$$\begin{aligned} \ln y_{ij} &= \beta' x_{ij} + u_j + \varepsilon_{ij} \\ &= \beta' x_{ij} + \zeta_{ij} \end{aligned} \tag{1}$$

where; $\ln y_{ij}$ is the log of per capita annualized household consumption expenditure, β are coefficients, x_{ij} is a set of observed household (or community) characteristics, $u_j \sim N(0, \sigma_u^2)$ are community-level spatial random effects (random intercepts), assumed to be uncorrelated across communities, and uncorrelated with covariates, and $\varepsilon_{ij} \sim N(0, \sigma_\varepsilon^2)$ is a household-specific idiosycratic error term assumed to be uncorrelated across households, and uncorrelated with covariates. u_j, and ε_{ij} are assumed to be independent of each other. The assumptions about u_j, and ε_{ij} imply that $\zeta_{ij} \sim N\left(0, \sigma_\zeta^2\right)$, where $\sigma_\zeta^2 = \sigma_u^2 + \sigma_\varepsilon^2$.

Thus, the overall error variance is partitioned into two components, and this leads to an intracluster correlation coefficient (ICC), $\rho = \frac{\sigma_u^2}{\sigma_\zeta^2}$, which measures the strength of clustering within the community. If unobserved differences between communities matter more than unobserved differences within communities, the ICC approaches one, and the ICC will be close to zero if the reverse holds. A likelihood ratio (LR) test of the null hypothesis $H_0 : \sigma_u^2 = 0$, is used to determine the presence of community level random effects.

Following Morduch (1998), I define the exit time for a household (t_{ij}) as the time it will take the household to reach a given poverty line through consumption growth. Assuming consumption grows at a constant positive rate of g every year, then the relationship between the poverty line z, and current consumption is expressed as (Morduch, 1998):

$$z = y_{ij} e^{t_{ij} g} \tag{2}$$

Taking logarithms, and solving for t_{ij} gives

$$t_{ij} = \frac{\ln z - \ln y_{ij}}{g} \tag{3}$$

Define a consumption shortfall or excess variable as follows

$$m_{ij} = \begin{cases} g t_{ij} & \text{if } \ln z - \ln y_{ij} > 0 \\ 0 & \text{if } \ln z - \ln y_{ij} \leq 0 \end{cases} \tag{4}$$

This means that the consumption shortfall is positive when consumption is below the poverty line, and it is zero when consumption is above the poverty line. The average exit time from poverty for the entire population is found by taking a weighted average of equation (4) to get

$$
\begin{aligned}
T_g &= \frac{1}{g}\frac{\sum_{ij}^{N} w_{ij} m_{ij}}{\sum_{ij}^{N} w_{ij}} \\
&= \frac{W}{g}
\end{aligned} \tag{5}
$$

Where $W = \frac{\sum_{ij}^{N} w_{ij} m_{ij}}{\sum_{ij}^{N} w_{ij}}$ is the Watts Index (Watts, 1968), w_{ij} is the weight of each household, defined as the product of the survey sampling weight of the household, and the number of members in the household, and $N = M_j * J$ is the total number of households in the sample. The weighting mechanism employed here assumes that poverty is distributed equally within the household; this assumption is obviously strong. It is however difficult to avoid it because individual-specific consumption expenditure is rarely available. Equation (5) shows that the average exit time is just equal to the Watts Index divided by the growth rate of consumption.

The set up and assumptions in equation (1) imply that $\ln y_{ij} \sim N\left(\beta' x_{ij}, \sigma_{\zeta}^{2}\right)$, and that y_{ij} is log normally distributed. Muller (2001) shows that the parametric formula of the Watts Index of a log normal variable in discrete form can be expressed as

$$
W = \frac{\sum_{ij}^{N} w_{ij}\left(\ln z - \beta' x_{ij}\right)\Phi\left(\frac{\ln z - \beta' x_{ij}}{\sigma_{\zeta}}\right)}{\sum_{ij}^{N} w_{ij}} + \frac{\sum_{ij}^{N} w_{ij}\sigma_{\zeta}\phi\left(\frac{\ln z - \beta' x_{ij}}{\sigma_{\zeta}}\right)}{\sum_{ij}^{N} w_{ij}} \tag{6}
$$

Where Φ and ϕ are respectively cumulative and probability density functions of the standard normal distribution, and

$$
H = \frac{\sum_{ij}^{N} w_{ij}\Phi\left(\frac{\ln z - \beta' x_{ij}}{\sigma_{\zeta}}\right)}{\sum_{ij}^{N} w_{ij}} \tag{7}
$$

in the first term of equation (6) is the headcount index (H) i.e. it gives the percentage of poor people in a population.

I next introduce the random effects linear regression into the average exit time from poverty. Substituting equation (6) into equation (5), gives the average exit time from poverty in terms of regression parameters and independent variables as follows

$$
T_g = \frac{1}{g}\left[\frac{\sum_{ij}^{N} w_{ij}\left(\ln z - \beta' x_{ij}\right)\Phi\left(\frac{\ln z - \beta' x_{ij}}{\sigma_{\zeta}}\right)}{\sum_{ij}^{N} w_{ij}} + \frac{\sum_{ij}^{N} w_{ij}\sigma_{\zeta}\phi\left(\frac{\ln z - \beta' x_{ij}}{\sigma_{\zeta}}\right)}{\sum_{ij}^{N} w_{ij}}\right] \tag{8}
$$

Equation (8) says that knowledge of $\frac{\ln z - \beta' x_{ij}}{\sigma_{\zeta}}$ is sufficient for the knowledge of the average exit time. It also says that factors which increase the proportion of poor people also increase the average exit time from poverty. It also means that since equation (8) is just a sum of household specific exit times, one can easily use it to analyse patterns of exit times such as: (a) what would be the required growth rate of consumption for individuals to exit from poverty in given year?, and (b) the distribution of the exit times.

