Labor Calendars and Rural Poverty:
A case study for Malawi

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Motivation

- Absolute poverty is mainly and increasingly located in rural Sub-Saharan Africa and closely associated with work in agriculture.
- Economic life in these contexts is deeply seasonal.
- Seasonality itself is rarely a central topic of study.

Contributions

This paper uses detailed seasonal labor data from Malawi to

▶ Show that seasonality is deep and highly entrenched, accounting for 2/3 of total rural underemployment

▶ Show that low household consumption in rural areas is critically associated with lack of work opportunities

▶ Show where seasonality is coming from, by connecting the labor requirements of crops to the labor supply reported by households

▶ Explore in detail activities associated with increased and/or smoother labor hour distributions across the calendar year

▶ Methodologically, show that retrospective agricultural questionnaires can be used to coarsely identify labor calendars

Literature

Role of agriculture in development:

- ▶ Urban based structural transformation: Lewis (1954), Lele and Mellor (1981)
- ▶ Rural and agricultural transformation: IFAD (2016), Goyal and Nash (2017), Beegle and Christiaensen (2019), McMillan, Rodrik, and Verduzco-Gallo (2014)

Sectoral productivity gaps:

- ▶ Large: McMillan and Rodrik (2011) and Gollin, Lagakos, and Waugh (2013)
- ▶ Small: Hamory et al. (2021), McCullough (2017)

Impact of interventions on seasonality and work availability:

- ▶ Bandiera et al. (2017), Bryan, Chowdhury, and Mobarak (2014), Breza, Kaur, and Shamdasani (2021), Jones et al. (2020), Fink, Jack, and Masiye (2020), Imbert and Papp (2015)

Literature

Labor and productivity in Malawi:

▶ Wodon and Beegle (2006), McCullough (2017), Dillon, Brummund, and Mwabu (2019)

We focus on hours connected to market production:

▶ consistent with literature on sectoral productivity gaps

▶ data limitations

▶ our measure of work is strictly a measure of market-production, not of leisure

We focus on labor by area of residence (rural vs. urban)

▶ consumption is measured at the household level,

▶ households can have diversified sources of income that cut across sectors.

Outline

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► Malawi's Third (2010-11) Integrated Household Survey (IHS3): well suited for this purpose
   ► cross-section of 12,266 households: sufficient observations in each month
   ► relatively homogeneous agricultural conditions (avoid subdividing to sample by micro-climates)
   ► KEY: was designed to be temporally representative
      ► we can observe labor supply throughout the calendar year by using the time use questions featured in the employment module of the household questionnaire.

The time-use questionnaire

For all 5yr+ household members we observe the hours spent in the past seven days on:

- ▶ agriculture (agricultural activities including livestock and fishing),
- ▶ business (running a household business and helping in a household business),
- ▶ casual labor
- ▶ regular wage-paying labor

Analyze this at the household and working age individual levels (15-65 yrs, not in school) levels.

- ▶ Household level better captures the aggregate availability of work (young, elderly, temporary residents...)
- ▶ Individual level focuses on key demographic, accounts for composition differences, aligns with traditional labor market indicators (18,620 are rural and 4,563 are urban)

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Livelihoods in Malawi

Increasing household livelihoods and consumption is key to poverty reduction efforts

- ▶ Since 1990, substantial improvements in life expectancy and education
- ▶ GNI per capita has not grown proportionally
  - ▶ in 2016, 70% of the population lived below the international absolute poverty line of USD1.90 PPP per day

Regular wage-paying jobs are scarce, even in cities

- ▶ Seasonal migration is uncommon:
- ▶ "there are insufficient potential migration destinations to absorb excess labor from rural areas" (Evidence Action 2014).

