Income-Induced Expenditure Switching

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Motivation

- Revisit external sector adjustment and the role of relative prices
- Focus on expenditure switching from foreign to domestic goods
- **Conventional Macro models**: Expenditure switching is
  - Central ingredient of external sector rebalancing
  - Driven solely by changes in the relative price of foreign/domestic goods
- **Needed**: Empirical evidence

This Paper

- Examines 2008–09 crisis in Latvia with a novel supermarket scanner dataset with home/imported goods
  - Classic boom-bust episode with a sudden stop
  - Limited role for nominal exchange rate in adjustment due to EUR peg ▸ Figure
- Measures the role of expenditure switching
- Measures relative price changes
- Asks whether relative price changes can explain the observed expenditure switching through the lens of standard models

Preview of Results

- Expenditure switching accounted for 1/3 of the fall in imports
- No corresponding change in relative prices
- Fall in income induced consumers to switch towards cheaper domestic substitutes $\Longrightarrow$ Expenditure switching driven by *income effect*, not changes in relative prices

Related Literature

- Expenditure switching and crisis: Burstein et al. (2005); Diaz Alejandro (1965); Kehoe & Ruhl (2008); Mendoza (2005); Obstfeld & Rogoff (2005). Also Engel (2003) for general review on models
- International prices: Burstein & Gopinath (2013), Berka et al. (2012), Parsley & Popper (2006)
- Micro/scanner data: Broda & Weinstein (2010); Coibion et al. (2012); Handbury (2012)

Outline

1. Data
2. Empirical findings
3. Theoretical framework
4. Estimation strategy and results
5. Conclusion

Data

Supermarket transaction data for food & beverages (F&B) from one of largest retailers in Latvia

- Cover May 2006 – May 2011
- Monthly expenditure on and quantity sold for each item
- Identify domestic/foreign origin of each item
- Aggregated by type of store in Latvia
- 2-, 3- and 4-digit classification of items (Example: Food $\rightarrow$ Hot drinks $\rightarrow$ Tea $\rightarrow$ Herbal tea $\rightarrow$ UPC items)

Data

Representative of household expenditures on food:

- Add up to 15% of aggregate household expenditures on food in NIA
- Stable grocery retail market share of around 20%
- Broadly match: (i) official CPI for F&B; (ii) aggregate F&B imports

Food accounts for 30% of household expenditures

▸ Summary Statistics

Data

Advantages of scanner data

- Consistent measurement of expenditures on domestic/imported goods within a large dataset
- Not only domestic/imported breakdown of final consumer prices, but also of quantities

Limitations of scanner data

- Demand for food only
- No matching supply side or export data

Three Empirical Findings about the Crisis

1. Expenditure switching
    - Took place between goods *within* product groups

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2. Relative price adjustment
   - Took place *across* product groups

Three Empirical Findings about the Crisis

1. Expenditure switching
   - Took place between goods *within* product groups
2. Relative price adjustment
   - Took place *across* product groups
3. Within-group item mix
   - Shifted towards *cheaper domestic* substitutes