Additionally, using equation (8), one can examine the impact on the average exit time of: varying the rate of consumption growth g, redistribution and structural transformation through varying policy amenable observable household and community characteristics, changes in consumption inequality, and changes in the poverty line. I now turn to derivations of these marginal variations. For policy purposes, it is more interesting to quantify how changes in household and community characteristics that influence poverty affect the exit time.

The *ceteris paribus* effect of a change in a continuous regressor x_{ijk} on the average exit time from poverty is given by the following marginal effect

$$\begin{aligned}\frac{\partial T_g}{\partial x_{ijk}} &= -\frac{\beta_k}{g}\left[\frac{\sum_{ij}^{N} w_{ij}\Phi\left(u_{ij}\right)}{\sum_{ij}^{N} w_{ij}} + \frac{\sum_{ij}^{N} u_{ij}w_{ij}\phi\left(u_{ij}\right)}{\sum_{ij}^{N} w_{ij}}\right] \\ &\quad +\frac{\beta_k}{g}\left[\frac{\sum_{ij}^{N} u_{ij}w_{ij}\phi\left(u_{ij}\right)}{\sum_{ij}^{N} w_{ij}}\right] \\ &= -\beta_k\left(\frac{H}{g}\right)\end{aligned} \tag{9}$$

where $u_{ij} = \frac{\ln z - \beta' x_{ij}}{\sigma_\zeta}$. This marginal effect can simply be computed by multiplying the estimated coefficient on regressor x_{ijk} by the poverty headcount which is normalised by the rate of consumption growth. This marginal effect suggests that the direction of the relationship between regressor x_{ijk} and the exit average time depends on the sign of β_k, Thus, if x_{ijk} positively influences household welfare i.e. $\beta_k > 0$, then an increase in x_{ijk} reduces the average exit time from poverty. In contrast, the average exit time from poverty increases if x_{ijk} negatively affects household welfare i.e. $\beta_k < 0$.

For ease of interpretation, the marginal effect (9) can be transformed into an elasticity given as

$$\frac{\partial T_g}{\partial x_{ijk}}\frac{x_{ijk}}{T_g} = -\beta_k \frac{\sum_{ij}^{N} w_{ij}x_{ijk}}{\sum_{ij}^{N} w_{ij}}\left(\frac{H}{W}\right) \tag{10}$$

Thus, the elasticity of the average exit time with respect to a regressor is equal to the scaled ratio of two poverty measures; the poverty headcount index to the Watts index, where the scaling factor is a weighted average of the regressor multiplied by its corresponding slope parameter. Notably, the elasticity is invariant to the rate of consumption growth g while the marginal effect depends on g.

The marginal effect/elasticity of a binary independent variable on the exit time is calculated differently by replacing the partial derivative operator equations (9) and (10) with the discrete difference operator Δ. For statistical inference, standard errors for the marginal effects/elasticities can be computed by using either first-order mathematical approximation (see e.g. Davidson and MacKinnon (2004)), more commonly known as the delta method or by bootstrapping (Efron and Tibshirani, 1986). In the empirical application, I use bootstrapped standard errors.

Changes in the rate of consumption growth would also affect the length of the exit time. The relationship between the average exit time and consumption growth is expressed as

$$\frac{\partial T_g}{\partial g} = -\frac{W}{g^2} < 0 \tag{11}$$

Thus, an increase in the rate of consumption growth lowers the average exit time. Growth not only reduces the proportion of poor people, it also leads to reductions in the length of time people stay poor.

Since $\sigma_\zeta = \sigma_u + \sigma_\varepsilon = \sqrt{Var(\ln y_{ij}|x_{ij})}$, then σ_ε and σ_u respectively, capture the within and between community inequality in the log of per capita consumption. As a result, the relationship between the average exit time and within community consumption inequality is

$$\frac{\partial T_g}{\partial \sigma_\varepsilon} = \frac{1}{g} \frac{\sum_{ij}^{N} w_{ij} \phi\left(u_{ij}\right)}{\sum_{ij}^{N} w_{ij}} > 0 \tag{12}$$

Similarly, the change in the average exit time following a change in between community consumption inequality is expressed as

$$\frac{\partial T_g}{\partial \sigma_u} = \frac{1}{g} \frac{\sum_{ij}^{N} w_{ij} \phi\left(u_{ij}\right)}{\sum_{ij}^{N} w_{ij}} > 0 \tag{13}$$

This means that average exit time is positively related to both within and between consumption inequality. It should be noted that consumption inequality refers to inequality in the log of consumption.

The effect of changes in the cost of living of the poor as reflected by changes in the poverty line on the exit time is given by

$$\frac{\partial T_g}{\partial z} = \frac{1}{zg} H > 0 \tag{14}$$

The relationship is positive, implying that an increase in the poverty line lengthens the exit time from poverty. Many policies simultaneously affect household and community characteristics, consumption growth, income inequality, and the cost of living. All these changes in turn can affect the average exit time from poverty. The following total differential can be used to capture the total effect of these simultaneous changes on the exit time

$$dT_g = \frac{\partial T_g}{\partial x_k} dx_k + \frac{\partial T_g}{\partial g} dg + \frac{\partial T_g}{\partial \sigma_\varepsilon} d\sigma_\varepsilon + \frac{\partial T_g}{\partial \sigma_u} d\sigma_u + \frac{\partial T_g}{\partial z} dz \tag{15}$$

3 Empirical Application to Malawi

The empirical application focuses on two things: a) a descriptive analysis of the relationship between the exit time from poverty and consumption growth, poverty lines, within and between inequality, and, b) a regression based analysis of the relationship between the exit time from poverty and correlates of poverty through the computation of partial elasticities.