Agriculture is central to livelihoods

Agriculture in Malawi

- Agriculture is central to livelihoods:
  - 30% of the country's GDP
  - 92% of rural households and 38% of urban households surveyed report farming at least one plot of land
- Agricultural characteristics:
  - smallholder farms (mean holding of 2.38 acres)
  - land per adult decreased from 2004-2016 by 18% from 1.13 to 0.93 acres
  - mostly rainfed plots cultivated in the rainy season (Oct-Jun)
  - primarily maize or intercropped maize (72% of the area cultivated by the mean household)
  - mainly using household labor (27% report hiring)
  - tobacco is the main cash crop (51% of national export revenues in 2010)

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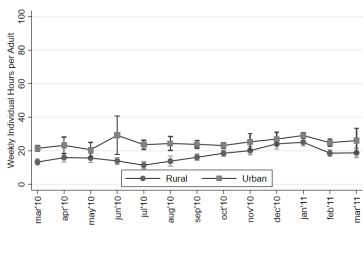
Total labor hours worked last week Equation

For urban and rural areas we estimate the total weekly hours worked in the past week by month:
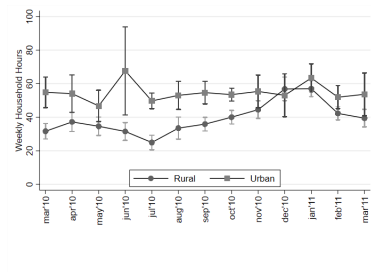
(a) **By all household members**   (b) **Per working age adult**

Using the plotted coefficients we calculate:

- ▶ Estimated Annual Total Household Labor by Zone:

$$\widehat{LL^{zone}} = \sum_{m=1}^{12} \widehat{\beta_m^{zone}} * \# \text{ weeks in } m. \qquad (1)$$

- ▶ Average hours per week in the high season (Dec-Jan)
- ▶ Average hours per week in the low season (Jul-Aug)
- ▶ The standard deviation of these monthly coefficients
- ▶ The coefficient of variation (the ratio of the standard deviation to the mean of the estimated coefficients, times 100)

Full table

Key patterns

- *there is much more seasonal variability in rural than in urban labor calendars.*
- *labor is more evenly spread across individuals in rural than in urban areas.*
- *significant underemployment in rural areas, even in the peak season.*
- *large unemployment in urban areas throughout the year.*
- *employment is lower for rural households more dependent on agriculture.*

There is significantly more monthly variation in rural than in urban labor calendars.

Panel 1a: Labor supplied (*hours worked*)

|	Contrast	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Rural vs. urban, individual	Rural	913.00	24.61	12.61	4.08	23.39
	Urban	1,299.00	28.05	23.98	2.52	10.13
	Rural/urban	0.70***	0.88**	0.53***	1.62	2.31

- ▶ high season activity offers similar work opportunities for rural and urban individuals.
- ▶ in the low season, rural individual labor per week is 53% that of urban individuals.
- ▶ Comparisons using total household hours are similar.
- ▶ rural individuals have:
  - ▶ a 62% higher standard deviation in work across months of the year
  - ▶ a lower mean value (by 30%)
  - ▶ ⇒ the coefficient of variation is 131% higher

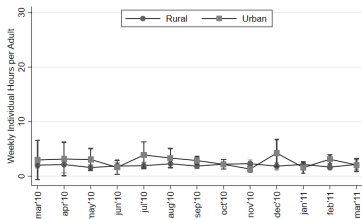# Individual weekly labor supplied by activity Household
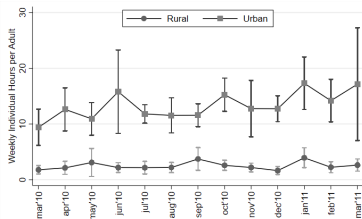
(a) Agriculture
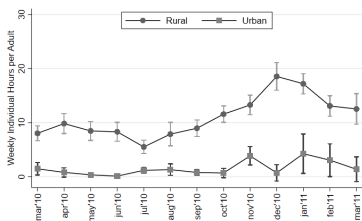
(b) Business
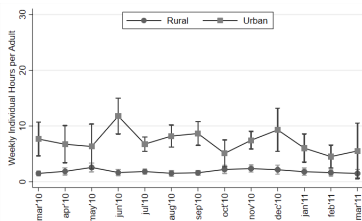
(c) Casual

(d) Wage

- ▶ agriculture is the most cyclical source of work
- ▶ employment in the other activities–household business, casual labor, and wage labor–is relatively stable throughout the year in both urban and rural area
- ▶ other activities reported in rural areas are not counter-cyclical to agriculture.

Work hours are more evenly shared among individuals in rural than in urban areas.

