Seasonal Employment and Development

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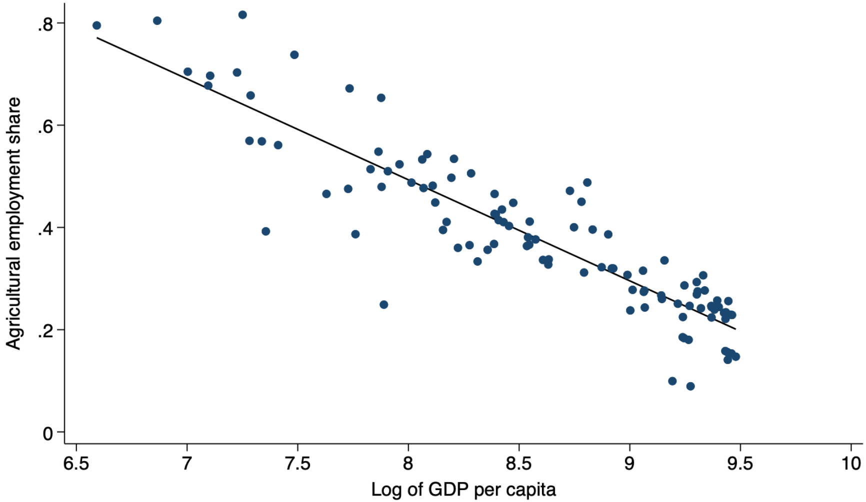
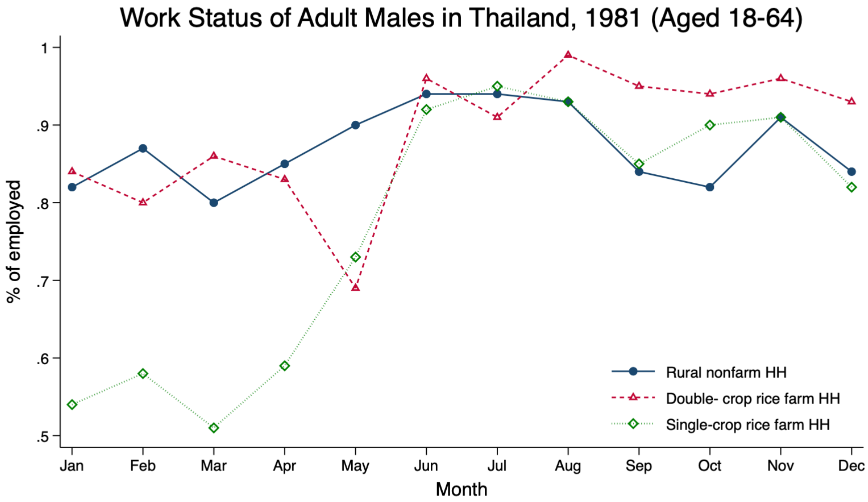
Agricultural employment and structural transformation

▸ labels ▸ macro data

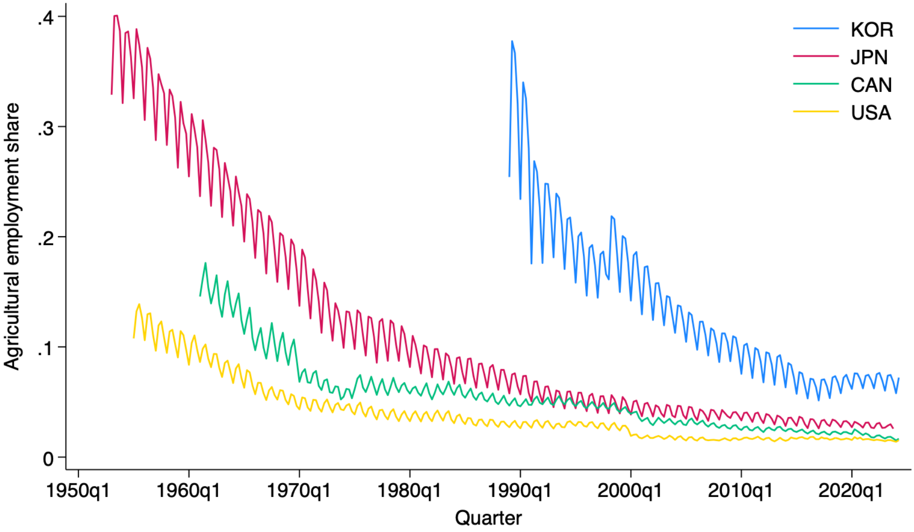


Seasonal demand for agricultural labour

full breakdown



Long time-series of today's high-income countries



Research question

1. How does seasonal employment in agriculture change with development?
2. Does seasonality foster or hinder structural transformation and development?

This paper

1. Assemble novel micro data to investigate seasonal employment
   - Collect data on labour market dynamics across 80 countries worldwide of all development levels, some spanning more than two decades
   - Harmonise data to provide quarterly, nationally representative sectoral employment

2. Document new empirical facts about seasonal employment and development
   - Study seasonal fluctuations in employment over the structural transformation process

3. Examine implications of seasonality for structural transformation and welfare
   - Develop a two-season, two-sector general equilibrium model to evaluate the contribution of seasonality to structural transformation and development

Contribution to literature

- Seasonality in low-income countries [Paxson (1993), Fafchamps (1993), Fink et al (2020), Mobarak et al. (2023), Walker et al. (2025)]
  - Provide novel link between seasonality in agriculture and structural transformation
- Structural transformation [Lewis (1954), Caselli & Coleman III (2001), Herrendorf et al. (2014), Porzio, Rossi & Santangelo (2022)]
  - Show high-frequency sectoral switches and highlight their role for development
- Labour market dynamics [Donovan et al. (2023), Alvarez-Cuadrado & Poschke (2011)]
  - Document seasonal labour market dynamics by income levels
  - Highlight how sectoral frictions are more costly under seasonality

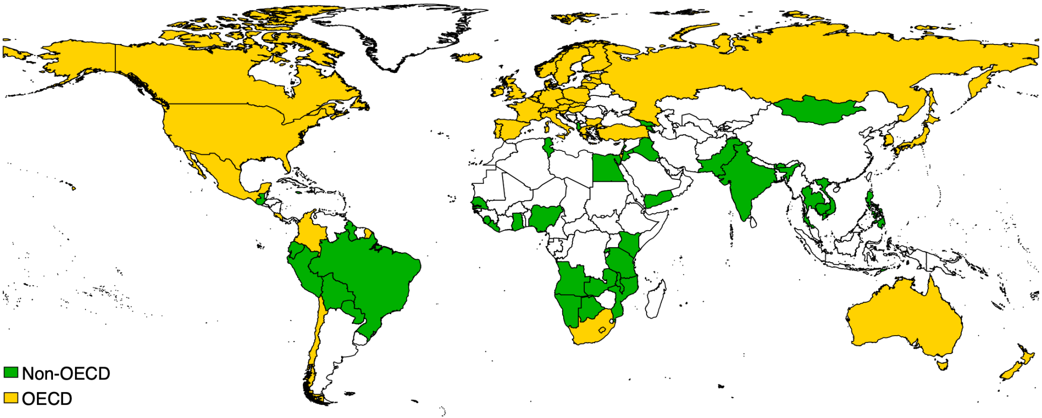
→ New perspective on how process of structural transformation may unfold

Towards a seasonality database: micro data from household surveys

- Three selection criteria to identify suitable micro datasets:
  1. Nationally representative at quarterly level (or higher frequency)
  2. Employment reference period of 7 days
  3. Micro data and documentation available
- Two suitable types of instruments:
  - Quarterly labour force surveys
  - Living standards surveys with quarterly representation
- Three permissible data structures:
  - Panel
  - Rotating panel
  - Repeated cross-section