3.1 Context

The Malawian government has pursued poverty reduction efforts through various strategies emphasizing economic growth, infrastructure development, and the provision of basic social services. Inspired by the adoption of the Malawi Vision 2020 in 1998, Malawi has implemented three medium term national development strategies; the Malawi Poverty Reduction Strategy (2002-2005); and, more recently, the Malawi Growth and Development Strategy (MGDS) (2006-2011 and 2011-2016). Although, Malawi has experienced a strong economic growth performance in the recent past, the impact of this growth on poverty and income inequality has been rather tepid.

Table 1 provides selected economic indicators for Malawi over the period 2004 and 2011. The economy grew at an average annual rate of 6.2% between 2004 and 2007, and surged further to an average growth of 7.5% between 2008 and 2011. Malawi's economy is agrobased, with the agricultural sector accounting for about 30% of GDP over the period 2004-2011. Over the same period, the agriculture sector was by far Malawi's most important contributor to economic growth, with a contribution of 34.2% to overall GDP growth (NSO, 2012b). Given that economic growth was primarily driven by growth in the agriculture sector, and considering that about 90% of Malawians live in farm households (Benin et al. 2012), one would expect that this impressive growth would lead to significant reductions in poverty.

Official poverty statistics indicate that the high economic growth rates over this five year period, however, could only translate into marginal poverty reduction. Official poverty figures in Table 1 show that the percentage of poor people in Malawi was 52.4% in 2004, and marginally declined to 50.7% in 2011. Interestingly, the high economic growth rate had contrasting effects on rural and urban poverty. For the period 2004-2011, the poverty headcount in rural areas minimally increased from 55.9% to 56.6% while urban poverty declined from 25.4% to 17.3%. Ironically, this dismal poverty reduction performance coincided with the Farm Input Subsidy Program (FISP), which every year provides low-cost fertilizer and improved maize seeds to poor smallholders who are mostly rural based. Implementation of the FISP started in the 2005/6 cropping season, and in the 2012/13 financial year, the programme represented 4.6% of GDP or 11.5% of the total national budget (Chirwa and Dorward, 2013; World Bank, 2013).

A recent re-examination of these poverty figures however shows that the decrease in poverty was much larger than officially estimated. Pauw et al. (2014) estimate new regional poverty lines and poverty rates for Malawi using a new consumption aggregate. Their approach relative to the official one is more robust as they use an entropy-based approach to ensure that poverty lines are reflective of consumption bundles that are utility-consistent across space and over time. Their results show a more substantial decline in poverty between 2004 and 2011 of 8.2 percentage points. Further to this, Pauw et al. (2014) find that these results are consistent with improvements in several other non-monetary dimensions of well-being.

3.2 Data description, poverty lines, and variables used

The data used in the paper are taken from the Third Integrated Household Survey (IHS3) conducted by Malawi's National Statistical Office (NSO). It is a multi-topic survey which is statistically designed to be representative at both national, district, urban and rural levels. It was conducted from March 2010 to March 2011. A stratified two-stage sample design was used. At the first stage, enumeration areas, representing communities, as defined in the 2008 Population Census, stratified by urban/rural status with sampling probability proportional. At the second stage, systematic random sampling was used to select households. The survey collected information from a sample of 12271 households; 2233 (representing 18.2%) are urban households, and 10038 (representing 81.8%) are rural households. A total of 768 communities were selected from 31 districts across the country[1]. In each district, a minimum of 24 communities were interviewed while in each community a total of 16 households were interviewed. In addition to collecting household level data, the survey collected employment, education, and other socio-economic data on individuals within the households. It also collected community level information on access to basic services.

In this empirical application, the unit of analysis is an individual, and this is achieved by using sampling weights. In order to capture possible locational differences, the empirical illustration distinguishes between rural and urban households, and I use the new annualized consumption aggregate for each household generated by Pauw et al. (2014) instead of the official aggregate as a welfare indicator i.e. the dependent variable. This choice is necessitated by the fact that the food component in the official aggregate is based on conversion factors which have been shown to have inconsistencies and errors (Verduzco-Gallo et al., 2014). The computation of quantities of food consumed is based on conversion factors which are used to covert non-standard units of measurements such

[1] Malawi has a total of 28 districts. However, the IHS3 treats Lilongwe City, Blantyre City, Mzuzu City, and Zomba City as separate districts. Likoma district is excluded since it only represents about 0.1% of the population of Malawi, and it was determined that the corresponding cost of enumeration would be relatively high. The total number of districts or strata covered is therefore 31.

as pails, basins, and pieces into standard units such as kilograms and grams. The new aggregate uses a new set of conversion factors developed by Verduzco-Gallo et al. (2014) to generate the new food component. The official and the new consumption aggregates however have the same non-food component.

