What Drives Diversification of National Food Supplies?
A Cross-Country Analysis

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Background

- Dietary diversity important for adequate nutrient intake and a strong predictor of growth in young children
- But what drives dietary diversification?
- Microeconomic studies show strong income elasticities for most nutrient-rich foods (de Melo et al.; Subramanian-Deaton)
- But farm households models point to severe market failures: diets influenced by local production patterns (agroecology) because markets don't supply full range of desired foods
- Substantial variation in diets even at similar levels of income?
- Dietary diversification slow in some contexts?

Background

- Little previous research analyses diversification of food supply (DFS), even though diversification of food supplies is a necessary condition for diversification of individual diets

Research questions

- ***How DFS varies across countries and regions?***
- ***How rapidly has DFS has changed over time?***
- ***What structural transformation and agroecological indicators may be driving these trends in DFS?***

Data

- **Food Balance Sheets** from FAO: DFS indicator (Share of calories supplied from non-staples)
- **World Bank** – Private Consumption Expenditure Per Capita, Share of urban population, Share of children aged 0-14 years, Topography (hills and mountains, lowland areas), Infrastructure
- **Barro and Lee** – Average years of schooling
- **Global Climate database** – Ave. monthly rainfall & SD
- Construct a 5-year unbalanced panel: 51 countries for 1965-2010
- Use descriptive techniques, panel regressions and decomposition analysis to understand drivers of DFS change over time

Methods

- Given panel data, we can estimate Fixed Effects (FE) models of the form:

$$\boldsymbol{DFS_{i,t} = \alpha + \beta log X_{i,t} + T_t + \mu_i + \varepsilon_{i,t}}$$

DFS = diversity of food supply *(DFS)* for a country *i* and time *t*

X = consumption, education, urbanization, and population ages 0–14 years

μ = country fixed effects

T = time period effects

ε = error term

Methods

- But we are also interested in time-invariant factors
- The correlated random effects (CRE) model keeps these in the model:

$$\boldsymbol{DFS_{i,t} = \alpha + \beta log\, X_{i,t} + \theta \overline{log\, X_i} + \gamma log\, z_i + T_t + \varepsilon_{it}}$$

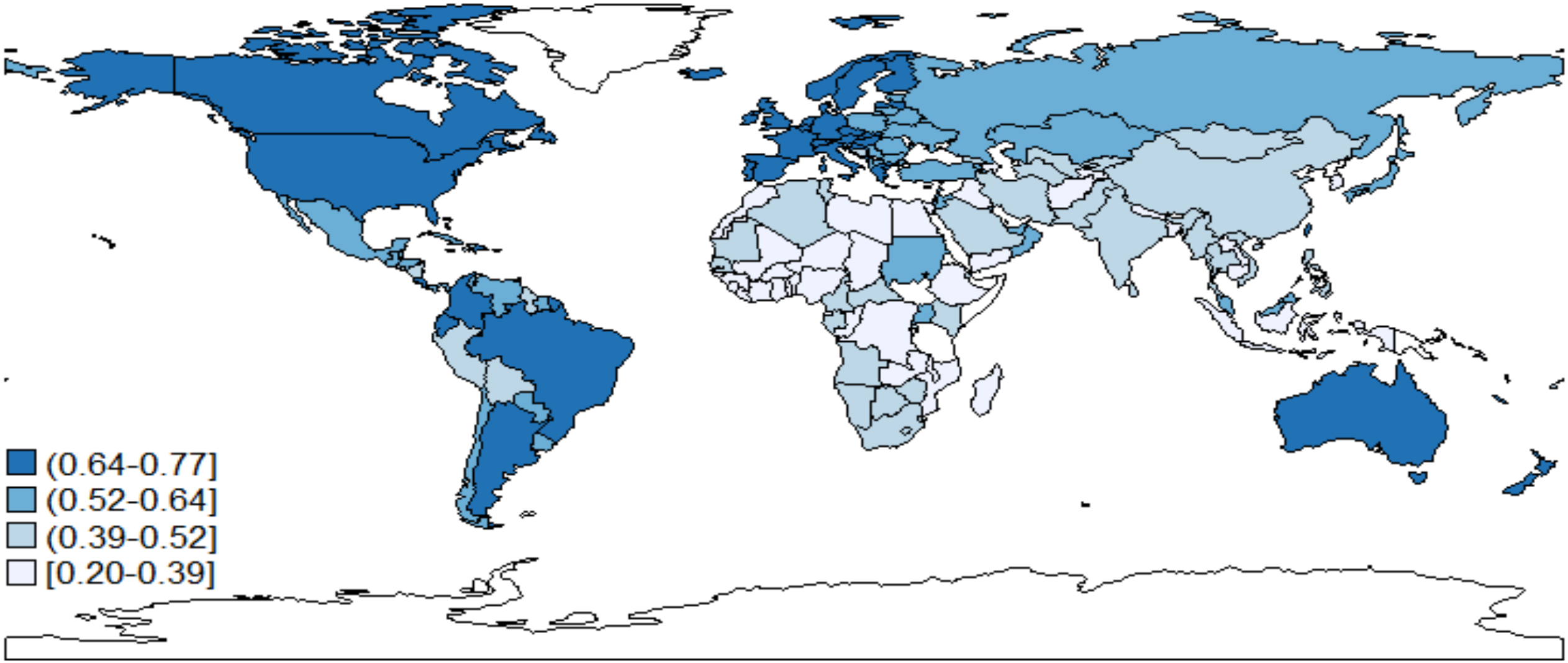
$\overline{X_i}$ = time averages of X (no real interpretation, but quasi-FE)