Finding 1. Expenditure Switching

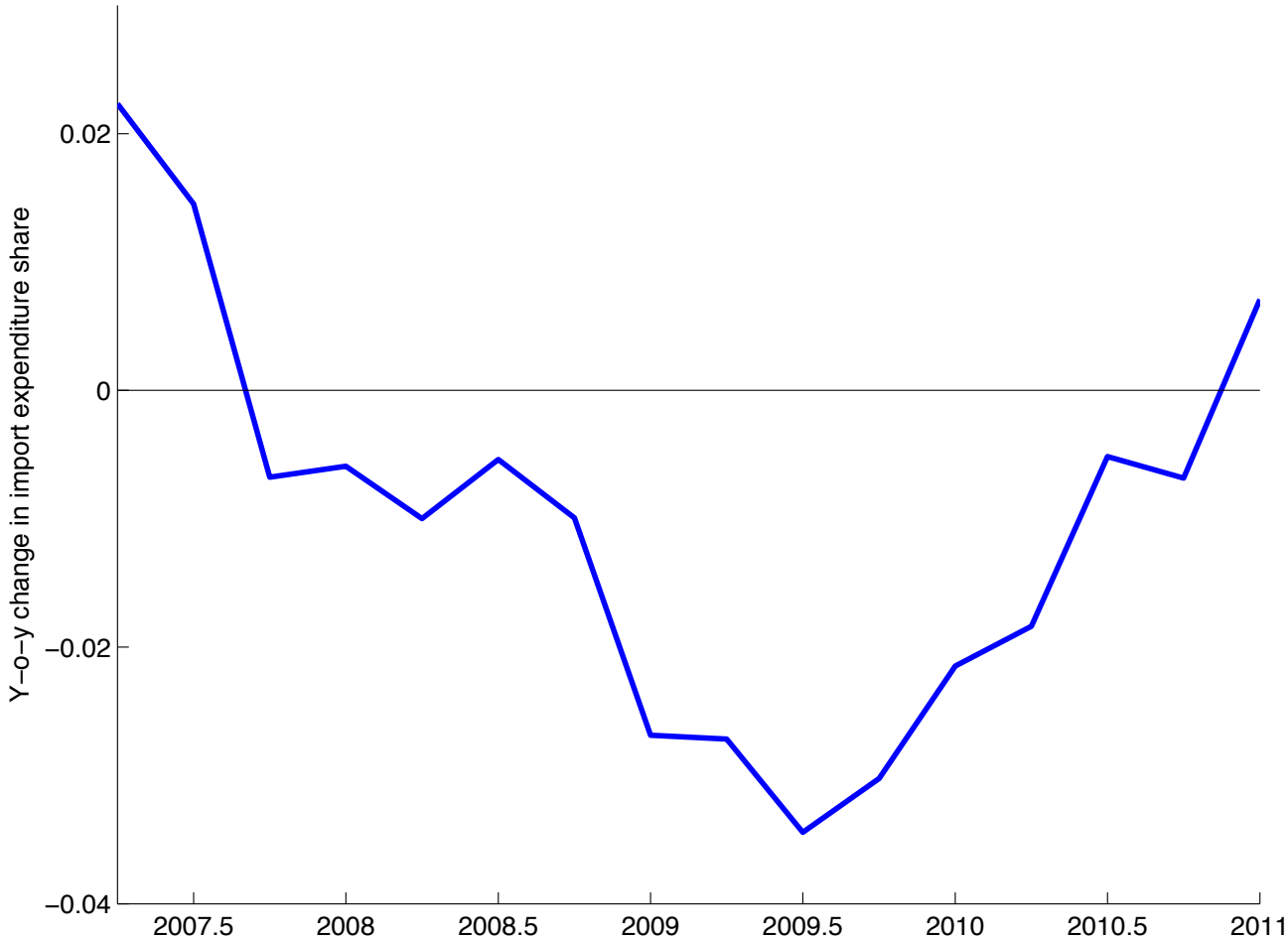
- Crisis year: Q4:09/Q4:08 (largest y-o-y fall in food consumption)
- Did expenditure switching contribute to the fall in consumption of imported food?

$$\underbrace{\Delta x^{F}_{crisis}}_{\text{Imported food: } -26\%} = \underbrace{\Delta x_{crisis}}_{\text{All food: } -18\%} + \underbrace{\left(\Delta x^{F}_{crisis} - \Delta x_{crisis}\right)}_{\text{Expenditure switching: } -\mathbf{8\%}}$$

$\Longrightarrow$ **YES!**

Finding 1. Expenditure Switching

or... 3% of expenditures reallocated (imports $\longrightarrow$ domestic)



Finding 1. Expenditure Switching

Two sources of expenditure switching: (i) **within** product groups and (ii) **across** product groups

Notation:

- $g \in \{1, ..., G\}$: 4-digit product group
- s_{gt}: product group's expenditure share
- s_{gt}^F: product group's imports to total expenditures
- φ_{gt}^F: share of imports in a product group $(= s_{gt}^F / s_{gt})$
- $s_t^F \equiv \sum_g s_{gt} \varphi_{gt}^F$: total import share

