Meat Demand Analysis in Urban China: To Include or Not to Include Meat Away from Home?

Junfei Bai (Center for Chinese Agricultural Policy, CAS)
Thomas Wahl (Dept. of Agribusiness & Applied Econ, NDSU)
James Seale Jr. (Food & Resource Economics, UF)
Bryan Lohmar (U.S. Grains Council China)

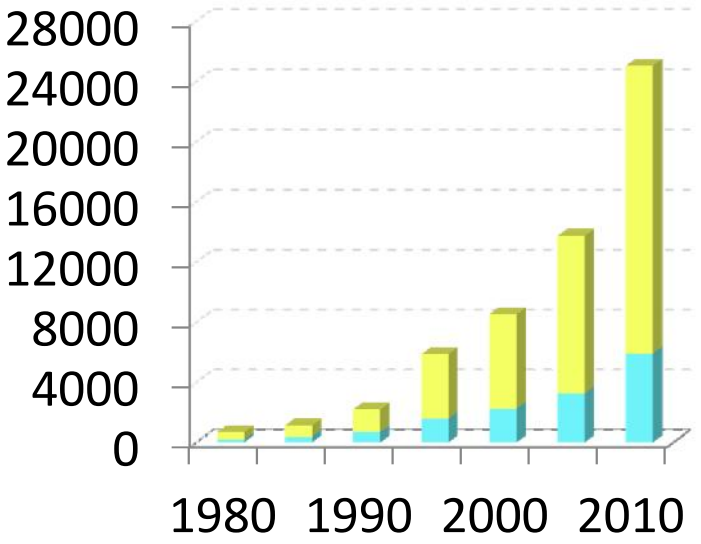
Presented at 2012 IATRC Conference, San Diego, CA
December 10, 2012

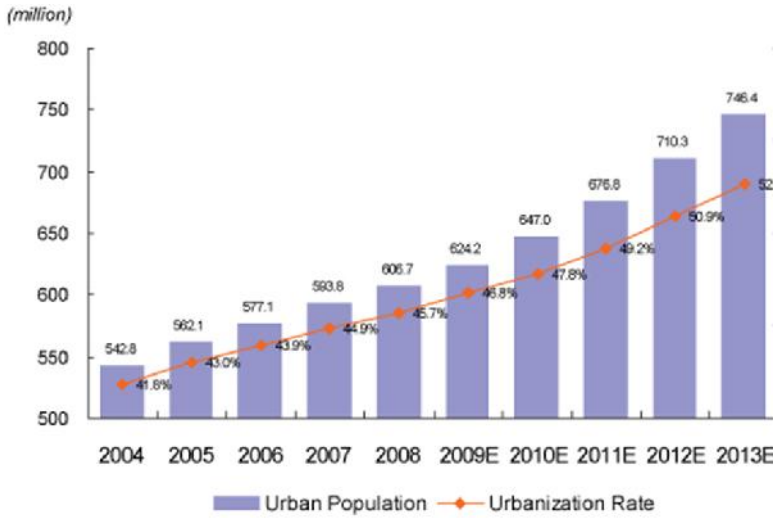
Content

- Background and motivation
- Survey and data
- Methodology
- Empirical results discussion
- Conclusions

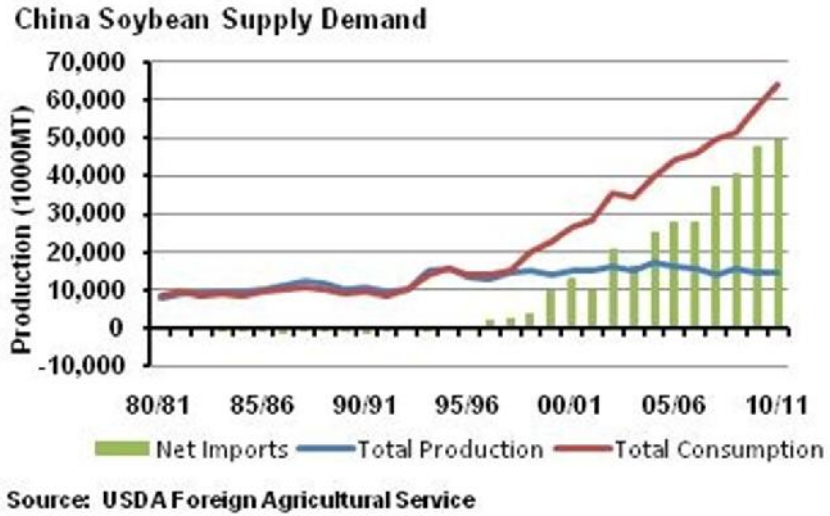
Background & Motivation

- Economic growth over the last three decades;
- Urbanization (50% of population live in urban);
- Chinese diet is shifting rapidly from the one centered on staple foods to the one incorporated with more animal products, which raises concerns:
  - China's ability to feed animals, or rely on the world market for feed purchases?
  - Self-sufficient rate of meat?