Towards a seasonality database: sample coverage

sample overview

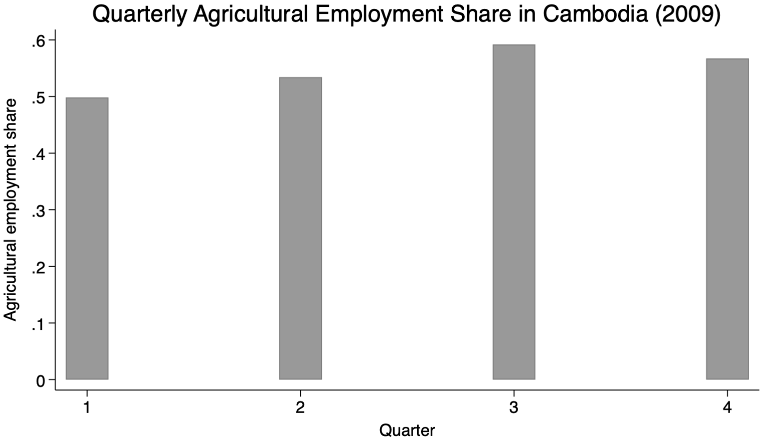


191 quarterly representative surveys from 38 non-OECD countries

Towards a seasonality database: define agricultural employment

- Use occupation to assign workers to the agricultural sector
  - Main occupation in the last 7 days
  - Occupation codes:
    - ISCO code 6 (skilled agricultural, forestry and fisheries workers)
    - ISCO code 92 (elementary occupations in agricultural, forestry and fishery labourers)
- Estimate share of agricultural employment as the number of individuals with agricultural occupation over the total number employed in the last 7 days
- ‘Employed’ defined as individual who:
  1. worked in the last 7 days;
  2. or did not work in last 7 days, but has a job return to

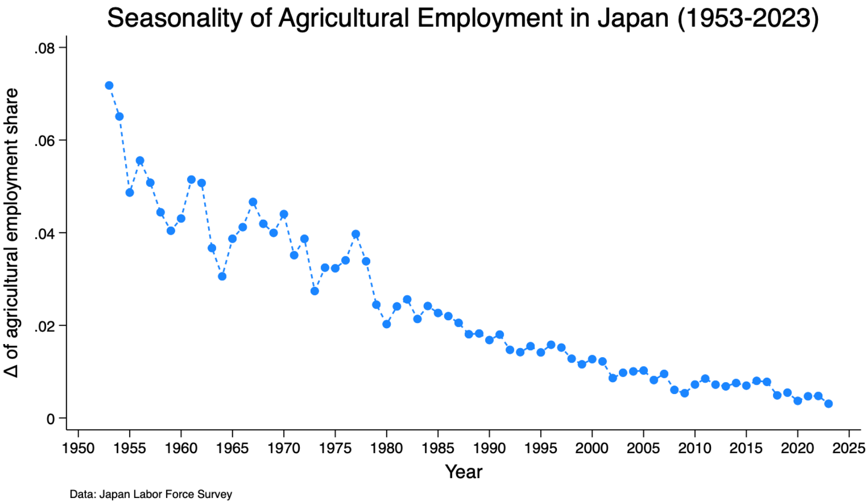
Towards a seasonality database: measure seasonality in employment



- Measure of seasonal employment fluctuations: $\Delta L_t^A = L_{t,peak}^A - L_{t,slack}^A$ ▸ peak

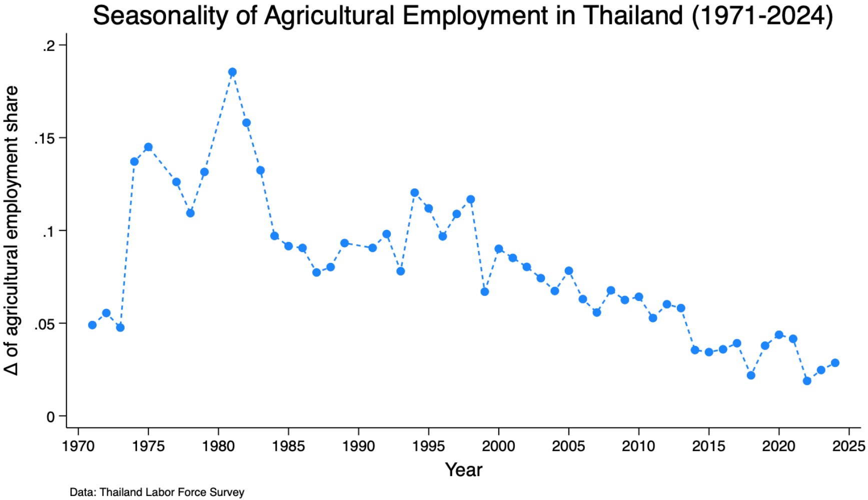
Towards a seasonality database: Japan

▸ seasonality vs ST ▸ seasonality vs GDP



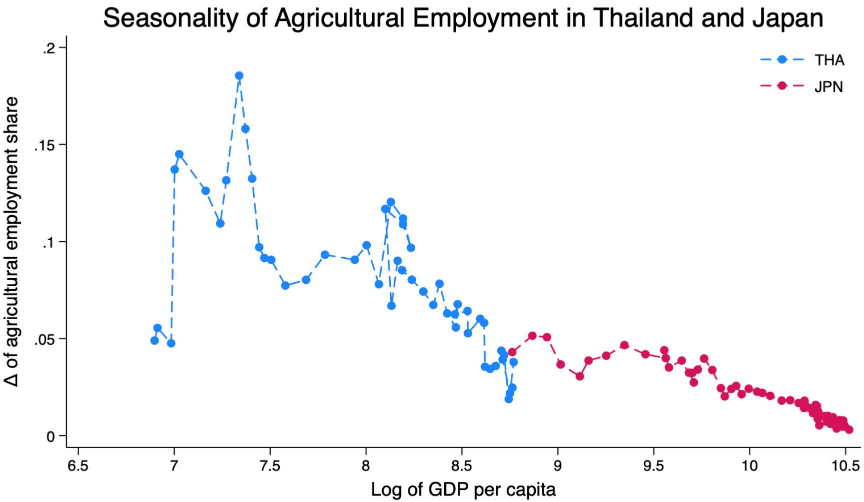
Towards a seasonality database: Thailand

▸ seasonality vs ST ▸ seasonality vs GDP



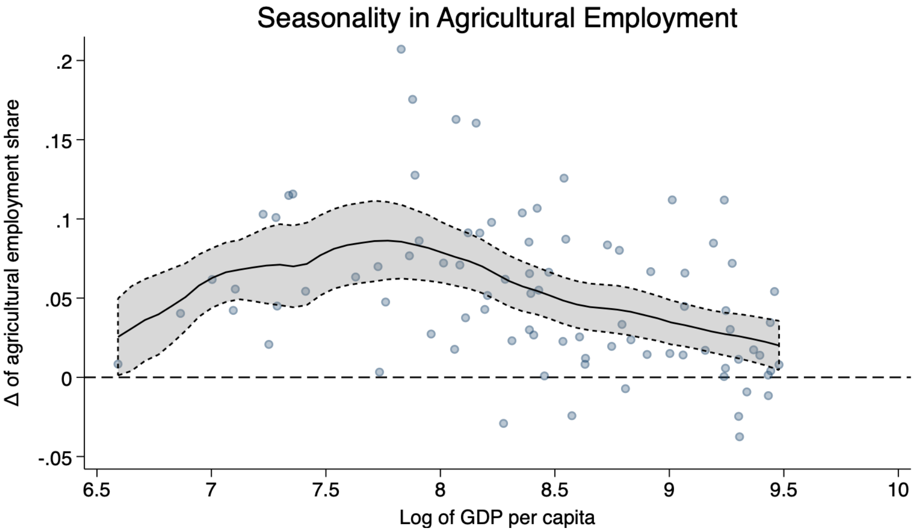
Towards a seasonality database: Japan/Thailand vs GDP pc

