A New Final Demand System for GTAP?

Presented by

Thomas Hertel

Building on collaborative work with John Cranfield, Alla Golub, Paul Preckel, Robert McDougall, Tasneem Mirza, Jeffrey Reimer and Wusheng Yu

And inspired by the original work of Maureen Rimmer and Alan Powell!

Outline

- **Current demand system:**
  - **strengths and limitations**
- **Proposed demand system:**
  - **Private consumption**
  - **Regional household**
- **Illustration of strengths:**
  - **Projections: 1997-2025**
  - **Poverty analysis**
- **Estimation and calibration**
- **Limitations and future directions**

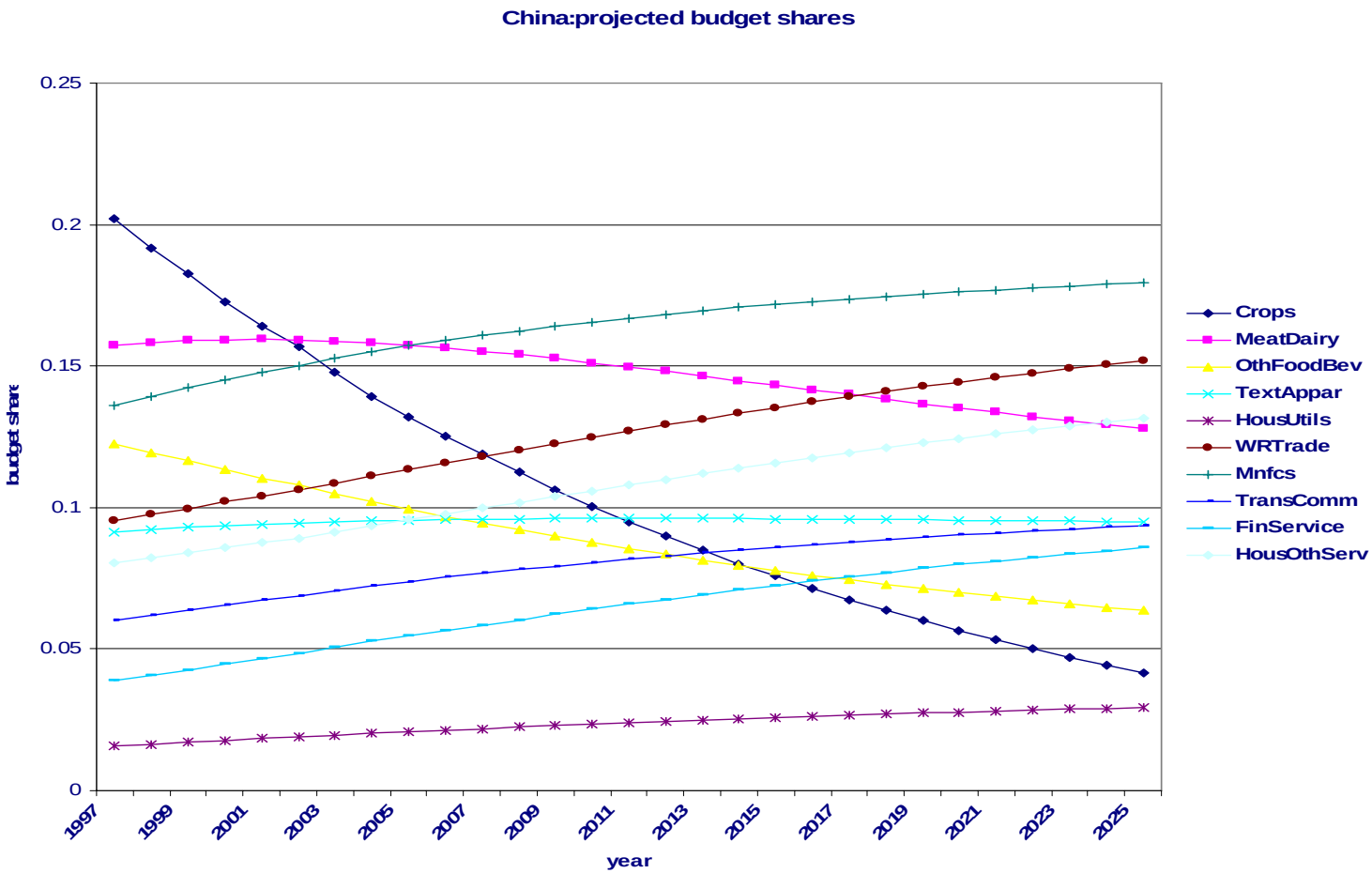
Current demand system

- **Strengths:**
  - **Flexible: CDE Calibrates to own-price and income elasticities of private demand**
  - **Two level theory: CD-CDE is worked out (elasticity of expenditure wrt utility drives changes in top level shares)**
  - **Robust: it has been used for 15 years!**
- **Limitations:**
  - **Ltd ability to capture behavior across wide range of per capita incomes; e.g., CDE luxuries today remain luxuries forever**
  - **Negative net national savings is problematic for CD top level**
  - **Not econometrically estimated (calibrate to elasticities obtained from estimation of other functional forms – LES/AIDADS)**