z_i = a vector of time-invariant variables

Note: All parameters are scale-free elasticities

Results

Figure 1. Calories supply from non-staples across countries, 2010



Source: Authors' estimates from FAO (2016) data.

Notes: Each country is colored according to value of corresponding diversity of food supply

Figure 2. Calorie supply from non-staples and household consumption per capita, 2010

Notes: 3-letter World Bank country codes denote specific observations.

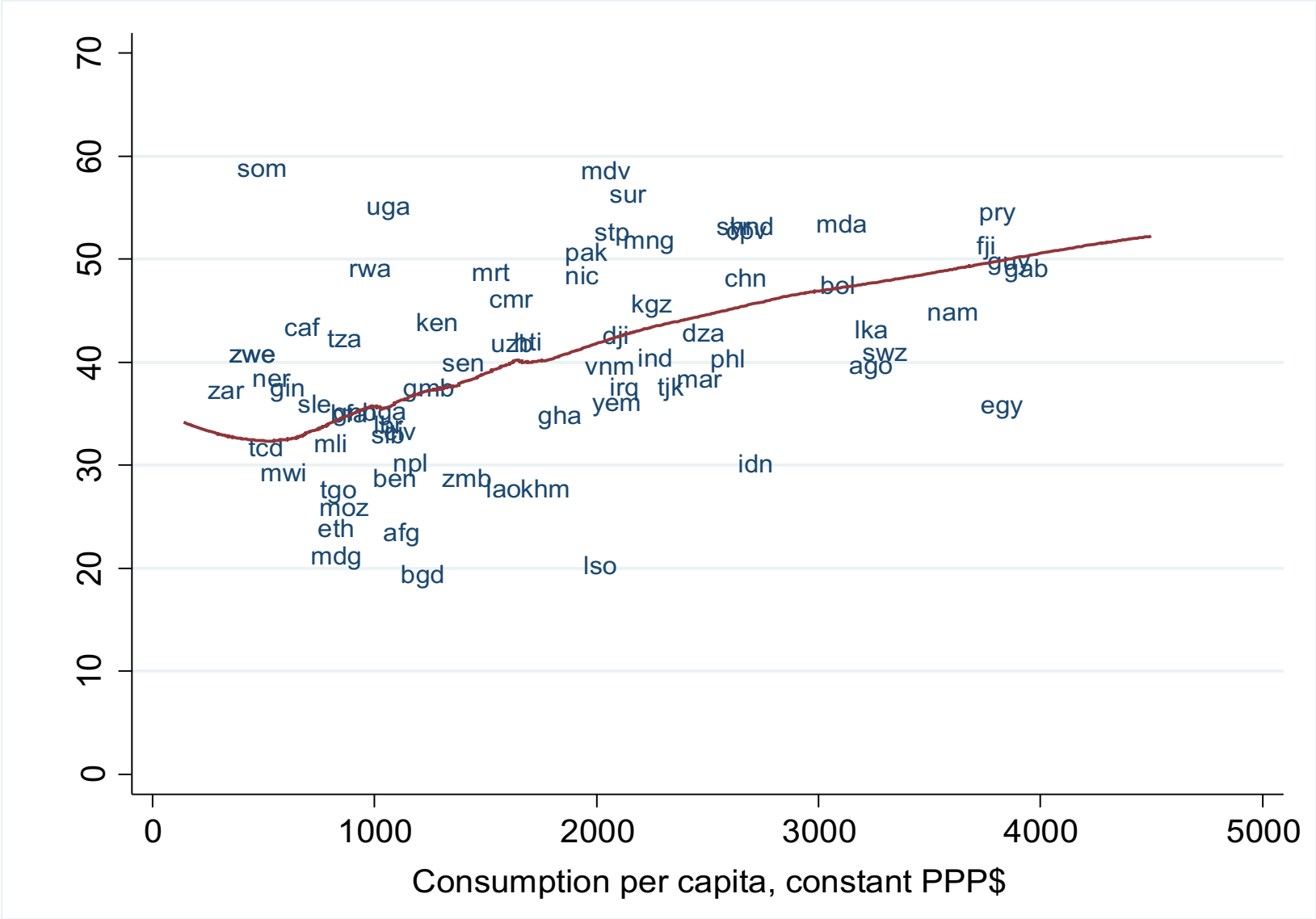
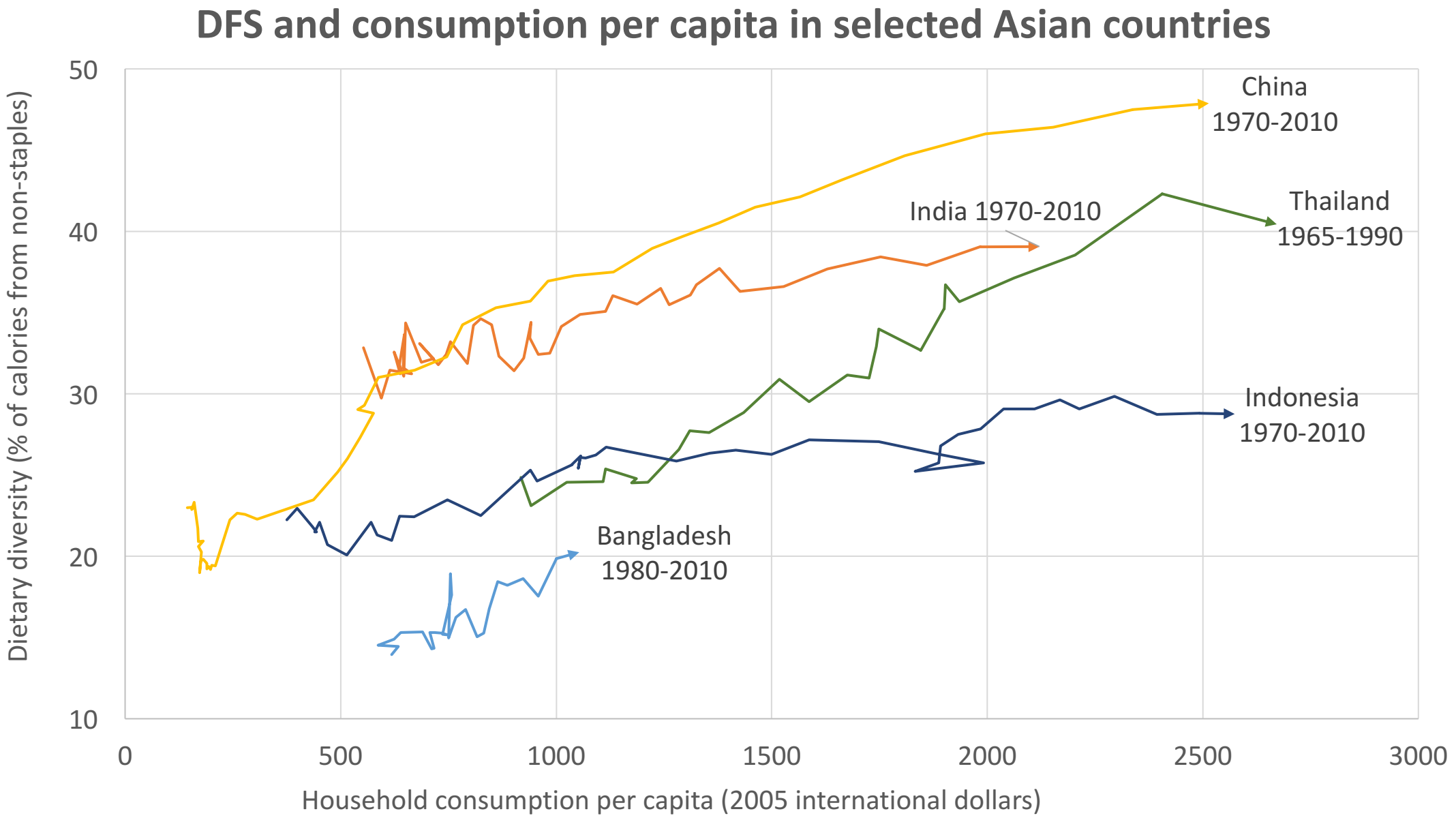
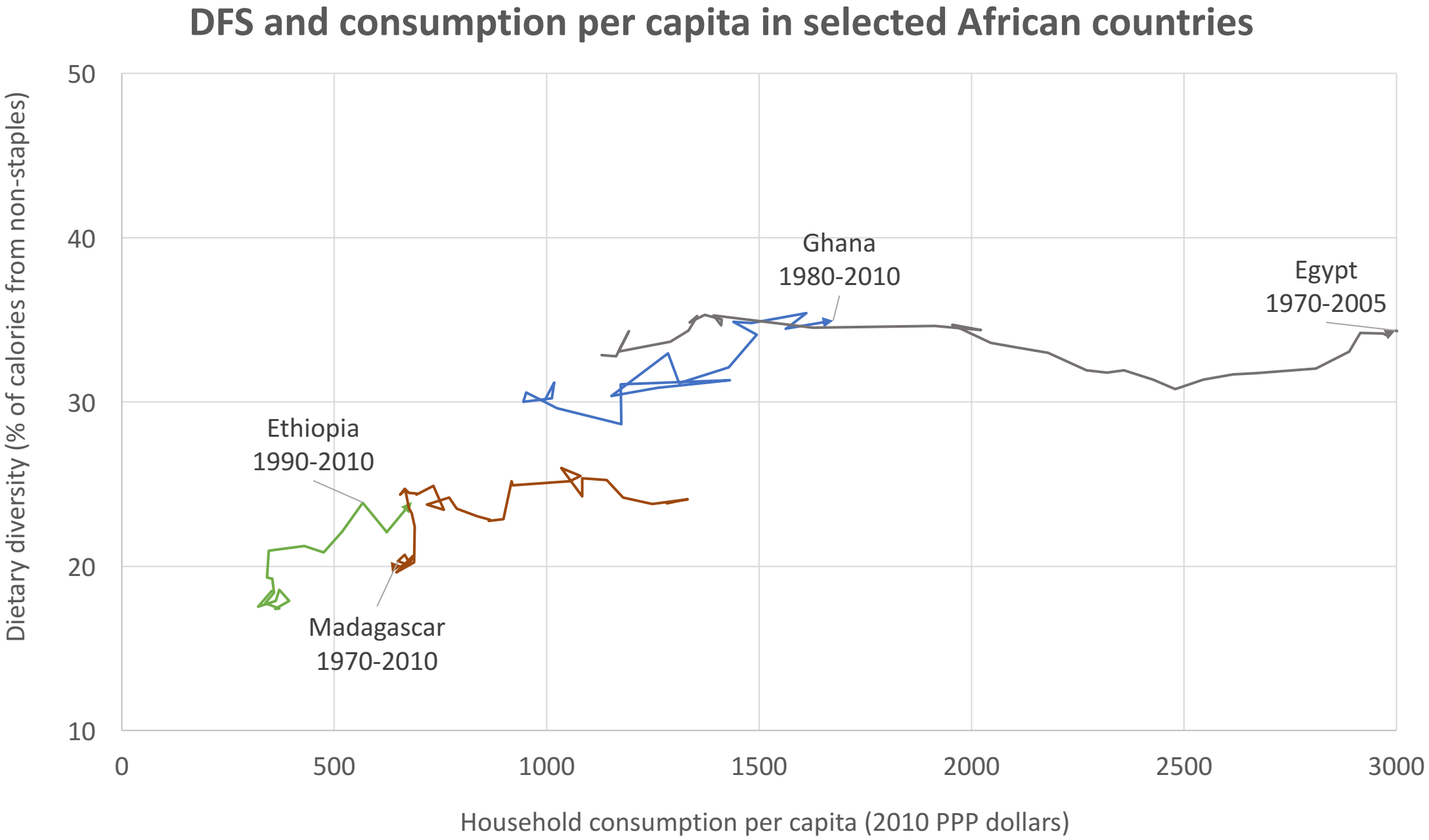


