Demographic Transition and Engel's Law Across the Development Spectrum

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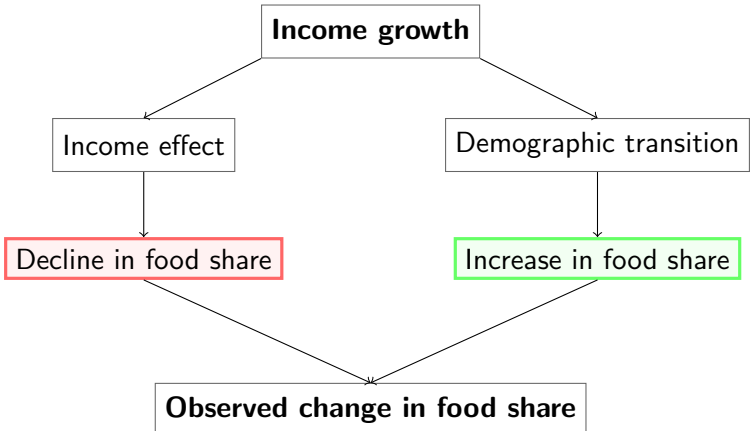
Motivation

- Economic growth is correlated with two key patterns:
  - Demographic Transition - Shift from high mortality and fertility to low rates, leading to an aging population. Evidence
  - Structural Transformation - Decline in the food share of total expenditures as incomes rise (Engel's Law). Evidence
- This work documents that individual's age drives food spending:
  $\Rightarrow$ Demographic Transition affects structural transformation.
- Research question: how does the demographic transition influence the decline in the food share of total expenditures?

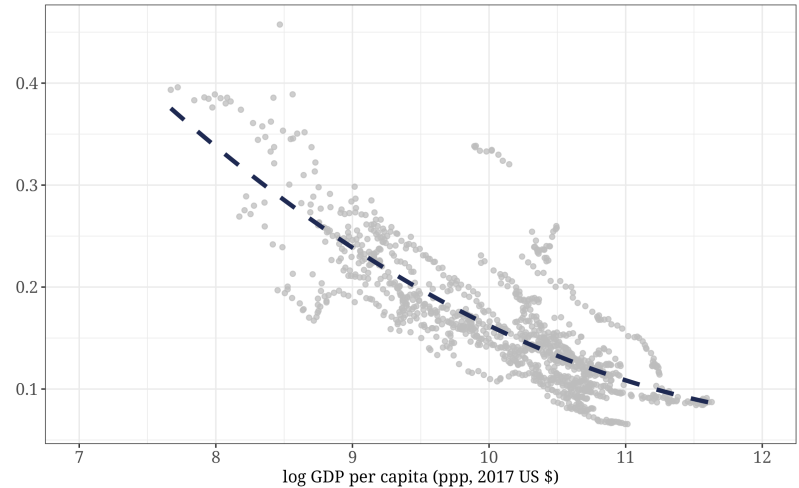
Preview of the Results

- Empirical Work:
  1. Key result: As household members' age increases, their share of food expenditures also rises.
  2. There is a large heterogeneity in the age elasticity of food expenditure shares across the development spectrum.
  3. Heterogeneity declines when controlling for detailed household composition.
- Structural Model:
  1. Objective: Construct a link between individual household member preferences and aggregate expenditures.
  2. Counterfactual exercise – The demographic transition significantly slows down structural transformation out of food expenditures.
  3. This result is opposite to, but not in conflict with, existing literature. contribution