Proposed Demand System (1): Private Consumption via AIDADS

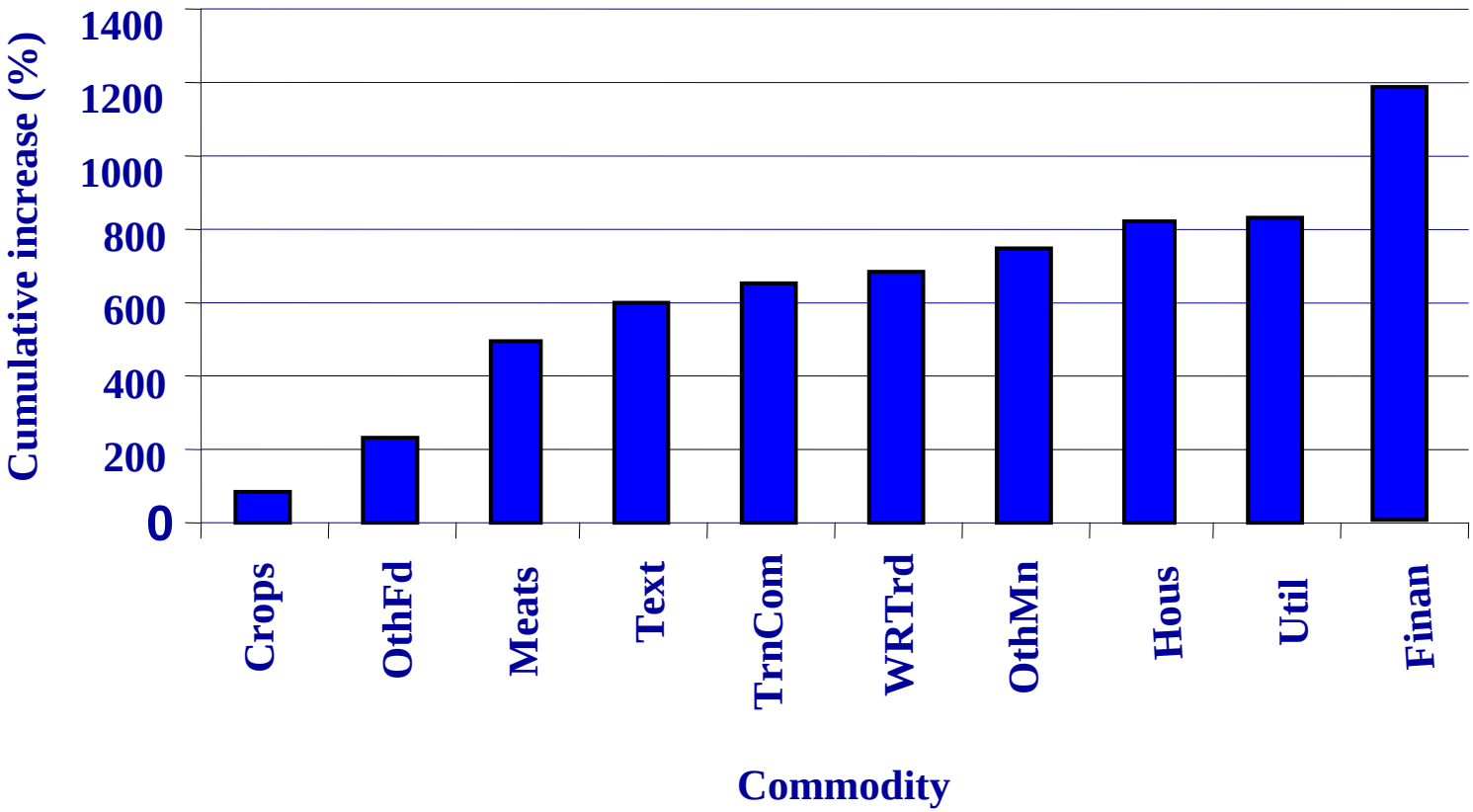
- **An Implicitly Directly Additive Demand System:**
  - **Invented by Powell and Rimmer in early 1990s**
  - **Goal of getting better performance for LR GE simulations**
- **Additivity: appropriate for broad groupings of goods**
- **Rank 3 = very flexible Engel curves**
- **3n-1 parameters govern the following:**
  - **Subsistence quantities (demanded regardless of price)**
  - **Marginal budget shares at subsistence level of income**
  - **Marginal budget shares for infinite income**
- **With 2n-1 parameters focused on behavior at low income levels, this is good for poverty analysis**