Panel 1b: Labor engagement (*indicator set to 1 if any labor hours are reported*)

	Contrast	Mean % active	High season % active	Low season % active	Standard deviation	Coeff. of variation (%)
Rural vs. urban, individual	Rural	0.79	0.93	0.65	0.10	12.56
	Urban	0.65	0.67	0.63	0.05	7.98
	Rural/urban	1.22***	1.39***	1.03	2.00	1.57

- ► Individual participation rates are 22% higher in rural than in urban areas.
- ► In the high season: 93% of rural individuals report labor engagement (compared to only 67% in urban areas).
- ► Bi-modal distribution of labor hours in urban areas
- ► A large share of household labor hours are supplied by non-working age individuals in rural areas, particularly during the peak season.

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

- ▶ Substantial underemployment in rural areas, even in the high season:
    - ▶ At 24.6 hours per week for working age adults, peak season labor hours are low
    - ▶ A substantial share of individuals reporting less than 15 hours per week
- ▶ Underemployment becomes even more pronounced in the low season:
    - ▶ falls to 12.4 hours per week
    - ▶ Close to 50% of surveyed rural adults report working no or a very low number of hours in the low season.
    - ▶ Individual participation rates drop to 64%.

There is also significant unemployment in urban areas, limiting seasonal migration opportunities.

- ▶ significant unemployment in urban areas too: urban labor hours are bi-modal
  - ▶ many urban adults reporting either no work hours or full-time employment (40+ hours).
  - ▶ The mean individual employment rate is 65%
- ▶ Finding urban employment is challenging for migrants limiting the use of seasonal migration as a labor smoothing strategy.

Low employment is associated with dependence on agriculture.

- ► Rural households are more diversified than urban households but still quite specialized `Multiple activities`
  - ► Only 32.9 % of rural households report engaging in more then one labor category
  - ► Of these non-diversified households that only report engaging in a single activity, 77.4 % are working in agriculture.
- ► Severe underemployment in the low season is tied to dependence on agriculture for labor opportunities

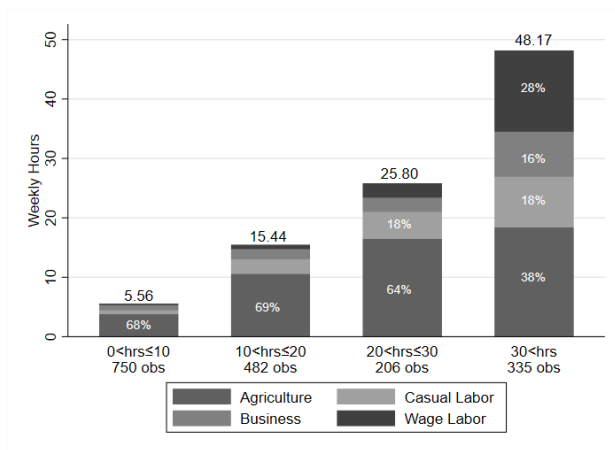# Allocation of time across activities in rural areas during the low season

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Urban-rural consumption gaps can come from:

► a differential return per hour worked
► a significant difference in the number of hours worked
► (this is similar to the sectoral productivity gap documented by McCullough (2017))

The IHS3 survey generates an estimate of surveyed households' total real annual consumption. We use consumption to proxy for productivity to investigate urban-rural consumption gaps.

Rural-Urban Contrasts in Consumption

Rural households work on average 72% of the annual hours worked by urban households

▶ adjusting for hours worked, the rural/urban ratio to rise from a mean of 0.42 to 0.58

Household consumption		Rural	Urban	Rural/urban
Per household	Mean	197,000.00	468,000.00	0.42
	Median	152,000.00	284,000.00	0.54
Per individual	Mean	110,000.00	238,000.00	0.46
	Median	86,000.00	152,000.00	0.57
Per household hour worked	Mean	95.00	163.00	0.58
	Median	74.00	99.00	0.75
Per individual hour worked	Mean	120.00	183.00	0.66
	Median	94.00	117.00	0.80

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Decomposing rural underemployment

What share of underemployment comes from seasonality?

