Labor Calendars and Rural Poverty: A case study for Malawi

Alain de Janvry, Claire Duquennois, and Elisabeth Sadoulet
University of California at Berkeley*

November 20, 2018

Abstract

The persistence of rural poverty in Sub-Saharan Africa is a major challenge to meet the Sustainable Development Goal on poverty eradication. Using data for Malawi, we investigate the contribution of seasonality to this phenomenon by showing that labor calendars for rural households offer similar employment opportunities as for urban households at peak planting time, but much lower opportunities throughout the rest of the year. Due to a high level of urban unemployment, structural transformation is not the current solution to rural poverty. By contrast, we explore how elements of both an agricultural and a rural transformation can help fill and smooth-out labor calendars, providing a pathway to rural poverty reduction.

1 Introduction

Rural poverty is the most prevalent form of extreme poverty at a world scale, and it is increasingly concentrated in Sub-Saharan Africa (SSA) and among households dependent on agriculture. In 2013, SSA accounted for 51% of the total number of poor at a PPP $1.90/day poverty line, up from 18% in 1993.[1] In 2013, 82% of the SSA poor lived in rural areas, and 75% of SSA rural households income was obtained in agriculture (Beegle et al., 2016). With eradication of extreme poverty the number one Sustainable Development Goal, there is much interest in understanding why poverty in SSA is associated with agriculture and rural areas and in exploring what can be done to reduce this association.

The LSMS data give an opportunity to explore these two issues empirically. Information for Malawi is particularly useful for this as it gives a detailed characterization of the use of household labor across months in the calendar year.

In his pioneering work on rural poverty in India, Bardhan (1984) stressed the role of institutional arrangements in the agricultural labor market as an important determinant of the permanence of poverty. In this case, a high level of land concentration gives large landowners monopsony or oligopsony power to set wages on local labor markets. Because of the importance of timeliness in accessing labor at critical periods of the year, they engage in labor-tying arrangements with local workers. For this, they make transfers to selected workers in idle periods of the year in exchange for a commitment to work for them when they will require labor. This results in a flexible wage set above the full employment equilibrium. Involuntary unemployment on the rural labor market thus becomes a cause

*We are indebted to Calogero Carletto, manager of the LSMS-ISA project, for facilitating our use of the data.
[1]Using data from PovcalNet http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx

of rural poverty. Technological change in agriculture, by making cultivation practices increasingly capital intensive and costly, can reinforce the importance of timeliness in labor practices and further perpetuates labor-tying arrangements.

We propose in this paper an interpretation of the permanence of rural poverty that is also related to the role of seasonality in the performance of rural labor markets. Here, we focus on the importance of seasonality in rural labor calendars in leaving households under-employed for a vast majority of months, while labor markets may equalize work opportunities across sectors in high employment months. The reasoning on the importance of labor calendars in understanding poverty starts from the observation that there is a strong correlation between poverty, as measured by per capita consumption, and the use of household labor across months of the year. This is because labor is the main asset of the poor in generating income. Time worked across months of the year by household members will translate into household income depending on (1) the productivity of labor for time worked, which is 34% lower in rural areas, and (2) the time worked in each month of the year relative to capacity, which across the year is 29% lower in rural areas. They together combine in making household consumption 58% lower in rural areas. Work can be in self-employment or in wage employment. For rural households, work can be in agriculture, in the rural non-farm economy (RNFE), and in distant labor markets through seasonal migration.

There has been a long standing controversy as to whether rural poverty will be reduced through the structural transformation of the economy–shifting labor out of agriculture into the urban economy– or through agricultural and rural transformations–intensifying labor use in agriculture and in the RNFE where the rural poor reside. The debate started with Lewis (1954) who argued that labor incomes will only rise with resorption of surplus labor in agriculture as employment is created through capital accumulation in the urban industrial sector. Gollin, Lagakos, and Waugh (2013) showed that value added per worker is indeed much higher in the non-agricultural sector than in agriculture, with a productivity gap typically in excess of 3 in developing countries. As a consequence, labor is considered to be greatly misallocated in most developing countries, with too much labor in agriculture and a large agricultural productivity deficit. A structural transformation would thus be an important source of aggregate output growth and an instrument for poverty reduction. Collier (2008), Collier and Dercon (2014), and Dercon and Gollin (2014) have endorsed this agro-pessimist viewpoint, whereby agriculture offers limited promise as a source of growth and poverty reduction compared to urban-industrial growth.

Using the LSMS-ISA data for four African economies, McCullough (2017) makes the important distinction between annual per capita labor productivity (used by Gollin, Lagakos, and Waugh (2013)) and labor productivity per hour worked in comparing agriculture and non-agriculture. For Malawi, she finds that labor productivity per person per year is 4.8 times higher in non-agriculture than in agriculture, confirming the Gollin, Lagakos, and Waugh (2013) observation.[2] By contrast, labor productivity per hour worked is only 40% higher in non-agriculture than in agriculture. The discrepancy between the two ratios is due to the high seasonality of agricultural labor calendars, with a few

[2]This is computed as the total revenue generated in each sector–net returns to farming and livestock or non-farm enterprises and wage income by sector of employment– divided by the number of household members sorted by their primary sector of occupation

months of high employment at peak time (planting in this case) and a large number of months with high hidden unemployment. On an annual basis, the ratio of the two productivity measures says that the number of hours worked in a sector divided by the number of persons that declare their main activity to be that sector is 3.3 times higher in non-agriculture than in agriculture. This suggests that lack of opportunities for year-round labor use in agriculture is a more important contributor to differentially higher poverty than lower labor productivity when working. It also suggests that labor markets tend to equilibrate across rural and urban areas through equalization of expected wages at peak labor times with seasonal unemployment in other months of the year rather than through annual wage adjustments.

The policy implication of this observation is stark. As opposed to the ineluctable need for a structural transformation to secure growth and eradicate extreme poverty, other transformations become a possibility. One is an agricultural transformation following which farming systems become more diversified, correspondingly diversifying sources of income in agriculture and smoothing-out labor calendars throughout the year. The other is a rural transformation following which a rural non-farm economy largely linked to agriculture emerges locally, allowing rural households to diversify their sources of income outside of agriculture and further smooth-out labor calendars.

A key question for implementation of an agricultural and rural transformation is to determine whether there is full employment at peak time in rural areas and how much under-employment there is in other months. Full employment at peak time would put emphasis on the importance of labor productivity gains in agriculture (such as through mechanization) to increase value added in the peak labor-constrained tasks (principally planting, and perhaps harvesting). Large under-employment in other periods of the year stresses the need to pursue agricultural and rural transformations to smooth labor calendars in agriculture and the RNFE.

In this paper, we use the 2004, 2010, and 2016 LSMS data for Malawi, with most of the analysis done with the 2010 data which are of higher quality for our purpose. Data were collected monthly over a 13-month period, allowing the measure of seasonality in labor use. We analyze the use of rural and urban labor, estimating unemployment in high and low seasons of labor demand and throughout the year. We find that unemployment affects both urban and rural areas, throughout the year. Unemployment in Malawi is thus an overall problem, limiting the potential gains for rural poverty reduction coming from seasonal or permanent rural-urban migration as advocated for example by Lagakos, Mobarak, and Waugh (2018) for Bangladesh.

We decompose total unemployment in rural areas between what we call peak unemployment (the high-season unemployment level extended throughout the year) and seasonal unemployment (the additional unemployment in other months of the year). We find that seasonal unemployment amounts to 2/3 of total rural unemployment and peak unemployment to 1/3. We then explore in detail elements in both the agricultural and rural transformations that could help increase high-season employment and smooth out seasonal employment.

Rural labor calendars are much more prone to under-employment than urban calendars. Agricultural and rural transformations have thus an important role to play in reducing rural poverty. We however find that that there is no silver bullet to smooth out labor calendars and that a broad array of

instruments needs to be mobilized to have impact, as each of them only makes a (small) contribution to addressing the seasonal under-employment problem. For the agricultural transformation, raising livestock and, in a limited way, dry-season planting permitted by irrigation and crop diversification reduce the variability of hours worked across months. Growing tobacco may smooth out labor demand in the growing and harvest seasons but its high planting season labor demand corresponds to that of the main staples. Rural transformation includes labor market participation and engagement in a non-farm enterprise. Both of these activities add labor use throughout the year, with labor market participation more effective as a counter-cyclical activity. Finally, we find that permanent migration associated with the structural transformation may create gains for men, but imposes a penalty on women. This reduces the gains from the permanent migration of rural households, putting greater emphasis on the potential roles of agricultural and rural transformations as opposed to the structural transformation in reducing rural poverty, particularly in a gender perspective.

Our results are in sharp contrast with the conclusion drawn by Wodon and Beegle (2006) who analyzed the same 2004 LSMS data for Malawi. Like us, they find an important seasonality in labor use and substantial under-employment during most of the year in rural areas. But contrary to us, they find labor shortages in some months of the cropping season that, they conclude, limits households' ability to fully use their productive endowments such as land. Part of the difference in overall employment is due to changing conditions over time, with a large decline in farm size, as we will see below. But there is also a methodological difference with our analysis, as they include in total time worked not only productive activities in agriculture (on-farm self-employment, labor exchange, and wage labor) and the RNFE (off-farm self-employment and wage labor), but also domestic chores and the production of z-goods such as fetching water and firewood collection. These activities roughly add 23 hours to women's weeks and 4 hours to men's in both rural and urban contexts, with almost no variation across months of the year. We opted for a narrower definition of total work that solely includes income generating activities (productive activities in agriculture and the RNFE), more in line with the focus of our paper on the poverty consequences of under-employment. This choice does not negate the long hours that households have to spend on these other activities, with their potential gender imbalance, nor the time and cost that workers may have to spend getting to their employment. In that sense, our measure of under-employment is strictly a measure of lack of opportunities for income generating activities, not of leisure.

The outline of the paper is as follows. In section 2 we describe the data. Section 3 presents the context of agriculture and poverty in Malawi. In section 4 we analyze the use of rural and urban labor across months of the year. In section 5 we decompose unemployment between peak and seasonal dimensions. Section 6 analyzes elements of the agricultural transformation that can help smooth out labor calendars. Section 7 does the same for the rural transformation. Section 8 evidences factors that limit a structural transformation. Section 9 provides a robustness check of results obtained with the 2010 data by comparing them with results obtained with the 2004 and 2016 surveys, and by pooling all available data. Section 10 concludes and draws policy implications.

2 Data

To investigate labor market seasonality, we utilize principally data from Malawi's Third Integrated Household Survey (IHS3) collected in 2010-11. This is a living standards measurement survey (LSMS) covering a cross section of 12,271 households. The IHS3 uses a stratified two-stage sample design, first sampling enumeration areas (EA) in the 2008 Population and Housing Census stratified into rural and urban areas and then sampling households from a list that was constructed for each sampled EA. A minimum of 24 EAs were sampled in each district. For practical reasons, a multiple of 12 EAs were sampled in each stratum in order to distribute the sample evenly across the 12 months. The IHS3 is a very comprehensive household survey designed to monitor conditions in Malawian households. The survey is composed of many modules designed to capture measures of household and individual demographics, economic and agricultural activities, health, education, assets, consumption and community indicators.