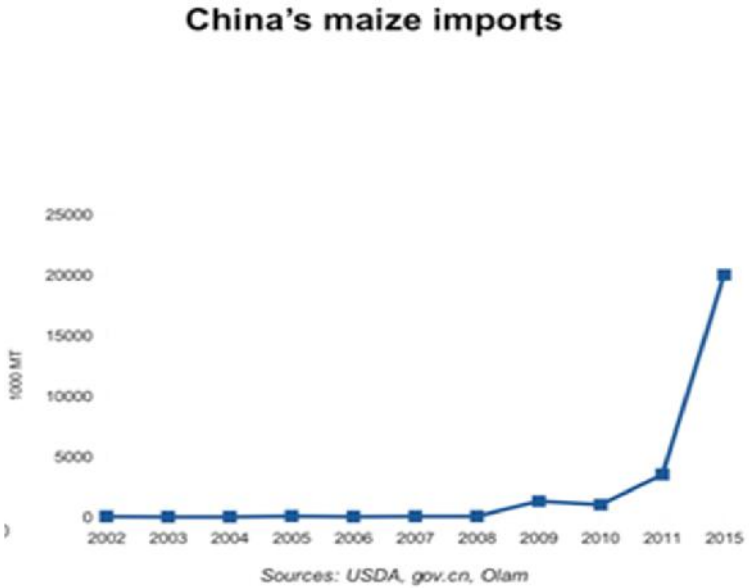




Background & Motivation



Source: USDA Foreign Agricultural Service



- China has been importing soybean for many years, most of soy meal used for livestock feed;
- China has started importing maize from world market since 2009, and maize imports have increased rapidly since then.

Background & Motivation

- Meat demand?
  - Zhong *et al*. (1997): “be careful of NBS meat data”
  - Ma *et al*. (2006): “Discrepancy between production and consumption reported by NBS—pork supply is likely 45% higher than demand”
- Most of related researches are based on the NBS-UHIE survey data in which meat consumed away from home is very likely underestimated (Fan *et al.*, 1995; Gao *et al*. 1997; Huang et *al*. 1999; Dong *et al*. 2010).

Objectives

- To empirically answer how much meat is consumed away from home (MAFH);
- To re-estimate expenditure and price elasticities by incorporating MAFH into a demand system ;
- To test effects of demographic and socioeconomic factors on meat demand

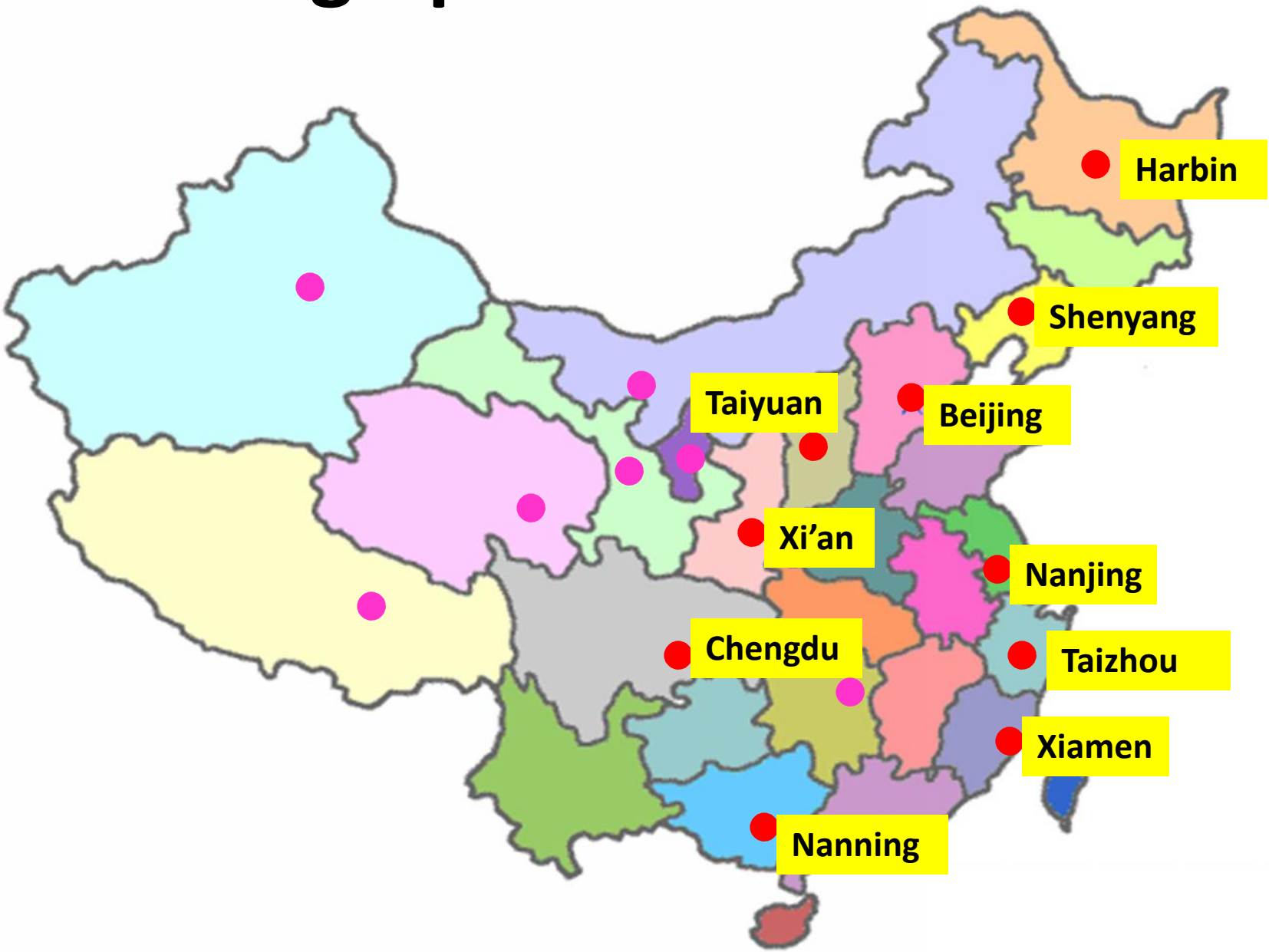
Data

- Overview of the survey—subset of NBS-UHIE households by stratified and random sampling in six cities:

City	Year	Sample Size	City	Year	Sample Size
Beijing	**2007**	**315/1,000HH**	**Harbin**	**2012**	**200HH**
Nanjing	**2009**	**246/700HH**	**Taiyuan**	**2012**	**200HH**
Chengdu	**2010**	**208/700HH**	**Nanning**	**2012**	**200HH**
Xi'an	**2011**	**215/600HH**	**Taizhou**	**2012**	**180HH**
Shenyang	**2011**	**149/300HH**	Lanzhou	**2012**	**200HH**
Xiamen	**2011**	**207/600HH**			

- Method: 3-meal/7-day diary record

Geographic Distribution



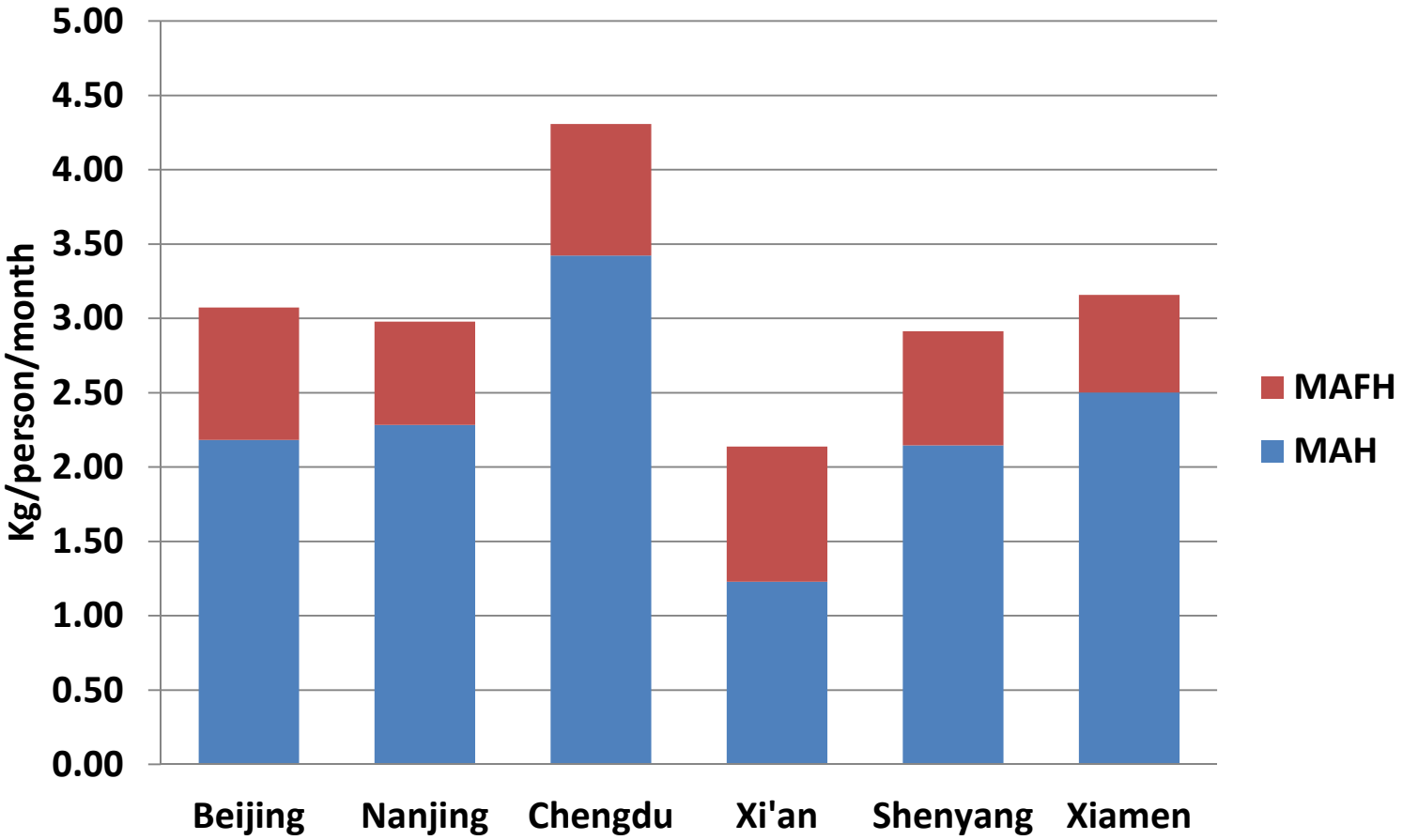
Mapping Dishes Into **79** **Commodities**