- ▶ Definition of full employment: 1920 annual work hours (48 weeks per year at 40 hours per week)
  - ▶ urban individuals: 1288 hrs (67.1%), High season: 70.2%
  - ▶ rural individuals: 909 hrs (47.3%), High season: 61.5%.
- ▶ Definition of full employment:1459 annual hours (the high season urban workload: 28.05 hours per week)
  - ▶ total rural deficit: 1459-909=550 hours
  - ▶ peak rural deficit: 3.44 hours a week (179 annual hours)
  - ▶ seasonal rural deficit: 550-179=371 hours (67%)

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Crop specific calendars

To better identify the labor needs of particular crops we construct crop labor calendars using an alternative approach:

- ▶ Use the retrospective agricultural questionnaire for the 2009/2010 rainy season
- ▶ For each plot we track the reported timing and labor associated with planting, growing and harvest activities
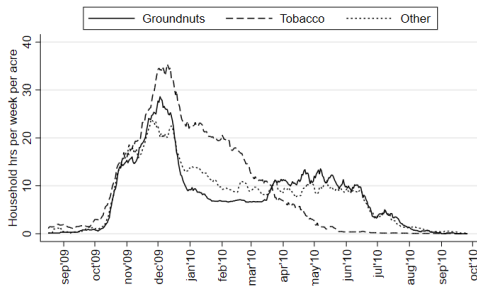- ▶ Area weighted plot level estimates are then used to generated an estimate for one acre of key crops

(Note: this approach uses commonly found retrospective data and does not require that the survey be conducted continuously across the calendar year).

Estimated labor demand per week for an acre of the crop

Maize and inter-cropped maize
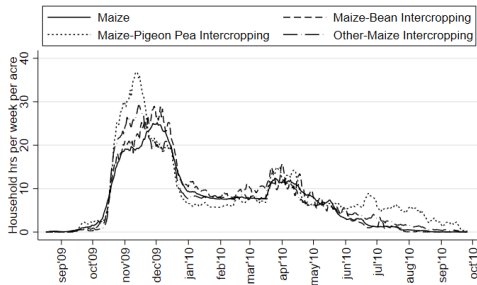
Non-maize

- ▶ Nov-Dec planting period is the peak of labor demand.
- ▶ Commonly grown crops (maize, tobacco and groundnuts) compete for labor hours during the same high demand planting season.
- ▶ Labor demand at harvest is much lower and is spread out over a longer harvest season as different crops mature at different speeds.
- ▶ Tobacco labor demand is noticeably different requiring substantial labor inputs for its early harvest.

Representative household

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What activities/characteristics correlate with smoother agricultural labor calendars?

► We contrast the labor calendars of rural households that do and do not participate in a particular activity, by estimating:

$$L_h = \sum_{m=1}^{13} \beta_{1m} Month_h + \sum_{m=1}^{13} \beta_{2m} Month_h * Activity_h + \gamma_n(X_h - \bar{X}) + \epsilon_h,$$
(2)

► Note: we cannot control for selection into an activity, so these should not be interpreted as the causal impact of the activity.

Two ways in which an activity can smooth labor calendars:

- ▶ the activity could be counter-cyclical to other activities (decline in the standard deviation (SD) of labor)
- ▶ the activity could generate a constant amount of labor through the year (no change in SD but a decline in the coefficient of variation (CV))

Labor Supply by Household Activities: Agricultural labor hours of cultivating rural households

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Livestock	Livestock	5275	1667	50.37	20.43	10.40	32.62
	No livestock	4114	1252	41.87	13.93	10.15	42.36
(Livestock)	Liv/NoLiv		1.33 ***	1.20***	1.47***	1.02	0.77
	–ratio w/ controls		1.16 ***	1.13**	1.22**	1.04	0.89
Tobacco	Tobacco	1255	1870	54.32	20.25	13.01	36.32
	No tobacco	8134	1404	44.43	17.19	9.59	35.72
(Tobacco)	Tob/NoTob		1.33 ***	1.22**	1.18	1.36	1.02
	–ratio w/ controls		1.15 ***	1.10	0.86	1.33	1.15
Crop diversity	More diverse	1920	1899	61.43	22.92	14.31	39.41
	Less diverse	2510	1133	36.62	9.84	8.86	40.87
(Crop Div.)	More/Less		1.68 ***	1.68***	2.33***	1.62	0.96
	–ratio w/ controls		1.52 ***	1.55***	2.08***	1.50	0.99
Dry season planting	Planting	1287	1903	57.27	23.36	12.72	34.95
	No planting	8102	1408	45.15	16.38	10.10	37.49
(Dry Planting)	Plant/NoPlant		1.35 ***	1.27***	1.43**	1.26	0.93
	–ratio w/ controls		1.26 ***	1.19**	1.34	1.21	0.96
Uses hired labor	Hires	2309	1493	45.07	20.31	9.76	34.16
	No hiring	7080	1460	46.38	16.17	10.41	37.28
(Hires)	Hires/NoHires		1.02	0.97	1.26**	0.94	0.92
	–ratio w/ controls		1.01	0.96	1.26*	0.92	0.91
Uses exchange labor	Exchanges	1242	1460	37.34	17.43	6.98	24.97
	No exchange	8147	1464	46.82	17.55	10.59	37.81
(Exchanges)	Exch/NoExch		1	0.80***	0.99	0.66	0.66
	–ratio w/ controls		1.08 *	0.93	1.03	0.80	0.75
Farm area	Highest quartile	2343	1926	58.33	20.96	13.13	35.61
	Lowest quartile	2379	1001	32.76	10.70	7.68	40.12
(Farm size)	Highest/Lowest		1.92 ***	1.78***	1.96***	1.71	0.89
	–ratio w/ controls		1.57 ***	1.60***	1.33**	1.71	1.09