Mechanism

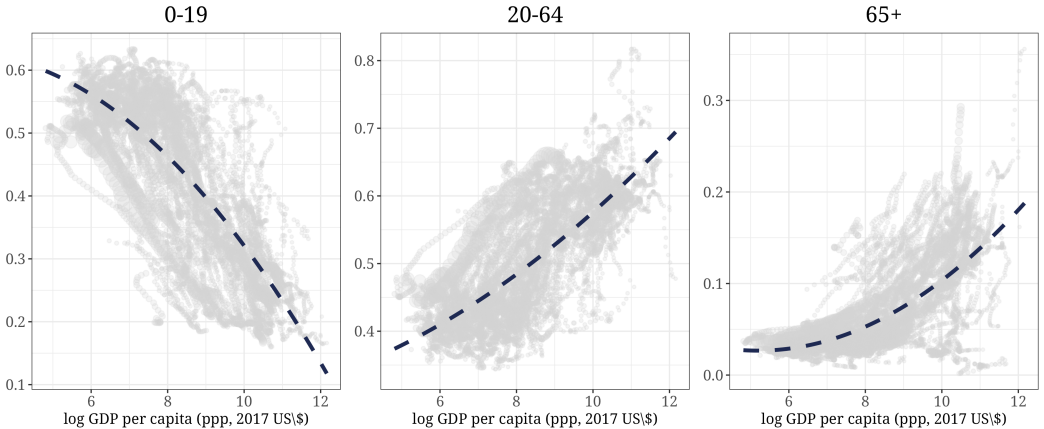

Income growth
Income effect
Demographic transition
Decline in food share
Increase in food share
Observed change in food share

Cross-country evidence - Engel's Law



Food as share of total expenditure and GDP per capita

Cross-country evidence - Demographic Transition



Age groups shares of total population

Household-Level Evidence - Data

- Luxembourg Income Survey (LIS).
  - Harmonized, cross-section microdata from different national surveys such as NIDS (South Africa), ENIGH (Mexico), CHIP (China)...
  - Large set of socio-economic variables.
  - 23 countries across the development spectrum (Mali $\rightarrow$ Switzerland)
  - Covers $\sim$ 55% of the world population.
  - Expenditure data by use (COICOP 2018). Food expenditure = food purchased for home consumption

return

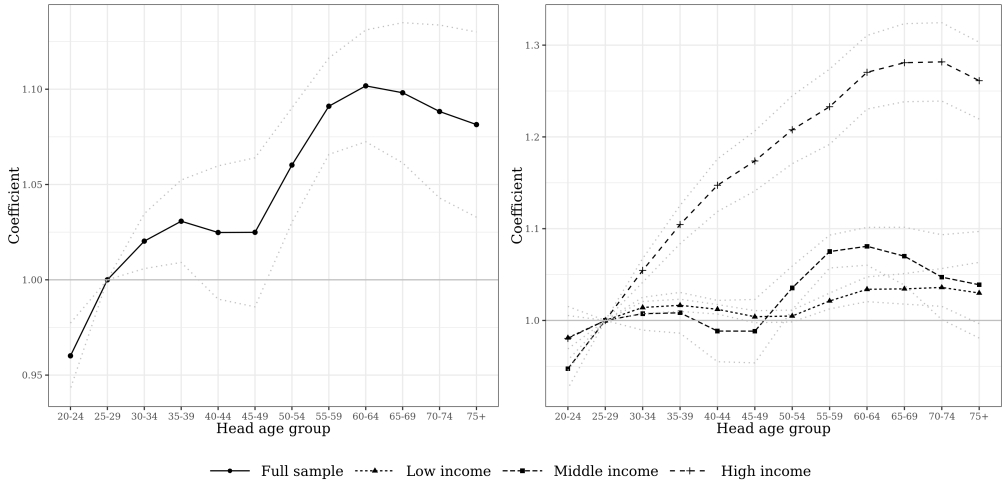
Household-Level Evidence - Baseline Model

- Objective: Uncover the relationship between age and food expenditure shares.
- The baseline model is:

$$\log(\omega_h^f) = \beta_0 \log e_h + \boldsymbol{\beta} \cdot \boldsymbol{\Gamma}_h + \mathbf{X}_h + \delta_t + \epsilon_h.$$