seasonality vs ST

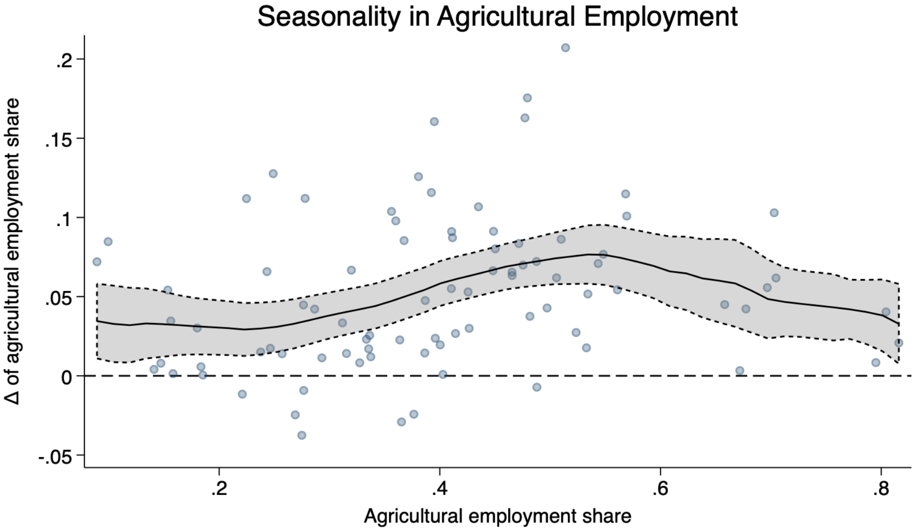


Results: seasonal employment and development

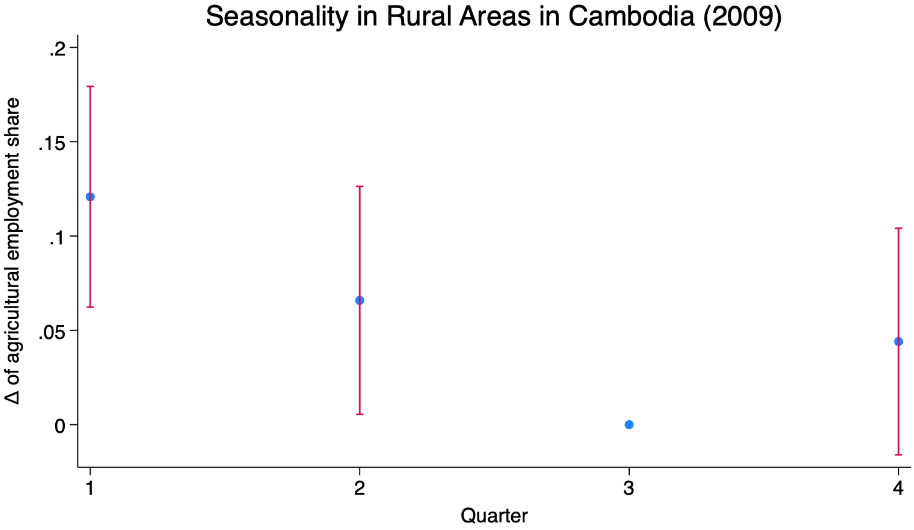
▸ standard errors ▸ all locations ▸ age group ▸ gender group



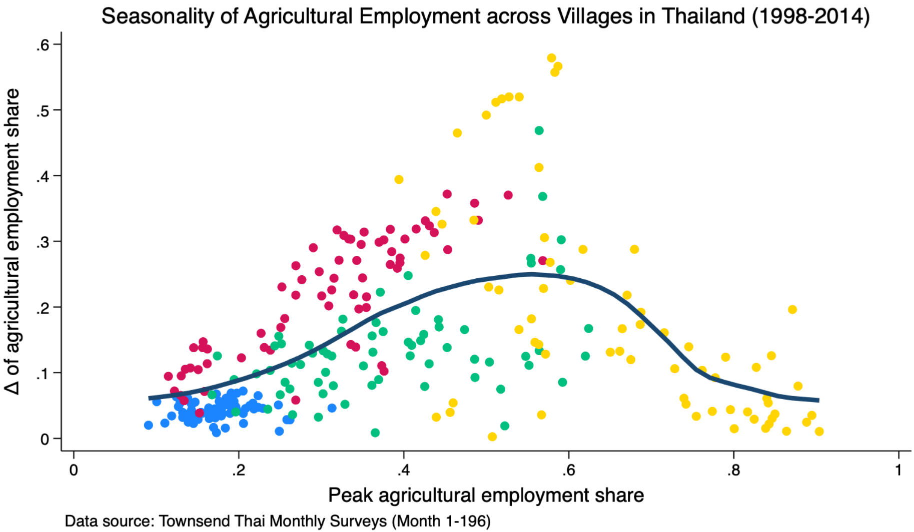
Results: seasonal employment and structural transformation



Results: seasonal employment out of rural agriculture driven by lean season

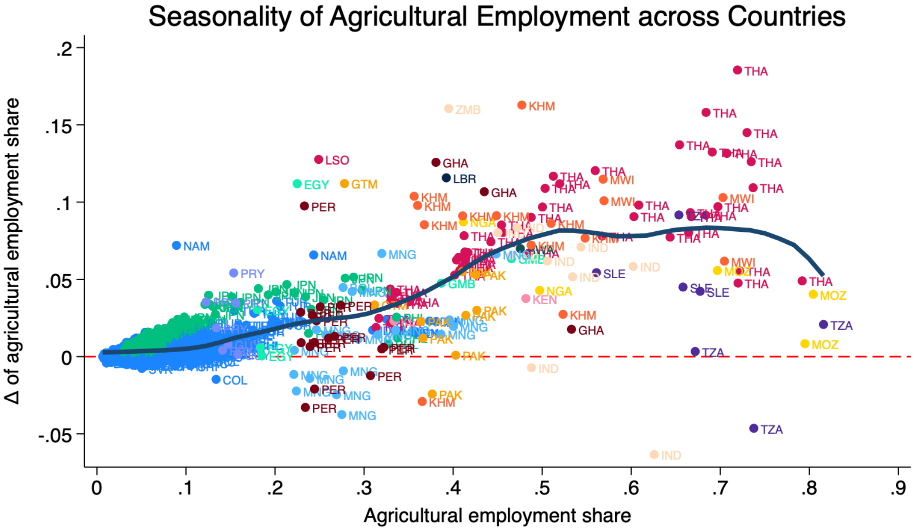


Results: dynamics by village within country



Results: dynamics by country

dynamics GDP/capita



Summary of empirical results

- Hump-shaped seasonal employment pattern
- Seasonal employment pattern driven by:
  - rural areas
  - workers switching out of agriculture
  - during slack season
- Document consumption seasonality with parallel expenditure survey database

→ Develop model of structural transformation with endogenous seasonal employment

Model: setup

- Two sectors, agriculture/non-agriculture, and two seasons per year, peak/slack
- Consumers value both sectoral goods with constant elasticity of substitution, and can substitute between seasonal consumption of each good with constant elasticity
- Consumption of agricultural good across seasons more substitutable than agriculture/non-agriculture within season
- Consumers face subsistence constraint for agricultural good in every season

- Production in every sector uses only labour, but to varying degrees
- Nature drives seasonal productivity in agriculture: high in peak, low in slack season
- Labour mobility ensures wages equalised across sectors within season
- Within year, labour can work throughout in agr., non-agr. or switch per season

Model: labour market

- l_{at} and l_{nt} denote share of labour that works in agr. and non-agr. throughout t
- s_t denotes share of seasonal labour that works in agriculture in peak season $j = 0$, but works in non-agriculture in slack season $j = 1$
- Assume goods markets perfectly competitive and labour freely mobile

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- Assume goods markets perfectly competitive and labour freely mobile
- In equilibrium, wage rates equalised across sectors:
  - Season 0:
$$\omega_{0at} = p_{0at}\theta_a A_{0at}(l_{at} + s_t)^{\theta_a - 1} = p_{0nt}\theta_n A_{nt} l_{nt}^{\theta_n - 1} = \omega_{0nt} \tag{1}$$
  - Season 1:
$$\omega_{1at} = p_{1at}\theta_a A_{1at} l_{at}^{\theta_a - 1} = p_{1nt}\theta_n A_{nt}(l_{nt} + s_t)^{\theta_n - 1} = \omega_{1nt} \tag{2}$$

  where p_{jat} and p_{jnt} represent price of agricultural goods and non-agricultural goods in season j in year t, respectively.