AIDADS Projections: *per capita* Shares for China: 1997-2025

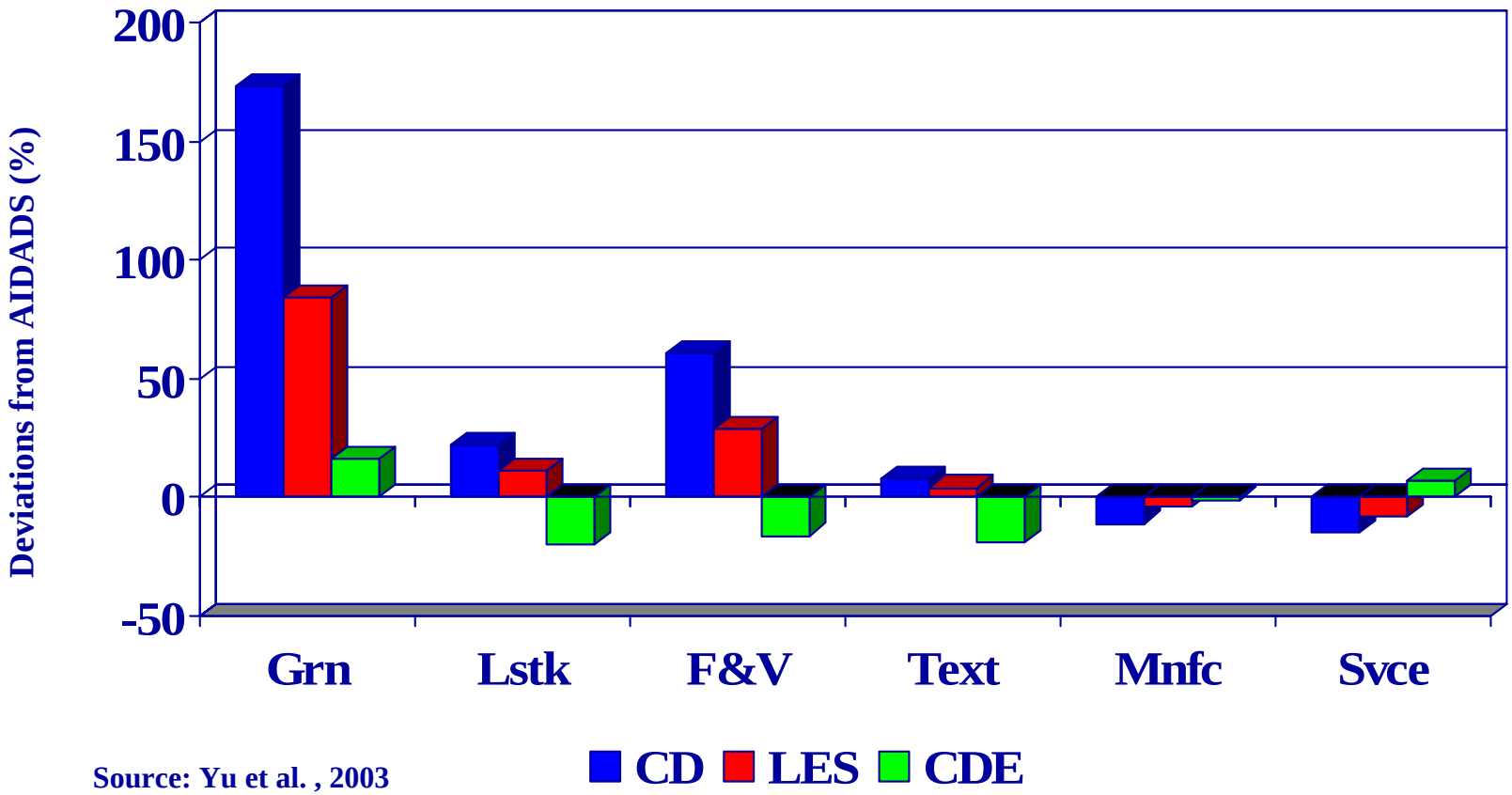


Note: based on calibrated version of estimated demand system in Reimer and Hertel, *assuming constant prices.*

Consumption Growth in China: 1997-2025



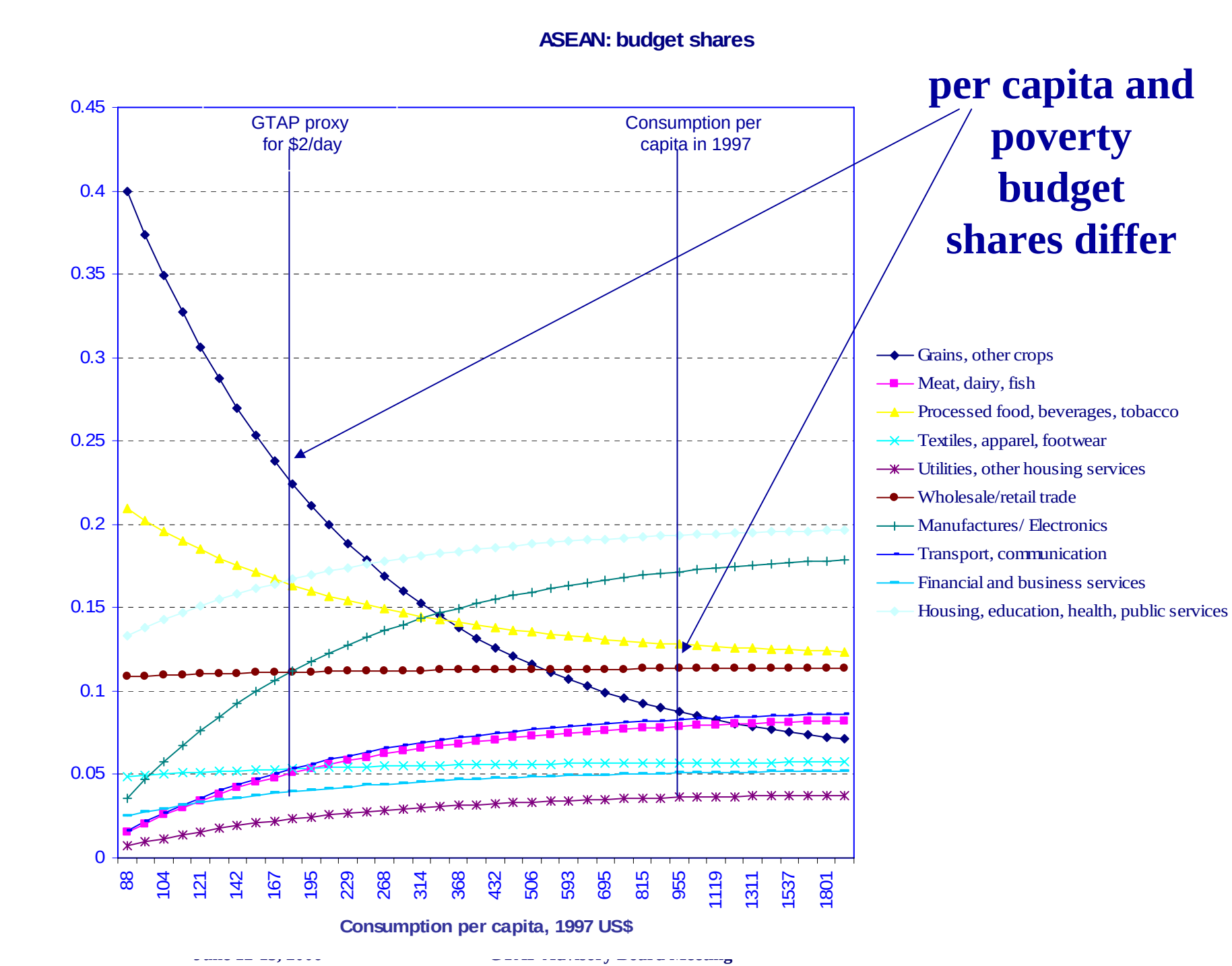
Comparison with other F.Forms: 1995-2020 Projections, NICs