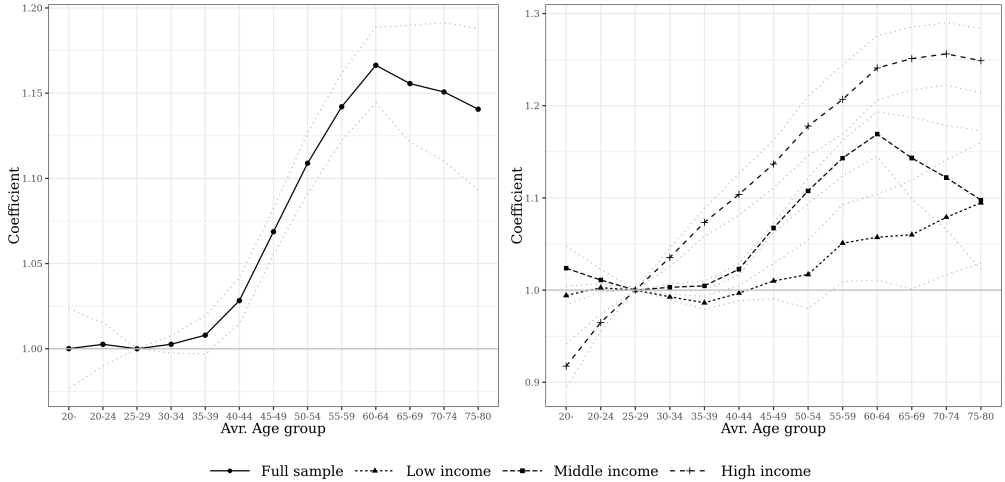
  - $\delta_{c,t}$: Region-time FE (controls for prices).
  - $\boldsymbol{\Gamma}_h$: Vector of household age groups, either:
    1. **Head Age** (Cravino et al., 2022, Aguiar and Hurst, 2013),
    2. **Average Age** (Mao and Xu, 2014).
  - $\mathbf{X}_h$: Socio-demographic controls (number of members and earners, household type, rural).
  - Expenditure instrumented with income (Aguiar and Bils, 2015).

Household-Level Evidence - Head's Age



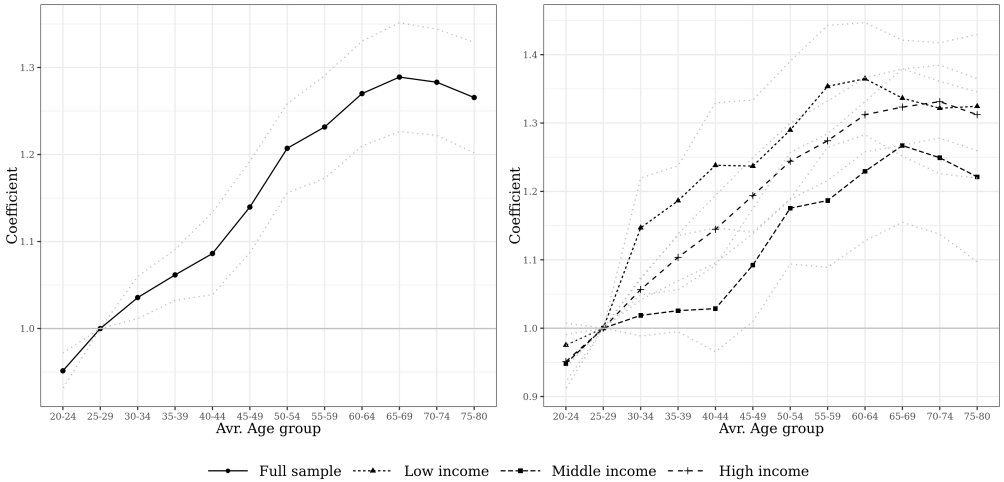
Estimated value of $\exp(D_h^{\text{Head Age}})$ grouped by income By Country.

Household-Level Evidence - Average Age



Estimated value of $\exp(D_h^{\text{Average Age}})$ grouped by income By Country.

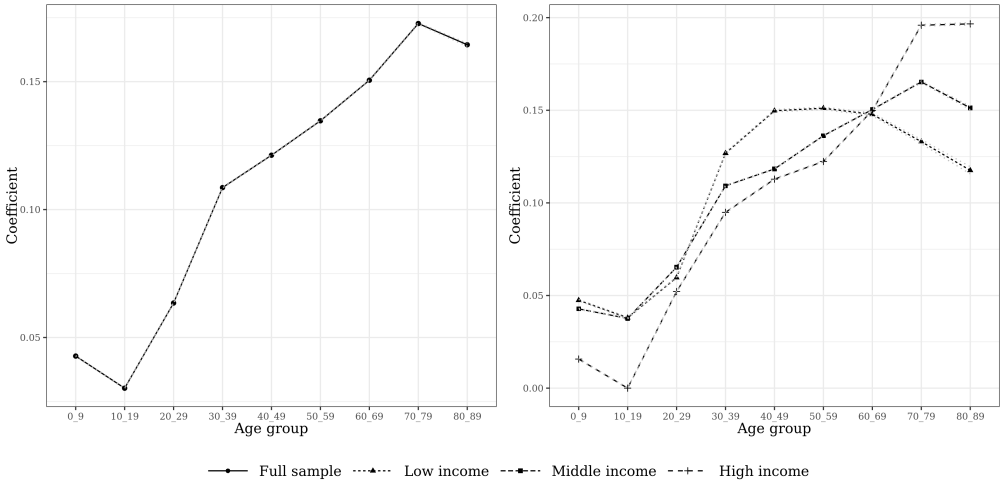
Household-Level Evidence - Single-Member Households



Estimated value of $\exp(D_h^{\text{Average Age}})$ grouped by income, for single-member households.

