Consumer Acceptance of Biotech Foods in China

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Objectives of the Presentation

To provide an overview of the acceptance of biotech foods by consuming public in China

- **Lay out key issues and results from previous related studies**
  - *Consumer attitudes*
  - *Willingness to pay (WTP)*
- **Present results from a case study of vegetable oils in Nanjing, China based on retail scanning data:**
  - *How does biotech labeling affect consumers' purchasing decisions?*

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Previous Related Studies: Consumer Attitudes

- **City-Specific Studies**

  – Telephone interviews with over 500 households in Nanjing, summer 2002 (Zhong, Marchant, Ding, and Lu, 2002)

  – Personal interviews with about 600 respondents in Beijing, August 2002 (Li, Curtis, McCluskey, and Wahl, 2003)

  – A Consumer survey with about 600 respondents conducted in Beijing, August 2002 (Curtis and Moeltner, 2006)

  – Personal interviews with 671 consumers for GM vegetable oil in Beijing, winter 2002 and spring 2003 (Hu and Chen, 2004)

- **Multiple-City Studies**

  – Asia Food Information Center consumer survey with about 200 respondents in Beijing, Shanghai and Guangzhou, 2002 (AFIC, 2003)

  – A large-scale survey with 1,100 consumers in 11 small to large cities along the eastern coast of China conducted in fall 2002 (Bai, 2003; Qiu, 2005)

  – A four-city survey with about 2,000 respondents in Zhejiang province conducted in summer 2003 (Lu, 2006)

  – A survey of almost 1,000 consumers in Beijing and Shijiazhung in Sept. 2003 (Ho and Vermeer, 2004)

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Key Findings from Previous Studies

- **While 40-70 percent of urban consumers had heard about biotech foods, their basic understanding and knowledge of biotechnology is limited**
  –Those who "know something" accounted for 1-40 percent of total responses

- **About 40-65 percent of the urban consumers were willing to accept biotech foods**
  – The percentage went up to as much as 80 percent if biotechnology is characterized with less pesticide use

- **The percent of respondents who had a neutral position about biotech foods ranges from 7% to 51%**

- **Mixed effects on consumer acceptance:**
  – Higher education
  – Awareness
  – demographic variables, such as gender and age

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Key research issues

- **All previous related studies are survey-based, which is subject to hypothetical bias**
  – Leading to the use of "cheap talk" to address this bias (e.g., Lusk)
- **Consumer acceptance of biotech foods depends on how the question was asked**
  – Consumer acceptance goes up if biotechnology is characterized with less pesticide use
- **The beta-coefficient of the awareness variable in the logit or probit model is biased because of the interdependence between the awareness variable and error term**
- **Potential endogenity of a few explanatory variables in the probit model, such as awareness and trust in information accuracy from mass media**
- **Consumer attitudes toward biotech foods are mostly estimated outside of the context of price differentials between biotech and non-biotech foods**

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Previous Related Studies:WTP

- **The Li, Curtis, McCluskey, and Wahl study in Aug. 2002**

  – **GM rice:** *Product-enhancing attribute*
  Key finding: A 38.0% premium for GM rice over non-GM rice

  – **GM soybean oil:** either product-enhancing or process-enhancing
  Key finding: A 16.3% premium for GM soyoil over non-GM soyoil

- **Research Issues:**

  – Potential inconsistent interpretations among respondents on the attribute of GM soybean oil

  – The Li *et al*.study offers no direct evidence on the WTP for process-enhancing biotech products, such as soybean oil made from herbicide-tolerant soybeans

  – Hypothetical nature of survey data overstates the WTP

  – Asymmetry of the lower bound and upper bound of the WTP in the contingent valuation method also overstates the true WTP