Recipe Matrix

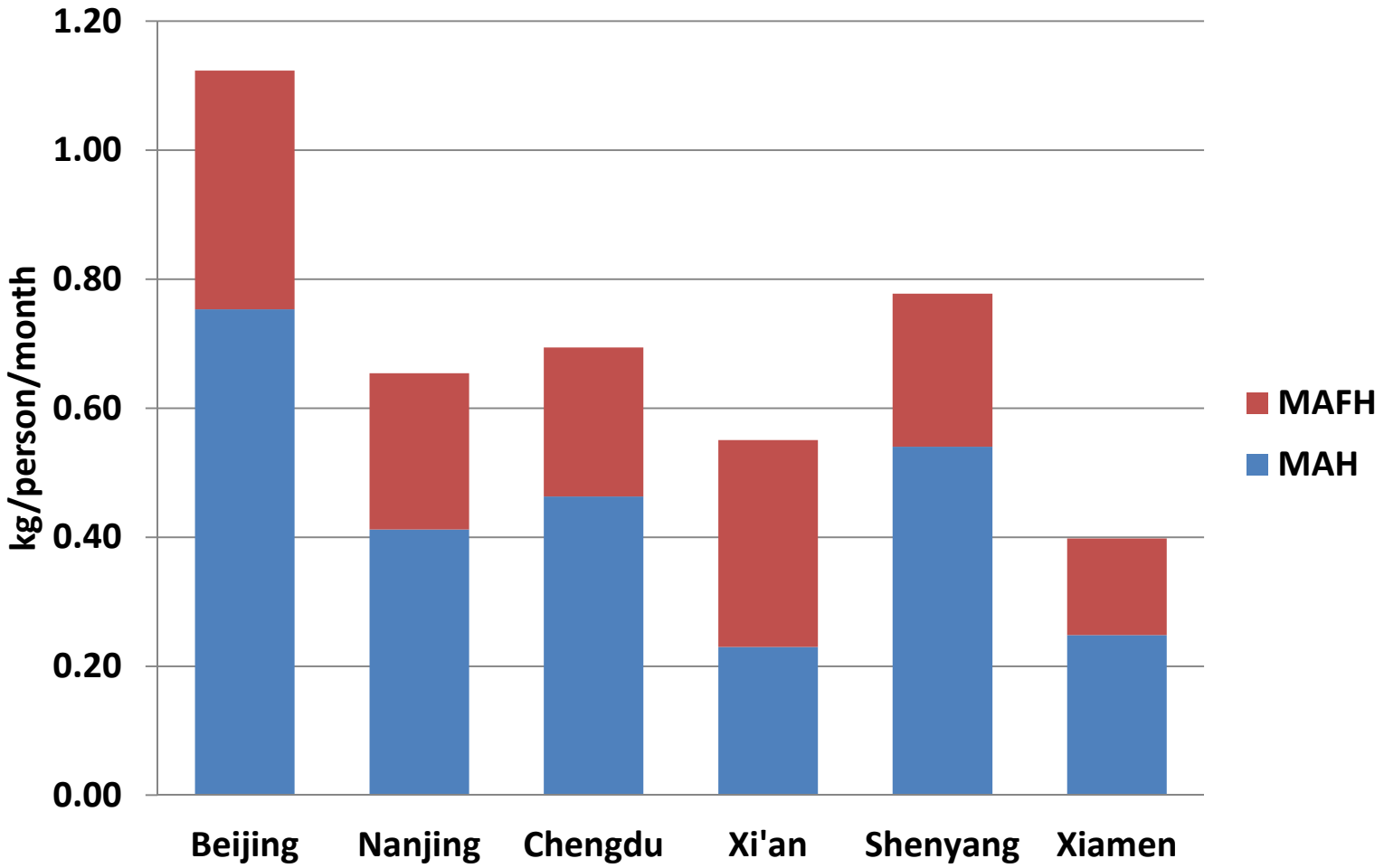
(1) 32 different cook books, about 9000+ recipes

(2) 50 chef surveys for unknown recipes & parameter estimation to adjust weight by type of food facility