The rural labor supply can be observed using the time use questions featured in the employment module of the household questionnaire. The questions ask each member of the household above the age of five to report the number of hours spent in the past seven days on several different activities which we group into four categories: agriculture (agricultural activities including livestock and fishing), business (running a household business and helping in a household business), casual labor, and regular wage-paying labor.[3] The survey also asks about unpaid apprenticeships but we drop this category as very few respondents engage in it. The time use survey also asks respondents how much time was spent yesterday on collecting firewood and water which we omit from our analysis. In this paper, weekly work hours reported will be evaluated at both the household and individual levels. Household labor hours per week aggregates the hours reported by all members of the household over the age of five thereby capturing the labor of household members that may not be the primary bread winners. After data cleaning, our main household sample consists of 12,266 households of which 10,037 are rural and 2,229 are urban. These households are comprised of 56,193 individuals. Analysis of individual labor hours per week only includes individuals of working-age (15 to 65 years old) who report that they are not attending school, which we will refer to as 'individuals' or 'adults' without further reference to these selection criteria. Our adult sample consists of 23,324 individuals in 11,492 households as 774 households have no working-age adults. Of theses adults, 18,699 are rural and 4,625 are urban. Since interviews were spread throughout the year, we can observe the seasonality of activities and establish labor calendars for the whole population or subgroups of the population, at both an individual and a household level.

These two levels of analysis correspond to different ways of looking at labor use. Employment is normally measured at the individual level, leading to clear measures of unemployment (no hours worked) and underemployment (comparing hours worked to a norm of full employment). However, the averaging of these hours worked does not necessarily measure the aggregate availability of work

[3]The survey questions distinguish between "casual, part-time or ganyu labour", and "for a wage, salary, commission, or any payment in kind, excluding ganyu". It is this second category that we name 'regular wage-paying labor' or 'wage labor' as 93% of the respondents declare working at least 35 hours last week, while the majority of those under casual labor worked less than 15 hours.

in any particular area in the given month. This is because working age members of a household may temporarily leave or come back in response to availability of income generating opportunities where the household resides. At the extreme, a fully unemployed person migrating during the low season would raise the average per individual employment while obviously it does not increase aggregate employment. It is much less likely that any household would entirely leave an area for seasonal migration. Additionally, fluctuations in labor demand may induce the young and elderly to provide supplemental labor in times of need which would not be reflected in the individual analysis. For these reasons the average number of hours worked by households in a week of a given month should give a better measure of aggregate work availability during that month, where the household resides.

We also use the other surveys in this series, the second and fourth Integrated Household Survey collected using the same methods in 2004 and 2016, respectively. However, we rely primarily on the 2010 results as the 2010 survey features both a large number of EAs and the most even spread of the timing of EA interviews across calendar months. We use the data from the 2004 and 2016 waves to observe aggregate trends over these 12 years in some household characteristics, and as robustness checks for the results established with the 2010 survey.

3 Agriculture and poverty in Malawi

Malawi is a landlocked country in south-eastern Africa with a population estimated at 18 million in 2016. It is one of the least developed countries in the world with a human development index of 0.476 giving it a rank of 170 out of 188 countries based on the UNDP's Human Development Index[4]. Though Malawians have experienced significant improvements in life expectancy and education since 1990, estimated GNI per capita has not grown proportionally during this time period, contributing to the reproduction of monetary poverty.[4] While 71% of the population lived below the international absolute poverty line of US$1.90 PPP per day in 2010, this percentage was still equal to 70 in 2016.[5]

Representing about 30% of the country's GDP, agriculture is central to livelihoods.[5] 92% of rural households and 38% of urban households surveyed report farming at least one plot of land. In all three of Malawi's regions–North, Central, and South–the agricultural sector is characterized by smallholder farms primarily cultivating maize on rainfed plots during the rainy season, the main agricultural cycle, that runs from October to June. Irrigation is rare leaving crops vulnerable to floods and droughts and limiting farming in the dry season (Chafuwa, 2017). During the rainy season, 99% of plots in our sample are rainfed. Only 10% of households report planting during the dry season that runs from June to October and those that do so rely primarily on bucket irrigation.

Maize and intercropped maize account for the majority of farmed acreage. Tobacco is an important cash crop, particularly in the central region, accounting for 51% of national export revenues in 2010.[6] Table 1 gives the average acreage planted per household by crop or intercropped combination for surveyed households for the country and each of the three regions. Categories were defined by first

[4]Human Development Report 2016, UNDP, www.hdr.undp.org, accessed 5th Feb. 2018.
[5]World Bank Country Data: Malawi, www.worldbank.org/en/country/malawi, accessed 5th Feb. 2018.
[6]The Atlas of Economic Complexity, http://atlas.cid.harvard.edu, accessed 5th Sep. 2018.

grouping varietals of the same crop (i.e., hybrid maize, local maize, etc.) and then looking for common crop combinations as multiple crops are commonly grown on the same plot. Farms are small, with a mean holding of 2.38 acres though it is slightly higher in the central region where it reaches 3.47 acres. Maize and crops intercropped with maize account for 72% of the area cultivated.

63% of farming households in our sample report relying solely on household labor. 27% make use of hired labor and 14% of labor that was "free of charge, as exchange laborers, or to assist for nothing in return", with 4% using both. Off farm employment opportunities are limited mostly to small scale entrepreneurship and casual "ganyu" day labor.

Regular wage-paying jobs are scarce, even in the cities, which are characterized by high levels of unemployment which we will characterize in the next section. A feasibility analysis by Evidence Action in 2014 for a migration subsidy intervention interviewed 81 respondents who reported very low success rates at finding urban jobs leading the report to conclude that "there are insufficient potential migration destinations to absorb excess labor from rural areas" (Evidence Action, 2014). Overall unemployment in both rural and urban areas is thus a serious issue in Malawi.

Continued demographic pressure on the land and lack of urban employment opportunities result in a dramatic decline in farm size and in time worked by households across surveys. Table 2 shows farm size over time. Because GPS measures are not available for 2004, to make the comparison over time we use self reported areas in all three years. Furthermore, because there are far more outliers in the self reported area (mainly due to what are likely miscoding of the unit of measurement (m2 vs acres), we winsorized the area at 5 pct. Farm size declined from 2.29 acres per household engaged in agriculture in 2004 to 1.38 in 2016. Total household labor hours declined from 59.2 per week in 2004, to 41 in 2010, and 31.7 in 2016, while the number of adults in the household declined from 2.0 in 2004 to 1.8 in 2016. This means that land per adult decreased by 18% from 1.13 to 0.93 acres. Malawi thus epitomizes countries stuck in a Malthusian trap.

4 Use of rural and urban labor

To characterize labor calendars for households and for individuals within households, we use five indicators: the total annual hours worked, the high season (December-January) weekly hours worked, the low season (July-August) weekly hours worked, and the standard deviation and coefficient of variation of weekly hours worked across months.[7] We also characterize the seasonality of labor engagement by measuring the percentage of active households in each month of the year and the percentage of active individuals in each month of the year. We use a graphical representation of labor calendars with 95% confidence intervals to appreciate the significance of month-specific differences in contrasted calendars. We report our findings in six points below.

There is significantly more variability in rural than in urban labor calendars.

To assess total work availability throughout the year, we observe the average participation and

[7]Since the survey lasted 13 months, we have two observations for the month of March, in 2010 and 2011. Figures report them separately, but for all calculations that refer to one year, the two observations are averaged to represent March.

hours worked by households, contrasting those living in rural and urban areas. Figure 1a displays total reported labor hours for a week by month of interview for urban and rural households, Figure 1b the percent of households reporting any hours worked, i.e., active households, and Table 3 gives the corresponding descriptive statistics. Notable in these urban-rural contrasts in labor calendars is that high season activity offers similar work opportunities for rural and urban households, both in terms of hours worked (both 57-58 hours) and percent of active households (urban just higher by 3 percentage points, not significantly different from 0). There is however a large significant discrepancy in the rest of labor calendar months, with labor per week for rural households 57% of that for urban households and engagement 10 percentage points lower among rural households in the low season. This higher variability of rural calendars is captured by comparing the coefficients of variation of work over the different months of the year. The coefficients of variation in hours worked is 136% higher for rural compared to urban households. We can decompose the difference in the coefficient of variation between rural and urban households into the difference in mean values and the difference in standard deviations as follows:

$$\frac{\Delta CV}{CV} \approx \frac{\Delta St.Dev.}{St.Dev.} - \frac{\Delta Mean}{Mean} \tag{1}$$

In this case, rural households have both a higher standard deviation in work across months of the year (70 and 50% for hours and participation, respectively) and, for hours work, a lower mean value (by 28%). Both of these contribute to the very large difference in variability of labor calendars.

Figure 2 disaggregates the labor hours reported in Figure 1a by activity. It shows that agriculture is by far the largest and the most cyclical source of work for rural households, and that employment in the other activities–household business, casual labor, and wage labor–is relatively stable throughout the year. Importantly, they are not countercyclical to agriculture. Their contributions to overall smoothing of the labor calendar is thus by adding labor opportunities in less seasonal activities throughout the year rather than by complementing work in agriculture when the latter is low.

There is significant underemployment in rural areas even in the high season.

Looking now at effective unemployment, we turn to individual level observations. Figure 3 shows histograms of hours worked in the past week for rural adults in all activities. Panel a shows the distribution for the high season while panel b shows the distribution for the low season. We see a dramatic contrast between seasons, with a large increase in the share of individuals with no or very low numbers of hours in the low season. Referring to numbers reported in Table 3, unemployment rises from 7% in high season to 36% in low season and the average number of hours worked per week falls by half from 24.6 to 12.4. However, even in high season, underemployment prevails. With 25 hours per week, underemployment is 38% for a benchmark full-employment of 40 hours per week.

Figure 4 shows histograms differentiated by gender for the high season. Many of both genders work less than full-time. For men average high season work is 70% of full employment and for women 55%. Clearly, for both genders, there is underemployment even in the high season.

There is also significant unemployment in urban areas.

Referring to Table 3b, we see significant unemployment in urban areas too. The mean individual unemployment rate is 36%, and it remains high throughout the year. Unemployment in urban areas affects both genders. The distribution of hours worked by gender reported in Figure 5 shows however a contrast between men and women. Women suffer particularly low employment rates. 51.3% of urban females report working no hours compared to 20.3% for men. This contrasts with the more equal sharing that we observe in rural areas, as illustrated for the high season in Figure 4. Income generating opportunities are particularly scarce for women in urban areas, likely differentially affecting their incentives to migrate.