Labor Supply by Household Activities: All labor hours of all rural households

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Work as paid labor	Paid work	6077	2323	61.13	35.49	9.40	21.17
	No paid work	3960	1698	50.70	21.15	10.21	31.45
	Paid/NoPaid		1.37 ***	1.21***	1.68***	0.92	0.67
Paid labor	−ratio w/ controls		1.3 ***	1.20***	1.62***	0.95	0.73
Non-farm enterprise	Enterprise	1755	2659	70.96	40.17	11.46	22.53
	No enterprise	8282	1948	54.34	27.13	9.43	25.31
	Ent/NoEnt		1.36 ***	1.31***	1.48***	1.22	0.89
Enterprise	−ratio w/ controls		1.27 ***	1.25***	1.38***	1.20	0.95

Summary of patterns

Listed activities do not correlate with strongly counter-cyclical labor demand

- ▶ intensification of agriculture: raising livestock, crop diversification and irrigation:
  - ▶ correlated with a lower variability in agricultural hours worked across months.
  - ▶ mostly due to higher labor use throughout the year
- ▶ labor market participation and having a non-farm enterprise
  - ▶ associated with a large increase in total employment and lower variability in hours worked
  - ▶ hours are not distinctly counter-cyclical
- ▶ labor exchange seems to correlate with smoother labor calendars, with little change in aggregate annual labor.

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Discussion and Conclusion

- ▶ Underemployment is high in urban areas and even higher in rural areas with the additional seasonal work deficit.

- ▶ In this context, any increased market work opportunities helps to fill in and smooth rural labor calendars.

- ▶ Activities filling in rural labor calendars are various and mainly not counter-cyclical to the farming of staple crops

- ▶ No single silver bullet: need a comprehensive agenda to facilitate engagement in all activities that increase labor opportunities, such as interventions evaluated in existing work

  - ▶ Bandiera et al. (2017) (livestock), Jones et al. (2020)(irrigation), Fink, Jack, and Masiye (2020) (credit), and Imbert and Papp (2015)(workfare program)

Thank You!

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Appendix

Rural-Urban Contrasts in Labor Calendars: Labor Supply and Engagement
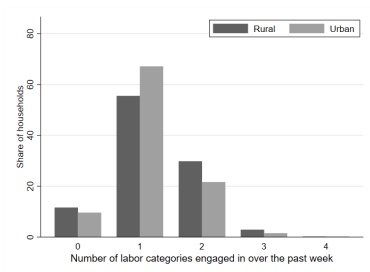
Back

Panel 1a: Labor supplied (*hours worked*)

	Contrast	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Rural vs. urban, household	Rural	2,065.00	56.93	29.23	9.58	24.26
	Urban	2,863.00	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	913.00	24.61	12.61	4.08	23.39
	Urban	1,299.00	28.05	23.98	2.52	10.13
	Rural/urban	0.70***	0.88**	0.53***	1.62	2.31

Panel 1b: Labor engagement (*indicator set to 1 if any labor hours are reported*)

	Contrast	Mean % active	High season % active	Low season % 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	0.65	0.10	12.56
	Urban	0.65	0.67	0.63	0.05	7.98
	Rural/urban	1.22***	1.39***	1.03	2.00	1.57