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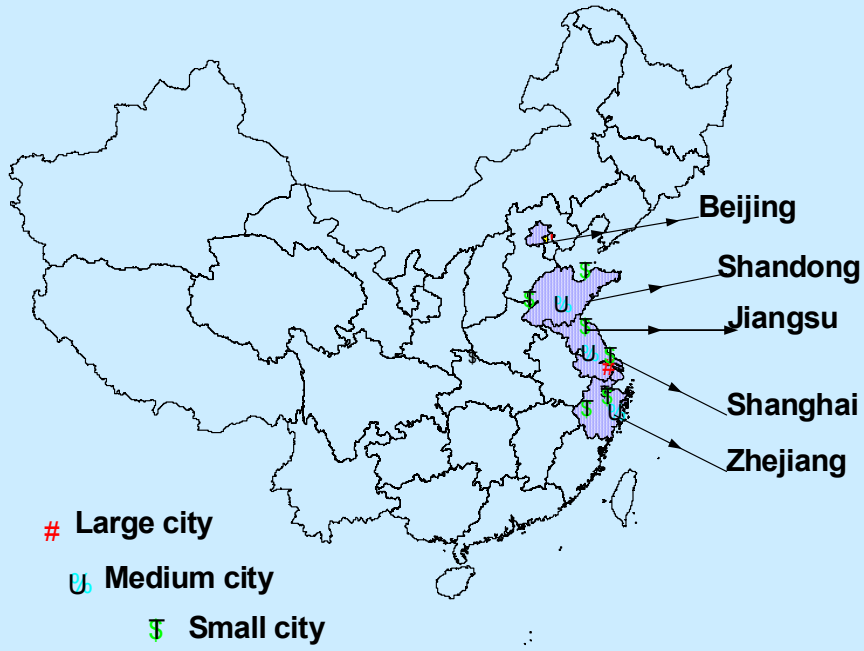
The ERS-CCAP Consumer Attitudes Survey

- **A large-scale survey:**
  – 11 small-to-large cities
  – including Beijing and Shanghai

- **Surveyed 1,100 consumers:**
  – sample randomly selected
  – conducted by China's National Bureau of Statistics in fall 2002

- **Survey questionnaire:**
  – jointly developed and pre-tested by CCAP/CAS and ERS analysts
  – assisted by Carl Pray of Rutgers Univ.
  – comparable with other studies
  – covers household demographic/ socio-economic characteristics, awareness, and attitudes
  – covers 8 kinds of foods



- Pre-tests of this survey suggested that rural residents have little awareness of biotechnology and are primarily concerned about prices of foods instead of biotech issues

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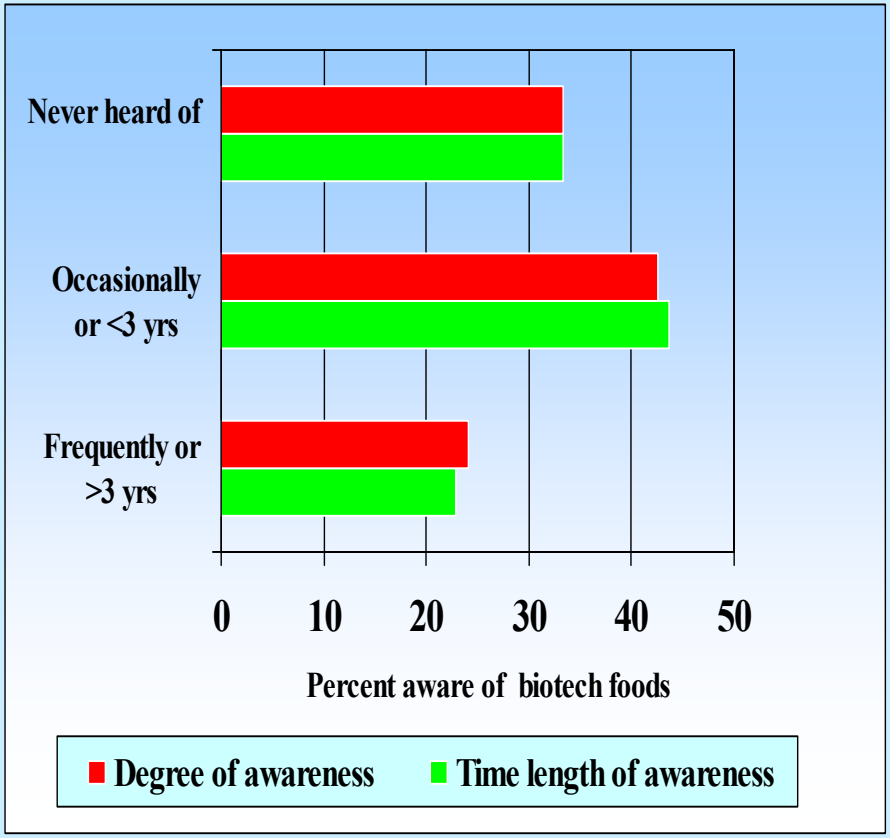
Some Basic Statistics—Respondents' awareness remains low…