Low employment is associated with dependance on agriculture

In this section we try to get some insights on who is most affected by high unemployment, especially in rural areas. Table 4 compares the employment structure across the four major categories of activities for rural individuals based on working hours reported when interviewed in the low season (July and August). Note that 34% of individuals report no work at all and are not included in this table. We see that individuals severely underemployed in the low season are less likely to be working in occupations else than agriculture. Hence, despite working very few hours in agriculture, they depend on agriculture for 68% of their work time compared to 38% for those working over 30 hours. Work in household non-agricultural businesses and in casual labor gains some importance as we move from households that work less than 10 hours to those working more than 30 hours. The main activity that makes a difference for those working full time is engagement in the wage labor market. As a group, these individuals work on average 18 hours in agriculture, 8 in their businesses, 9 in casual labor, and 14 in wage labor.

The importance of one's sector of employment is also highlighted by exploring correlates of individual employment in the low and high seasons in rural areas. For the high season, Table 5 reports correlates of high employment. The first column is an indicator variable to report working over 35 hours in the past week, close to full employment, and the second the number of hours worked. As seen in Table 3, open unemployment in the high season is very low at 3%, so this table roughly reflects averages among those that work. We begin by noting that while open unemployment may be low in the high season, only 25% of respondents work over 35 hours per week, reemphasizing the prevalence of rural underemployment even in the peak season. To interpret these correlates, we note that two-thirds of the adults only work in one activity (61% in agriculture and 7% in one of the other three activities), and 26% have an additional activity to agriculture (15, 6, and 4 in casual labor, business, and wage labor, respectively). Column 1 indicates that full employment even in the high season is primarily determined by having an activity outside of, or in addition to, agriculture, of which wage labor once again stands out as the key predictor of full employment. Other covariates have a very limited effect on either the probability of being fully employed or the number of hours (in column 2). For the low season, Table 6 reports the correlates of working at least 20 hours (column 1) and the number of hours worked (column 2). During the low season, the employment situation is quite different. Only 11% of respondents work over 20 hours per week, with a third of adults reporting no hours in any of the productive activities, and only 12% of adults reporting hours in more than one

activity. Compared to the high season, where 87% report some agricultural hours, only 50% do so in the low season. Given the lower 20 hour per week bar and that adults who report hours in agriculture are more selected in the low season, reporting agricultural activity has a larger coefficient in column 1 but a similar coefficient on hours worked (in column 2) compared to the high season. Note once again that wage labor really stands out as the key predictor of higher employment. It becomes apparent that while low employment may be a problem throughout Malawi's economy, it is particularly pronounced for rural households that are dependent on agriculture as their primary occupation, highlighting the importance of not only an agricultural transformation but the need for opportunities in the RNFE that would emerge in a rural transformation.

Urban-rural labor time equilibrates in the high season.

Against this backdrop of large unemployment in both rural and urban areas, one should notice that in the high season, hours worked in the two sectors are not very different (Table 3a). Households work 56.9 hours per week in the rural areas and 58.2 in the urban areas. Individuals work 24.6 hours per week in rural areas and 28.1 in urban areas. Yet, participation rates for individuals show a striking contrast, with 93% of the population employed in rural areas, indicating extensive work sharing, while all work available in urban areas is shared among 67% of the population, leaving 33% unemployed.

The role of unemployment in understanding differences in welfare between rural and urban households.

The IHS3 survey administers a consumption module to each household. From these responses, an estimate of total real annual consumption is generated for each surveyed household. Table 7 compares urban and rural household consumption levels at the mean and median levels, showing a low rural/urban ratio of 0.42 for means and 0.54 for medians. Similarly to McCullough (2017)'s adjustments for sectoral productivity, we proceed to adjust household consumption by how much it works. For this we divide rural and urban household consumption by annual average hours worked in rural or urban areas, respectively. As seen in Table 3a, rural households work on average 72% of the hours worked by urban households, annually. Calculating consumption on a per hour worked basis, the rural/urban ratio raises sharply to 0.58 for means and 0.75 for medians.

One issue with this adjustment by average hours worked at the household level is that it assumes the same annual employment level for all households.[8] If employment and consumption levels are correlated (which we expect, larger households having higher employment and consumption), this would not be correct. An alternative is then to compare household consumption per adult and use the relative annual hours worked per adult in rural vs. urban areas to adjust consumption per adult. We do this using the number of adults not in school, as in the rest of this paper. These per adult calculations have a potential opposite bias if adults in a household share work opportunities, and the employment rate of adults decreases with the number of adults in the household. Results reported in Table 7 show our results to be very robust to the method used. Because the number of adults per

[8]Recall that we only observe each household labor use for one week in a very seasonal calendar. Hence we cannot infer its own annual labor use, and need to resort to an average over the population or a segment of the population.

household is lower in rural than in urban areas, the rural/urban ratio in consumption per adult is a bit higher in per adult terms, but the main adjustment comes from measuring it on a per-hour basis. The rural/urban ratio of consumption per hour worked is 0.66 for the mean and 0.81 for the median.

This result is similar to McCullough (2017) comparing the sectoral productivity contrast between agriculture and non agriculture. It stresses the fact that urban-rural consumption gaps come not so much from a differential return per hour worked than from a differential in number of hours worked, much to the advantage of the urban population.

5 Decomposing Rural Unemployment between Peak and Seasonal Deficits

Malawi distinguishes itself as having a large deficit in employment opportunities. If we define full employment as 48 weeks per year (to allow for unexpected shocks such as illness and political disruptions) and 40 hours per week (to allow time for household maintenance and reproduction), annual hours reported in Table 3a show urban individuals to be at 67.1% of the 1920-hours work potential and rural individuals at 47.3%. Looking at the high season, urban workers work 28.1 hours per week and rural workers 24.6. Urban workers are thus still only at 70.2% of a 40 hour week, and rural workers at 61.5%. Hence, a deficit in work opportunities applies to both urban and rural workers, and exists throughout the year. It is this large and pervasive urban work deficit that limits the possibility of using rural-urban migration as a major instrument for poverty reduction (Evidence Action, 2014). Solving the deficit in work opportunities, basically through labor-intensive aggregate economic growth, remains the key issue for large scale poverty reduction in Malawi.

Given this important deficit, what is the importance of seasonality in rural households labor calendars in their opportunities to work? Since full employment as defined above is completely out of reach, we propose to consider the current high-season urban workload as the potential maximum employment for rural adults throughout the year. We then define peak deficit as the annualized difference between the high season work load in rural areas and this potential maximum. In other words, this is the unemployment level that would prevail in rural areas assuming that high-season employment was constant throughout the year. Seasonal unemployment is then defined as the difference between the observed employment through the year and this annualized high-season level.

Using numbers reported in Table 3a, rural adults work 3.44 hours less in high season than their urban counterparts. Over one year, this adds up to a deficit of 179 hours relative to the maximum 1459 hours if working 28.05 hours a week. With an observed 909 hours a year, the total employment deficit is 550 hours. The seasonal deficit is then 371 hours and it represents 67% of the total deficit. Beyond addressing the high-season deficit for urban and rural workers, the seasonality of rural labor calendars is indeed a big issue. Finding ways of smoothing rural labor calendars through agricultural and rural transformations is thus a key policy problem in addressing rural poverty. This is what we explore in what follows.

6 Elements of an agricultural transformation that can help smooth labor calendars

6.1 Agricultural labor calendars

After selecting households reporting on activities in the 2009/2010 rainy season, we use information in the agriculture questionnaire to construct an estimate of labor demand by crop per acre for each day of the agricultural season. We first clean the crop data for significant outliers in the reported planting and harvest months. In order to build a representative calendar of labor demand by crop we then focus on the 69.4% of the remaining plots that rely solely on household labor. We exclude households that engage in hiring and exchanging labor as non-household labor is not disaggregated by task and is measured in days rather than hours, making comparisons to household labor difficult. We verified that while these households typically farm fewer acres, their crop composition is broadly comparable to that of households hiring and exchanging labor. Estimates of the timing of farming activities and the labor hours required for each task and crop using this subset consisting of 10,253 plots farmed by 6,260 households should thus be generalizable to the full sample.

We construct labor demand calendars for the most common types of crops and intercropping combinations reported in Table 1. Households report planting and harvest months for each crop, as well as labor applied to a plot by each member of the household in planting, harvesting, and other activities and the number of weeks household members were engaged in each activity. Since intercropping is common in this setting plots are commonly composed of multiple crops with differing planting and harvest dates. Since labor variables are reported at the plot level, we divide them by the number of crops planted on each plot. For each of up to four crops, we then randomly assign the harvest and planting date of the crop to a date in the month reported. Using these dates as starting points, we construct the harvest and planting periods around them by calculating the weeks and labor hours assigned to that crop, normalized by the acreage of the plot. Since the timing of activities other than planting and harvesting is not specified in the survey, we spread the labor hours involved across the growing season though the number of weeks people actually report working in other activities during that period suggest that in actuality these hours are often lumped together over a few weeks. This procedure generates a labor calendar for each plot in our data that is farmed using household labor only. We then calculate a daily mean for the main crops and intercropping combinations reported in Figure 6. Table 8 presents a summary of the estimated labor requirements for the different crop categories. We see that the December planting period is the peak of labor demand and that most crops compete for labor at the same time. Labor demands at harvest time are more dispersed, especially for tobacco that comes ahead of other crops. Else than planting and harvesting, labor demands in agriculture are minimal.

The household labor demand calendar is constructed from the plot level calendars estimated above. First we select only households that do not hire or exchange labor on any plots leaving 8,543 plots farmed by 5,094 households. We then reweight the plot level labor calendar by the plot acres and sum the labor demand for each day across all of the plots a household reports. This generates a labor demand calendar for each household. We then calculate a daily mean across all households re-

ported in Figure 7. The agricultural labor demand calendar generated with this procedure covers the 2009/2010 agricultural season (rather than the 2010/2011 survey season) and relies on retrospective recalls of significant agricultural dates and labor requirements. Nonetheless, this calendar is consistent with the labor hours in agriculture reported in Figure 2a.[9] This generates a sharply concentrated labor calendar, particularly at planting time. These concentrated labor demands in agriculture are at the origin of the high seasonality in rural households' labor calendars.

6.2 Specific contributors to labor smoothing

We saw in Figure 2a that agricultural activities have a very strong seasonal pattern of labor use, largely responsible for the seasonality in rural labor calendars. In this section, we look into more specific activities or characteristics of agricultural production that could contribute to smoothing the agricultural labor calendars. In order to do this, we contrast the agricultural labor calendars of households that do or do not participate in these activities. Note that undertaking an activity may or may not generate higher employment depending on whether it fully substitutes or not to the other household activities, which we can check by comparing total annual hours worked. In terms of its contribution to smoothing the labor calendar, best would be that the activity be counter-cyclical to the other activities in which households are engaged, as it will then generate a decline in the standard deviation (SD) of labor use across months. Nonetheless, even if it is not counter-cyclical, an activity that generates a constant amount of labor through the year will induce no change in SD but a decline in the coefficient of variation (CV) of the labor calendar, as illustrated by equation (1).