Household and individual engagement in multiple labor activities
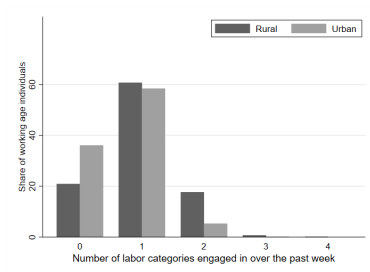
(a) **By households**

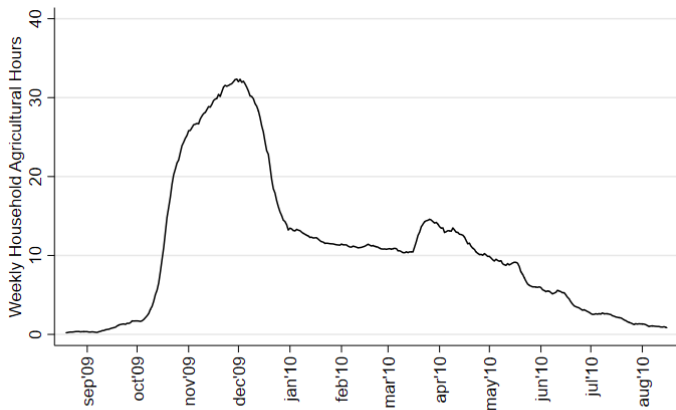(b) **By individuals**

Household agricultural labor demand per week

From these crop calendars, we can generate a representative calendar for household agricultural labor demand.
(Note: Maize and intercropped maize account for over 70% of the acreage of the typical household farm, its timing governs household agricultural labor fluctuations.)
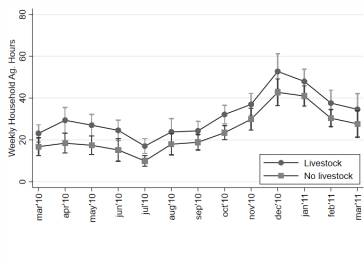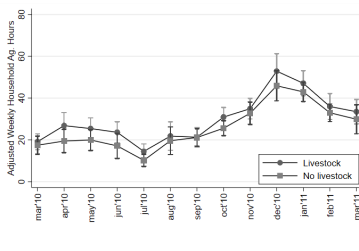
Household hours in agriculture by ownership of livestock

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Livestock	Livestock	5275	1667	50.37	20.43	10.40	32.62
	No livestock	4114	1252	41.87	13.93	10.15	42.36
	Liv/NoLiv		1.33 ***	1.20***	1.47***	1.02	0.77
	–ratio w/ controls		1.16 ***	1.13**	1.22**	1.04	0.89

(a) **No controls**

(b) **With controls**

Household hours in agriculture by tobacco cropping

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Tobacco	Tobacco	1255	1870	54.32	20.25	13.01	36.32
	No tobacco	8134	1404	44.43	17.19	9.59	35.72
	Tob/NoTob		1.33 ***	1.22**	1.18	1.36	1.02
	–ratio w/ controls		1.15 ***	1.10	0.86	1.33	1.15

(a) **No controls**
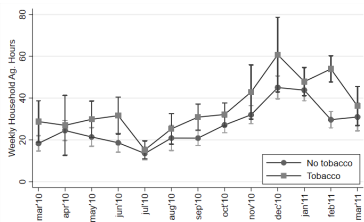
(b) **With controls**
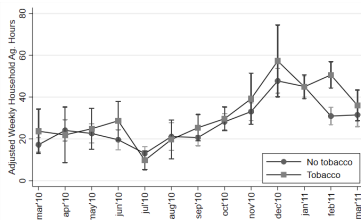
Household hours in agriculture by dry season planting

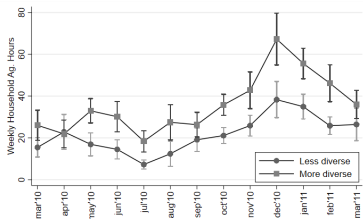|	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
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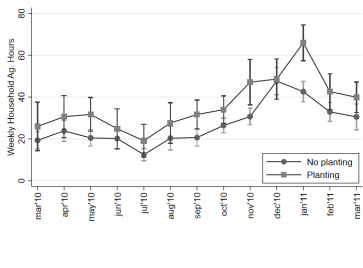
(b) **With controls**
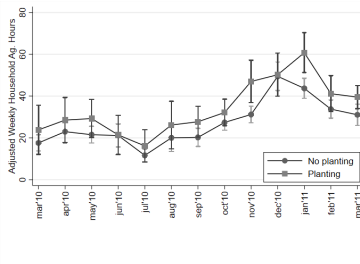
Household hours in agriculture by farm area