Household-Level Evidence - Individual Demand Decomposition

details



Estimated values of dummy regression by income group

Structural Model - Highlights

- Household preferences take a PIGL (Boppart, 2014) indirect form:

$$\mathcal{V}^h(\mathbf{P}, E_{h,t}) = \frac{1}{\epsilon}\left[\frac{E_t^h}{P_t^n}\right]^{\epsilon} - \frac{\nu_t^h}{\gamma}\left[\frac{P_t^f}{P_t^n}\right]^{\gamma} - \frac{1}{\epsilon} + \frac{\nu_t^h}{\gamma},$$

  where

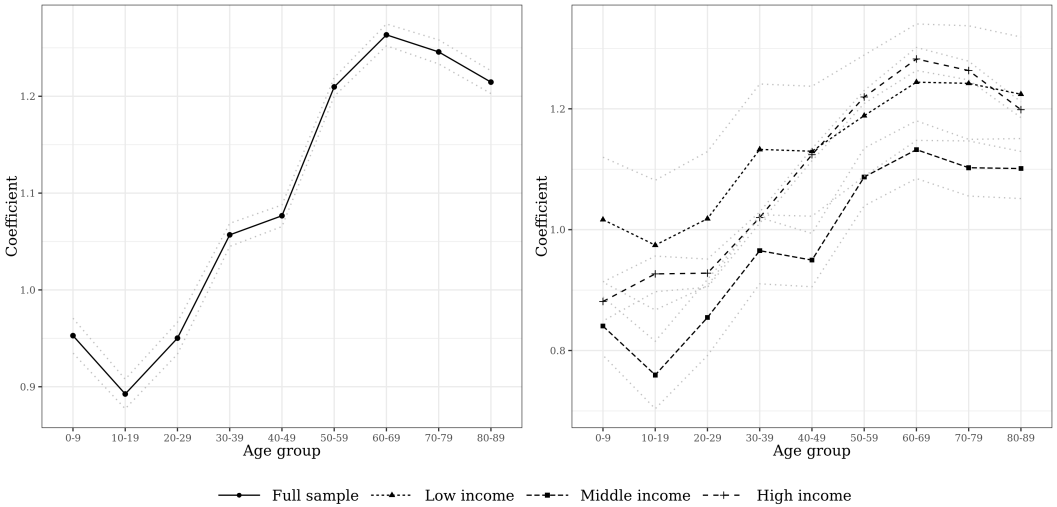
  - ϵ: income elasticity-ruling parameter.
  - γ: parameter governing price elasticity.

- The household-level taste shifter is the geometric average of individual shifters:

$$\nu_t^h \equiv \left(\prod_i^{N_h} \nu_t^i(a)\right)^{\frac{1}{N_h}}$$

  where $\nu_t^i(a)$ is a parameter driving the food preferences of an individual aged a.