Model: labour market

- l_{at} and l_{nt} denote share of labour that works in agr. and non-agr. throughout t
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$$\omega_{0at} = p_{0at}\theta_a A_{0at}(l_{at} + s_t)^{\theta_a - 1} = p_{0nt}\theta_n A_{nt} l_{nt}^{\theta_n - 1} = \omega_{0nt} \tag{1}$$

  - Season 1:

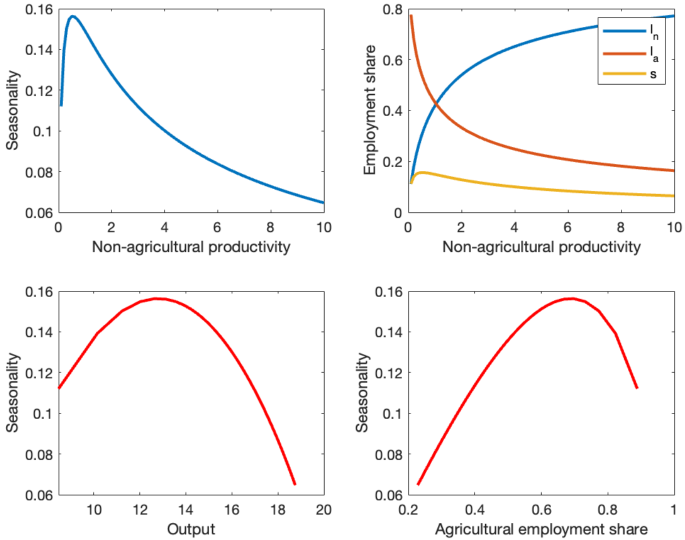
$$\omega_{1at} = p_{1at}\theta_a A_{1at} l_{at}^{\theta_a - 1} = p_{1nt}\theta_n A_{nt}(l_{nt} + s_t)^{\theta_n - 1} = \omega_{1nt} \tag{2}$$

  where p_{jat} and p_{jnt} represent price of agricultural goods and non-agricultural goods in season j in year t, respectively.

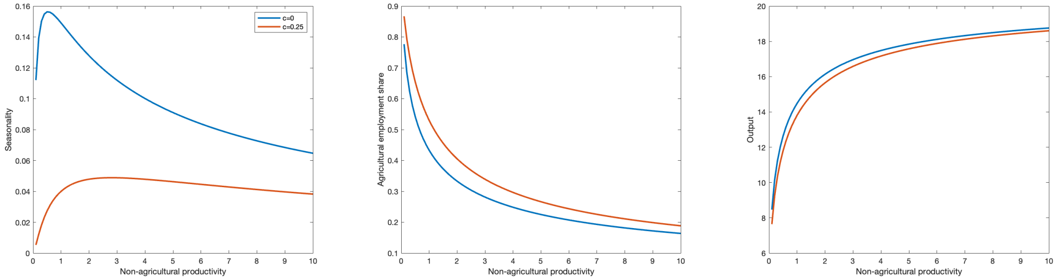
- Labour market clearing condition:

$$l_{at} + s_t + l_{nt} = 1 \tag{3}$$

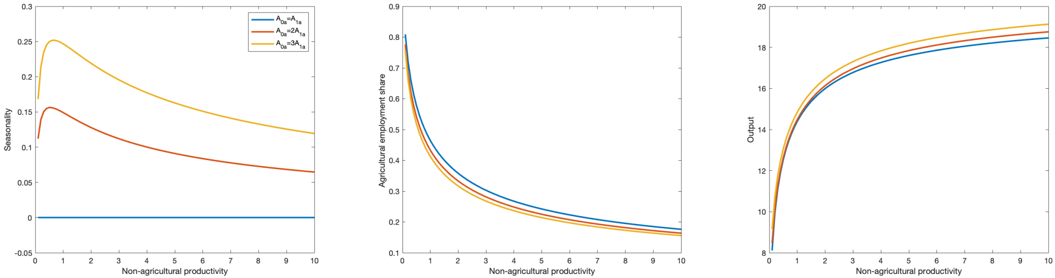
Model: simulation



Counterfactual: sectoral mobility cost ($\omega_a = \omega_n - c$)



Counterfactual: natural seasonality ($A_{0a} \geq A_{1a}$)



Conclusion and next steps

1. Build novel, global database of seasonality from representative micro data
2. Document hump-shaped seasonal employment pattern in development
3. Multi-sector model of endogenous seasonality can reproduce empirical results
4. Basic counterfactuals suggest seasonality may accelerate structural transformation

Next steps:

Complete data harmonisation, add further measures/dimensions of seasonality

Endogenise non-agricultural productivity via learning-by-doing

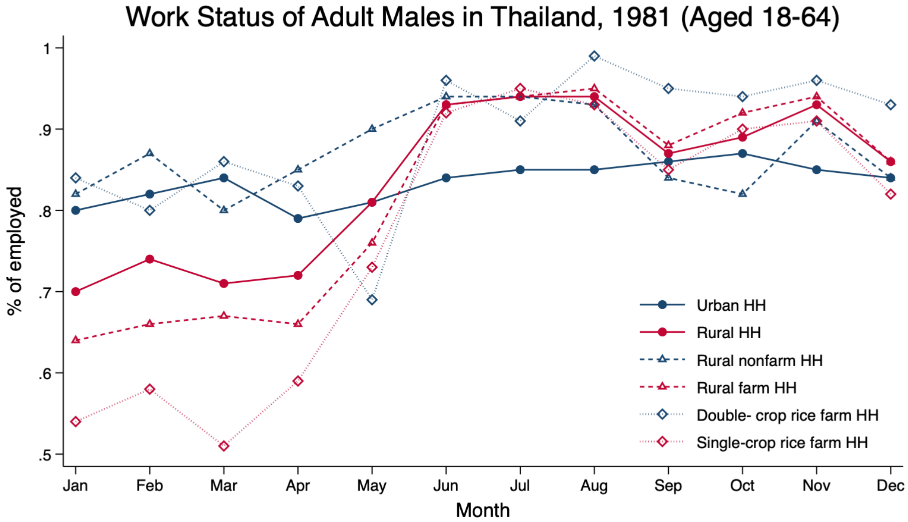
Allow dynamics in model via capital accumulation