Table 9 reports total hours worked, high and low season work, SD and CV of hours worked across months of the year for households that do or do not participate in these activities. Because we are looking at potential smoothing of the agricultural work calendar, the sample used in this table consists of the 9389 rural households (93.5% of all rural households) that are directly engaged in agriculture by cultivating a plot of land and/or owning livestock. As discussed in section 4, the ultimate measure of variability in monthly labor use is the CV, but it can be reduced either by an increase in the overall labor use through the year with a non-seasonal activity, or by a decrease in the SD by a countercyclical activity. We thus use this grid of indicators to assess in this section the contributions of livestock, tobacco, crop diversity, farm area, irrigation, and use of non-family labor to smoothing the agricultural labor calendar.

Livestock. About 56% of rural households engaged in agriculture own livestock. Of the households that own livestock, the mean is of 10.7 heads, of which 62% are poultry, 24% are sheep or goats, 7% pigs, and 3% cattle. Figure 8 shows working hours for households (panel a) and individuals (panel b) in households that own livestock compared to those that do not. The figures show that livestock adds to household work hours throughout the year, with no seasonal effect, except possibly during the harvesting period when livestock has to be herded away from crops. This is reflected in a 33%

[9] Differences between these two graphs could be due to differences between years and recall errors. In addition, recall labor hours questions induce respondents to report in a rather lumpy way which creates some arbitrariness in the way we define the length and intensity of work when there are different members of the household working different lengths of time. Figure 2a also include hours spent on other activities not associated with specific crops (eg livestock).

increase in total hours worked with almost no difference in the SD (Table 9). The fact that livestock adds less to individuals' hours worked than to households' and reduce the SD for individuals suggests that care of livestock is provided by labor categories else than the main household workers. By adding to work opportunities, livestock reduces the CV of the agricultural labor calendar by 23-24% for both households and individuals.

Tobacco. Comparing hours worked in households that grow tobacco compared to those that do not shows that tobacco adds significantly to household labor. Because the labor intensive planting season coincides with that of other crops, tobacco provides limited smoothing opportunities. Nonetheless, as visible in figures 6b and 9, the labor intensive harvest season of tobacco does create an increase in labor requirements during the early period of the growing season prior to the harvest of other crops. The net of these two effects results in an increase of the SD, and the CV of agricultural labor calendars is 2% higher for tobacco growing households than for the other households.

Crop diversity. A similar analysis applies to crop diversification. Here we compare households with three or more crops with households planting only one crop. In general one expects crop diversity to smooth the agricultural calendar. Yet, here as with the case of tobacco, the seasonal patterns of rain implies that planting of all crops happen at the same time, and hence multiple crops provide substantially more work but no relief from seasonality of demand for labor.

Farm area. Comparing reported hours for rural households in the top 25% of farmed area compared to the bottom 25% shows that land area is a major determinant of household time worked. By increasing labor a bit more in the low season than in the high season, larger farms have an 11% lower CV of labor calendar than smaller farms.

Irrigation and dry season cultivation. We compare household labor hours in households that report planting a plot in the previous year's dry season. This is generally done with bucket irrigation. What is interesting is that irrigation raises labor demand not only in the dry period, but also during the wet season, suggesting that it is associated with intensification of land use. Irrigation decreases the CV of agricultural labor calendars by 7%.

Use of hired labor. The last two comparisons look at the use of non-family labor to smooth tension in period of high labor demand. Only 25% of the households ever hire labor. Among those that do hire labor, they hire on average 16 days of labor per year, although the distribution has a long tail with 1% of the households hiring more than 60 days. These numbers are small relative to annual work, although they are certainly critical at particular times of the year. We see very little difference in family labor between households that hire and those that do not hire labor. The interpretation is that households can easily hire labor when their demand is higher than what they would like to supply, so that households maintain their own labor supply in either case. There could have been some difference by selection, as households that do not hire labor include households that are always in surplus of

labor. This is likely very marginal as we see that total hours worked is also very similar across these two groups.

Use of exchange labor. The contrast between the roles of exchange labor and hired labor is interesting. Labor exchange is a within season arrangement between households. Typically, instead of having a short very intense few days of work on your own field, you get neighbors to come and help you and then go on to help them. This helps spread each household's work over a longer period of time if there is some heterogeneity in the exact timing of the operation, or if the operation is for technical reason difficult to spread over more days. The CV of monthly hours worked in agriculture is 34% lower for household that use labor exchange and this is all due to spreading labor rather than adding any labor.

In conclusion, agricultural activities on the farm have little countercyclical patterns of labor use with the main crops that could contribute to smooth the labor calendars. Only households raising livestock and to a lesser extent having irrigation that allows intensification of agriculture or more crop diversification have a lower variability in hours worked across months, and this is mostly due to increased labor use throughout the year. In contrast, using labor exchange seems to allow smoothing labor calendars, without any change in aggregate annual labor.

7 Elements of rural transformation that can help smooth labor calendars

While the agricultural transformation may affect labor calendars through agricultural activities, the rural transformation seeks to affect labor calendars through decisions beyond agriculture such as engagement in non-farm activities. We look into the effect of seasonal participation to labor market activities by household members and the role of household enterprises. Results are summarized in Table 10.

Agricultural Labor Markets. Participation in the labor market is associated with a large increase of annual hours worked by 37%. It decreases a bit the SD of monthly hours worked by adding a few more hours in the low season than in the high season, but the very large 33% decline in the CV is largely due to the increased overall level of employment.

Household Enterprises. Figure 10 compares reported hours worked by rural households that run a household enterprise to those that do not. Most of the households that run an enterprise are engaged in retail or trade selling consumer products or services. With the exception of some basket weaving, brick making, mat weaving, and tailors there is very little manufacturing of non-perishable goods. Household enterprises increase work hours throughout the year (by an average 36%) with no evidence of counter-cyclical smoothing, to the contrary (the SD is higher by 22%). Work in household enterprises reduces the CV of labor calendars by 11%.

In conclusion, participation to the labor market and having a non-farm enterprise are both associated with a large increase in total employment, and through this with a decrease in the seasonality of work. Participation in the labor market is also associated with some counter-cyclical opportunities that allow a large decrease in the overall seasonality of the labor calendar, which the non-farm enterprises do not provide.

8 Limiting factors to a structural transformation

The structural transformation has historically been heralded as the mechanism through which agriculture contributes to aggregate economic growth and to rural poverty reduction. As the productivity of labor rises in agriculture, less labor is needed in agriculture and it can be reallocated to the urban-based industrial and services economy. We have seen, however, that high urban unemployment limits the possibility for rural labor to find productive employment in the urban economy. Labor displacement to the urban sector is not accompanied by productive employment, but by accumulation of labor in urban slums and no effect on growth. This phenomenon was observed in the 2008 World Development Report (World Bank, 2007) for many SSA countries where a decline in the share of the labor force employed in agriculture is not accompanied by a corresponding increase in GDP per capita. Malawi was one of them.

We observed that there is a gender penalty in rural-urban migration, with women apparently losing labor opportunities from migration while men gain. This reduces the gains from permanent migration for the household and contributes to reticence to migrate for rural households. This further reinforces the potential importance of focusing on agricultural and rural transformations in addressing rural poverty in a country like Malawi.

9 Robustness check with the 2004 and 2016 LSMS-ISA data

We verify the results obtained with the 2010 data for household labor supplied in Table 10 and for individuals participation in Table 12 using the 2004 and 2016 LSMS-ISA data. We see that results are broadly consistent to those of 2010. Rural household labor calendars for hours worked have a CV which is larger than their urban counterparts. The same applies to individual labor engagement, with exception of the 2004 result. Pooled data across the three surveys show a CV which is almost three times higher for rural household hours worked and double for individual labor participation compared to their urban counterparts. Variability of labor calendars is indeed a major curse for rural households in spite of the many different instruments available to them to potentially smooth calendars.

10 Conclusion

Structural transformation has been advocated as an engine of growth and poverty reduction for the agriculture-based economies, which include most of the SSA countries. In that perspective, land

and labor productivity growth in agriculture enables the transfer of labor out of rural areas at no opportunity cost on the price of food. Released labor can then be employed at a higher level of productivity in the urban industrial and services economy. As a consequence, the shares of agriculture in employment and GDP decline while the engine of aggregate growth and poverty reduction is found in capital accumulation and employment creation in the urban economy. The analysis of rural household data permitted by some LSMS surveys shows that this approach to growth and poverty reduction is less evident in countries like Malawi where there is a large deficit of urban employment. Labor transfers from the rural sector are less likely to stimulate GDP growth than to displace poverty to the urban environment. As a consequence, we have focused on growth and poverty reduction in the rural areas themselves through agricultural and rural transformations. Key in using these transformations for rural poverty reduction is to reduce seasonality in labor calendars. We have seen that, taking the urban high season employment rate as the maximum workload that could be attained by rural households under current circumstances, the seasonal work deficit explains 2/3 of the total work deficit for rural households. Smoothing rural labor calendars can be achieved in the agricultural transformation through a variety of instruments including livestock, crop diversity, irrigation, and use of non-family labor, especially exchange labor. Smoothing of labor calendars through the rural transformation includes labor market participation and rural non-farm enterprise development. We have shown that there is no single magic bullet among these various instruments to smooth out labor calendars, requiring instead a comprehensive agenda focusing on all available instruments. Activities that contribute to labor smoothing are however not countercyclical to the labor demands of staple crops agriculture. They instead add to labor opportunities throughout the year. As a consequence, family members are likely to each specialize in one or several of these new activities, rather than engaging in seasonal job switching. In any case, our main result is that the increasingly prevalent agro-pessimism needs revisiting and that, for agriculture-based countries like Malawi, facilitating the engagement of rural households in agricultural and rural transformations seems to be the most effective policy option for growth and poverty reduction.

References

Bardhan, Pranab K. 1984. Land, labor, and rural poverty: Essays in development economics. Columbia University Press.

Beegle, Kathleen, Luc Christiaensen, Andrew Dabalen, and Isis Gaddis. 2016. Poverty in a rising Africa. The World Bank.

Chafuwa, Chiyembekezo. 2017. "Priorities for irrigation investment in Malawi." Policy Note 28, International Food Policy Research Institute.

Collier, Paul. 2008. "The politics of hunger: How illusion and greed fan the food crisis." Foreign Affairs Nov-Dec:67–79.

Collier, Paul and Stefan Dercon. 2014. "African agriculture in 50 years: smallholders in a rapidly changing world?" World Development 63:92–101.

Dercon, Stefan and Douglas Gollin. 2014. "Agriculture in African development: theories and strategies." Annual Review of Resource Economics 6 (1):471–492.

Evidence Action. 2014. "Seasonal Migration Feasibility Analysis: Malawi and Zambia." Tech. rep., https://www.givewell.org/evidence-action/march-2014-grant.

Gollin, Douglas, David Lagakos, and Michael E Waugh. 2013. "The agricultural productivity gap." The Quarterly Journal of Economics 129 (2):939–993.

Lagakos, David, Ahmed Mushfiq Mobarak, and Michael E Waugh. 2018. "The Welfare Effects of Encouraging Rural-Urban Migration." Working Paper w24193, National Bureau of Economic Research.