Model - Estimated values for δ^a by income group



Counterfactual exercise - Table

Country	Interval	$\Delta\Omega_f$	$\Delta\Omega_f$ (CAGR)	$\Delta\Omega_f$ (counterfactual)	$\Delta\Omega_f$ (counterfactual, CAGR)	Δ	Δ (yearly)
Mali	2011-2019	10.45	2.21	9.28	1.98	1.17	0.23
India	2004-2011	-4.54	-1.53	-5.69	-1.95	1.15	0.42
Ivory Coast	2002-2015	-1.71	-0.30	-1.25	-0.22	-0.46	-0.08
Vietnam	2005-2013	0.37	0.12	-0.53	-0.17	0.90	0.29
Egypt	1999-2017	-2.85	-0.39	-4.24	-0.59	1.39	0.20
Jordan	2002-2013	-2.16	-0.52	-3.38	-0.83	1.22	0.31
Georgia	2009-2019	-0.75	-0.21	-1.26	-0.36	0.51	0.15
Iraq	2007-2012	-6.90	-3.24	-6.21	-2.90	-0.69	-0.34
South Africa	2008-2017	3.70	1.80	2.90	1.43	0.80	0.37
Serbia	2006-2019	-4.66	-0.98	-5.64	-1.20	0.98	0.22
Peru	2004-2019	-3.77	-0.77	-4.23	-0.87	0.46	0.10
China	2002-2018	-4.22	-0.86	-5.56	-1.17	1.34	0.31
Russia	2000-2010	-1.27	-0.37	-1.98	-0.59	0.71	0.22
Mexico	1996-2018	-20.10	-2.58	-21.53	-2.83	1.43	0.25
Hungary	1999-2015	2.04	0.36	1.71	0.30	0.33	0.06
Poland	1999-2019	-7.43	-1.24	-7.93	-1.34	0.50	0.10
Italy	1998-2016	-0.49	-0.08	-1.55	-0.25	1.06	0.17
Israel	2001-2019	-0.47	-0.14	-2.87	-0.94	2.40	0.80
United Kingdom	1990-1993	-1.30	-2.13	-1.30	-2.13	0.00	0.00
Australia	2004-2016	-1.25	-0.77	-1.82	-1.15	0.57	0.38

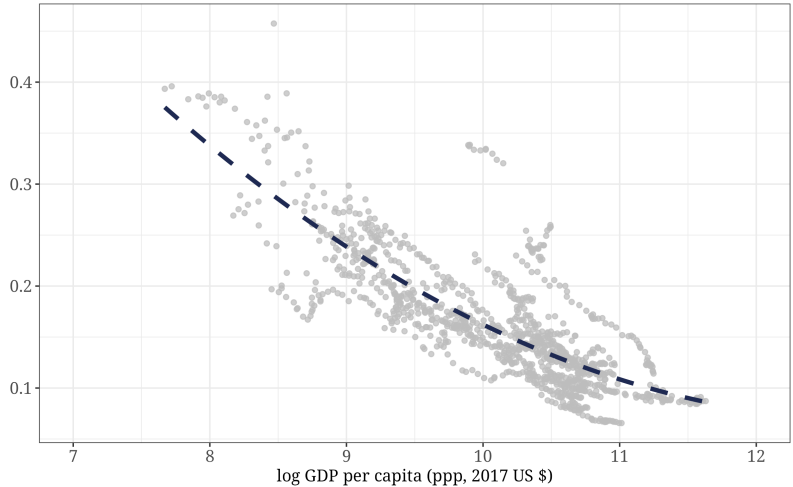
Conclusion

- This work:

  1. Documents how aging increases household food expenditures.
  2. Highlights how household composition differences drive heterogeneity across development levels.
  3. Estimates a quantitative, structural model that takes into consideration exact household composition.
  4. The model suggests the demographic transition has a slowing effect on structural transformation away from food expenditures.

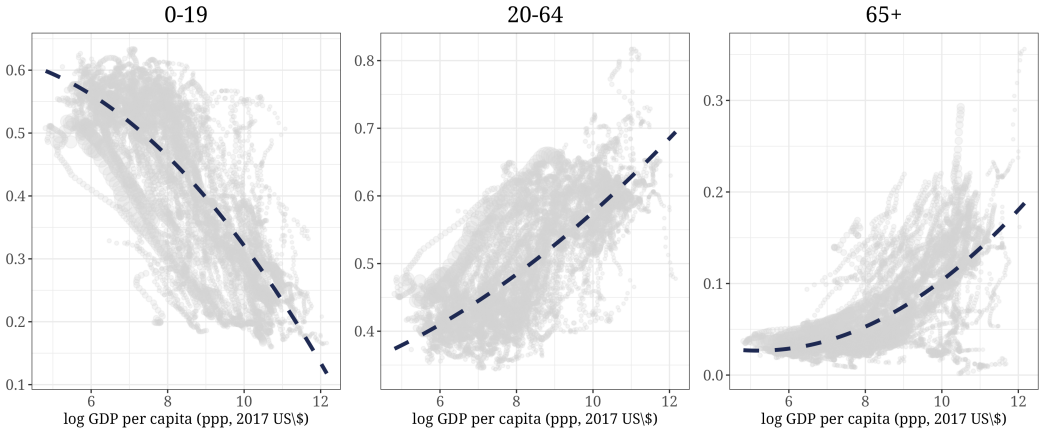
Thank you!