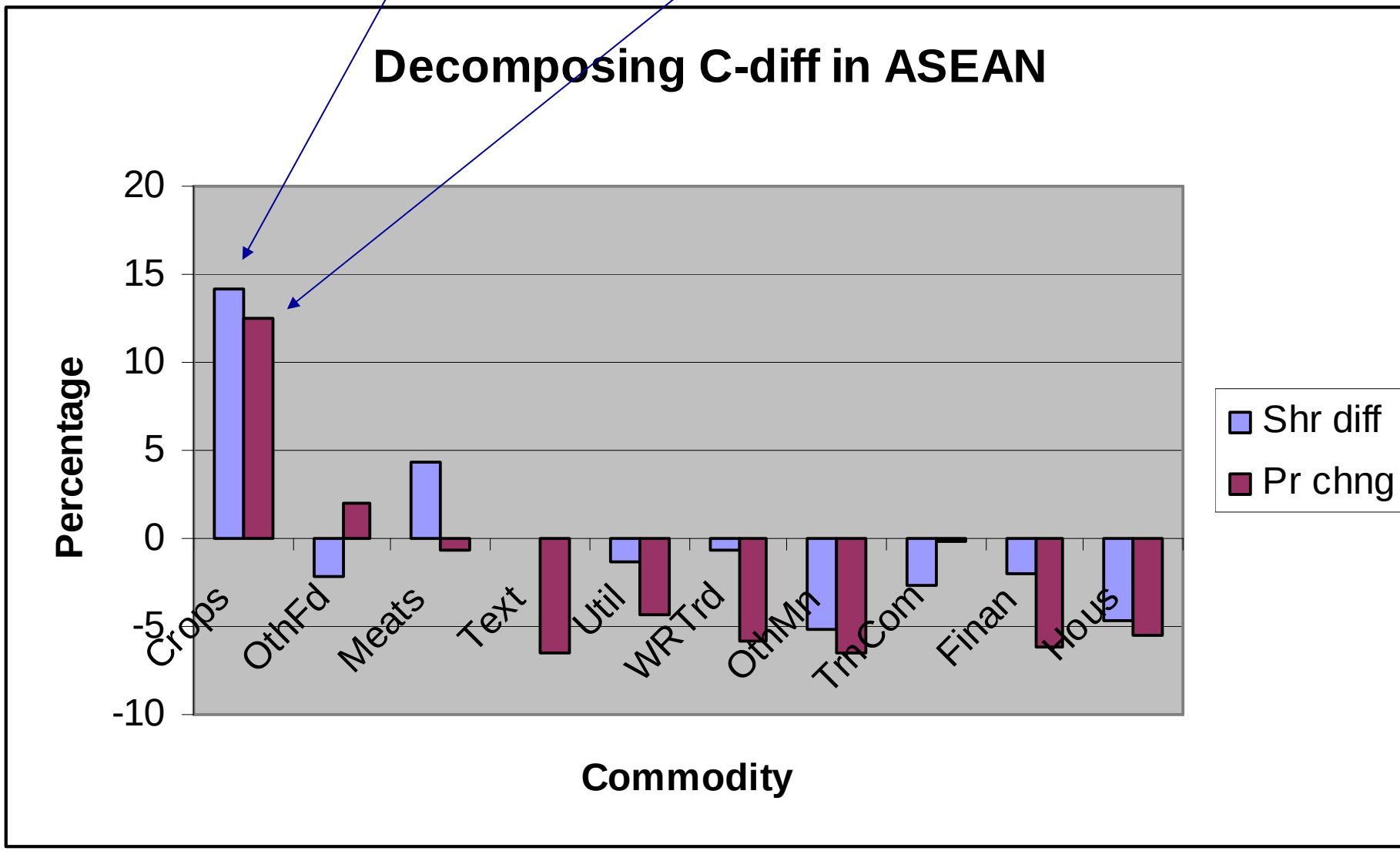
Source: Yu et al. , 2003

Poverty Analysis

- **To estimate poverty impacts of policy, need to deflate income with cost of living at poverty line; current approaches include using:**
  - **observed consumption bundle, if you can get it!**
  - **national CPI**
  - **food price index**
  - **explicit expenditure functions, but different for each group of households in the country**
- **AIDADS predicts spending patterns at poverty line *using common preferences*, nationwide: establishes common "poverty level of utility"**
- **Evaluate true cost of living, by computing expenditure associated with poverty level of utility for given prices**