Male-female ratio:	0.71:1
Ave. age:	46.6
Yrs. of education:	11.1
Household size:	3.0
Per capita monthly disposal income (rmb):	844.2
Size of residing city (%):	
small	30.3
medium	29.9
large	39.8

Awareness: remains at a low level



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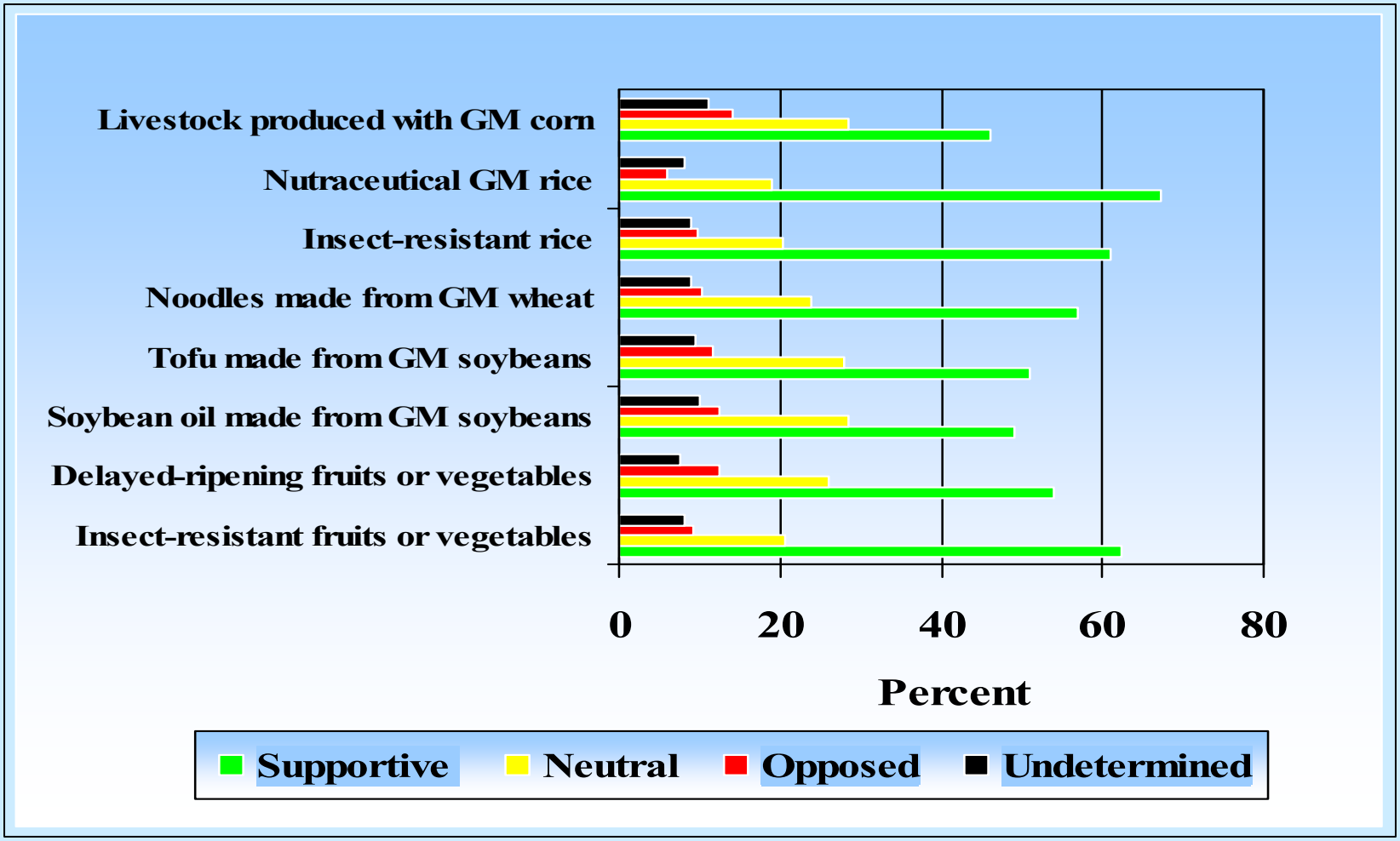
…But a great majority have positive attitudes toward biotech foods