Motivation - Engel's Law



Food as share of total expenditure and GDP per capita return

Motivation - Demographic Transition



Age groups shares of total population return

Literature

- Role of demographic characteristics (age) upon food expenditures:
  Aguiar and Hurst [2013], Foster [2015], Mao and Xu [2014]...
  1. Expands the analysis to multiple countries across the development spectrum
  2. Documents large heterogeneity across development levels
  3. Suggests differences in household composition explain the differences
- Aging and structural transformation
  Brembilla [2018], Cravino et al. [2022]...
  1. Expands the analysis to multiple countries and to a complementary setting
  2. Uses a household model that accounts for exact household composition.
  3. Presents a opposite but non-conflictual evidence (aging hinders structural change)

return

Cross-country evidence

Dependent Variable:	Food Share of Household Expenditures						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Median age	-0.0082***	0.0023**	0.0021*	0.0021**	0.0018*	0.0021**	0.0016**
	(0.0014)	(0.0010)	(0.0012)	(0.0008)	(0.0010)	(0.0009)	(0.0006)
log(GDP per capita)		-0.1368***	-0.1720			-0.1108***	
		(0.0153)	(0.1227)			(0.0177)	
log(GDP per capita)^2			0.0019				
			(0.0071)				
log(Total Exp. per capita)				-0.1392***	-0.2176		-0.1101***
				(0.0191)	(0.1737)		(0.0199)
log(Total Exp. per capita)^2					0.0045		
					(0.0099)		
Relative prices						0.0448***	0.0435***
						(0.0093)	(0.0121)
Fixed-effects							
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics							
Observations	1,244	1,166	1,166	1,241	1,241	1,098	1,174
R^2	0.83972	0.93026	0.93039	0.91975	0.92027	0.96884	0.95522
Within R^2	0.49376	0.78131	0.78171	0.74794	0.74957	0.87960	0.82633

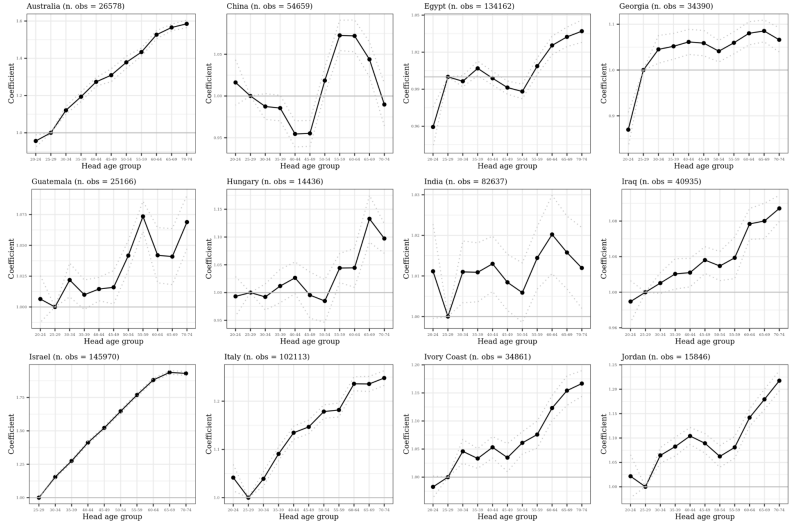
Clustered (Country) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Data

- Household-levelc data: Luxembourg Income Survey (LIS).
  - Harmonized, cross-section microdata from different national surveys such as NIDS (South Africa), ENIGH (Mexico), CHIP (China)...
  - Large set of socio-economic variables.
  - 23 countries across the development spectrum (Mali $\rightarrow$ Switzerland)
  - Covers $\sim$ 55% of the world population.
  - Expenditure data by use (COICOP 2018). Food expenditure = food purchased for home consumption
- Aggregate data: OECD private expenditure by COICOP and UN's WPP.
- Prices: IMF's and OECD's CPI by COICOP 2018, Reserve Bank of India.