Investigate role of storage and financial frictions

Appendix

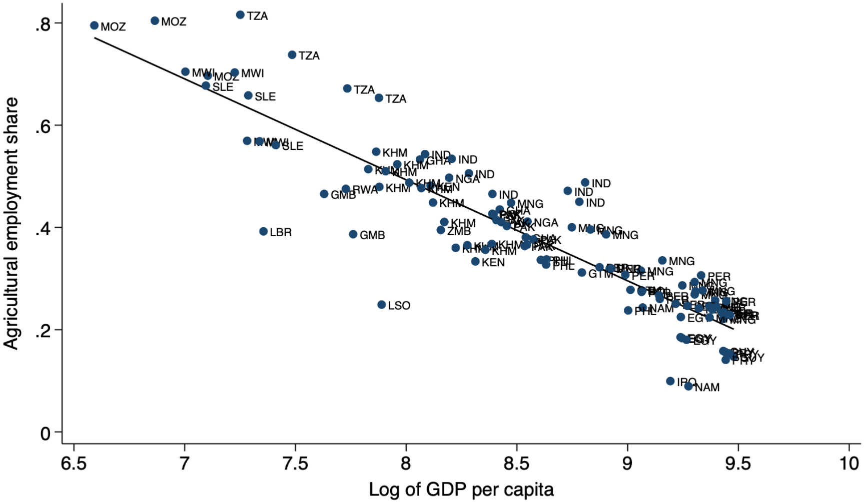
Seasonal demand for agricultural labour by location and crop

back



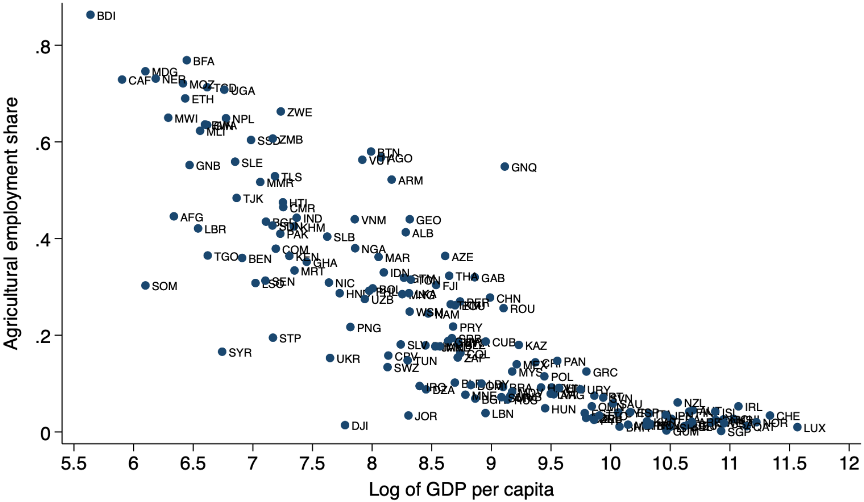
Agricultural employment and structural transformation (labelled)

back



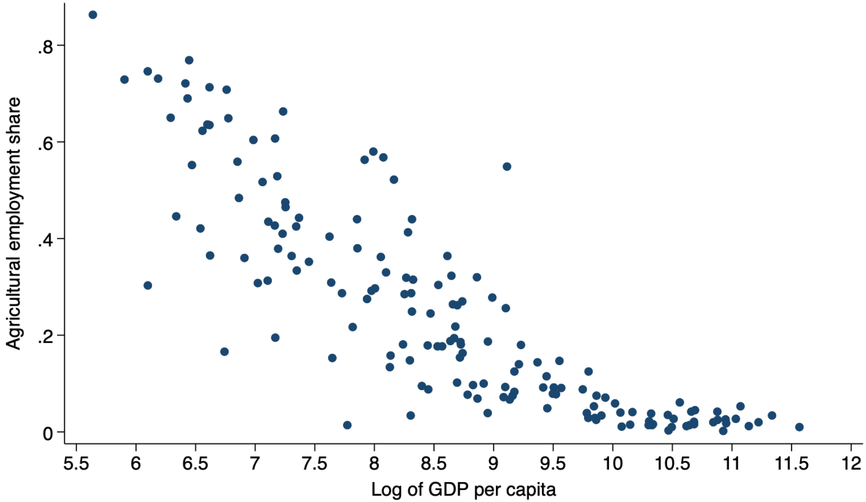
Agricultural employment and structural transformation (macro data)

back



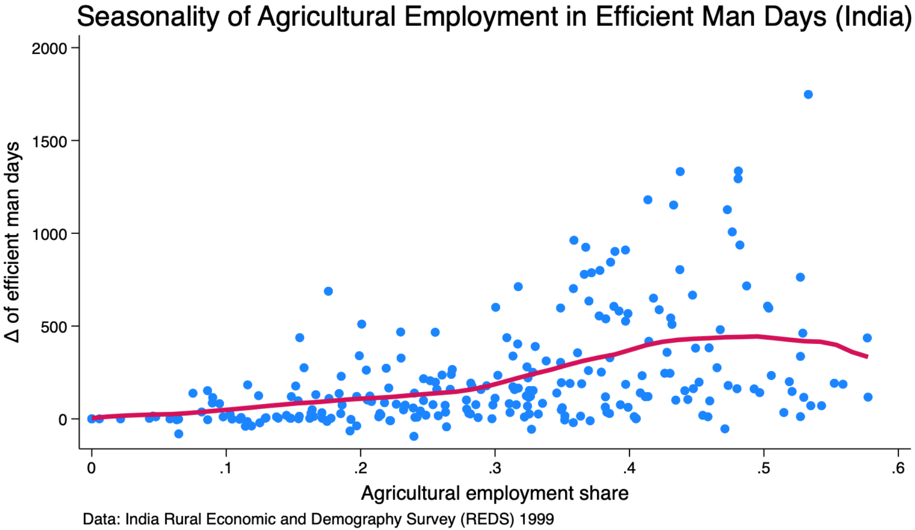
Agricultural employment and structural transformation (macro data)

back



Village-level cross-sectional data from India

back



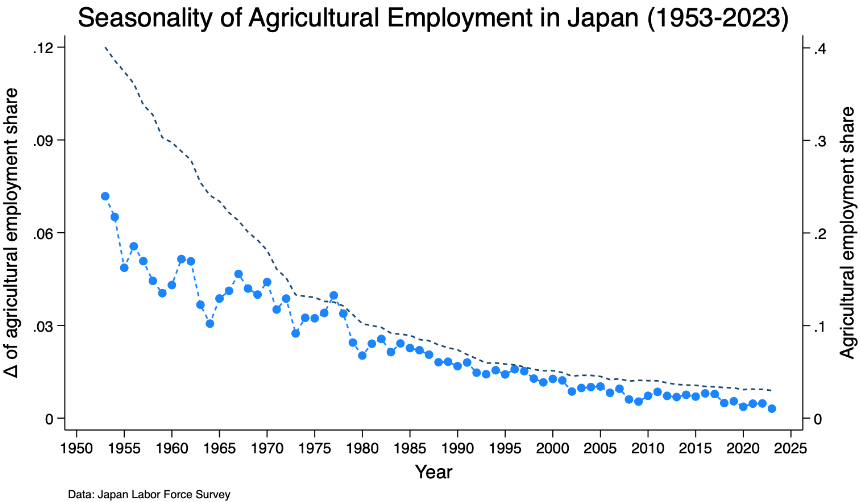
Towards a seasonality database: define peak and slack seasons

◂ back

- Agricultural cycles are roughly consistent across years within a given country
- Define peak and slack seasons:
  - Find the quarter with the highest and lowest agricultural employment share for each country-year
  - Take the mode of the quarter with the highest (lowest) agricultural employment as the peak (slack) season within each country
  - Match with the crop calendar in FAO GIEWS