Table 1. Trends in calorie supply from non-staples for income groups, major regions and countries, 1961-2010

	Sample median: 1961	Sample median: 2010	Change in median
High income OECD	61%	70%	9%
Upper middle income	44%	55%	11%
Lower middle income	35%	40%	5%
Lower income	25%	30%	5%
Latin America & Caribbean	48%	55%	7%
Sub-Saharan Africa	32%	36%	5%
Nigeria	34%	34%	0%
Kenya	34%	41%	7%
South Asia	30%	37%	7%
India	36%	39%	3%
Bangladesh	15%	19%	4%
East Asia & Pacific	33%	43%	10%
China	23%	48%	25%
Indonesia	23%	29%	6%


DFS and consumption per capita in selected Asian countries
Dietary diversity (% of calories from non-staples)
50
40
30
20
10
0
500
1000
1500
2000
2500
3000
Household consumption per capita (2005 international dollars)
China
1970-2010
India 1970-2010
Thailand
1965-1990
Indonesia
1970-2010
Bangladesh
1980-2010


DFS and consumption per capita in selected African countries
Dietary diversity (% of calories from non-staples)
50
40
30
20
10
0
500
1000
1500
2000
2500
3000
Household consumption per capita (2010 PPP dollars)
Ghana
1980-2010
Egypt
1970-2005
Ethiopia
1990-2010
Madagascar
1970-2010

Results

- Growth in consumption seems a strong predictor of diversification of food supplies, but substantial heterogeneity
- Heterogeneity may exist because of market failures limiting ability of national food systems to diversify food supplies
- May also be the result of demand-side factors (preferences)

Table 2. Correlated Random Effects and Fixed Effects regressions of the semi-log DFS model

Estimator	Fixed Effects	Correlated Random Effects
Consumption per capita	0.055*** (0.006)	0.059*** (0.012)
Education (years)	0.006 (0.012)	0.014 (0.024)
Urban population	0.066*** (0.011)	0.067*** (0.023)
Population ages 0-14 years	-0.095*** (0.018)	-0.088** (0.036)
Electricity consumption		-0.003 (0.012)
Road density		0.039*** (0.004)
Shipping costs		-0.002 (0.004)

	Fixed Effects	Correlated Random Effects
Suitable land		0.024*** (0.007)
Population density		-0.114*** (0.012)
Hills and mountains		0.006** (0.003)
Lowland areas		0.002 (0.003)
Groundwater depth		-0.014*** (0.005)
Average rainfall		-0.028*** (0.010)
Rainfall variation		-0.011 (0.007)
R-squared	0.870	
R-squared within		0.624
Number of observations	557	557

Table 3. Decomposing sources of DFS change for the full sample, 1961-2010

	Estimated β	Sample mean: 1961	Sample mean: 2010	Change in mean	Predicted DFS change	Share of predicted DFS change
Diversity of food supply		0.43	0.52	0.10	0.13	100%
Consumption per capita	0.06	7.58	8.58	1.00	0.06	41%
Urban population	0.07	3.47	4.09	0.62	0.04	31%
Population ages 0-14	-0.10	3.63	3.23	-0.40	0.04	28%

Conclusion

- First cross-country study explaining DFS with panel regressions
- Strong support for Bennett's (1941) law: growth matters!
- But other forms of structural transformation also explain DFS
- Road density explains DFS
- High population density, high rainfall, high groundwater predict lower diversity: may be related to rice production
- Ecology of irrigated rice production has poor suitability for growing other foods? (e.g. Bangladesh)

Conclusion

Policy implications?

- Economic growth and broader structural transformation are major drivers of diversification, but….
- Results provide a strong role for food policies too: *Diversification can be slow & hindered by production constraints*
- Critically important for food policies to focus on reducing the real price of nutrient-rich foods via production & trade interventions
- Dairy a particular example: dairy consumption in Bangladesh *very* low, domestic potential very limited ….

Thank you!