ASEAN: budget shares
per capita and poverty budget shares differ
GTAP proxy for $2/day
Consumption per capita in 1997
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
88
104
121
142
167
195
229
268
314
368
432
506
593
695
815
955
1119
1311
1537
1801
Consumption per capita, 1997 US$
Grains, other crops
Meat, dairy, fish
Processed food, beverages, tobacco
Textiles, apparel, footwear
Utilities, other housing services
Wholesale/retail trade
Manufactures/ Electronics
Transport, communication
Financial and business services
Housing, education, health, public services

$$cdiff = -\sum_n \left(pcshr_n - povshr_n \right) p_n$$



The consumption side poverty impacts of China's growth are driven by higher food prices and lower svces & mnfcs prices

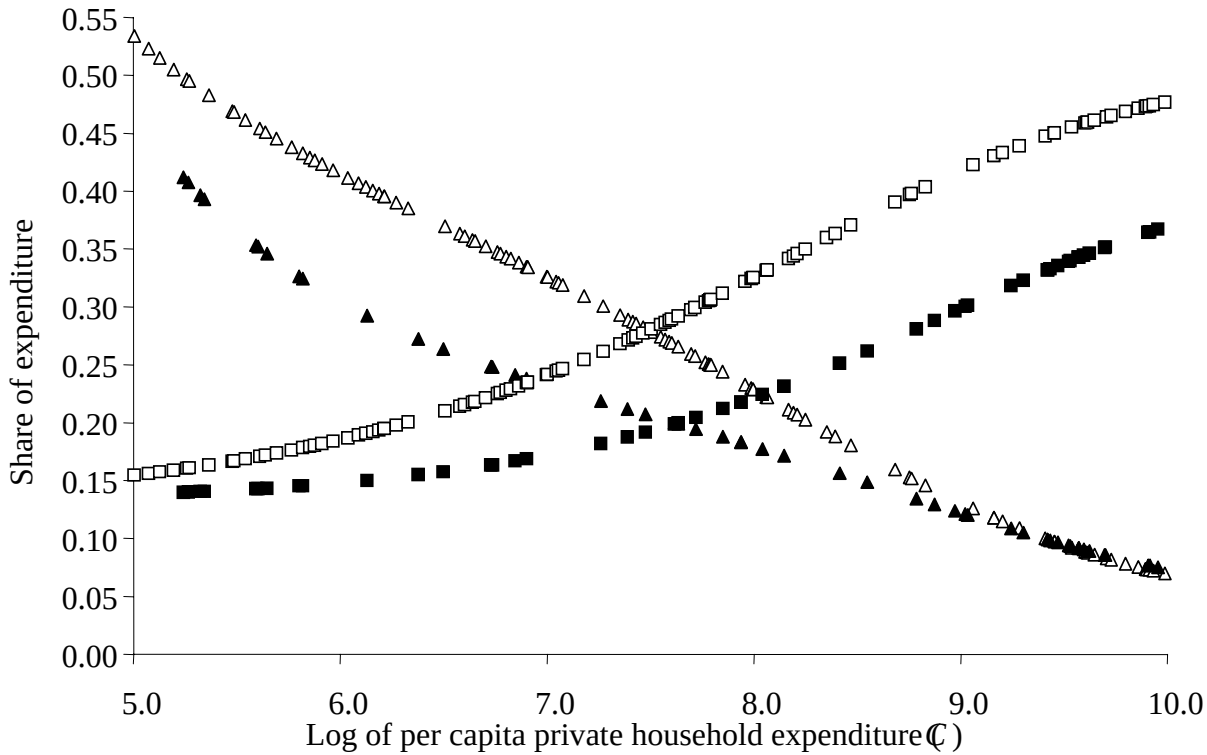
Proposed demand system (2): Leontief Regional Hhld Utility Function

- **McDougall shows (TP#20) that must account for varying elast of expend wrt utility in CDE in order to get "top level" CD system right:**
  - **"Cost" of private utility varies with income**
  - **Induces regional household to substitute towards government and savings**
  - **As a consequence, share of C in net national expenditure falls with rising per capita income, shares of G, S rise**
- **Can circumvent this "feature" by substituting Leontief utility fnc for regional hhld:**
  - **While plausible, no empirical basis for rate of decline of C**
  - **Greatly simplifies code and analysis, teaching too!**