I adopt area-specific poverty lines generated by Pauw et al. (2014) instead of the national level official annualised poverty line of 37002 Malawi Kwacha (MK). I use four poverty lines: a total poverty line of MK31573 and an extreme poverty line of MK21353 for rural areas, and for urban areas, the total and extreme poverty lines are MK46757 and MK24017 respectively. These location-specific poverty lines are based on the cost of basic needs approach but they differ from the official poverty line in two important ways. Firstly, in keeping with Ravallion (1998), they use an iterative procedure to devise consumption bundles and poverty lines that more closely represent actual consumption by the poor. Secondly, following Arndt and Simler (2010), the poverty lines are utility-consistent in that they pass a series of spatial and temporal revealed preference conditions that ensure comparability in the quality of the bundle across space and through time.

Three groups of independent variables are included in the regressions namely; household, community, and fixed effects variables. The choice of variables is guided by previous literature (e.g. Mukherjee and Benson, 2003; Datt and Jollife, 2005; Cruces and Wodon, 2007; Echevin, 2012) on determinants of poverty. At the household level, I include a set of demographic variables: number of individuals aged below 9 years, number of individuals aged 10-17 years, number of females aged 18-59 years, number of males aged 18-59 years, the number of the elderly (above age 60) household members, the age of the household head, and a dummy variable for male head of household.

I also include a set of education variables. First, the highest education qualification attained by any adult (aged 20-59 years) in the household is included. This enters the regressions as four dummies reflecting if an adult member: completed Primary School Leaving Certificate (PSLC), completed Junior Certificate of Education (JCE) (junior secondary school qualification), completed Malawi School Certificate of Education (MSCE) (senior secondary school qualification), or completed a tertiary qualification. Second, I also include measures of the number of male and female adults with JCE and MSCE in a household. In terms of agricultural variables, I include the number of crops the household cultivated that are not maize or tobacco, a measure of the diversity of crop cultivation. These include the food crops cassava, groundnut, rice, millet, sorghum, and beans, and the cash crop cotton. Another agriculture variable included is the area of cultivated land that is owned by the household. The agriculture variables are included in the rural regressions only. The regressions also contain variables capturing the number of household members employed in the primary, secondary, and tertiary industries.

At the community level, I include community level health infrastructure and economic infrastructure indices to measure availability of and access to basic medical and economic infrastructure and services in a community. The two indices are constructed by using multiple correspondence analysis (MCA) (see e.g. Asselin (2002) and Blasius and Greenacre (2006) for more details). The health infrastructure index is constructed from information on the availability in a community of the following: a place to purchase common medicines, a health clinic, a nurse, midwife or medical assistant, and groups or programs providing insecticide-treated mosquito bed nets free or at low cost. The economic infrastructure index is based on the presence of the following in a community: a perennial and passable main road, a daily market, a weekly market, a post office, a commercial bank, and a microfinance institution.

Two sets of spatial and temporal fixed effects variables are included. I include agro-ecological zone dummies which capture zone level fixed effects. There are eight agro-ecological zones. The agro-ecological zone dummies control for differences in land productivity, climate, and market access conditions in an area. Agro-ecological zones are rural, consequently, they only appear in the rural regression. Being an agro-based economy, household welfare in Malawi may vary across the year due to possible seasonal effects. I account for these variations by including three seasonal dummies reflecting the harvest, postharvest, and preplanting periods. I use a Wald test to check for the presence of these fixed effects. Detailed definitions and summary statistics for all the independent variables are given in Table 2.

4 Results

4.1 Regression Results

Before turning to a discussion of the exit time from poverty, I first look at the validity of assumptions adopted in this paper. The determinants of poverty results are reported in Table 3. Wald test results indicate the null hypothesis that poverty regression parameters between rural and urban areas are equal is not supported by the data. The rejection of parameter homogeneity suggests that estimating separate rural and urban regressions is appropriate. The exit time methods developed in this paper are critically predicated on the assumption that consumption expenditure is log normally distributed. This parametric assumption is tested for both rural and urban areas by using normal probability plots of the residuals from the poverty regressions shown in Figure 1. The plots suggest that the errors are normally distributed.

In both rural and urban regressions, log likelihood tests reject null hypothesis of no community random effects. This conclusion has two implications; first, even after controlling for individual characteristics, there are significant community-specific factors which affect poverty, and second, estimating a linear model as in for example Mukherjee and Benson (2003) and Datt and Jollife (2005) is invalid. The Wald test results further indicate the presence of significant seasonal and agro-ecological effects. Consequently, seasonal and agro-ecological dummies are included in the two regressions. The parameter estimates for the two regressions generally conform to *apriori* expectations, and their relative magnitudes are plausible.

4.2 Exit from Poverty

I now turn to a discussion of the results of the proposed regression based exit time from poverty. The Malawi Growth and Development Strategy (MGDS) for period 2011-2016 pegs real per capita economic growth at 6% in order to achieve its stated aim of reducing poverty. For illustration, I assume that consumption grows uniformly at the same rate of 6%, and then examine the pattern of exit times from poverty. As noted earlier, it is possible to descriptively examine the pattern of exit times because the regression based exit times developed in this paper are individual specific. Summary statistics for exit times are shown in Table 4. A number of things are notable. As a reflection of the fact that poverty is higher in rural areas, exit times for urban areas are lower than those for rural areas.

The lower the poverty line, in this case using the food poverty relative to the total poverty line, the shorter the exit time. For the food and total poverty lines, the average exit times for rural areas are 1.33 years and 3.17 years respectively, and for urban areas, they are 0.33 years and 2 years respectively. This suggests that it would take a shorter time to end extreme poverty than it would to eradicate overall poverty in Malawi. The maximum exit times for the total poverty line are 31.50 years and 14.83 years for rural and urban households respectively. This implies that with a uniform consumption growth of 6%, it would take some poor people over two decades to be lifted out of poverty.