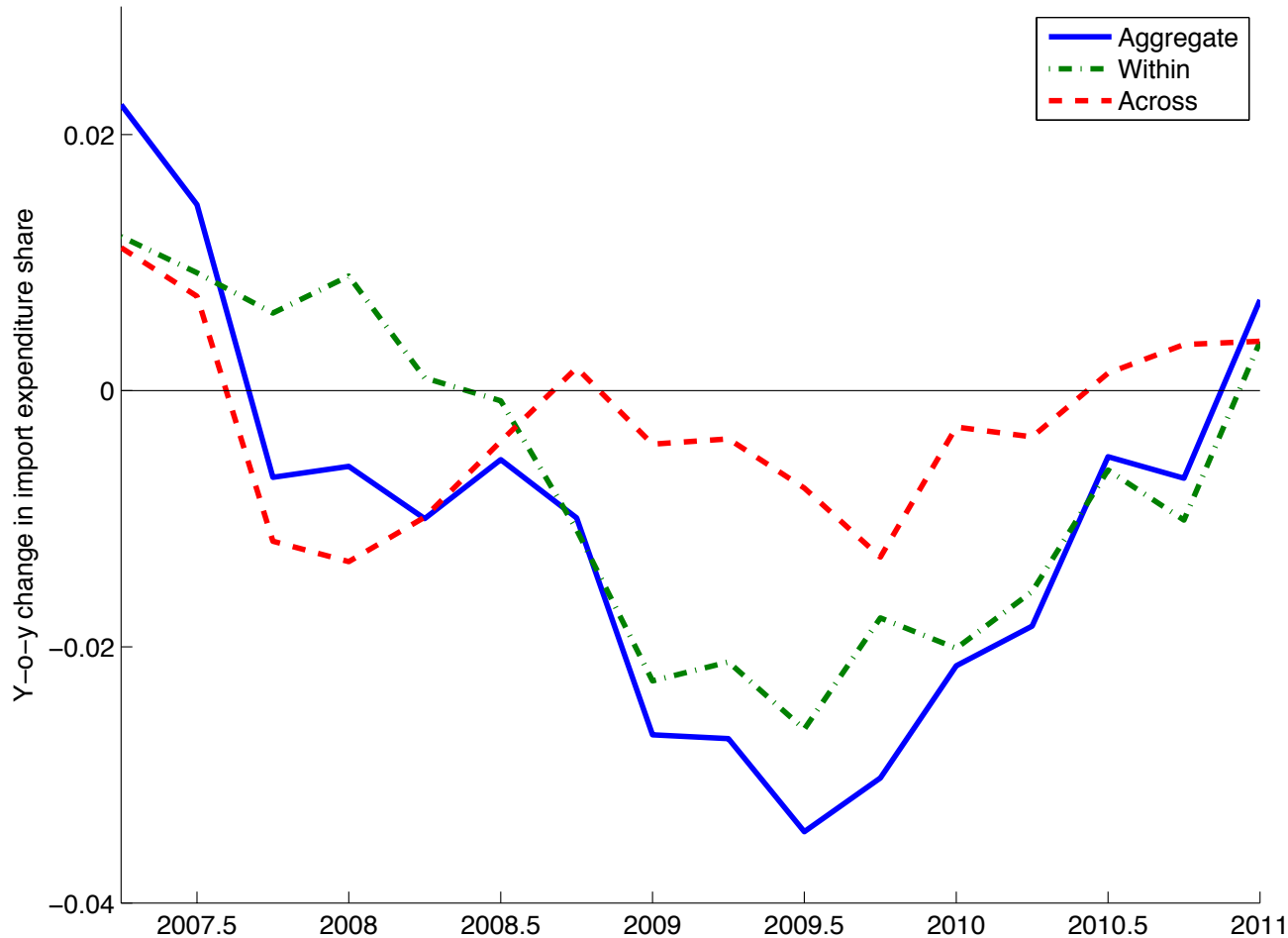
Finding 1. Expenditure Switching

Decompose expenditure switching as:

$$\begin{aligned}
\Delta s_t^F &\equiv s_t^F - s_k^F \\
&= \sum\nolimits_g s_{gt}\varphi_{gt}^F - \sum\nolimits_g s_{gk}\varphi_{gk}^F \\
&= \underbrace{\sum\nolimits_g s_{gk}\Delta\varphi_{gt}^F}_{\text{Within}} + \underbrace{\sum\nolimits_g \varphi_{gk}^F\Delta s_{gt}}_{\text{Across}} + \underbrace{\sum\nolimits_g \Delta\varphi_{gt}^F\Delta s_{gt}}_{\approx 0}
\end{aligned}$$

Finding 1. Within and Across Components

Driven by reallocation of expenditures **within** narrow (4-digit) product groups



Finding 1. Intensive or Extensive Adjustment?