Proposed demand system (3): Estimation

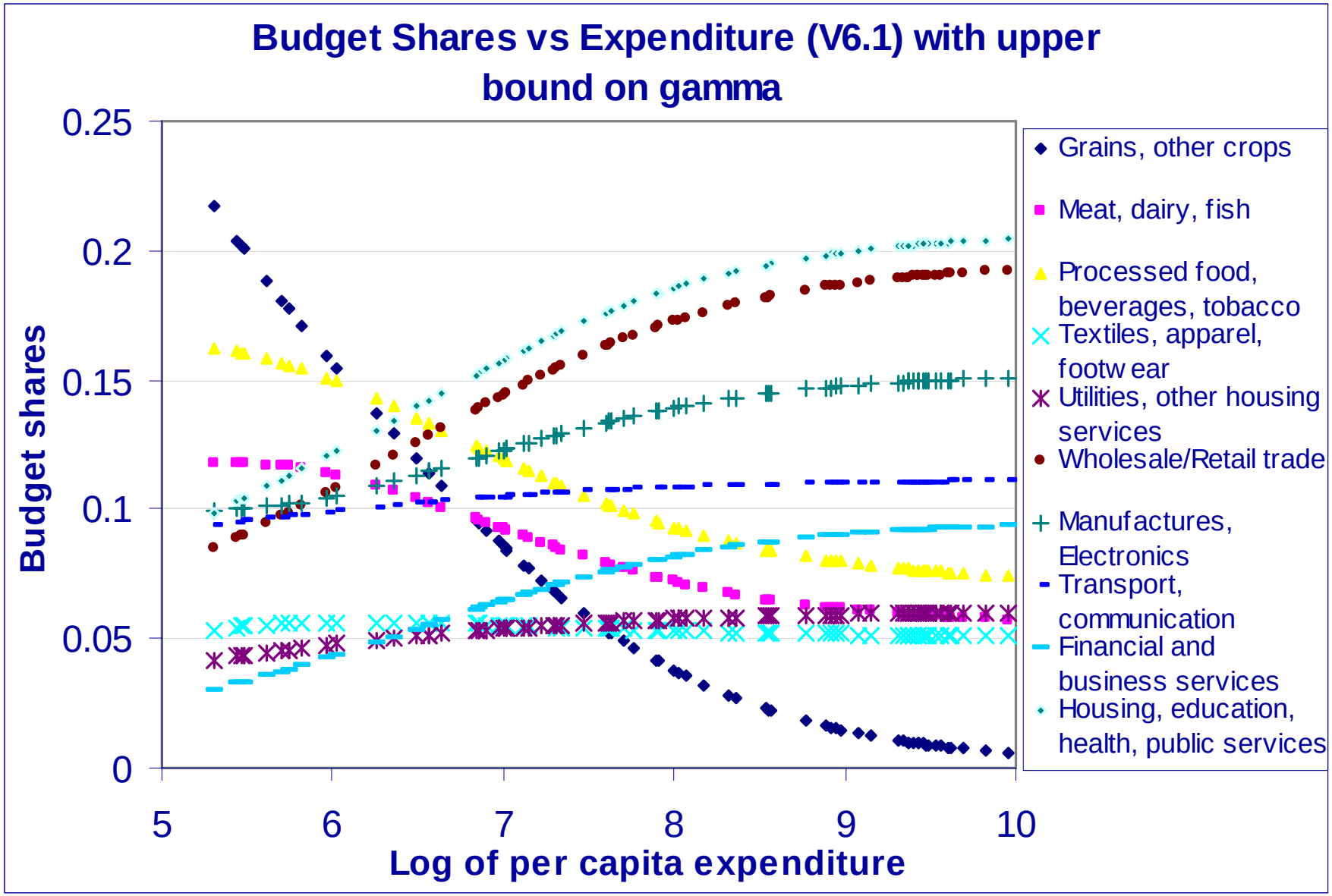
- Early work involved estimation on ICP data:
  - Conforms with international literature
  - But requires transition matrix to GTAP sectors
- Reimer first to directly estimate on GTAP data
- Estimate on all authentic countries in GTAP:
  - Budget shares evaluated at producer prices
  - W/R/T margins become separate demand category
  - Tremendous variation in per capita income
  - Price variation from border wedges only