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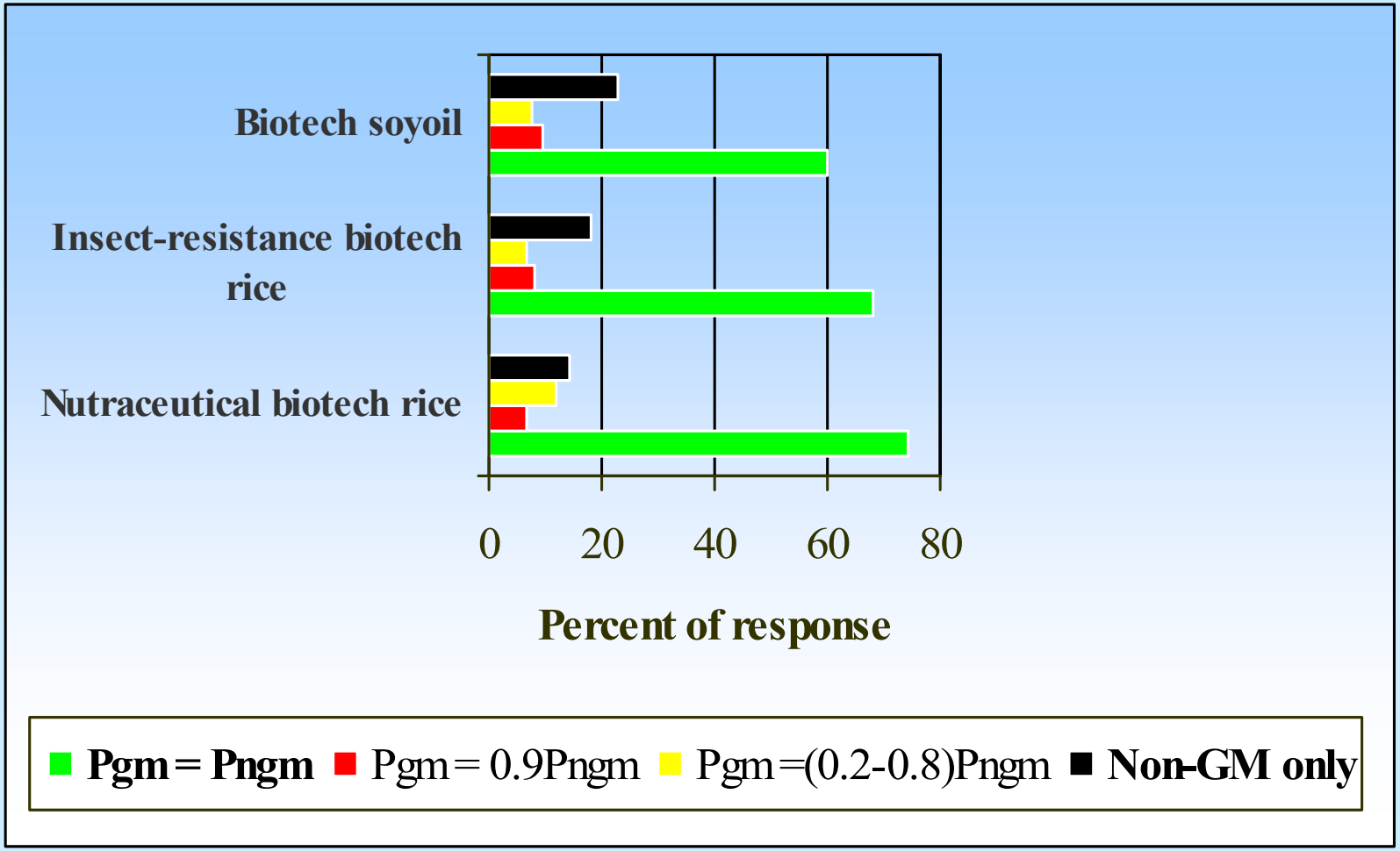
Respondents' WTP for biotech foods: survey data