The distributions of the exit times from poverty are positively skewed with the mean ranging from 1.4 to 2 times the median. This asymmetry in the distribution of exit times is further confirmed by the Gini coefficients of exit times. The Gini coefficient of exit times when the total poverty line is used for rural households is 0.47, and it is 0.53 for urban households. This means that there are fewer poor individuals in urban areas than in rural areas with long exit times. The Gini coefficient of exit times are higher when the food poverty line is used; rural 0.58 and 0.72 for rural and urban households respectively. This implies that relative to poor people, there are fewer ultra-poor people with long exit times.

The above analysis has assumed that consumption grows at 6%; the methods developed in this paper can also be used to analyse the pattern of average exit times for different rates of consumption growth. Instead of fixing the growth rate, Figure 2 shows average exit times for different growth rates. The results indicate that at all growth rates, exit times for poor people in urban areas are lower than those for their rural counterparts.

Thus, average exit times for poor people in rural areas first order dominate those in urban areas. The gap however narrows at high growth rates. Furthermore, and as expected, the exit times for the food poverty line are invariably shorter than those for the total poverty line.

What would be the required growth rate of consumption for individuals to exit from poverty within one year or five years? The methods developed in this paper can also be used to provide answers to this question. Figure 3 shows boxplots which capture the relationship between exiting in one year or in five years, and the growth rate required to achieve that. The results reveal that the required growth rates are higher for poor people in rural areas. Besides, there is a wider variation in the required growth rates in rural areas. A number of poor people in both areas would require uniform consumption growth rates in excess of 50% to exit from poverty in one year. All this suggests that modest consumption growth would not end poverty in Malawi.

Table 4 reports differences in selected household characteristics categorised by whether they would require a uniform consumption growth of below or above 6% to exit from poverty in 5 years. In both rural and urban areas, households that require a consumption growth rate of below 6% exhibit significantly better schooling endowments, and they have significantly more adult members employed in the tertiary sector. Besides, rural households that would require a growth of below 6% have significantly larger land sizes, and they are more diversified in terms of number of crops grown. This analysis is essentially bivariate, I later turn to a multivariate analysis of exit times where partial elasticities are utilised.

The intra-class correlation coefficients (ICC) in Table 3 can also be used to provide a descriptive portrait of the relationship between average exit time from poverty and inequality. In both areas, the ICCs range from 17% to 21%, hence the vast majority of the variation in welfare (79% to 83%) exists within communities rather than between them. This means that the relationship between average exit time from poverty and inequality is dominated by within-inequalities (vertical inequalities) rather than between-inequalities (horizontal inequalities). A reduction in vertical inequalities relative to horizontal inequalities in Malawi would lead to a larger reduction in the length of time poor people stay poor.

In addition to the descriptive analysis of exit times above, and for policy purposes, it may be more useful to assess how household and community characteristics influence the average exit time from poverty. This can be done by using the partial elasticities developed in this paper. Changes in policy amenable household and community characteristics either reflect redestribution or structural transformation. For instance, increasing the number of people employed in manufacturing or in the services sector relative to agriculture would represent structural transformation. Elasticities of average exit time from poverty with respect to household and community characteristics are reported in Table 5.

These results are based on the total poverty line, for the food poverty line the results are qualitatively similar. A negative sign on elasticities means that the variable in question reduces the average exit time. Since these are elasticities, their magnitudes assist in assessing the relative strengths of the effects of the regressors. With a few exceptions, the signs of the elasticities conform to *a priori* expectations.

Holding other things constant, female headed households have significantly longer exit times than male headed households in rural areas. A negative sign on the gender dummy in urban areas suggests that this gender difference is in favour of female headed households. In terms of household composition, the results indicate that the elasticities are more negative for children aged 0-9 than for the economically active category (i.e. 18-59 age category). A rather counterintuitive result is that increases in the number of economically active males relative to females leads to a larger increase in the exit time.

Education emerges as a strong determinant of exit time from poverty. The elasticities for qualification of the most educated adult (20-59 years) household member are consistently negative and statistically significant in all areas: holding other factors constant, attainment of higher levels of education will reduce the exit time from poverty. These returns to education are quantitatively larger in urban areas than in rural areas. The results also reveal that based on the size of the elasticities, education has a gender-differentiated effect on the exit time from poverty.

In both rural and urban areas, increases in the education of females have a larger effect on the exit time. For instance, a *ceteris paribus* 1% increase in the number of adult females and males who have completed JCE in rural areas leads to a decrease in the exit time by about 0.03% and 0.003% respectively. Furthermore, the responsiveness of exit time from poverty to changes in the number of adult females and males who either completed JCE or MSCE is more pronounced in urban areas than in rural areas. This reflects the fact that there are more remunerative economic opportunities in urban areas which require possession of a JCE or MSCE.

There are statistically significant advantages to finding employment in the primary (agriculture, fishing, mining, etc.), the secondary (manufacturing), tertiary (sales and service industries) sectors. However, regardless of location, increases in employment in the tertiary industry reduce the exit time by a larger amount than employment in the primary or the secondary industries. For instance, in urban areas, holding all else constant, a 1% rise in the number of household members employed in the tertiary sector reduces the exit time from poverty by 0.13%; but the corresponding change for the secondary sector is 0.009%.

The dominance of the impact of employment in the services sector over the manufacturing sector is consistent with what has been observed in other developing countries (UNCTAD, 2014). It is however markedly different from the classical pattern of structural transformation observed in developed countries where increases in income arose from a switch from agriculture to manufacturing rather than to the services sector.