GTAP- and ICP-based Estimate Yield the Same Behavior



Source: Reimer and Hertel

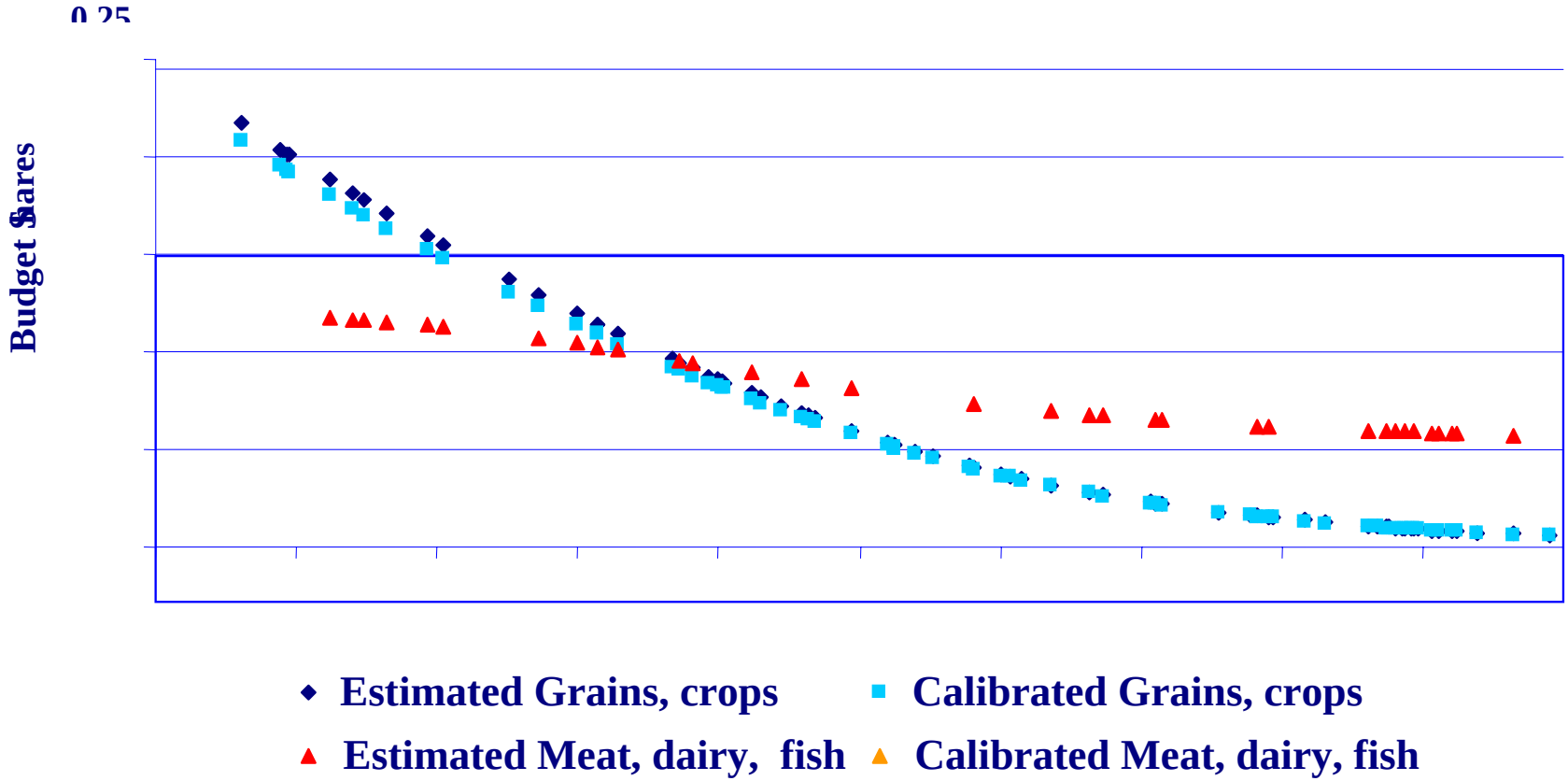
GTAP Version 6.1 Estimates



Proposed Demand System (4): Calibration

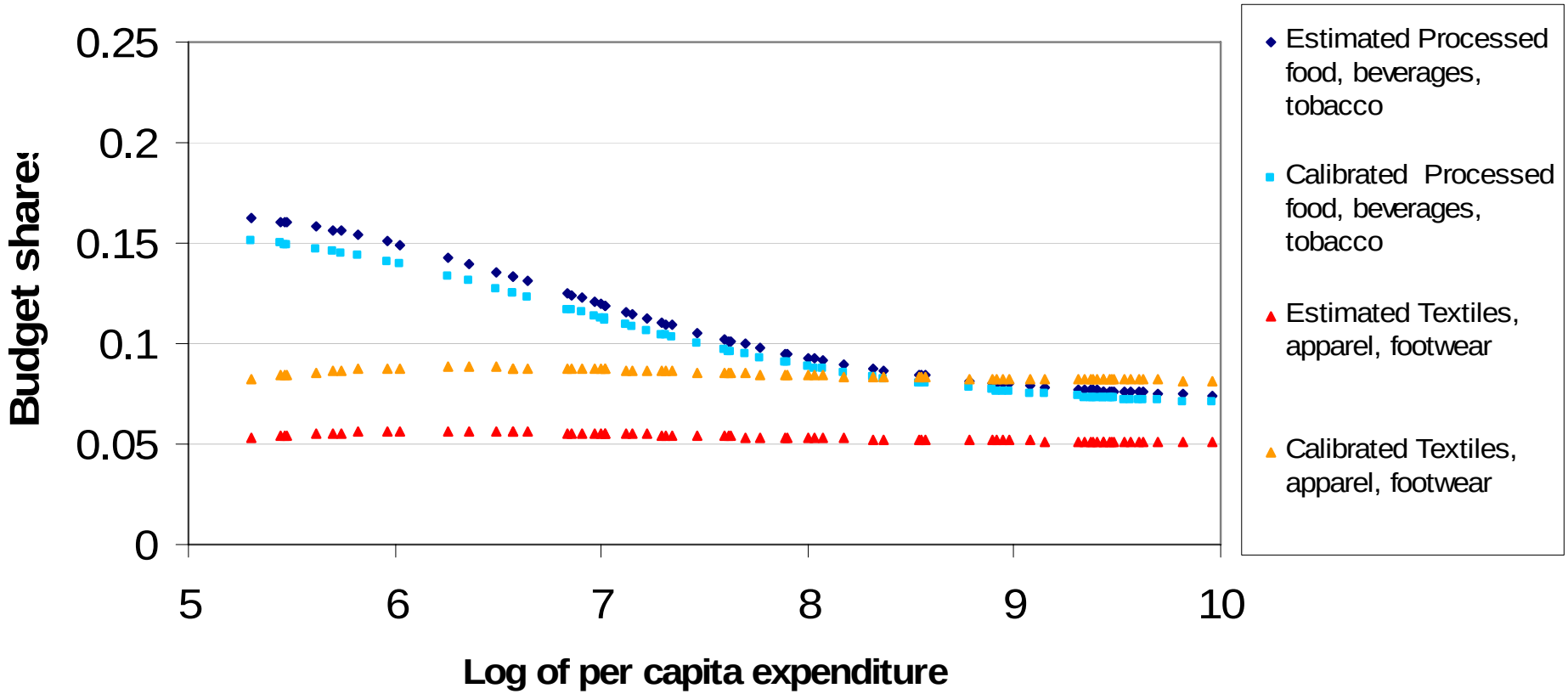
- **Need for Calibration:**
  - **Estimation assumes common preferences but national eccentricities as well as unmeasured price variation are reflected in error term**
  - **Demand system must predict observed per capita expenditures to conform with GTAP v.6 benchmark**
- **Calibration Strategy:**
  - **Leave subsistence quantities unchanged: these are determined based on basic human requirements**
  - **Adjust min/max marginal budget shares in equal proportions:**
    - **Preserve overall shape of expenditure share curves**
    - **Retain adding up property of demand system**
- **Examine Results for China:**
  - **Predicted based on international preferences**
  - **Calibrated to fit observed 2001 consumption shares**