Model Results: Attitudes

Instrumental Variable (IV) estimation vs. ordered probit model:

- **The interdependence between the awareness variable and error term necessitates the use of the IV estimation**

- **Beta-coefficient of the short-term awareness variable in the IV estimation is twice as large as that from the ordered probit model**

- **Most significant variables (based on IV estimation):**
  - ***the size of residing city***
  - ***awareness***
  - ***trust in information accuracy from media and government***
  - ***status of employment***
  - ***income***
  - ***an occupation of working for food processors***

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Model Results: WTP

- **Positive factors contributing to consumers' willingness to purchase biotech foods**

  –*Biotech soyoil*: price discount, residents of small cities, male, and unemployed

  –*Biotech rice* : price discount, residents of small cities, and unemployed

- **Negative contributing factors**

  –*Biotech soyoil*: income and respondents who do not consume soybean oil

  –*Biotech rice* : income and awareness

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Mean WTP

- **Mean WTP—average price premium (in percent terms) that respondents are willing to pay to avoid the purchase of biotech foods**

  Non-biotech soybean oil:

  – Lies in the range from 23.4% to 52.6%

  Non-biotech rice:

  – Lies in the range from 41.5% to 74.0%

- **WTP would be more likely around the low end**

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The ERS-NAU Biotech Labeling Case Study

Objective:

Analyze whether biotech labeling has an impact on consumers' purchasing decisions of vegetable oils using *actual* retail scanning data in Nanjing, China

- **Develop and estimate an Almost Ideal Demand System (AIDS) for this case study**

- **Estimate demand price elasticities for vegetable oils**

  —*Which vegetable oil being switched to if labeling has an impact on soybean oil consumption?*

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China's Biotech Labeling Regulations

- **In January 2002, China required that foods containing biotech ingredients be labeled**
  —*Most soybean and blended oils are labeled because they contain imported biotech soybeans*

- **However, the requirement was not strictly enforced until August 2003**

- **A central question:**
  Does biotech labeling induce a switch in Chinese consumers' purchasing behavior?

  —*away from labeled soybean and blended oils and toward non-biotech vegetable oils*

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Supermarket Retail Scanning Data

- **Edible oil data in five outlet stores were sampled from over 100 stores of a large supermarket company in Nanjing, China**
- **The data contain *actual* monthly aggregate sales, retail prices, and expenditures of edible oils at each of the outlets during January 2002 through April 2004**
- **Vegetable oils include soybean oil, peanut oil, sunflower oil, and others**

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AIDS Demand System

$$S_i = \alpha_i + \beta_i \log(\text{Exp/Price}) + \sum_{j=1}^{N} \gamma_{ij} \log P_j + \sum_{k=1}^{K} \phi_{ik} Z_k + \rho_i D_{label} + \varepsilon_i$$

S_i = share of edible oil i's expenditure relative to total expenditure for all edible oils;

Exp = total expenditure for all edible oils;

Price = composite average price of all edible oils weighted by mean expenditure shares of individual oils;

P_j = retail prices of the jth edible oil;

Z_k = a vector of time trend (January 2002=1, …), seasonal variables, sales promotion, and outlet-specific fixed effects (D_1=qichi dummy, D_2=zhongshan dummy, and D_3 =xinglong dummy)