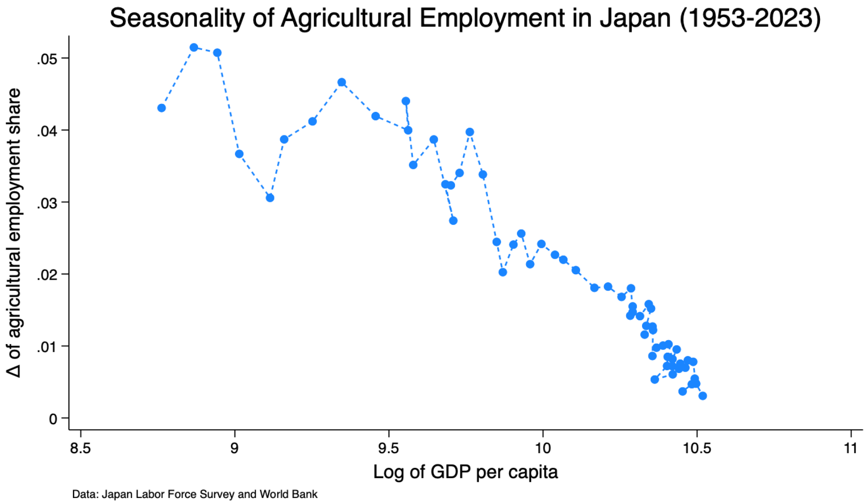
Towards a seasonality database: Japan (vs agr. emp. share)

back



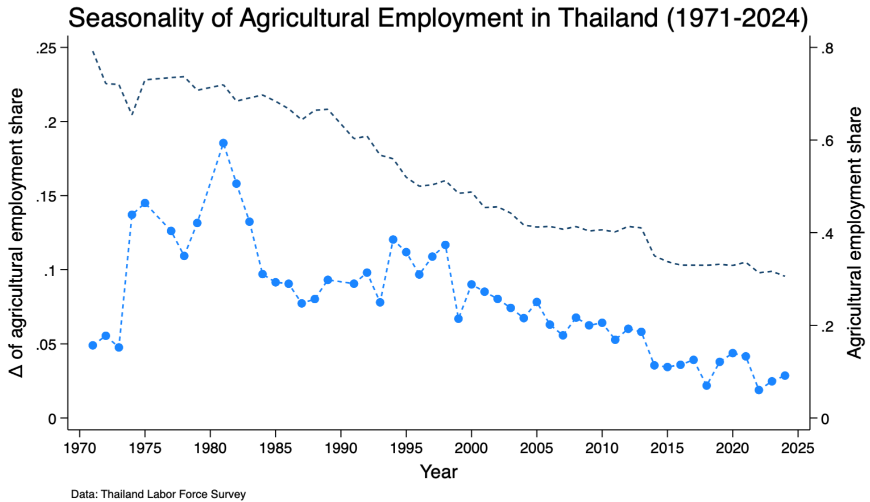
Towards a seasonality database: Japan (vs GDP pc)

back



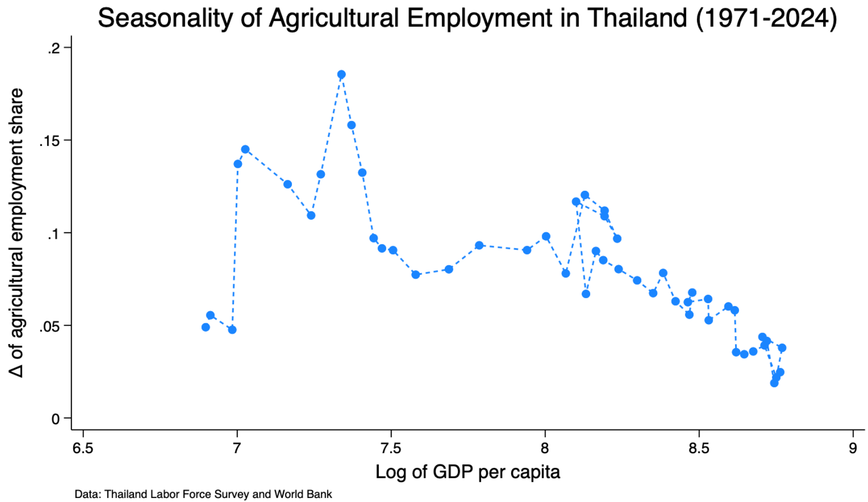
Towards a seasonality database: Thailand (vs agr. emp. share)

back



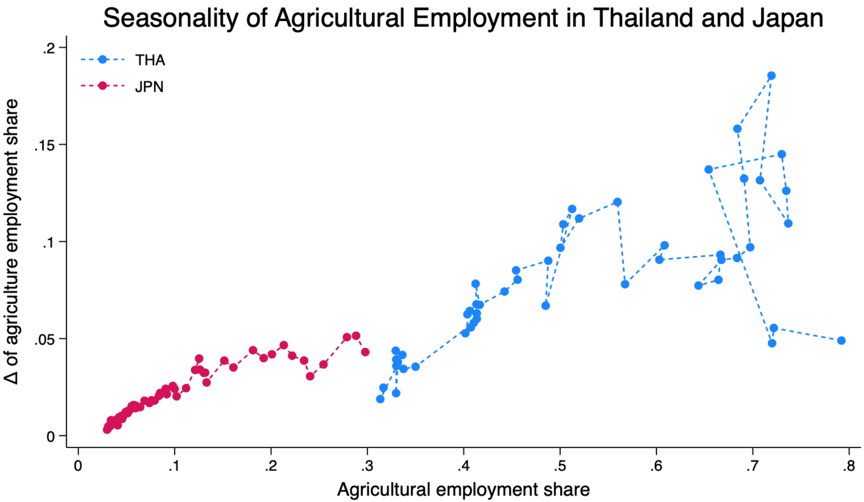
Towards a seasonality database: Thailand (vs GDP pc)

back



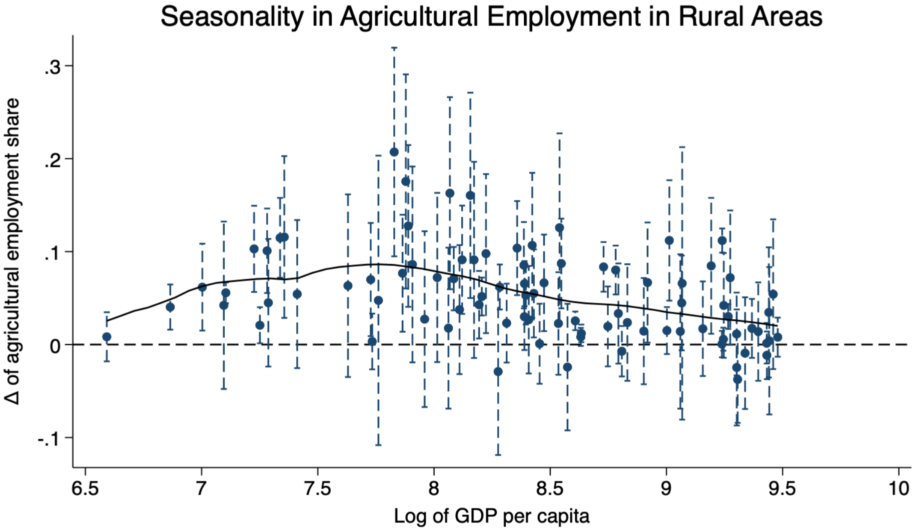
Towards a seasonality database: Japan/Thailand vs ST

back



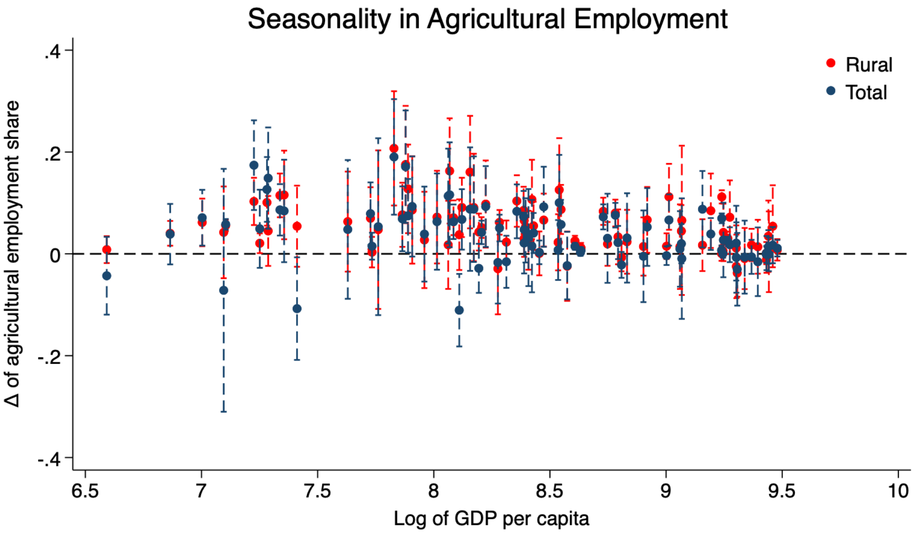
Results: seasonal employment driven by rural areas