Estimated and Calibrated Budget Shares for 'Grains, Crops' and 'Meat, Dairy, Fish'

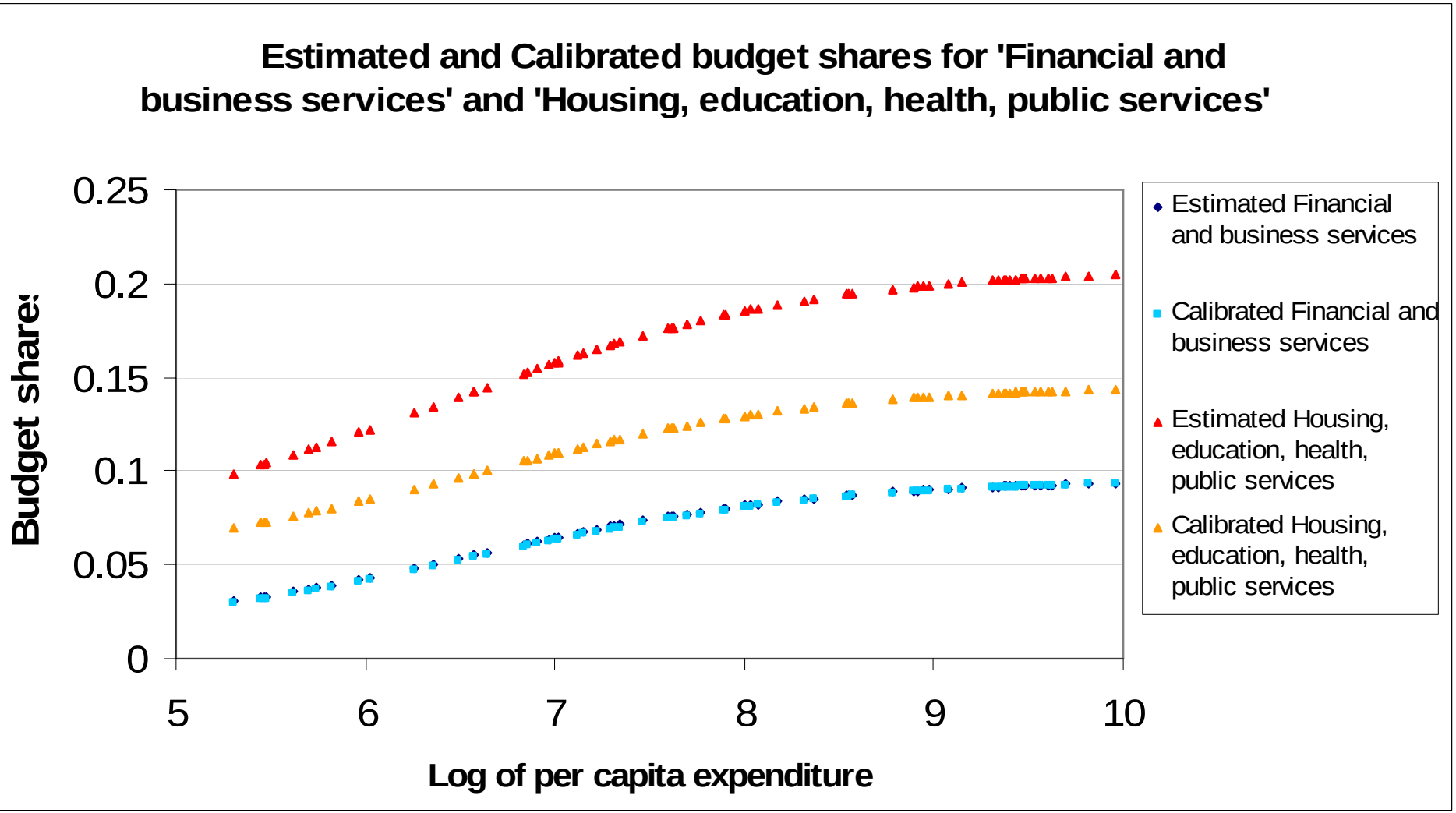


Note: In the case of China, the international demand system under-estimates meat consumption

Estimated and Calibrated budget shares for 'Processed food, beverages, tobacco' and 'Textiles, apparel, footwear'



Note: In the case of China, the international demand system under-estimates textiles and apparel consumption



Note: In the case of China, the international demand system over-estimates housing, education and health spending

Limitations and Future Directions

- **Aggregation:**
  - **Estimation at 10 good level = maximum**
  - **Below that form composite goods**
- **Complexity: estimation and calibration are extra steps that may be required for new aggregations (when countries or composites change)**
- **GTAP-based estimation has limited price variation, but doesn't appear to matter much:**
  - **since AIDADS is restrictive in price space**
  - **need to extend f. form to permit greater flexibility (Paul Preckel is working on this)**