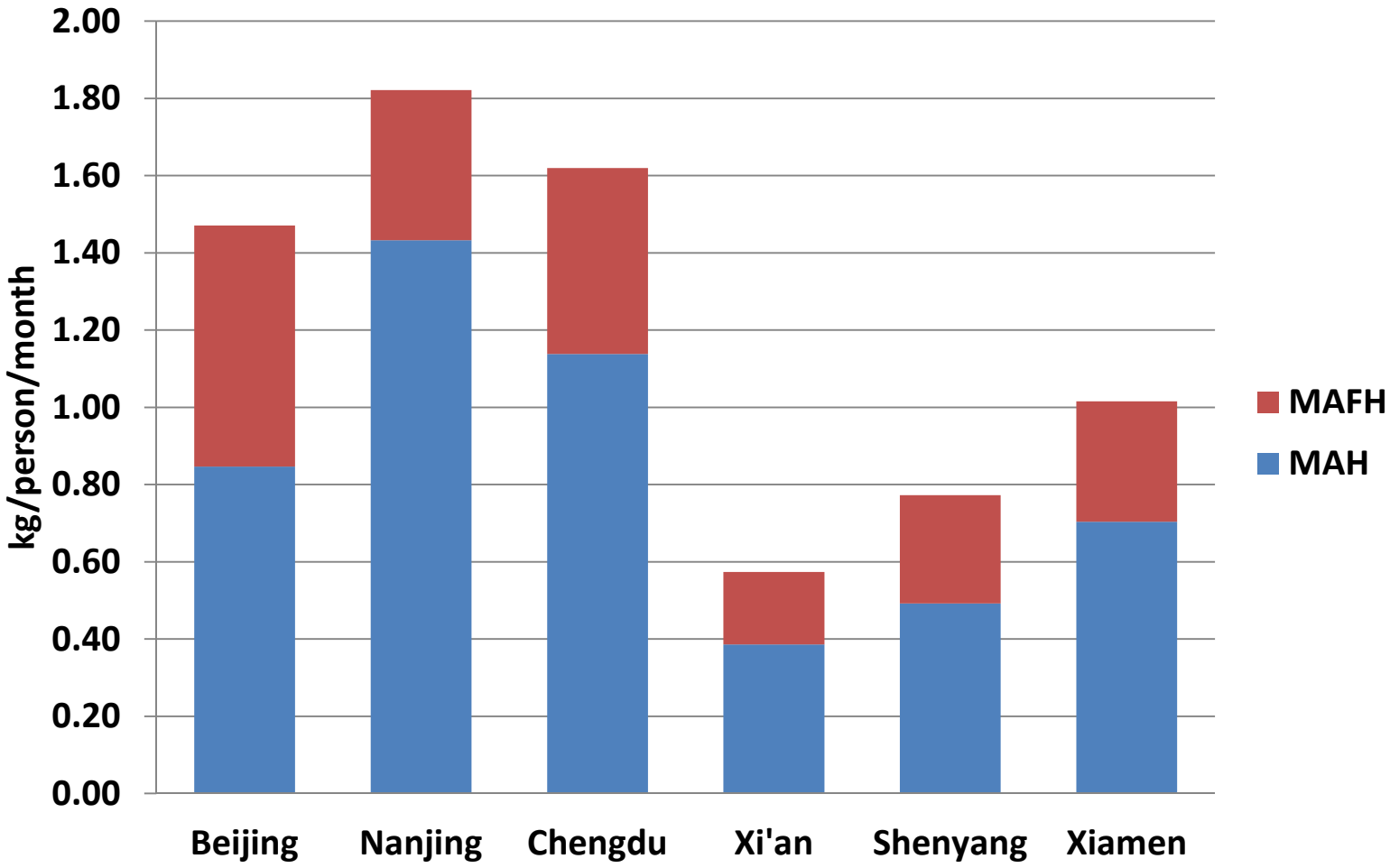
Role of MAFH-Pork



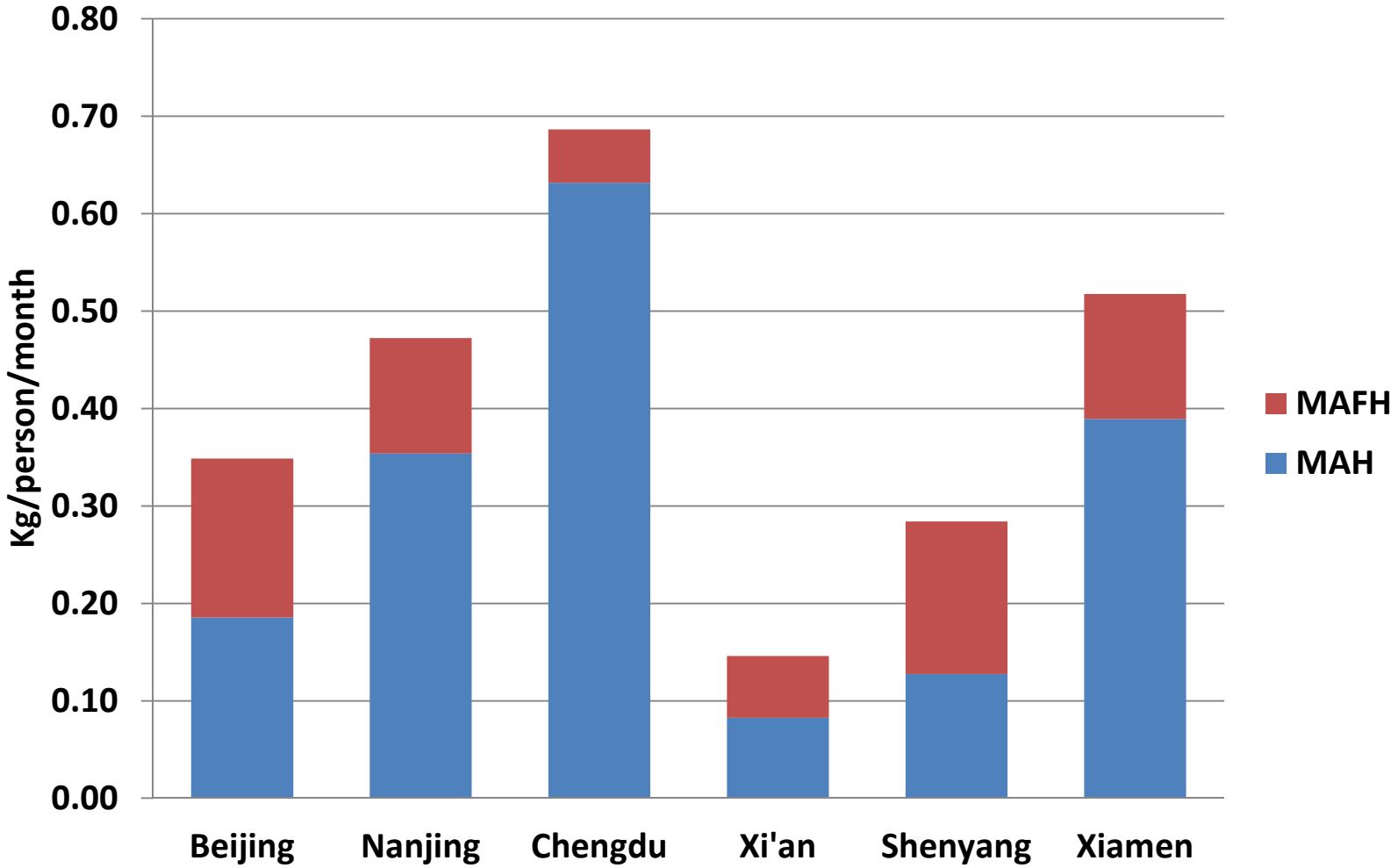
Role of MAFH-Beef & Mutton