◂ back



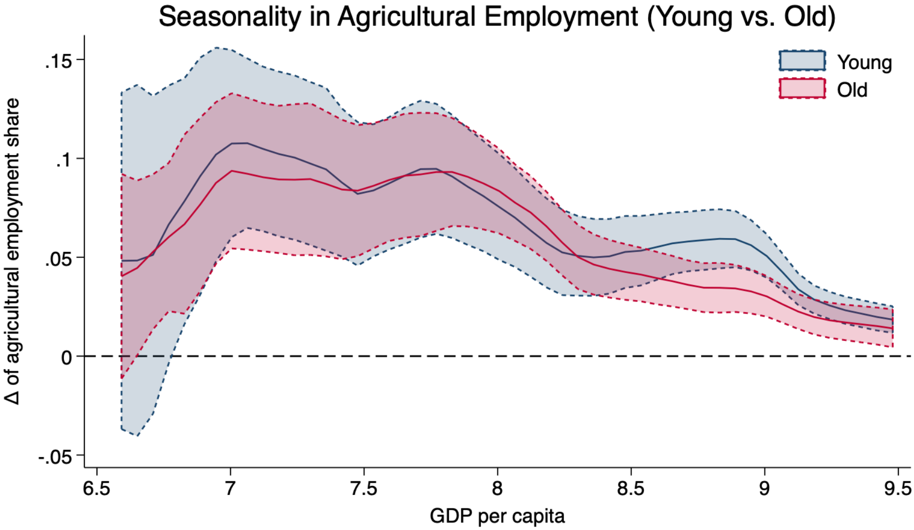
Results: seasonal employment driven by rural areas

back



Results: seasonal employment driven by rural areas

back

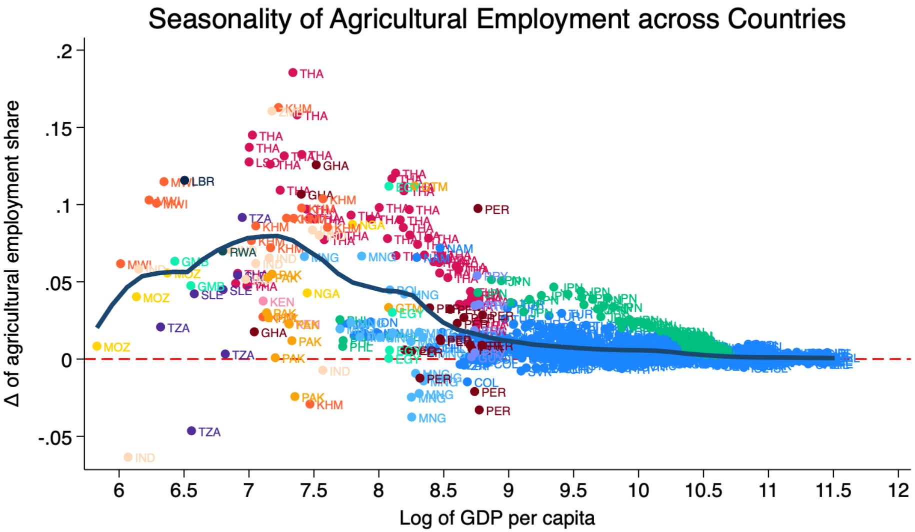


Results: seasonal employment driven by rural areas

back

Results: dynamics by country

back



Data appendix

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Table: Data appendix

Country	Survey	Frequency	No. of Years	Year
AGO	IEA	Quarterly	2	2020, 2021
ALB	LFS	Quarterly	2	2012, 2013
ARM	LFS	Quarterly	8	2014-2021
BOL	ECE	Quarterly	1	2018
BRA	PNADC	Quarterly	14	2012-2025
BTN	LFS	Quarterly	1	2024
EGY	LFS	Quarterly	11	2012-2022
GEO	LFS	Quarterly	8	2017-2024
GHA	LSS	Quarterly	3	2005, 2012, 2017
GMB	IHS	Quarterly	2	2010, 2015
GTM	ENEI	Quarterly	2	2002, 2016
GUY	LFS	Quarterly	2	2018, 2019
IND	NSS	Quarterly	9	1983,1987,1993,1999,2004,2005,2007,2009,2011
IND	PLFS	Quarterly	7	2017-2023
IRQ	HSES	Quarterly	2	2006, 2012
JAM	LFS	Quarterly	1	2017
JOR	EUS	Quarterly	15	2005-2014, 2016
KEN	IHBS	Monthly	2	2005, 2015
KHM	CSES	Monthly	14	2007-2019, 2021
LBN	LFS	Quarterly	1	2018

Data appendix

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Table: Data appendix - continued

Country	Survey	Frequency	No. of Years	Year
LBR	HIES	Monthly	1	2016
LSO	LFS	Monthly	1	2017
MNG	LFS	Quarterly	18	2002/03,2006/07-2008/09, 2010-2023
MOZ	IOF	Quarterly	3	2002, 2008, 2014
MUS	CMPHS	Quarterly	7	2001-2003, 2006,2007,2012,2017
MWI	IHS	Monthy	4	2004,2010,2016,2019
NAM	HIES	Monthly	2	2009,2015
NGA	LSS	Monthly	2	2003,2018
PAK	LFS	Quarterly	8	2009,2010,2012-2014,2017,2018,2020
PER	ENAHO	Quarterly	18	2004-2021
PHL	LFS	Quarterly	4	2007-2009,2017
PRY	EPHC	Quarterly	5	2017-2019,2022,2023
RWA	LFS	Quarterly	1	2021
SLE	IHS	Quarterly	3	2003, 2011, 2018
TLS	TLSLS	Quarterly	1	2007
TZA	ILFS	Quarterly	4	2000,2006,2014,2016
YEM	LFS	Quarterly	1	2013
ZMB	LFS	Quarterly	1	2017
Total:				
38 countries			191 country-years	

Model: setup

- Two sectors, agriculture/non-agriculture, and two seasons per year, peak/slack
- Consumers value both sectoral goods with constant elasticity of substitution, and can substitute between seasonal consumption of each good with constant elasticity
- Consumption of agricultural good across seasons more substitutable than agriculture/non-agriculture within season
- Consumers face subsistence constraint for agricultural good in every season

- Production in every sector uses only labour, but to varying degrees
- Nature drives seasonal productivity in agriculture: high in peak, low in slack season
- Labour mobility ensures wages equalised across sectors within season
- Within year, labour can work throughout in agr., non-agr. or switch per season

Model: preferences

- A representative agent's utility function

$$U \equiv \left(\beta C_{at}^{\frac{\sigma-1}{\sigma}} + (1-\beta) C_{nt}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

where C_{at} and C_{nt} are composites of agricultural/non-agr. goods over two seasons:

$$C_{at} = \left((c_{0at} - \bar{a})^{\frac{\gamma_a - 1}{\gamma_a}} + (c_{1at} - \bar{a})^{\frac{\gamma_a - 1}{\gamma_a}} \right)^{\frac{\gamma_a}{\gamma_a - 1}}$$

$$C_{nt} = \left(c_{0nt}^{\frac{\gamma_n - 1}{\gamma_n}} + c_{1nt}^{\frac{\gamma_n - 1}{\gamma_n}} \right)^{\frac{\gamma_n}{\gamma_n - 1}}$$

where c_{jat} and c_{jnt} are agricultural and non-agr. goods consumption in season j at year t, respectively, and $\bar{a}$ the subsistence level of agricultural consumption.