1. Decompose sales growth into two margins (di Giovanni et al., 2013):

$$\widetilde{\gamma}_t \equiv \ln \sum_{i \in I_t} x_{igt} - \ln \sum_{i \in I_t} x_{igt-1}$$

$$= \ln \frac{\sum_{i \in I_{t/t-1}} x_{igt}}{\sum_{i \in I_{t/t-1}} x_{igt-1}} - \left(\ln \frac{\sum_{i \in I_{t/t-1}} x_{igt}}{\sum_{i \in I_t} x_{igt}} - \ln \frac{\sum_{i \in I_{t/t-1}} x_{igt-1}}{\sum_{i \in I_{t-1}} x_{igt-1}} \right)$$

$$= \underbrace{\gamma_t}_{\text{Intensive margin}} - \underbrace{\ln \frac{\pi_{t,t}}{\pi_{t,t-1}}}_{\text{Extensive margin}}$$

Finding 1. Intensive or Extensive Adjustment?

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$$= \underbrace{\gamma_t}_{\text{Intensive margin}} - \underbrace{\ln \frac{\pi_{t,t}}{\pi_{t,t-1}}}_{\text{Extensive margin}}$$

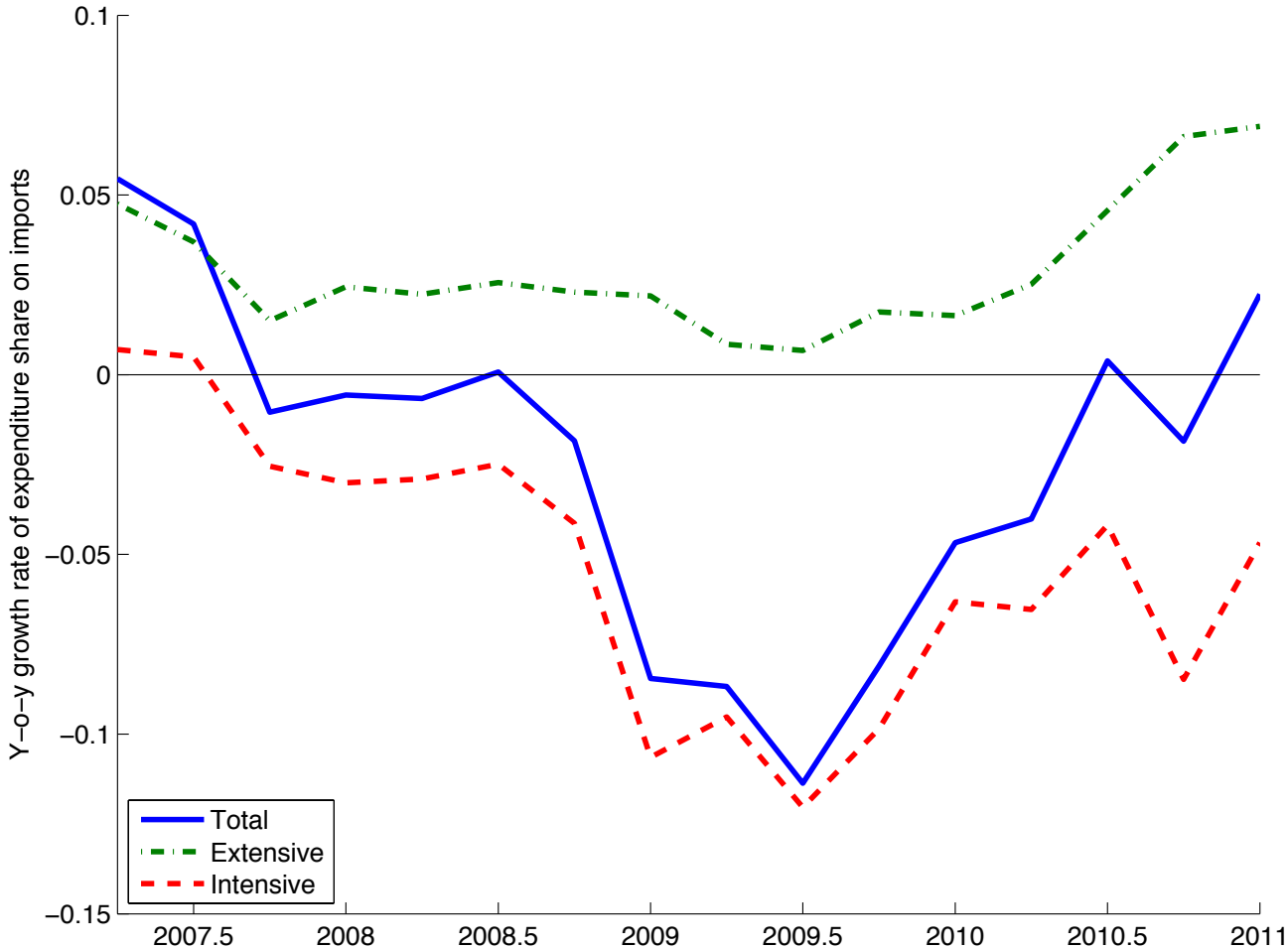
2. Apply to foreign and total sales:

$$\ln s_t^F - \ln s_{t-1}^F = \ln \frac{\sum_{i \in I_t^F} x_{igt}^F}{\sum_{i \in I_t} x_{igt}} - \ln \frac{\sum_{i \in I_{t-1}^F} x_{igt-1}^F}{\sum_{i \in I_{t-1}} x_{igt-1}}$$

$$= \widetilde{\gamma}_t^F - \widetilde{\gamma}_t$$

Finding 1. Intensive and Extensive Margins

Expenditure switching driven by the **intensive margin**



Finding 2. Relative Price Adjustment

Did relative prices adjust?

Notation:

- p_{igt}: unit value of item i in group g
- P^F_{gt}: price indexes for (F)oreign food in group g
- P^F_t: aggregate price indexes for food imports
- P_t: aggregate price indexes for food

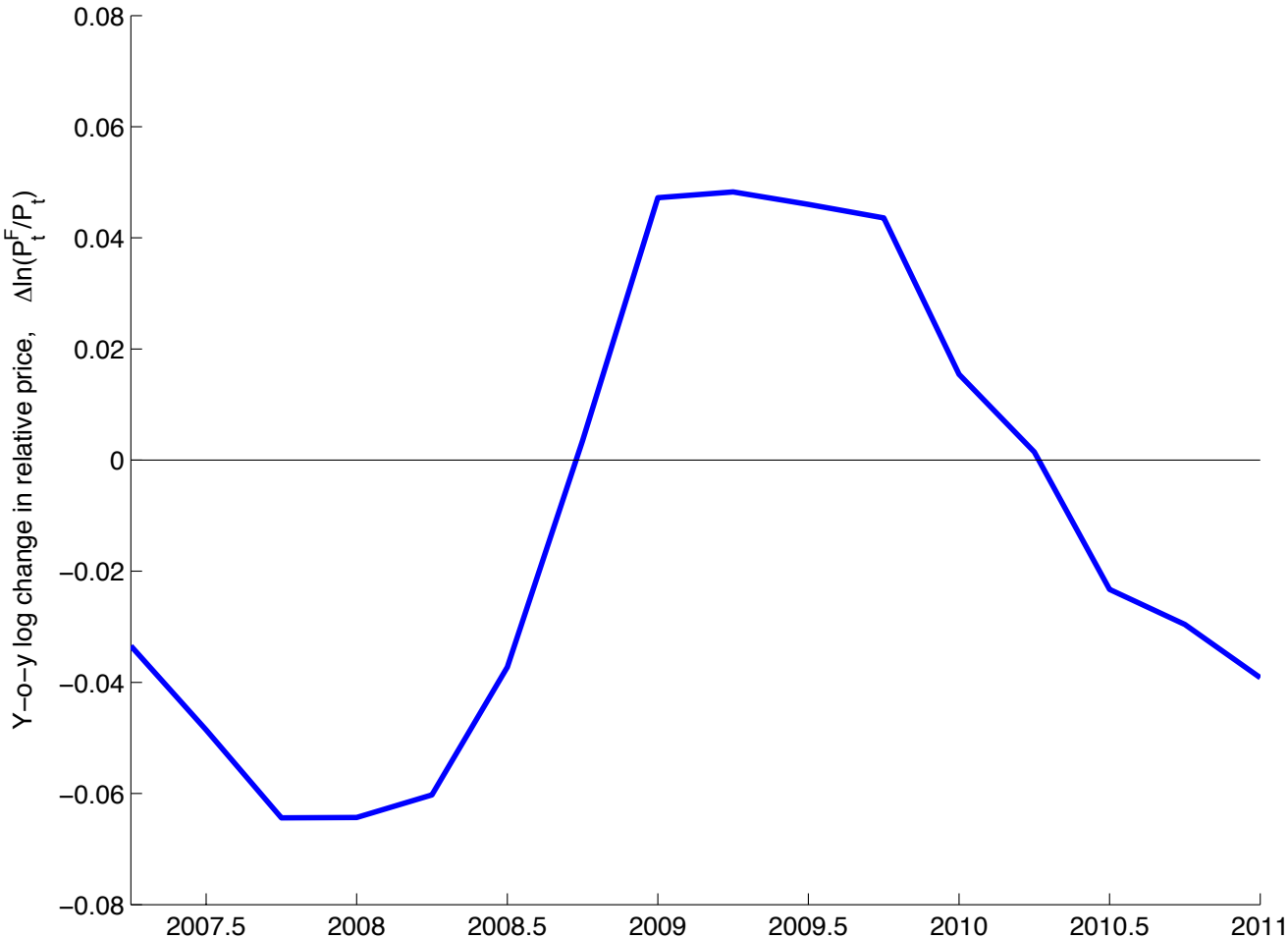
Construct aggregate prices with a discrete Divisia (Tornqvist) price index:

$$\Delta \ln P_t = \sum_g \sum_j \sum_{i \in I^j_{gt}} w_{igt} \Delta \ln p_{igt}, \quad j = \{D, F\},$$

and $w_{igt} = 0.5(s_{igt} + s_{igt-1})$

Finding 2. Relative Price Adjustment

Relative price of imports, defined as P_t^F / P_t, increased during the crisis: 4.5% y-o-y (2009Q4–2008Q4) and 6% trough-to-peak



Finding 2. Relative Price Adjustment

Again, decompose changes into **within** and **across** components:

$$\Delta \ln \frac{P_t^F}{P_t} \equiv \ln \frac{P_t^F}{P_t} - \ln \frac{P_k^F}{P_k}$$