In terms of agriculture, the results indicate that land ownership and crop diversification have statistically significant effects on the exit time from poverty. Further to this, increases in land ownership have a larger exit-time-reducing effect than crop diversification. Both health and economic infrastructure in the community have a positive effect on the exit time from poverty. Furthermore, in urban areas, improvements in economic infrastructure such as a perennial and passable main road, a daily market, a weekly market have a larger effect on the exit time than health infrastructure such as clinics and nurses. However, a reverse pattern is observed in rural areas.

5 Concluding Comments

The paper has developed a regression based model of exit time from poverty. This is done while controlling for spatial random effects. The model provides an integrated framework for analysing how policy interventions which target the growth rate of consumption, household and community characteristics, the poverty line, and inequality would affect the average exit time from poverty. The method has then been illustrated using Malawian data from the Third Integrated Household Survey.

The empirical results indicate that reduction in vertical inequalities relative to horizontal inequalities in Malawi would lead to a larger reduction in the length of time poor people stay poor. In both rural and urban areas, increases in the education of females have a larger effect on the exit time, and increases in employment in the tertiary industry reduce the exit time by a larger amount than employment in the primary or the secondary industries.

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Table 1: Trends and levels of economic growth, and poverty, 2005-2011

Area	2005	2011
GDP growth	6.2[a]	7.5[b]
Poverty headcount		
National	52.4	50.7
Rural	55.9	56.6
Urban	25.4	17.3

[a] Average GDP growth for 2004-2007, [b] average GDP growth for 2008-2011.
Source: NSO (2005, 2012a, 2012b)

Table 2: Variable description and summary statistics

Variable	Variable Description	Rural		Urban	
		Mean	SD	Mean	SD
male headed	Dummy (1 if head is male, 0 otherwise)	0.747	0.435	0.817	0.387
age of head	Years	42.934	16.682	38.724	13.409
under 9	No. of individuals aged below 9 years	1.561	1.306	1.275	1.173
10-17	No. of individuals aged 10-17 years	0.948	1.114	0.862	1.080
females 18-59	No. of females aged 18-59 years	0.955	0.571	1.119	0.723
males 18-59	No. of males aged 18-59 years	1.838	1.000	2.249	1.145
over 60 years	No. of individuals over 60 years old	0.263	0.546	0.125	0.404
none	Dummy (1 if adult's (20-59 years) highest qualification is none, 0 otherwise): Base	0.474	0.499	0.221	0.415
pslc	Dummy (1 if adult's (20-59 years) highest qualification is pslc, 0 otherwise)	0.116	0.320	0.126	0.332
jce	Dummy (1 if adult's highest qualification is jce, 0 otherwise)	0.099	0.299	0.189	0.392
msce	Dummy (1 if adult's highest qualification is msce, 0 otherwise)	0.057	0.232	0.262	0.440
tertiary	Dummy (1 if adult's highest qualification is tertiary qualification, 0 otherwise)	0.011	0.105	0.133	0.340
females with JCE	No. adult females (20-59 years) completed JCE	0.048	0.226	0.183	0.425
males with JCE	No. adult males (20-59 years) completed Junior Certificate of Education (JCE)	0.089	0.302	0.203	0.442
females with MSCE	No. adult females (20-59 years) completed Malawi School Certificate of Education (MSCE)	0.016	0.131	0.149	0.404
males with MSCE	No. adult males (20-59 years) completed MSCE	0.054	0.241	0.261	0.503
primary industry	No. of individuals in primary industry occupation	0.041	0.226	0.033	0.186
secondary industry	No. of individuals in secondary industry occupation	0.037	0.222	0.100	0.316
tertiary industry	No. of individuals in tertiary industry occupation	0.100	0.329	0.560	0.691
land	land per capita in acres	0.121	0.460	-	-
crops	number of crops grown other than maize/tobacco	0.189	0.576	-	-
economic index	index of economic infrastructure	-0.145	0.857	0.651	1.292
health index	index of health infrastructure	-0.846	1.190	-0.572	1.054
zone1	Nsanje, Chikwawa districts	0.073	0.261	-	-
zone2	Blantyre, Zomba, Thyolo, Mulanje, Chiradzulu, Phalombe districts	0.226	0.418	-	-
zone3	Mwanza, Balaka, Machinga, Mangochi districts	0.178	0.383	-	-
zone4	Dedza, Dowa, Ntchisi districts	0.110	0.313	-	-
zone5	Lilongwe, Mchinji, Kasungu districts	0.131	0.337	-	-
zone6	Ntcheu, Salima, Nkhotakota districts	0.107	0.309	-	-
zone7	Mzimba, Rumphi, Chitipa districts	0.107	0.309	-	-
zone8	Nkhatabay, Karonga districts	0.068	0.252	-	-
season1	Dummy (1 if household was interviewed in March-April, 0 otherwise): Base	0.189	0.392	0.172	0.378
season2	Dummy (1 if household was interviewed May-August, 0 otherwise)	0.275	0.446	0.259	0.438
season3	Dummy (1 if household was interviewed in September-November, 0 otherwise)	0.298	0.457	0.321	0.467
season4	Dummy (1 if household was interviewed in December-February, 0 otherwise)	0.238	0.426	0.248	0.432
Observations		10038		2233	