D_{label} = biotech labeling dummy (August 2003 and thereafter=1, else=0)

ε_i = error term

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Top Level Demand

- The AIDS expenditure share is conditioned on category expenditure (Exp) for all edible oils
- Two-stage budgeting approach—first the top-level demand and then category share
- **Top-level demand**:

$$\text{Log } Q_j = \delta_0 + \delta_j \log P_j + \lambda \log EXP + \sum_{k=1}^{K} \varphi_k Z_k + \eta_j$$

Q_j = overall quantity for the j^{th} category product

P_j = deflated composite average price of all products in the j^{th} category

EXP = deflated total expenditure (per capita disposable income) for all goods and beverages

Z_k = a vector of time trend and seasonable variables

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Empirical Estimation by SUR

- **The AIDS demand system is estimated by seemingly unrelated regression (SUR) using pooled time-series (28 months) and cross-section (5 outlet stores) data**
  - **140 observations**
- **SUR recognized that residual terms across various edible oils' share equations are interrelated**
- **Theoretical restrictions are tested to determine if they are statistically significant**
  - **Homogeneity of degree zero is an important constraint for soyoil's expenditure share equation**

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SUR Estimates With Constraints

Item	Expenditure share (%) of-- Soyoil	Peanut oil	Sunflower oil
Intercept	78.392 (15.25)***	-23.542 (-2.42) **	-16.825 (-3.13) ***
LogPsoy	-8.058 (-3.77) ***	14.940 (3.06) ***	8.058 (3.77) ***
LogPpea	--	-0.408[a]	--
LogPsun	8.058 (3.77)	--	-0.316[a]
Log (Exp/Price)	0.494 (0.40)	- 0.328 (-0.50)	0.326 (0.46)
Trend	--	-0.238 (-3.50)***	--
Dlabel	-1.753 (-2.59)**	-0.653 (-1.11)	2.341 (4.34)***

*,**, and *** denote statistically significant at 10%, 5%, and 1%, respectively.

[a] No t-ratio is shown due to a restriction of this beta coefficient to be consistent with the own-price expenditure elasticity for soyoil (-0.124).

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Biotech Labeling Impacts

- **Biotech labeling reduces the expenditure share of soybean oil by nearly 2 percentage points**
  - **–Down from an average of about 80 percent**
- **The expenditure share for sunflower oil increases by 2.3 percentage points**
  - **—Sunflower oil a more direct substitute for soybean oil than peanut oil**

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Estimated Demand Elasticities

	with respect to the price of --		
Consumption	Soyoil	Peanut oil	Sunflower oil
Soybean oil	-0.377	--	0.123
Peanut oil	5.356	-1.098	--
Sunflower oil	3.874	--	- 0.849

[a]These elasticities are estimated by restricting the aggregate demand price elasticity for all edible oil at -0.100. Varying this parameter value up and down does not appreciatively alter estimated demand elasticities.

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Conclusions

- **A great majority of China's urban consumers had positive attitudes for biotech foods**
- **Most significant factors affecting acceptance of biotech foods:**
  - *consumer awareness*
  - *the size of residing city*
  - *trust in information accuracy from media and government*
  - *status of employment*
  - income
  - an occupation of working for food processors
- **There is still a large gap in basic understanding of biotechnology in China. Hence, outreach to this sector would increase the acceptance of biotech foods**
- **The modest WTP for non-biotech soybean oil suggests that most processors and retailers are likely to use imported soybeans for crushing and label biotech soybean oil**

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Conclusions (cont.)

- **Mean WTP for non-biotech rice is higher than non-biotech soybean partly because rice is a major food staple in China**
- **In this case study, biotech labeling has only a modest impact in lowering the consumption of soybean oil in Nanjing, China**
- **The labeling impact would be even smaller if this analysis is extended to include consumers in smaller-sized cities and rural areas**
- **Rapid changes in the structure of supermarkets over time suggests need for regular updates**
- **Differences in the structure of super-markets across locations suggest extending this kind of analysis to other cities in China**

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