Role of MAFH-Poultry

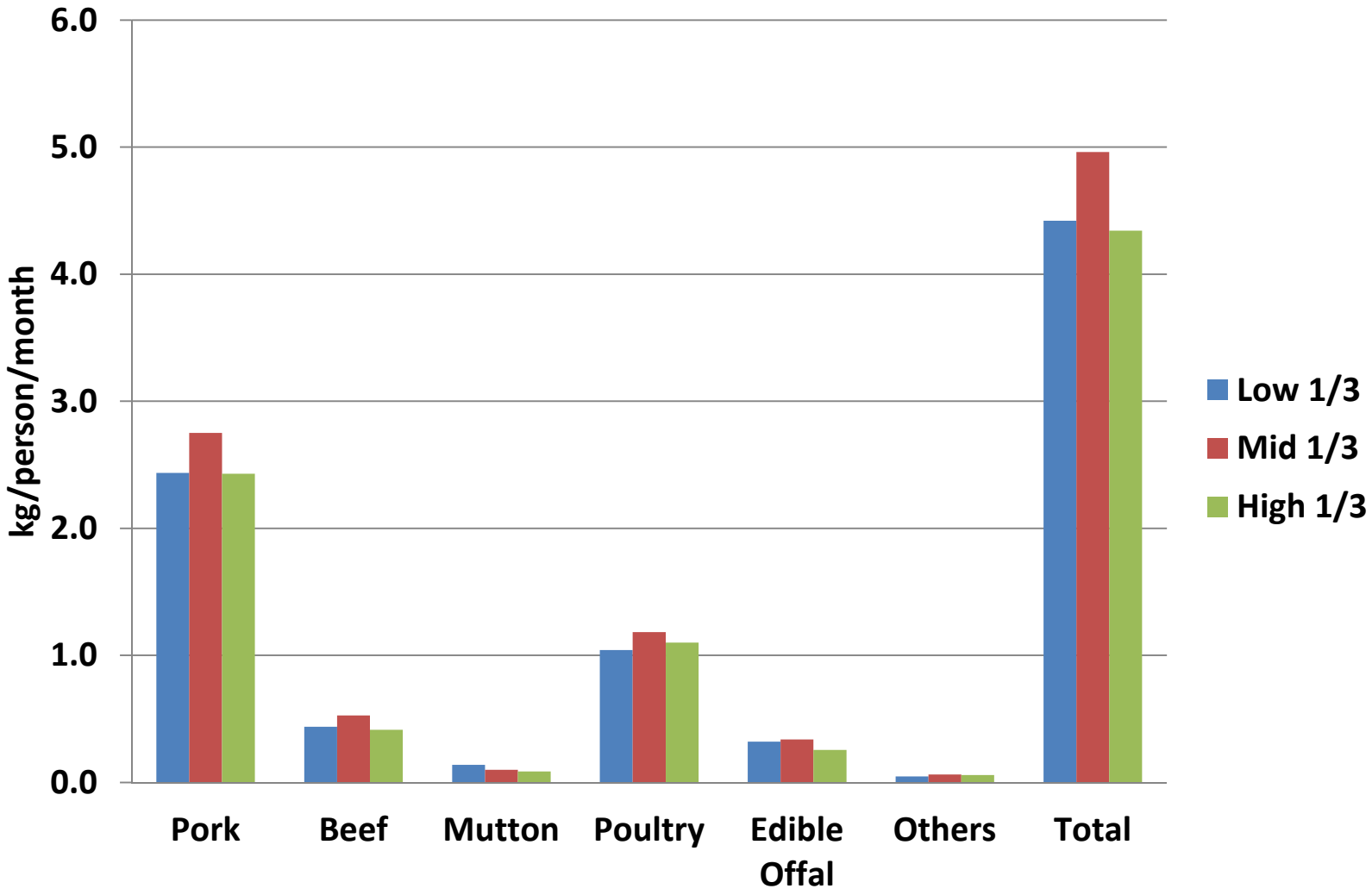


Role of MAFH-Other Meats



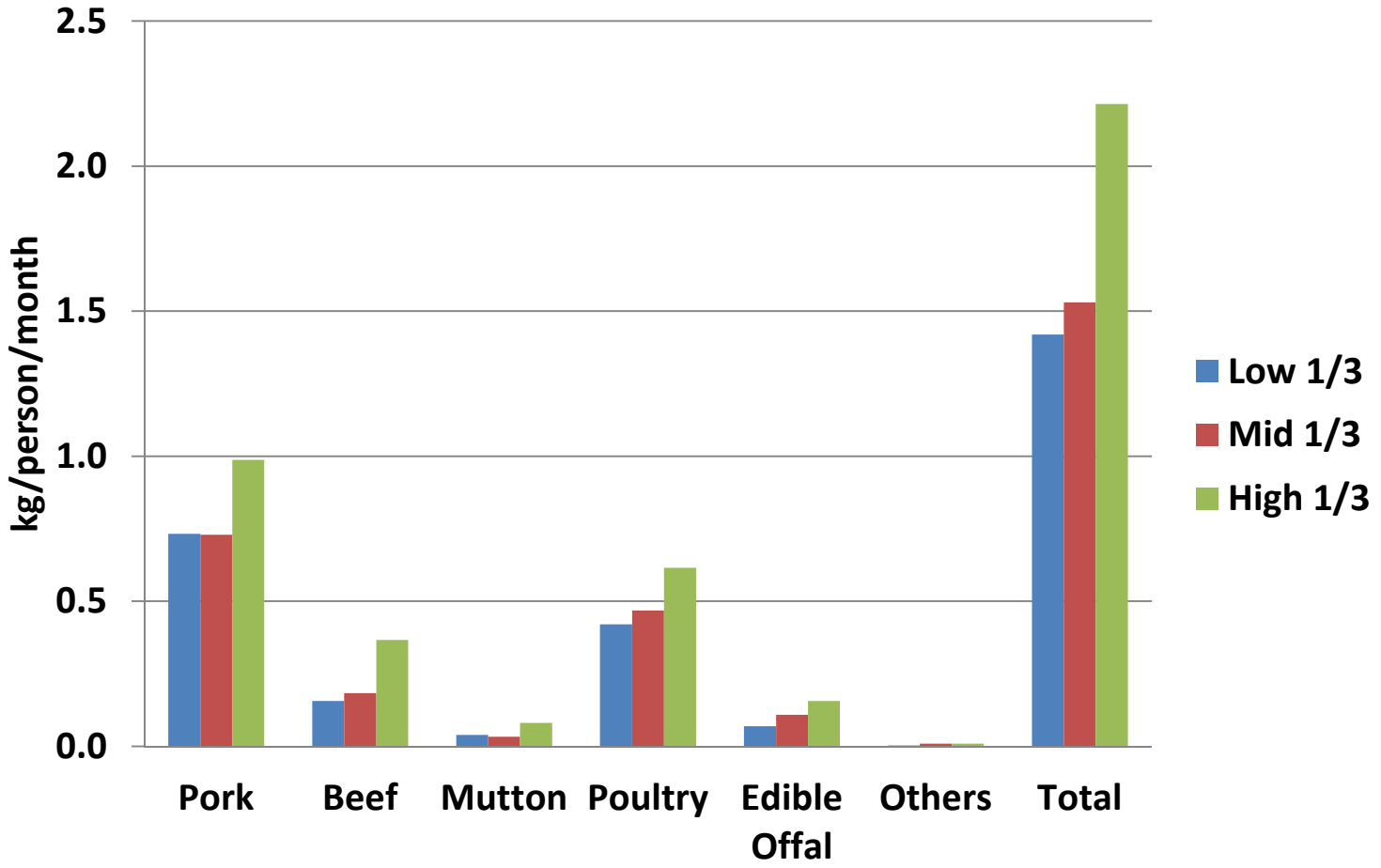
Income Effect:

Inverted-U shape for MAH

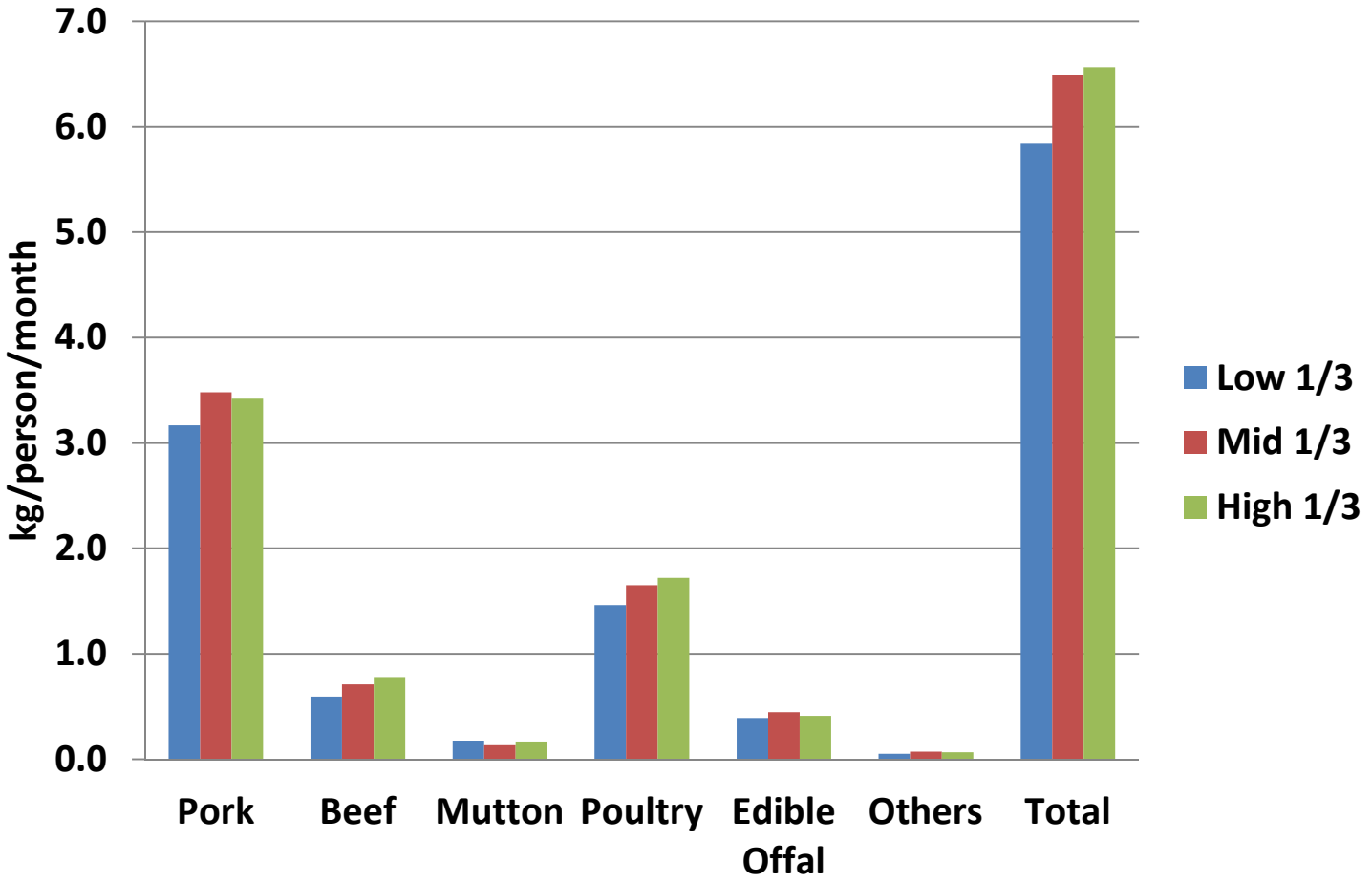


Income Effect:

Monotonously increasing for MAFH



Income Effect:
Increasing for MAH & MAFH



Methodology

Quadratic Almost Ideal Demand System (QUAIDS) (Deaton and Muellbauer 1980; Banks *et al*. 1997):

$$w_i = \boldsymbol{\alpha}_i + \boldsymbol{\beta}_i \ln\left(\frac{M}{P}\right) + \frac{\mathsf{a}_i}{b}\left[\ln\left(\frac{M}{P}\right)\right]^2 + \sum_{j=1}^{n} ¥_{ij} \ln p_j + £_i$$

$$b == \prod_{i=1}^{n} p_i^{\boldsymbol{\beta}_i}$$

$$\ln P = \sim_0 + \sum_{j=1}^{n} \boldsymbol{\alpha}_i \ln p_j + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \ln p_i \ln p_j$$

$$\sum_{i=1}^{n} \sim_i = 1,\ \sum_{\mathrm{i=1}}^{\mathrm{n}} \quad_i = 0,\ \sum_{i=1}^{\mathrm{n}} \mathsf{a}_i = 0,\ \text{and}\ \sum_{1=1}^{n} ¥_{ij} = 0$$

$$\sum_{j=1}^{n} ¥_{ij} = 0 \qquad ¥_{ij} = ¥_{ji}\ \forall i, j$$

Methodology

- Two-step estimator for censored demand system (Shonkwiler and Yen, 1999)

$$w_{it}^{*} = f\left(\mathbf{x}_{it}, \boldsymbol{\beta}_i\right) + £_{it}, \qquad d_{it}^{*} = z_{it}^{'}\boldsymbol{\alpha}_i + ³_{it}$$

$$d_{it} = \begin{cases} 1 \text{ if } d_{it}^{*} > 0 \\ 0 \text{ if } d_{it}^{*} \le 0 \end{cases} \qquad w_{it} = d_{it} w_{it}^{*}$$

$$\left(i = 1,....,n,\ t = 1,....,T\right)$$

$$E\left(w_{it} \mid \mathbf{x}_{it}, \mathbf{z}_{it}\right) = \Phi\left(\mathbf{z}'\boldsymbol{\alpha}_i\right) f\left(\mathbf{x}_{it}, \boldsymbol{\beta}_i\right) + ¶_i^{¨}\left(\mathbf{z}'\boldsymbol{\alpha}_i\right)$$

$$w_{it} = \Phi\left(\mathbf{z'}\boldsymbol{\alpha}_i\right) f\left(\mathbf{x}_{it}, \boldsymbol{\beta}_i\right) + ¶_i^{¨}\left(\mathbf{z'}\boldsymbol{\alpha}_i\right) + ş_{it}$$

Estimated Exp. & Own-price Elasticities

	8-equation system		4-equation system	
	Expenditure	Unconditional Marshallian	Expenditure	Unconditional Marshallian
FAH				
Pork	0.676***	-0.814***	0.871***	-0.856***
	(0.02)	(0.02)	(0.01)	(0.02)
Beef & Mutton	0.936***	-1.266***	1.408***	-1.553***
	(0.06)	(0.13)	(0.04)	(0.11)
Poultry	1.239***	-0.453***	1.280***	-0.634***
	(0.06)	(0.07)	(0.04)	(0.07)
Other meat	0.784***	-0.623***	1.030***	-1.639***
	(0.12)	(0.19)	(0.06)	(0.23)
FAFH				
Pork	1.129***	-0.998***		
	(0.03)	(0.06)		
Beef & Mutton	1.624***	-1.310***		
	(0.06)	(0.13)		
Poultry	1.601***	-0.878***		
	(0.07)	(0.12)		
Other meat	1.887***	-1.014***		
	(0.16)	(0.27)		

Comparison of Expenditure Elasticities

	Exp. Elas. (4-eq.)	Weighted Exp. Elas. (8-eq.)
Pork	0.871	0.861
Beef & Mutton	1.408	1.330
Poultry	1.280	1.435
Other meat	1.030	1.367

Own- & Cross-Price Elasticities

	Pork	Beef& Mutton	Poultry	Other meat	Pork	Beef& Mutton	Poultry	Other meat
Pork	-0.553***	1.510***	0.157	2.218***	0.677***	1.143***	1.308***	1.867***
Beef & Mutton	0.138***	-1.185***	0.045	-1.076***	0.117**	-0.022	0.021	-0.956***
Poultry	-0.026	0.406**	-0.308***	-0.070	0.123**	0.350**	0.255**	0.723*
Other meat	0.049**	-0.598***	-0.348***	-0.590***	0.016	-0.289**	-0.220**	-1.283***
Pork	0.092***	0.164*	-0.082	0.100	-0.795***	-0.191*	-0.470***	-0.609*
Beef & Mutton	0.094***	0.071	0.106*	-0.128	-0.025	-1.178***	-0.092	-0.046
Poultry	0.138***	0.244**	0.164**	0.315**	-0.063	0.109	-0.752***	0.303
Other meat	0.057***	-0.103	0.119***	-0.223*	0.027	0.070	-0.003	-0.960***

Summary

- MAFH accounts for a significant proportion of meat consumption. Projection based on data excluding MAFH could inaccurate and misleading.
- MAFH have consistently higher expenditure elasticities and own-price elasticities, suggesting that with income and total meat expenditure increases, MAFH consumption will increase more than proportionately to total meat expenditure.

Summary

- Household expenditure on poultry, beef and mutton will increase more than proportionately to total meat expenditure with income increases.
- MAFH consumption is more price-responsive than MAH, especially for beef & mutton

Acknowledgement

- This project is jointly funded by NSF of China, USDA AFRI and EMP grants, and Chinese Academy of Sciences.
- Team includes:
  - Chinese Academy of Sciences
  - North Dakota State University
  - University of Florida
  - Washington State University
  - Economic Research Services & Foreign Agricultural Service, USDA