Table 3: Determinants of poverty in Malawi

Variable	Rural		Urban	
	Coefficient	SE	Coefficient	SE
male headed	0.1614***	(0.0147)	-0.0139	(0.0353)
age of head	0.0011**	(0.0005)	0.0015	(0.0014)
under 9	-0.1839***	(0.0047)	-0.2361***	(0.0112)
10-17	-0.1183***	(0.0053)	-0.0885***	(0.0123)
females 18-59	-0.0024	(0.0161)	-0.0410	(0.0300)
males 18-59	-0.1103***	(0.0104)	-0.0816***	(0.0202)
over 60 years	-0.1617***	(0.0162)	-0.1349***	(0.0455)
pslc	0.1611***	(0.0180)	0.1049**	(0.0417)
jce	0.2102***	(0.0397)	0.1966***	(0.0536)
msce	0.3078***	(0.0626)	0.4734***	(0.0584)
tertiary	0.7263***	(0.0586)	1.0171***	(0.0508)
females with JCE	0.1528***	(0.0310)	0.0611*	(0.0341)
males with JCE	-0.0127	(0.0359)	0.0078	(0.0435)
females with MSCE	0.0852	(0.0527)	0.1320***	(0.0391)
males with MSCE	0.0272	(0.0556)	0.0135	(0.0447)
primary industry	0.0351	(0.0264)	-0.0003	(0.0672)
secondary industry	0.0381	(0.0267)	-0.0281	(0.0403)
tertiary industry	0.1580***	(0.0193)	0.0610***	(0.0209)
land	0.0817***	(0.0142)		
crops	0.0343***	(0.0130)		
economic index	0.0869***	(0.0144)	0.0398	(0.0242)
health index	0.0348***	(0.0108)	0.0301	(0.0296)
zones included	Yes		No	
Chi2 (parameter homogeneity)	7039.68			
P-value of Chi2	0.00			
Chi2 (significance of agro-ecological zones)	259.13		-	
P-value of Chi2	0.00		-	
seasons included	Yes		Yes	
Chi2 (significance of seasonal effects)	7.93		8.76	
P-value of Chi2	0.05		0.03	
Chi2 (regression)	4433.64		1573.43	
P-value of Chi2	0.00		0.00	
Chi2 (random effects)	880.18		254.47	
P-value of Chi2	0.00		0.00	
intracluster correlation coefficient (ICC)	0.17		0.21	
Observations	10038		2233	

Notes: Standard errors in parentheses. *** indicates significant at 1%; ** at 5%; and, * at 10%.

Table 4: Summary statistics for exit times with six percent consumption growth

Statistic	Food poverty line		Total poverty line	
	Rural	Urban	Rural	Urban
Mean	1.33	0.33	3.17	2.00
Median	0.67	0.17	2.33	1.17
Minimum	0.00	0.00	0.00	0.00
Maximum	25.00	6.00	31.50	14.83
Gini coefficient	0.58	0.72	0.47	0.58
Observations	10038	2233	10038	2233

Table 5: Differences in characteristics, required growth to exit in 5 years

Variable	Rural			Urban		
	Below	Above	Diff.	Below	Above	Diff.
pslc	0.122	0.078	0.044***	0.123	0.180	-0.058*
jce	0.106	0.053	0.053***	0.192	0.135	0.057
msce	0.064	0.011	0.053***	0.277	0.030	0.247***
tertiary	0.013	0.000	0.013***	0.141	0.008	0.133***
females with JCE	0.053	0.010	0.044***	0.191	0.060	0.131***
males with JCE	0.094	0.057	0.037***	0.207	0.150	0.056
females with MSCE	0.018	0.001	0.017***	0.158	0.008	0.150***
males with MSCE	0.061	0.012	0.049***	0.276	0.030	0.246***
primary industry	0.042	0.031	0.011	0.034	0.023	0.011
secondary industry	0.038	0.031	0.007	0.099	0.120	-0.021
tertiary industry	0.111	0.028	0.083***	0.579	0.271	0.308***
land	0.129	0.064	0.065***			
crops	0.192	0.170	0.022			
Observations	8697	1341	10038	2100	133	2233

Notes: Below is required consumption growth below 6%, Above is required consumption growth above 6%. *** indicates significant at 1%; ** at 5%; and, * at 10%.

Table 6: Elasticities of average exit time from poverty

Variable	Rural		Urban	
	Elasticity	SE	Elasticity	SE
male headed	-0.3503***	(0.0024)	0.0371***	(0.0004)
age of head	-0.1357***	(0.0007)	-0.1907***	(0.0018)
under 9	0.7095***	(0.0056)	0.8156***	(0.0146)
10-17	0.2786***	(0.0033)	0.2264***	(0.0059)
females 18-59	0.0064***	(0.0000)	0.1514***	(0.0025)
males 18-59	0.5662***	(0.0035)	0.6086***	(0.0080)
over 60 years	0.1236***	(0.0028)	0.0517***	(0.0036)
pslc	-0.0565***	(0.0016)	-0.0360***	(0.0021)
jce	-0.0665***	(0.0021)	-0.1127***	(0.0051)
msce	-0.0653***	(0.0028)	-0.4613***	(0.0170)
tertiary	-0.0419***	(0.0039)	-0.6789***	(0.0379)
females with JCE	-0.0265***	(0.0013)	-0.0390***	(0.0020)
males with JCE	0.0036***	(0.0001)	-0.0050***	(0.0002)
females with MSCE	-0.0056***	(0.0005)	-0.0850***	(0.0049)
males with MSCE	-0.0055***	(0.0003)	-0.0132***	(0.0005)
primary industry	-0.0045***	(0.0003)	0.0000***	(0.0000)
secondary industry	-0.0043***	(0.0003)	0.0093***	(0.0007)
tertiary industry	-0.0595***	(0.0021)	-0.1299***	(0.0038)
land	-0.0345***	(0.0027)		
crops	-0.0196***	(0.0006)		
economic index	0.0135***	(0.0026)	-0.0992***	(0.0042)
health index	0.0763***	(0.0012)	0.0518***	(0.0024)
Observations	10038		2233	

Notes: In parentheses are bootstrapped standard errors after 1000 replications. *** indicates significant at 1%; ** at 5%; and, * at 10%.