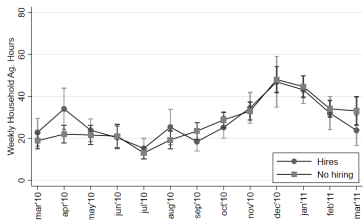|	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Farm area	Highest quartile	2343	1926	58.33	20.96	13.13	35.61
	Lowest quartile	2379	1001	32.76	10.70	7.68	40.12
	Highest/Lowest		1.92 ***	1.78***	1.96***	1.71	0.89
	–ratio w/ controls		1.57 ***	1.60***	1.33**	1.71	1.09

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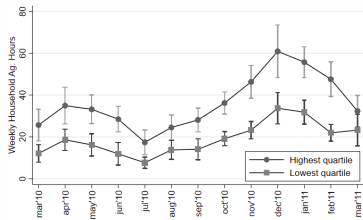
(b) **With controls**
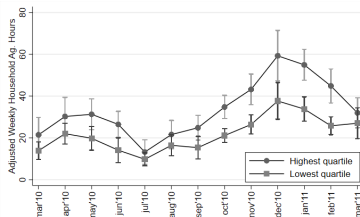
Household hours in agriculture by crop diversity

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Crop diversity	More diverse	1920	1899	61.43	22.92	14.31	39.41
	Less diverse	2510	36.62	36.62	9.84	8.86	40.87
	More/Less		1.68 ***	1.68***	2.33***	1.62	0.96
	–ratio w/ controls		1.52 ***	1.55***	2.08***	1.50	0.99

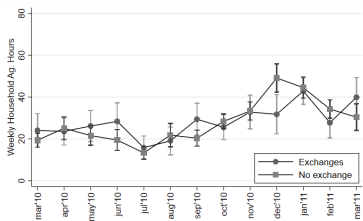(a) **No controls**

(b) **With controls**
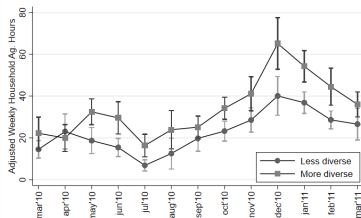
Household hours in agriculture by use of hired labor

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Uses hired labor	Hires	2309	1493	45.07	20.31	9.76	34.16
	No hiring	7080	1460	46.38	16.17	10.41	37.28
	Hires/NoHires		1.02	0.97	1.26**	0.94	0.92
	–ratio w/ controls		1.01	0.96	1.26*	0.92	0.91

(a) **No controls**

(b) **With controls**
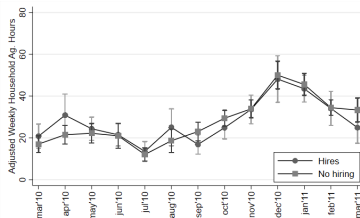
Household hours in agriculture by use of exchange labor

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Uses exchange labor	Exchanges	1242	1460	37.34	17.43	6.98	24.97
	No exchange	8147	1464	46.82	17.55	10.59	37.81
	Exch/NoExch		1	0.80***	0.99	0.66	0.66
	–ratio w/ controls		1.08 *	0.93	1.03	0.80	0.75

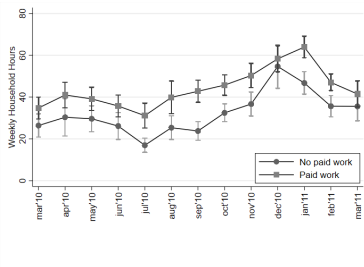### (a) **No controls**

(b) **With controls**
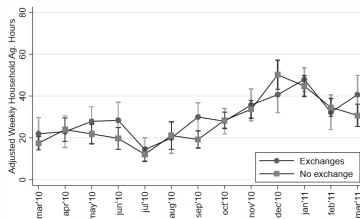
Household hours by engagement in paid work

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Work as paid labor	Paid work	6077	2323	61.13	35.49	9.40	21.17
	No paid work	3960	1698	50.70	21.15	10.21	31.45
	Paid/NoPaid		1.37 ***	1.21***	1.68***	0.92	0.67
	–ratio w/ controls		1.3 ***	1.20***	1.62***	0.95	0.73