Lewis, W Arthur. 1954. "Economic development with unlimited supplies of labour." The Manchester School 22 (2):139–191.

McCullough, Ellen B. 2017. "Labor productivity and employment gaps in Sub-Saharan Africa." Food Policy 67:133–152.

Wodon, Quentin and Kathleen Beegle. 2006. "Labor shortages despite underemployment? Seasonality in time use in Malawi." In Gender, Time Use, and Poverty in Sub-Saharan Africa, edited by Quentin Wodon and C Mark Blackden. The World Bank, 97–116.

World Bank. 2007. World Development Report 2008: Agriculture for Development. Washigton DC: The World Bank.

Tables

Table 1: Cropping Patterns

Mean acres	All	North	Central	South
Total	2.381	1.971	3.473	1.486
Maize	1.172	0.956	2.040	0.431
Maize-Beans	0.056	0.092	0.076	0.028
Maize-Pigeonpeas	0.135	0.001	0.006	0.290
Groundnuts	0.193	0.116	0.406	0.017
Tobacco	0.294	0.187	0.615	0.026
Other	0.180	0.271	0.150	0.183
Other-Maize	0.351	0.348	0.180	0.510
Observations	10,100	1,696	3,575	4,829

Note: Sample consists of all households reporting at least one cultivated plot. This includes 851 urban households. Land area is calculated using GPS measures of plot area.

Table 2: Descriptive Statistics by Year for Households Engaged in Agriculture

		2004	2010	2016
Cultivated area in acres	Mean	2.29	1.80	1.38
	Median	2	1.50	1
Total household labor hours in past week	Mean	59.19	41.00	31.73
	Median	50	30	21
Labor hours in past week in peak season (Dec-Jan)	Mean	72.20	58.91	45.57
	Median	63	51	36
Household size	Mean	4.77	4.72	4.43
	Median	5	5	4
Household working-age individuals not in school	Mean	2.02	1.91	1.79
	Median	2	2	2
Observations		9,798	10,096	9,470

Note: Sample consists of all households reporting at least one cultivated plot. For consistency across years, land area is calculated using self-reported plot size winsorized at 5pct.

Table 3: Rural-Urban Contrasts in Labor Calendars: Labor Supply and Engagement

Panel 3a: Labor supplied

	Contrast	Total annual hrs	High weekly hrs	Low weekly hrs	Standard deviation	Coeff. of variation (%)
Rural vs. urban, household	Rural	2,065	56.93	29.23	9.58	24.26
	Urban	2,863	58.21	51.38	5.62	10.26
	Rural/urban	0.72	0.98	0.57	1.70	2.36
Rural vs. urban, individual	Rural	909	24.61	12.39	4.14	23.85
	Urban	1,288	28.05	23.26	2.63	10.67
	Rural/urban	0.71	0.88	0.53	1.57	2.24

Panel 3b: Labor engagement

	Contrast	Mean % active	High % active	Low % active	Standard deviation	Coeff. of variation (%)
Rural vs. urban, household	Rural	0.88	0.97	0.78	0.06	7.31
	Urban	0.91	0.93	0.87	0.04	3.88
	Rural/urban	0.97	1.04	0.90	1.50	1.88
Rural vs. urban, individual	Rural	0.79	0.93	0.64	0.10	13.08
	Urban	0.64	0.67	0.61	0.05	8.58
	Rural/urban	1.23	1.39	1.05	2	1.52

Note: Sample consists of 23324 working age individuals who are not in school and 12266 households of which 10037 are rural. Mean percent active is the mean value over the year of the percentage of households that report positive working hours in any given month. High season is December and January, low season is July and August.

Table 4: Allocation of Time in Rural Areas during the Low Season

Panel 4a: Mean hours

	$0<\text{hrs}\leq 10$	$10<\text{hrs}\leq 20$	$20<\text{hrs}\leq 30$	$30<\text{hrs}$
Total hours	5.56	15.44	25.80	48.17
Hours in agriculture	3.78	10.59	16.51	18.38
Hours in household business	0.89	1.71	2.38	7.58
Hours in casual labor	0.68	2.46	4.52	8.55
Hours in wage labor	0.22	0.69	2.39	13.66

Panel 4b: Percentage allocation

	$0<\text{hrs}\leq 10$	$10<\text{hrs}\leq 20$	$20<\text{hrs}\leq 30$	$30<\text{hrs}$
Share of hours in agriculture	0.68	0.69	0.64	0.38
Share of hours in business	0.16	0.11	0.09	0.16
Share of hours in casual labor	0.12	0.16	0.18	0.18
Share of hours in wage labor	0.04	0.04	0.09	0.28
Observations	750	482	206	335
Percent of sample	0.28	0.18	0.08	0.12

Note: Sample consists of 2703 rural individuals interviewed in July and August. 930 individuals (34 % of the sample) who report working no hours are not included in the table.

Table 5: Correlates of Employment in the High Season in Rural Areas

	Mean	Works over 35 hrs/week		Total individual weekly hrs	
Female	.54	-0.075***	(0.014)	-3.244***	(0.605)
Age	34.41	0.002*	(0.001)	0.067*	(0.030)
Completed primary	.22	-0.019	(0.024)	-1.289	(1.154)
Reports hours in agriculture	.87	0.083**	(0.026)	13.443***	(1.502)
Reports hours in business	.08	0.233***	(0.066)	13.830***	(2.975)
Reports hours in casual labor	.18	0.210***	(0.036)	11.180***	(1.461)
Reports hours in wage labor	.08	0.647***	(0.055)	32.918***	(3.100)
Household acres	1.7	0.001	(0.008)	0.462	(0.372)
Individuals in household	4.91	-0.004	(0.006)	-0.042	(0.236)
Adults in household	2.19	-0.025	(0.015)	-1.702*	(0.669)
Household hires labor	.19	0.036	(0.029)	1.022	(1.131)
Household exchanges labor	.07	-0.019	(0.033)	0.643	(1.290)
Household has business	.16	0.108**	(0.033)	4.243**	(1.516)
Acres in tobacco	.16	-0.072***	(0.019)	-3.265**	(1.003)
Acres planted in dry season	.07	0.062	(0.033)	3.157*	(1.203)
Number of crops planted	1.87	0.031*	(0.013)	0.856	(0.577)
Livestock heads	5.56	0.001	(0.001)	0.013	(0.061)
Constant		0.038	(0.055)	8.028***	(2.363)
N		2768		2768	
Mean		.25		25.14	
Standard Deviation		.44		18.22	

Note: Sample consists of rural individuals surveyed in December and January. Standard errors in parentheses.
$*p < 0.05, **p < 0.01, ***p < 0.001$

Table 6: Correlates of Employment in the Low Season in Rural Areas

	Mean	Works over 20 hrs/week		Total individual weekly hrs	
Female	.54	-0.059***	(0.013)	-2.508***	(0.453)
Age	33.7	0.001	(0.001)	0.038*	(0.017)
Completed primary	.19	0.001	(0.029)	-1.211	(1.111)
Reports hours in agriculture	.50	0.218***	(0.028)	11.375***	(0.940)
Reports hours in business	.12	0.196***	(0.042)	12.079***	(1.772)
Reports hours in casual labor	.12	0.333***	(0.040)	15.689***	(1.453)
Reports hours in wage labor	.06	0.585***	(0.055)	30.302***	(2.424)
Household acres	1.98	-0.016	(0.008)	-0.531	(0.337)
Individuals in household	5.44	0.003	(0.006)	0.149	(0.190)
Adults in household	2.41	-0.009	(0.012)	-0.235	(0.542)
Household hires labor	.31	0.027	(0.026)	0.674	(0.865)
Household exchanges labor	.15	0.003	(0.026)	0.457	(0.905)
Household has business	.19	0.067**	(0.024)	3.009***	(0.815)
Acres in tobacco	.14	-0.049*	(0.022)	-2.286*	(0.989)
Acres planted in dry season	.13	0.007	(0.012)	0.515	(0.504)
Number of crops planted	2.05	0.020	(0.015)	1.031	(0.549)
Livestock heads	6.64	0.002	(0.001)	0.067	(0.047)
Constant		-0.005	(0.040)	-0.456	(1.463)
N		2703		2703	
Mean		.11		12.17	
Standard Deviation		.31		16.2	

Note: Sample consists of rural individuals surveyed in July and August. Standard errors in parentheses.
$*p < 0.05, **p < 0.01, ***p < 0.001$

Table 7: Productivity and Consumption

Household consumption units		Rural	Urban	Rural/urban
Per household	Mean	197,000	468,000	0.42
	Median	152,000	284,000	0.54
Per household hour worked	Mean	95	163	0.58
	Median	74	99	0.75
Per individual	Mean	109,000	233,000	0.47
	Median	86,000	151,000	0.57
Per individual hour worked	Mean	120	181	0.66
	Median	95	117	0.81

Note: The adjustment for hours worked is done by dividing consumption by the estimated annual hours worked for the relevant group reported in Table 3.

Table 8: Mean Labor Hours per Acre, by Crop

	Maize (MZ)	MZ-Beans	MZ-Pigeon Pea	MZ-Other	Groundnuts	Tobacco	Other
Total	418	441	471	410	484	592	496
....Planting	183	203	216	185	188	201	196
....Other	150	167	168	155	150	158	160
....Harvest	73	67	75	63	127	181	117
Observations	3,846	300	1,190	2,100	786	693	1,240

Note: Sample consists of all reported plots farmed using household labor only. Labor hours per acre are first winsorized at .05.

Table 9: Agricultural Labor Hours by Participation in Activities of Agricultural Transformation

	Contrast	Obs	Total annual hrs	High weekly hrs	Low weekly hrs	Standard deviation	Coeff. of variation (%)
Livestock	Livestock	5,275	1,667	50.37	20.43	10.40	32.62
	No livestock	4,114	1,252	41.87	13.93	10.15	42.36
	Liv/NoLiv		1.33	1.20	1.47	1.02	0.77
Livestock (individual)	Livestock	10,552	641	19.08	7.46	3.96	32.33
	No livestock	7,158	550	18.16	5.75	4.47	42.46
	Liv/NoLiv		1.17	1.05	1.30	0.89	0.76
Tobacco	Tobacco	1,255	1,870	54.32	20.25	13.01	36.32
	No tobacco	8,134	1,404	44.43	17.19	9.59	35.72
	Tob/NoTob		1.33	1.22	1.18	1.36	1.02
Crop diversity	More diverse	1,920	1,899	61.43	22.92	14.31	39.41
	Less diverse	2,510	1,133	36.62	9.84	8.86	40.87
	More/Less		1.68	1.68	2.33	1.62	0.96
Large farm	Highest quartile	2,343	1,926	58.33	20.96	13.13	35.61
	Lowest quartile	2,379	1,001	32.76	10.70	7.68	40.12
	Highest/Lowest		1.92	1.78	1.96	1.71	0.89
Dry season planting	Planting	1,287	1,903	57.27	23.36	12.72	34.95
	No planting	8,102	1,408	45.15	16.38	10.10	37.49
	Plant/NoPlant		1.35	1.27	1.43	1.26	0.93
Uses hired labor	Hires	2,309	1,493	45.07	20.31	9.76	34.16
	No hiring	7,080	1,460	46.38	16.17	10.41	37.28
	Hires/NoHires		1.02	0.97	1.26	0.94	0.92
Uses exchanged labor	Exchanges	1,242	1,460	37.34	17.43	6.98	24.97
	No exchange	8,147	1,464	46.82	17.55	10.59	37.81
	Exch/NoExch		1	0.80	0.99	0.66	0.66

Note: Sample consists of rural households that report cultivating a plot or owning livestock. Household crops are considered more diversified if they report planting three or more crops and less if they report planting a single crop. High season is December and January, low season is July and August.