Model: technology

Agricultural sector production, Y_a

- Season 0 (peak season):

$$Y_{0at} = A_{0at} l_{0at}^{\theta_a}$$

- Season 1 (slack season):

$$Y_{1at} = A_{1at} l_{1at}^{\theta_a}$$

where A_{jat} is agricultural productivity in season j, year t, $A_{0at} \geq A_{1at}$ for all t.

Non-agricultural sector production, Y_n

$$Y_{jn} = A_n l_{jnt}^{\theta_n}$$

where A_{nt} is non-agricultural productivity in year t, $A_{0nt} = A_{1nt}$ for all t.

Model: labour market

- l_{at} and l_{nt} denote share of labour that works in agr. and non-agr. throughout t
- s_t denotes share of seasonal labour that works in agriculture in peak season $j = 0$, but works in non-agriculture in slack season $j = 1$
- Assume goods markets perfectly competitive and labour freely mobile

Model: labour market

- l_{at} and l_{nt} denote share of labour that works in agr. and non-agr. throughout t
- s_t denotes share of seasonal labour that works in agriculture in peak season $j = 0$, but works in non-agriculture in slack season $j = 1$
- Assume goods markets perfectly competitive and labour freely mobile

- In equilibrium, wage rates equalised across sectors:
  - Season 0:
$$\omega_{0at} = p_{0at}\theta_a A_{0at}(l_{at} + s_t)^{\theta_a - 1} = p_{0nt}\theta_n A_{nt} l_{nt}^{\theta_n - 1} = \omega_{0nt} \quad (4)$$
  - Season 1:
$$\omega_{1at} = p_{1at}\theta_a A_{1at} l_{at}^{\theta_a - 1} = p_{1nt}\theta_n A_{nt}(l_{nt} + s_t)^{\theta_n - 1} = \omega_{1nt} \quad (5)$$

  where p_{jat} and p_{jnt} represent price of agricultural goods and non-agricultural goods in season j in year t, respectively.

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  - Season 1:
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  where p_{jat} and p_{jnt} represent price of agricultural goods and non-agricultural goods in season j in year t, respectively.

- Labour market clearing condition:
$$l_{at} + s_t + l_{nt} = 1 \tag{6}$$

Model: within-period household problem

- household i's utility maximization problem:

$$\max\left(\beta {C_{at}^{i}}^{\frac{\sigma-1}{\sigma}} + (1-\beta) {C_{nt}^{i}}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

  subject to budget constraints:

$$p_{0a}c_{0at}^{i} + p_{1a}c_{1at}^{i} + p_{0n}c_{0nt}^{i} + p_{1n}c_{1nt}^{i} = \omega_0 + \omega_1 + d_0^i + d_1^i$$

  where d_j^i is the dividend of household i in season j.

- firm ownership must not be equally distributed among households i

Model: inter- and intraseasonal substitution

- Assume static solution for now: $A_{0at} = A_{0a}$, $A_{1at} = A_{1a}$, $A_{nt} = A_n$
- First-order conditions
  - Interseasonal substitution equations:

$$c_{1a}^{*^i} - \bar{a} = \left(\frac{p_{0a}}{p_{1a}} \right)^{\gamma_a} (c_{0a}^{*^i} - \bar{a}) \tag{7}$$

$$c_{1n}^{*^i} = \left(\frac{p_{0a}}{p_{0n}} \right)^{\gamma_n} c_{0n}^{*^i} \tag{8}$$

  - Intraseasonal substitution equation:

$$\frac{\beta \left(1 + (\frac{p_{0a}}{p_{1a}})^{\gamma_a - 1} \right)^{\frac{\gamma_a}{\gamma_a - 1}(\frac{1}{\gamma_a} - \frac{1}{\sigma})} (c_{0a} - \bar{a})^{-\frac{1}{\sigma}}}{(1 - \beta) \left(1 + (\frac{p_{0n}}{p_{1n}})^{\gamma_n - 1} \right)^{\frac{\gamma_n}{\gamma_n - 1}(\frac{1}{\gamma_n} - \frac{1}{\sigma})} c_{0n}^{-\frac{1}{\sigma}}} = \frac{p_{0a}}{p_{0n}} \tag{9}$$

Model: market clearing

- Market clearing conditions:

$$\sum_i c^{*^i}_{0a} = y_{0a} \tag{10}$$

$$\sum_i c^{*^i}_{0n} = y_{0n} \tag{11}$$

$$\sum_i c^{*^i}_{1a} = y_{1a} \tag{12}$$

$$\sum_i c^{*^i}_{1n} = y_{1n} \tag{13}$$

Model: equilibrium

- Let $p_{0a} = 1$ be the numeraire good
- Equilibrium boils down to five unknowns $\{p_{0n}, p_{1a}, p_{1n}, l_a, l_n\}$ in five equations:

$$\theta_a A_{0a}(1-l_n)^{\theta_a - 1} = p_{0n}\theta_n A_n l_n^{\theta_n - 1}$$

$$p_{1a}\theta_a A_{1a} l_a^{\theta_a - 1} = p_{1n}\theta_n A_n (1-l_a)^{\theta_n - 1}$$

$$A_{1a} l_a^{\theta_a} - \bar{a} = p_{1a}^{-\gamma_a}\left(A_{0a}(1-l_n)^{\theta_a} - \bar{a}\right)$$

$$(1-l_a)^{\theta_n} = \left(\frac{p_{0n}}{p_{1n}}\right)^{\gamma_n} l_n^{\theta_n}$$

$$\beta p_{0n}\left(1 + p_{1a}^{1-\gamma_a}\right)^{\frac{\gamma_a}{\gamma_a - 1}\left(\frac{1}{\gamma_a} - \frac{1}{\sigma}\right)}\left(A_{0a}(1-l_n)^{\theta_a} - \bar{a}\right)^{-\frac{1}{\sigma}} = (1-\beta)\left(1 + \left(\frac{p_{0n}}{p_{1n}}\right)^{\gamma_n - 1}\right)^{\frac{\gamma_n}{\gamma_n - 1}\left(\frac{1}{\gamma_n} - \frac{1}{\sigma}\right)} A_n^{-\frac{1}{\sigma}} l_n^{-\frac{\theta_n}{\sigma}}$$

Model: baseline parameter choice

Parameter	Value	Source
θ_a	0.4	Herrendorf et. al (2012)
θ_n	0.7	Herrendorf et. al (2012)
$\bar{a}$	0.2	Adamopoulos et. al (2024)
σ	2	$\sigma > 1$
γ_a	2.5	$\gamma_a > \sigma$
γ_n	10	$\gamma_n > \gamma_a$

Note:

- $\gamma_n > \gamma_a$: non-agricultural goods are close substitutes across seasons
- $\sigma > 1$: prices track productivity changes one-for-one if $\sigma = 1$
- $\gamma_a > \sigma$: agricultural goods in other seasons are better substitutes than non-agricultural goods in the same season