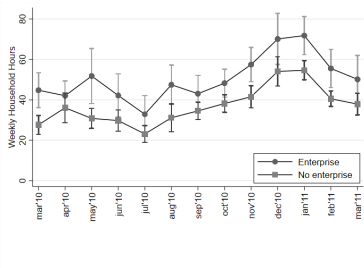(a) **No controls**

(b) **With controls**
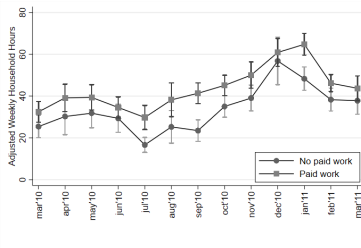
Household hours by presence of a household enterprise

	Contrast	Obs	Total hrs/yr	High season mean hrs/wk	Low season mean hrs/wk	Standard deviation	Coeff. of variation (%)
Non-farm enterprise	Enterprise	1755	2659	70.96	40.17	11.46	22.53
	No enterprise	8282	1948	54.34	27.13	9.43	25.31
	Ent/NoEnt		1.36 ***	1.31***	1.48***	1.22	0.89
	–ratio w/ controls		1.27 ***	1.25***	1.38***	1.20	0.95

(a) **No controls**
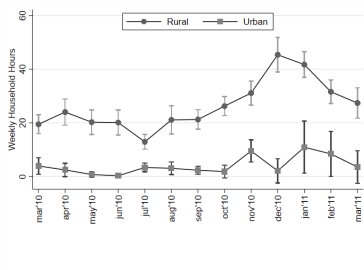
(b) **With controls**
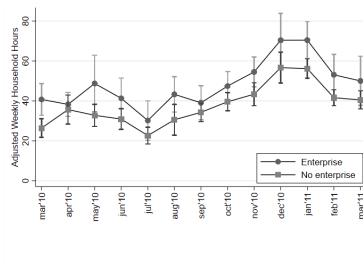
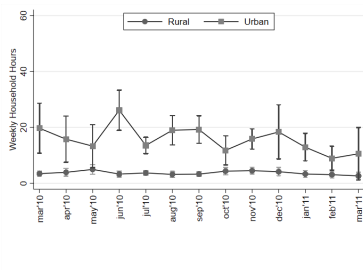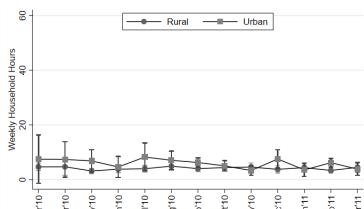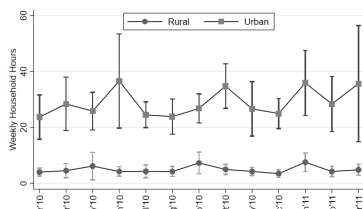# Total household labor supplied last week by activity

(a) Agriculture

(b) Business

(c) Casual

(d) Wage

$$L_j^a = \frac{\sum_{i=1}^{n} weeks_{ij}^a * days/week_{ij}^a * hours/day_{ij}^a}{Acres_j}, \text{ with } a \in \{p, g, h\}.$$
(3)

Plot level, acreage adjusted weekly labor hour demand for each of the three activities, l_j^a, is then estimated as

$$l_j^a = \frac{L_j^a}{D_j^a}.$$
(4)

For each plot we can then assign l_j^a, to each day of the calendar year in which the household is engaged in activity a. This defines ℓ_{dj}, the acreage adjusted weekly labor hour demanded for the week of day d on plot j, such that

$$\ell_{dj} = \begin{cases} 0 & \text{if } d \leq p_j^b \\ l_j^p & \text{if } p_j^b \leq d < p_j^e \\ l_j^g & \text{if } p_j^e \leq d < h_j^b \\ l_j^h & \text{if } h_j^b \leq d < h_j^e \\ 0 & \text{if } h_j^e < d \end{cases}$$
(5)

Back Figure 13a reports the estimated total weekly hours worked per household throughout the year from the estimation of:

$$L_h = \sum_{m=1}^{13} \beta_{1m} Month_h + \sum_{m=1}^{13} \beta_{2m} Month_h * Rural_h + \epsilon_h, \quad (6)$$