Table 10: Rural Household Labor Supply by Participation in Activities of Rural Transformation

	Contrast	Obs	Total annual hrs	High weekly hrs	Low weekly hrs	Standard deviation	Coeff. of variation (%)
Work as paid labor	Paid work	6,077	2,323	61.13	35.49	9.40	21.17
	No paid work	3,960	1,698	50.70	21.15	10.21	31.45
	Paid/NoPaid		1.37	1.21	1.68	0.92	0.67
Non-farm enterprise	Enterprise	1,755	2,659	70.96	40.17	11.46	22.53
	No enterprise	8,282	1,948	54.34	27.13	9.43	25.31
	Ent/NoEnt		1.36	1.31	1.48	1.22	0.89

Note: Sample consists of all rural households. Household are categorized as working as paid labor if any houshold member reports working for a wage, salary or in casual labor in the past 12 months. High season is December and January, low season is July and August.

Table 11: Labor Supplied by Households, Rural vs. Urban: 2004, 2010, and 2016

	Contrast	Obs	Total annual hrs	High weekly hrs	Low weekly hrs	Standard deviation	Coeff. of variation (%)
Rural vs. urban, 2010	2010 Rural	10,037	2,065	56.93	29.23	9.58	24.26
	2010 Urban	2,229	2,863	58.21	51.38	5.62	10.26
	2010 Rural/urban		0.72	0.98	0.57	1.70	2.36
Rural vs. urban, 2004	2004 Rural	9,840	3,088	70.98	48.41	8.75	14.82
	2004 Urban	1,440	3,266	66.67	61.58	6.06	9.72
	2004 Rural/urban		0.95	1.06	0.79	1.44	1.52
Rural vs. urban, 2016	2016 Rural	10,175	1,488	37.12	26	7.97	25.67
	2016 Urban	2,272	2,277	54.39	43.99	11.31	23.76
	2016 Rural/urban		0.65	0.68	0.59	0.70	1.08
Rural vs. urban, 04-10-16	Pooled Rural	30,052	1,858	49.37	27.06	8.33	23.45
	Pooled Urban	5,941	2,651	58.70	49.30	4.15	8.18
	Pooled Rural/urban		0.70	0.84	0.55	2.01	2.87

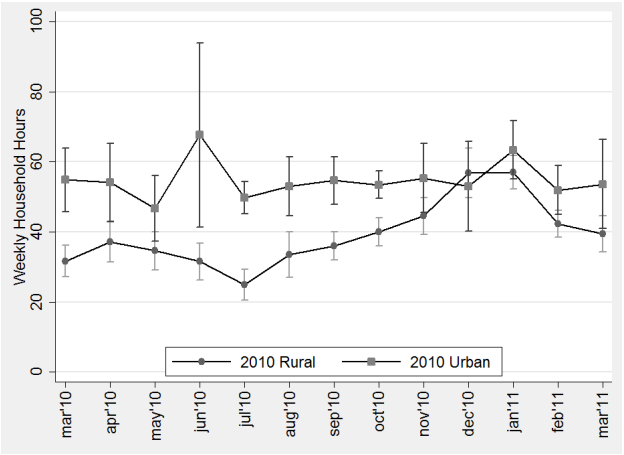
Note: High season is December and January, low season is July and August.

Table 12: Labor Engagement of Individuals, Rural vs. Urban: 2004, 2010, and 2016

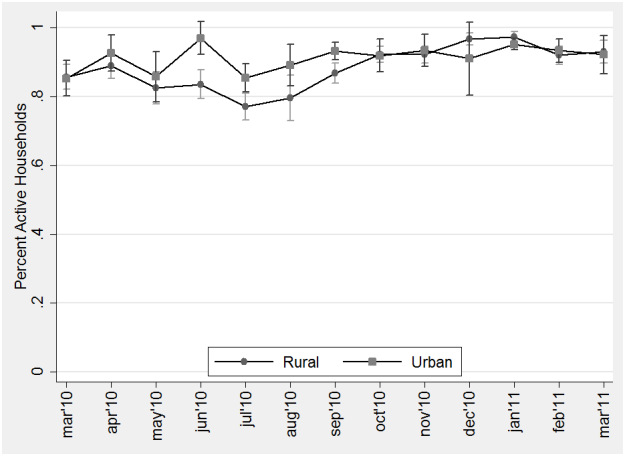
	Contrast	Obs	Mean % active	High % active	Low % active	Standard deviation	Coeff. of variation (%)
Rural vs. urban, 2010	2010 Rural	18,699	0.79	0.93	0.64	0.10	13.08
	2010 Urban	4,625	0.64	0.67	0.61	0.05	8.58
	2010 Rural/urban		1.23	1.39	1.05	2	1.52
Rural vs. urban, 2004	2004 Rural	19,674	0.88	0.95	0.79	0.05	6.09
	2004 Urban	3,114	0.67	0.72	0.62	0.05	7.48
	2004 Rural/urban		1.31	1.32	1.27	1	0.81
Rural vs. urban, 2016	2016 Rural	18,039	0.70	0.78	0.65	0.10	14.20
	2016 Urban	4,424	0.64	0.69	0.67	0.06	9.58
	2016 Rural/urban		1.09	1.13	0.97	1.67	1.48
Rural vs. urban, 04-10-16	Pooled rural	56,412	0.75	0.87	0.62	0.09	12.42
	Pooled urban	12,163	0.64	0.67	0.63	0.04	6.08
	Pooled rural/urban		1.17	1.30	0.98	2.25	2.04

Note: Sample consists of working age individuals who are not in school. High season is December and January, low season is July and August.

Figures

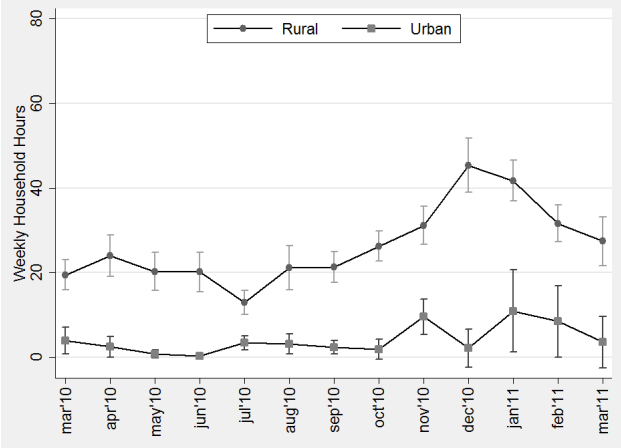


(a) Total hours supplied

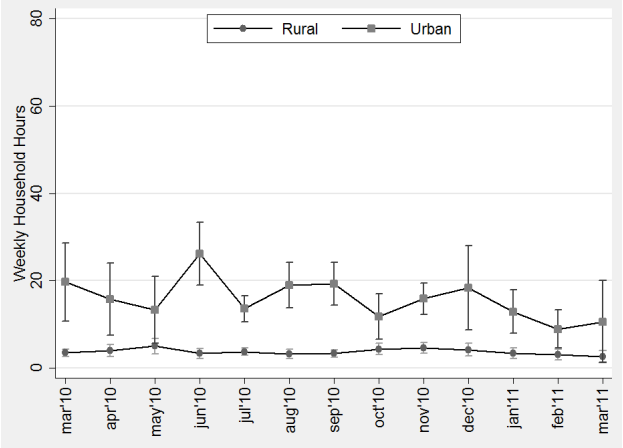


(b) Percent of active households

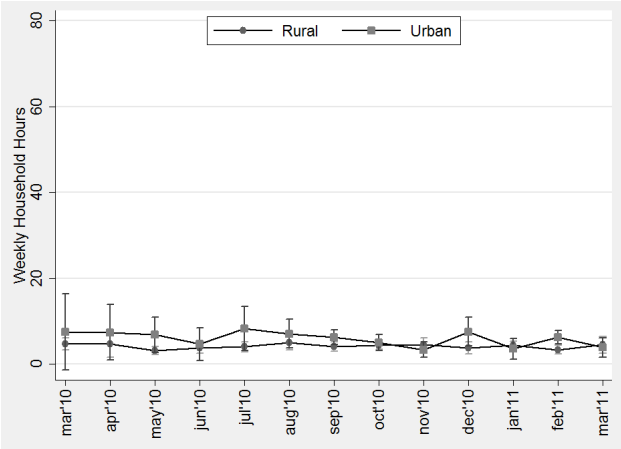
Figure 1: Household Labor Supplied Last Week