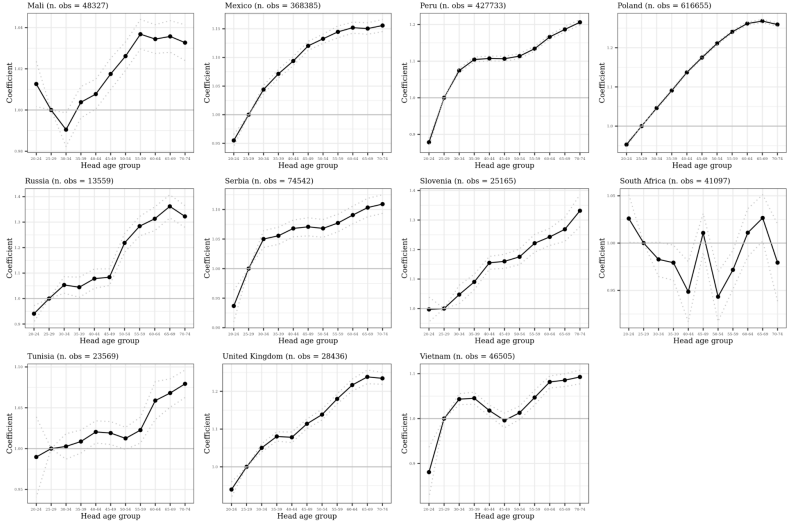
return

Household-level evidence - Head's age



Estimated value of $\exp(D_h^{\text{Head Age}})$ by country return

Household-level evidence - Head's age



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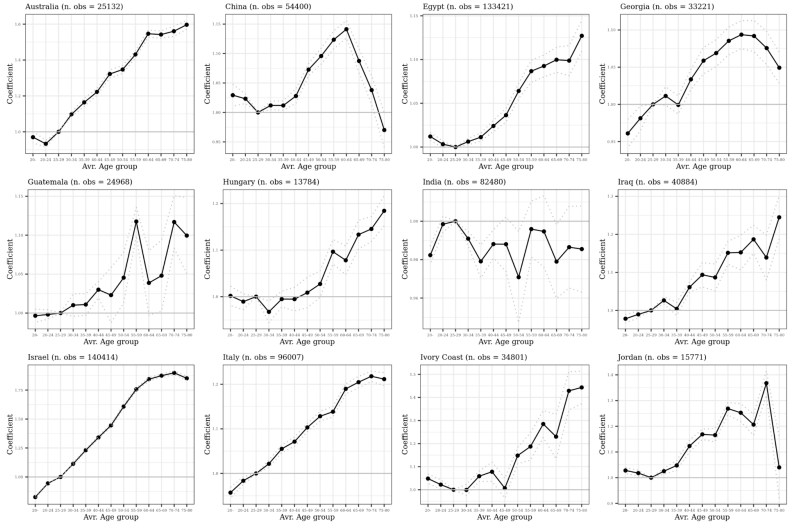
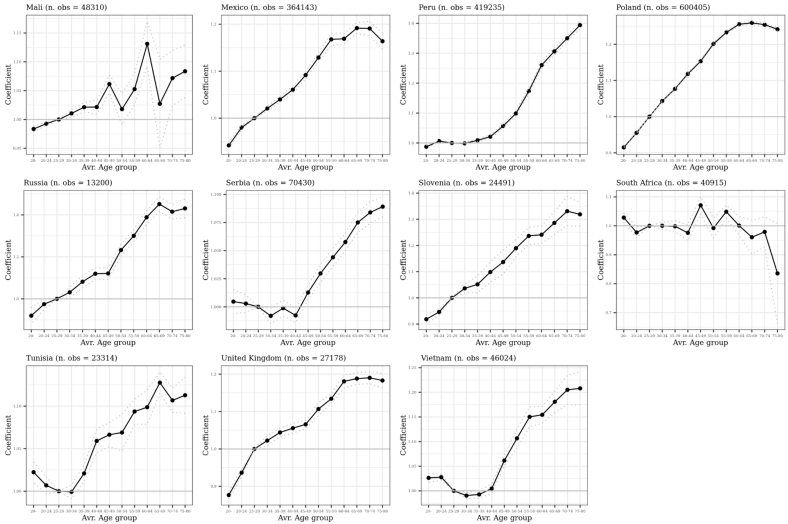
Household-level evidence - Average age



Estimated value of $\exp(D_h^{\text{Avr.}})$ by country return

Household-level evidence - Average age



Estimated value of $\exp(D_h^{\text{Avr.}})$ by country return

Household-level evidence - Individual demand decomposition

- Household level food expenditures are defined as the sum of the food expenditures for each member i:

$$E_h^f \equiv \sum_i E_i^f .$$

- Assuming that individuals of the same age are symmetric:

$$\omega_h^f \equiv \frac{E_h^f}{E_h} = \sum_a \phi_{h,a} \cdot \omega_{h,a}^f \cdot N_{a,h}.$$