Figure 1: Testing for normality of residuals

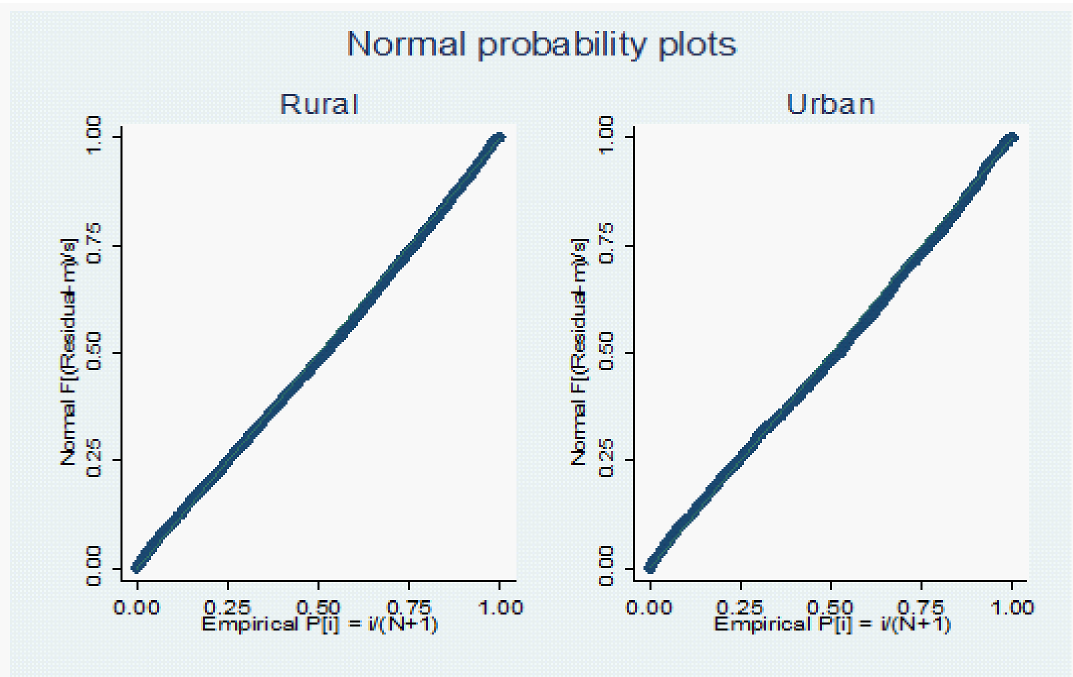

Figure 2: Average exit times for different growth rates

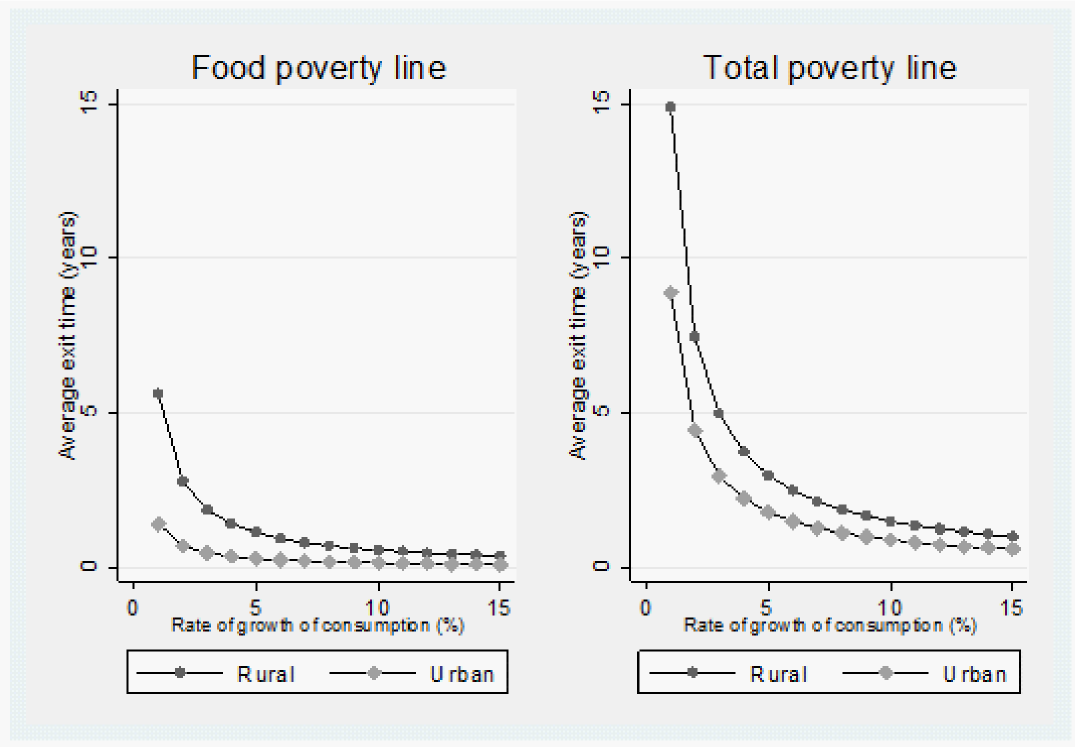

Figure 3: Boxplots of required growth rates to exit within one year and five years