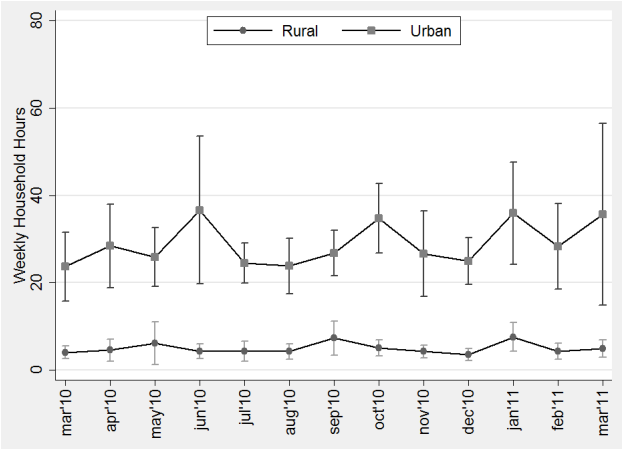
(a) Hours supplied to agriculture



(b) Hours supplied to household businesses

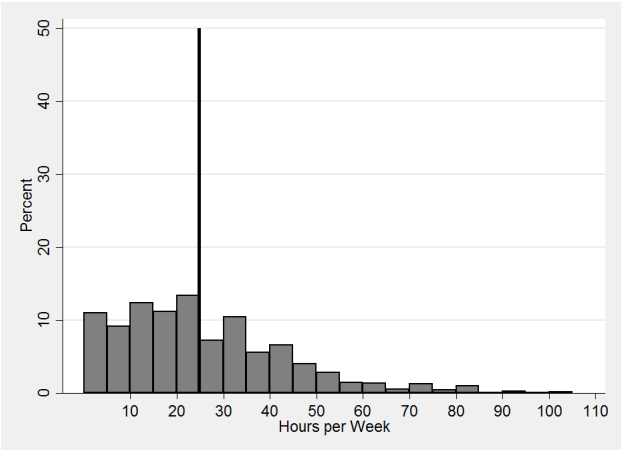


(c) Hours supplied to casual labor

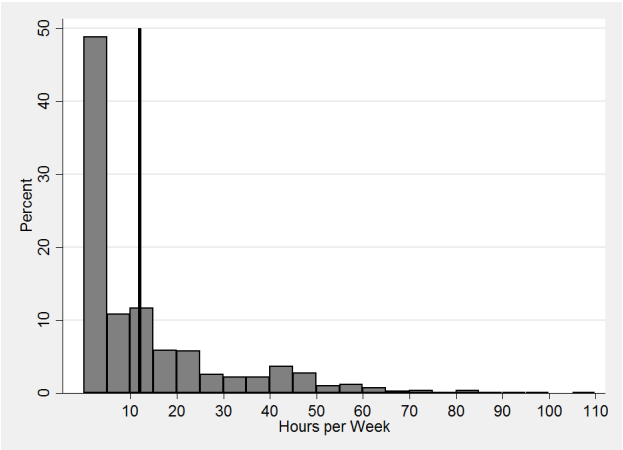


(d) Hours supplied to wage labor

Figure 2: Household Labor Supplied Last Week by Activity

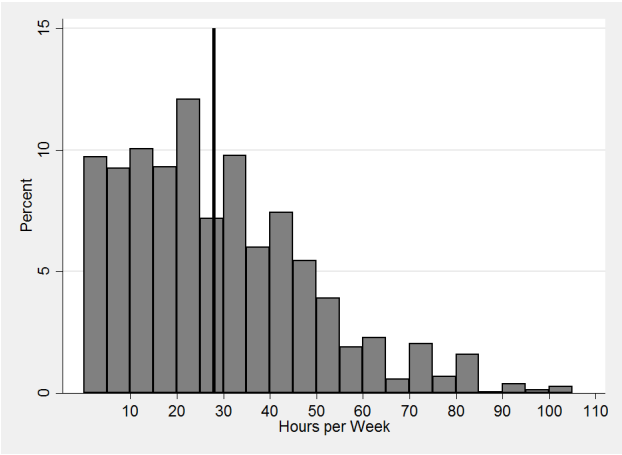


(a) High season (Dec-Jan)

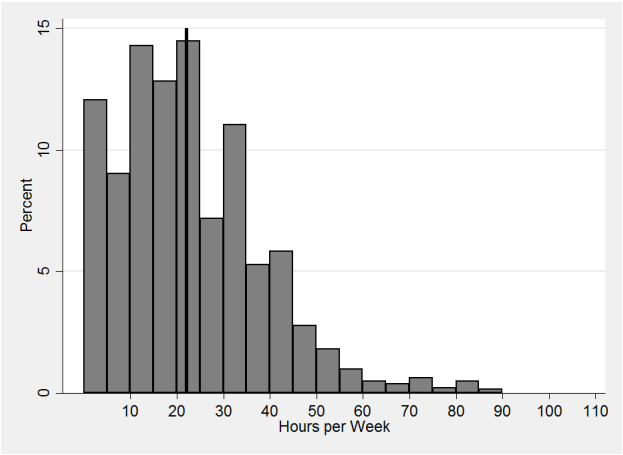


(b) Low season (Jul-Aug)

Figure 3: Distribution of Weekly Hours Reported by Rural Individuals by Season

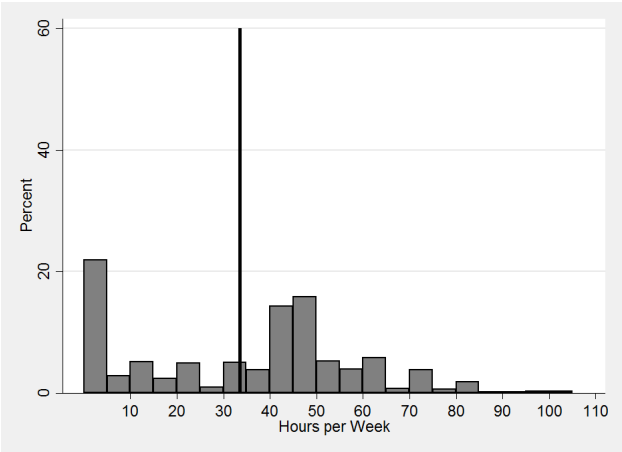


(a) Rural men (Dec-Jan)

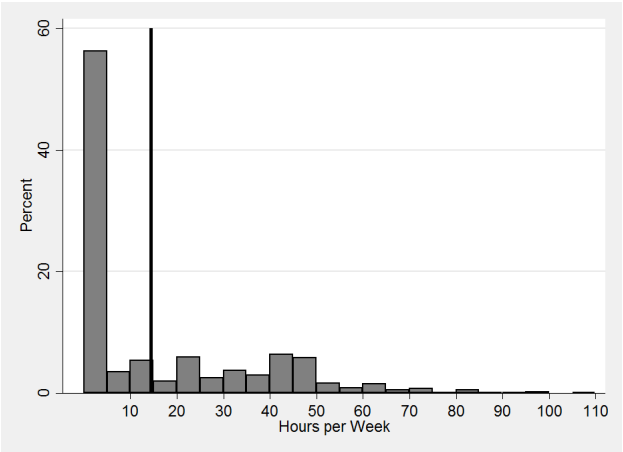


(b) Rural women (Dec-Jan)

Figure 4: Distribution of Weekly Hours Reported by Rural Individuals in High Season by Gender