- $\phi_{h,a}$ is the share of total household expenditures that are imputed to each member aged a:

$$\phi_{h,a} \equiv \frac{E_{h,a}}{E_h}, \qquad 0 \leq \phi_{h,a} \leq 1$$

Household-Level Evidence - Individual Demand Decomposition

- The expenditure allocations $\phi_{h,a}$ are unobservable given the data available.
- However, we can estimate $\phi_{h,a} \cdot \omega^f_{h,a}$ via OLS.
- Model:

$$\omega^f_h = \sum_a \beta_a \cdot N_{a,h}, \tag{1}$$

  where $N_{a,h}$ is the number of household members aged a in household h.

- $\hat{\beta}_a$ can be interpreted as the bargaining-power adjusted average food expenditure share by individuals aged a.

return

Driver decomposition

- The aggregated food share of total consumption can be written as

$$\Omega_{\mathrm{f}} \equiv \frac{\sum_h^H E_h^f}{\sum_h E_h} = \left(\frac{P_t^n}{\bar{E}_t}\right)^{\epsilon} \left(\frac{P_t^f}{P_t^n}\right)^{\gamma} \bar{\delta}_t \cdot \theta_t \cdot \nu_t,$$

where

$$\bar{E}_t \equiv \frac{1}{N_t} \sum_h N_{h,t} \cdot E_{h,t} \qquad \text{(Average expenditures per capita)}$$

$$\bar{\delta}_t \equiv \frac{1}{H_t} \sum_h^H \frac{E_{h,t}}{\bar{E}_t} \cdot \delta_t^h \qquad \text{(Weighted average of HH demographic shifters)}$$

$$\theta_t \equiv \frac{1}{H_t} \sum_h^H \frac{\delta_t^h}{\bar{\delta}_t} \cdot \left[\frac{E_{h,t}}{\bar{E}_t}\right]^{1-\epsilon} \qquad \text{(Preference-weighted expenditure inequality)}$$

Driver decomposition 2

- As in Boppart [2014], taking a log change of aggregated share of food consumption from a reference period τ allows us to decompose the different drivers of a change in aggregate food consumption:

$$\hat{\Omega}_t^f = \underbrace{\epsilon(\hat{\mathbf{P}}_t - \hat{E}_t)}_{\text{Income}} + \underbrace{(\gamma - \epsilon\Omega_t^f)(\hat{P}_t^f - \hat{P}_t^n)}_{\text{Substitution}} + \underbrace{\hat{\bar{\delta}}_t}_{\text{Demography}} + \underbrace{\hat{\theta}_t + \hat{\nu}_t}_{\text{Residual}}, \tag{2}$$

where

$$\hat{x}_t \equiv \ln x_t - \ln x_\tau \quad \forall x \qquad \text{(cumulative log change)}$$

$$\hat{\mathbf{P}}_t \equiv (1 - \Omega_t^f)\hat{P}_t^n + \Omega_t^f \hat{P}_t^f \qquad \text{(log change in the aggregate price index)}$$

return

Counterfactual exercise - Table

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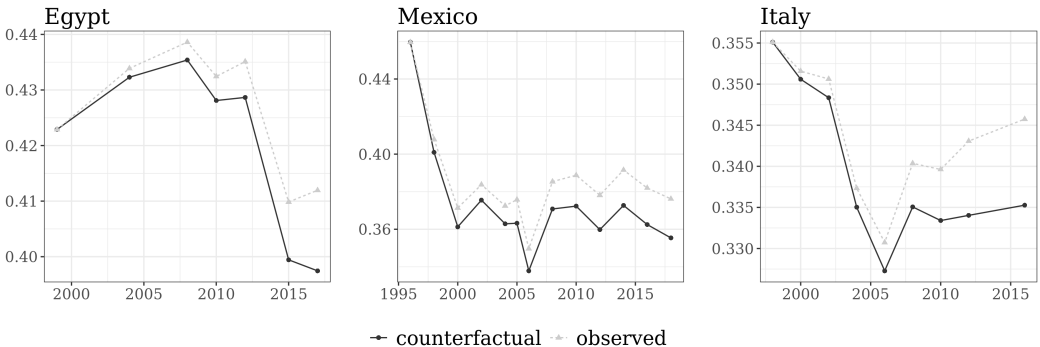
Model - Counterfactual exercise table



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