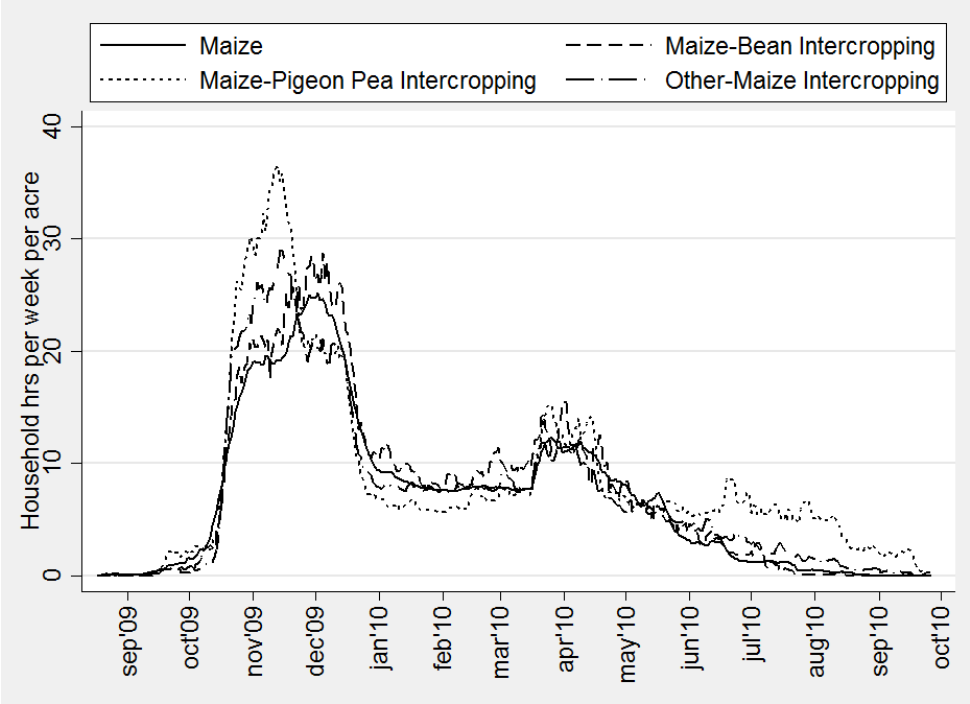


(a) Urban men

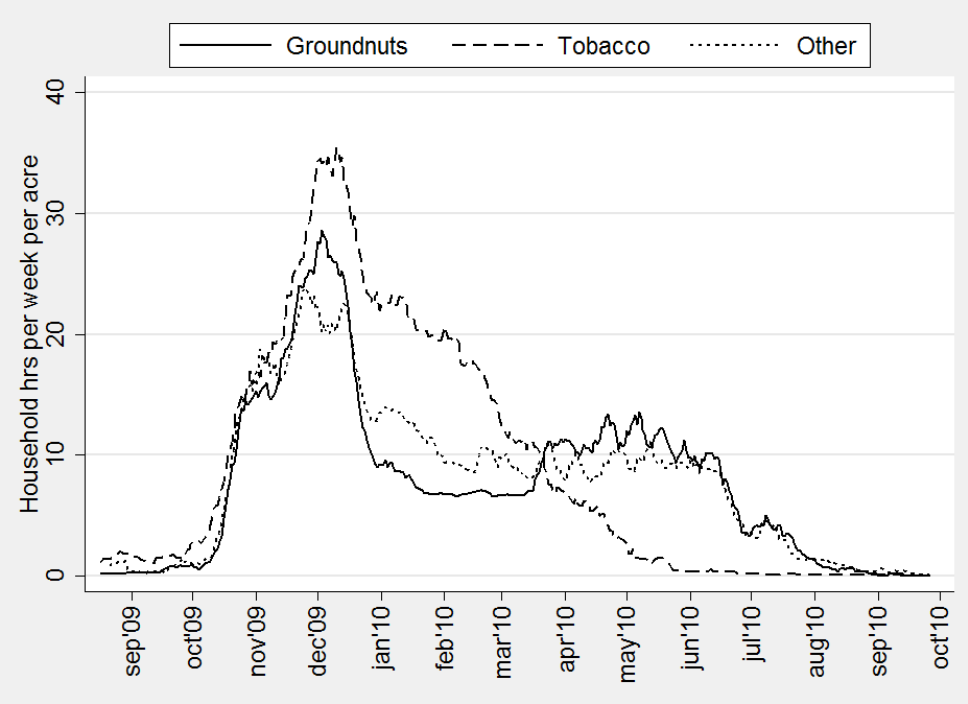


(b) Urban women

Figure 5: Distribution of Weekly Hours Reported by Urban Individuals by Gender



(a) Maize and intercropped maize



(b) Non-maize

Figure 6: Estimated Household Labor Demand per Week for an Acre of the Crop

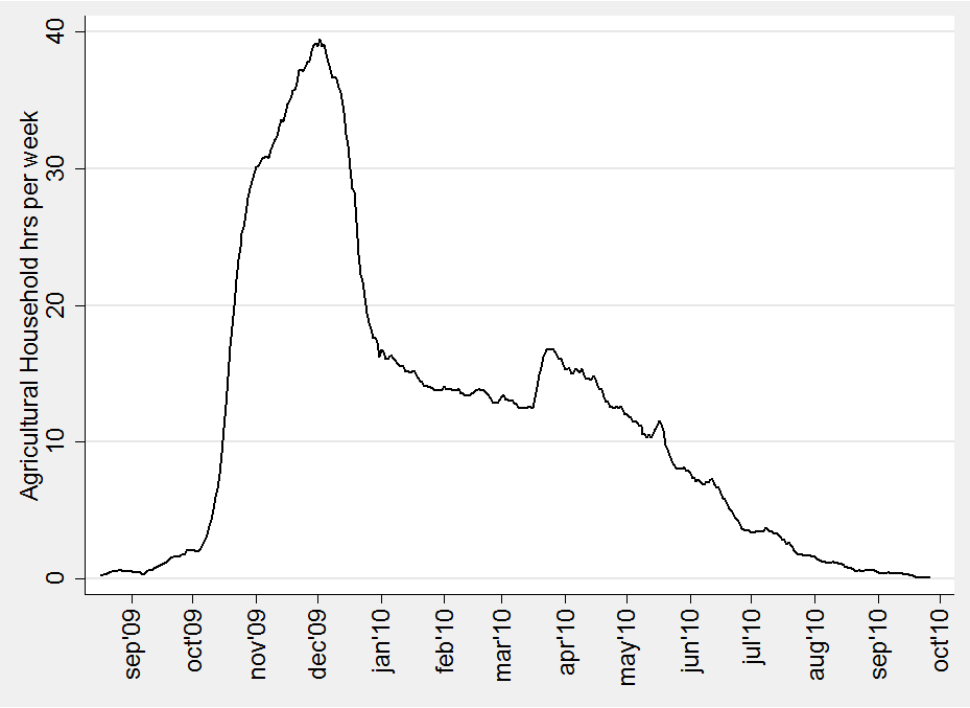
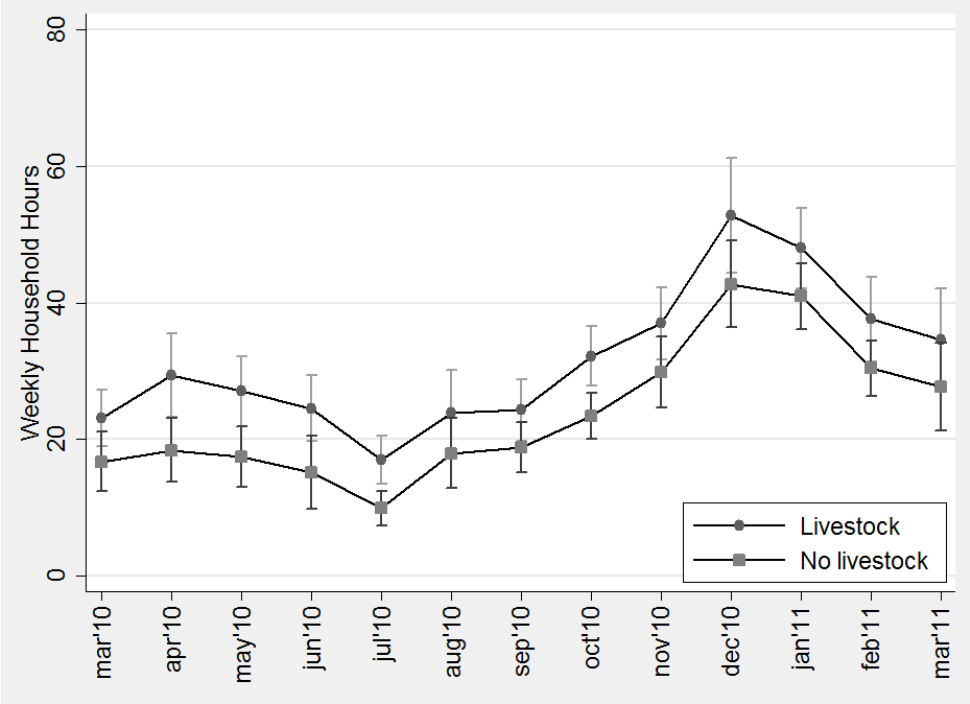
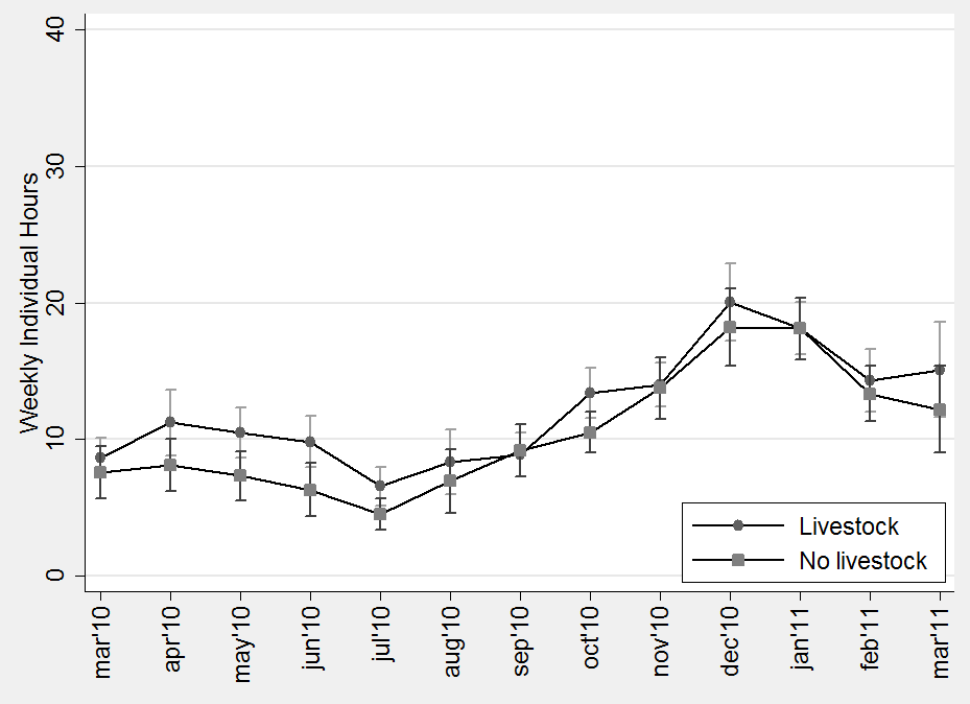


Figure 7: Estimated Household Agricultural Labor Demand per Week for Farming Households using Retrospective Agricultural Questionnaire



(a) Household hours in agriculture



(b) Individual hours in agriculture

Figure 8: Labor Supply to Agriculture by Household Ownership of Livestock

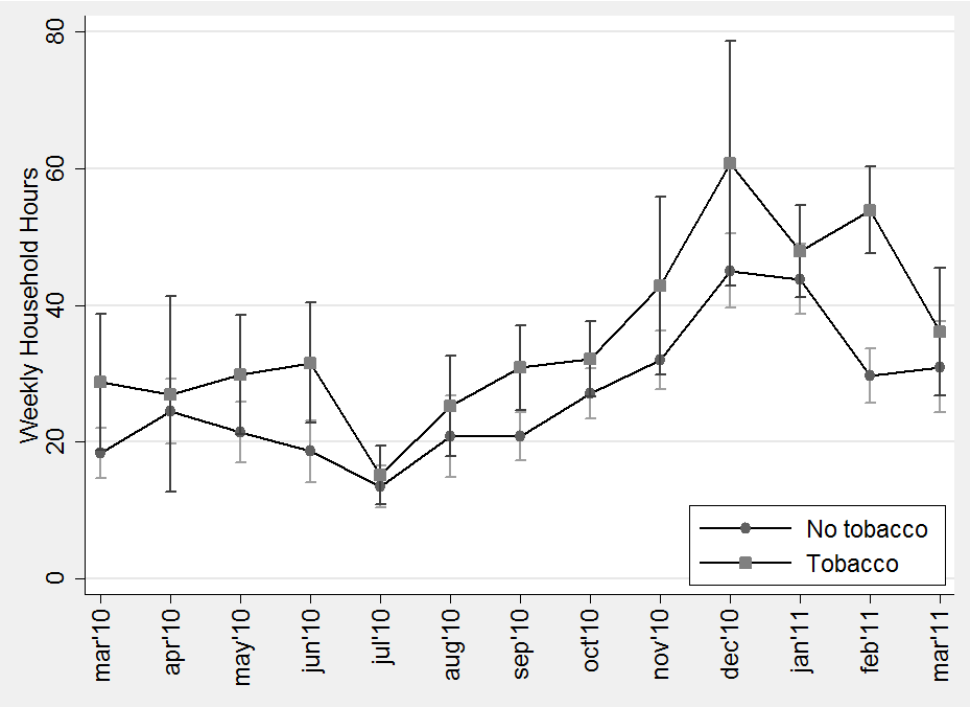


Figure 9: Household Labor Supplied to Agriculture by Tobacco Cropping

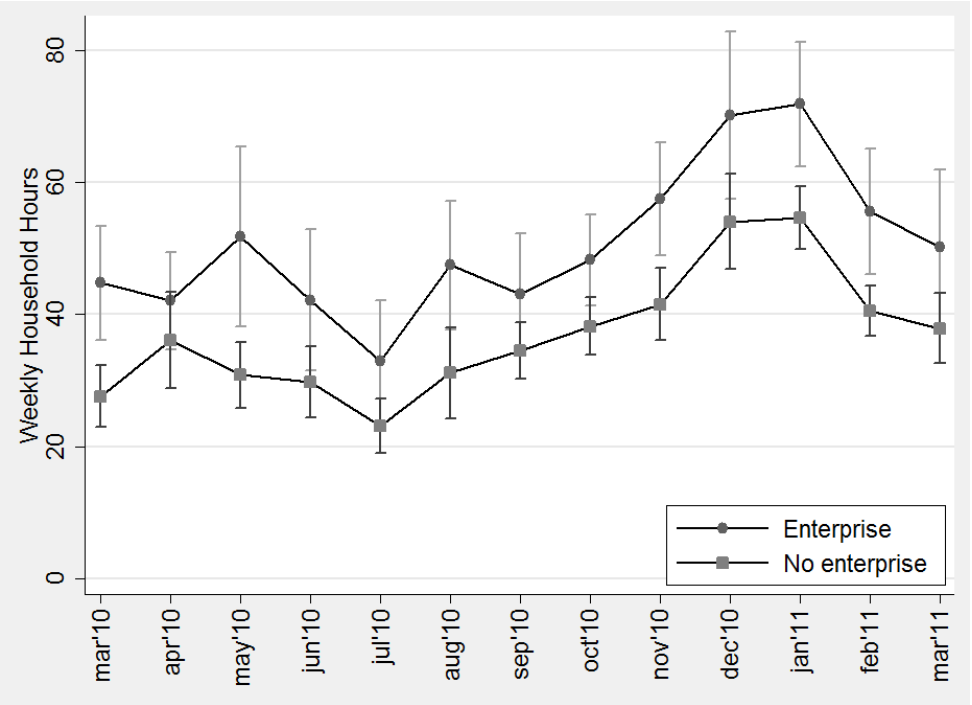


Figure 10: Total Household Hours by Presence of Household Enterprise