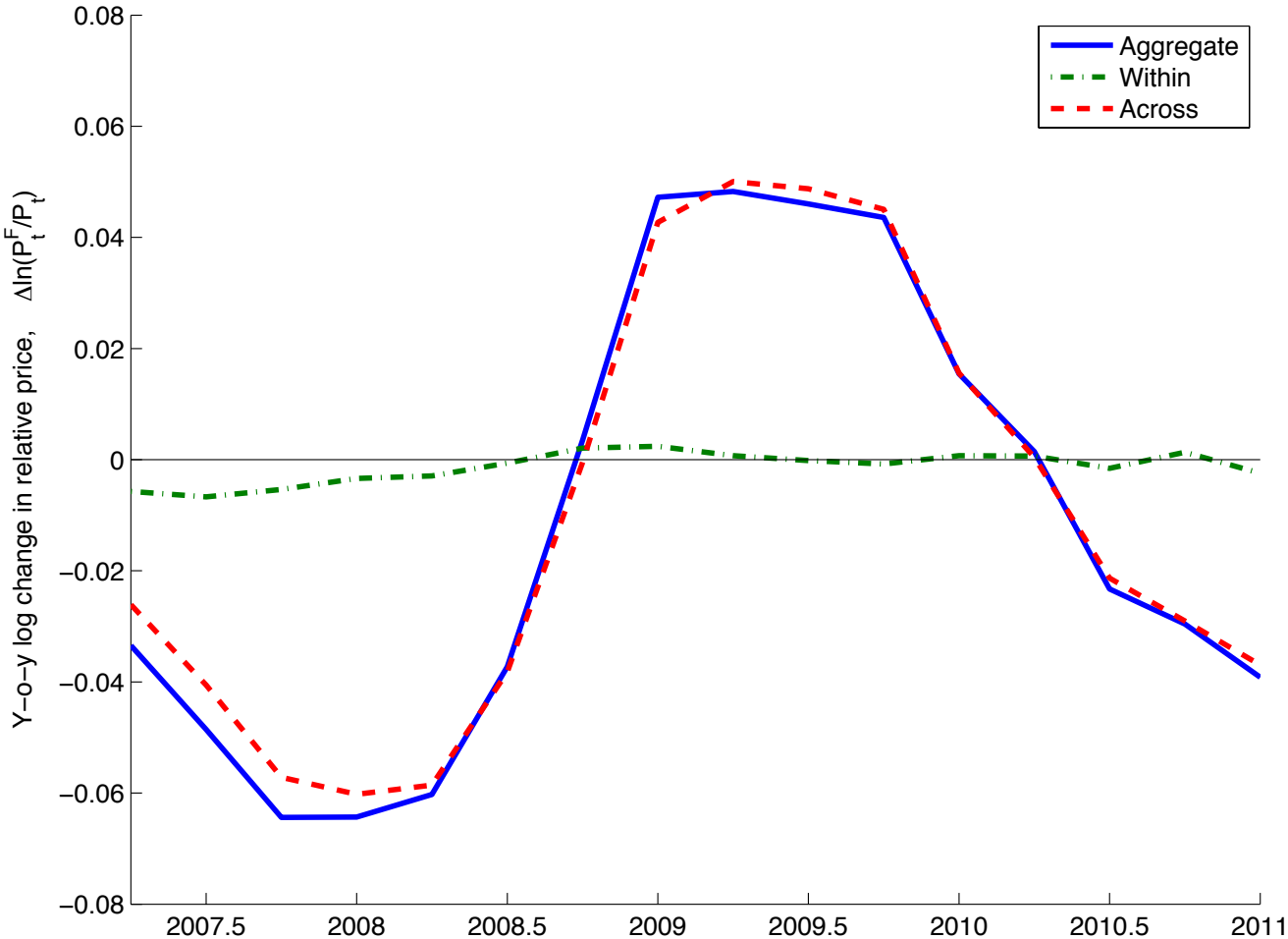
$$= \sum_g \frac{w_{gt}^F}{w_t^F} \left(\ln \frac{P_{gt}^F}{P_{gt}} + \ln \frac{P_{gt}}{P_t} \right) - \sum_g \frac{w_{gk}^F}{w_k^F} \left(\ln \frac{P_{gk}^F}{P_{gk}} + \ln \frac{P_{gk}}{P_k} \right)$$

$$= \underbrace{\sum_g \frac{w_{gk}^F}{w_k^F} \Delta \ln \frac{P_{gt}^F}{P_{gt}}}_{\text{Within}} + \underbrace{\sum_g \frac{w_{gk}^F}{w_k^F} \Delta \ln \frac{P_{gt}}{P_t}}_{\text{Across}}$$

$$+ \underbrace{\sum_g \Delta \left(\frac{w_{gt}^F}{w_t^F} \right) \ln \frac{P_{gk}^F}{P_k}}_{\approx 0}$$

Finding 2. Within and Across Components

No systematic change in relative price **within** product groups



Findings 1 and 2. A Puzzle?

The findings presented thus far show

1. Expenditure switching occurs *within* product groups
2. Relative price changes occurs *across* product groups

Puzzle:

Why are consumers buying more domestic varieties even though they are not becoming less expensive than their foreign counterparts?

Potential Explanation

25% fall in income induced switching towards cheaper substitutes within product groups

Finding 3. Unit Values

- Compare price **levels** within 4-digit product groups

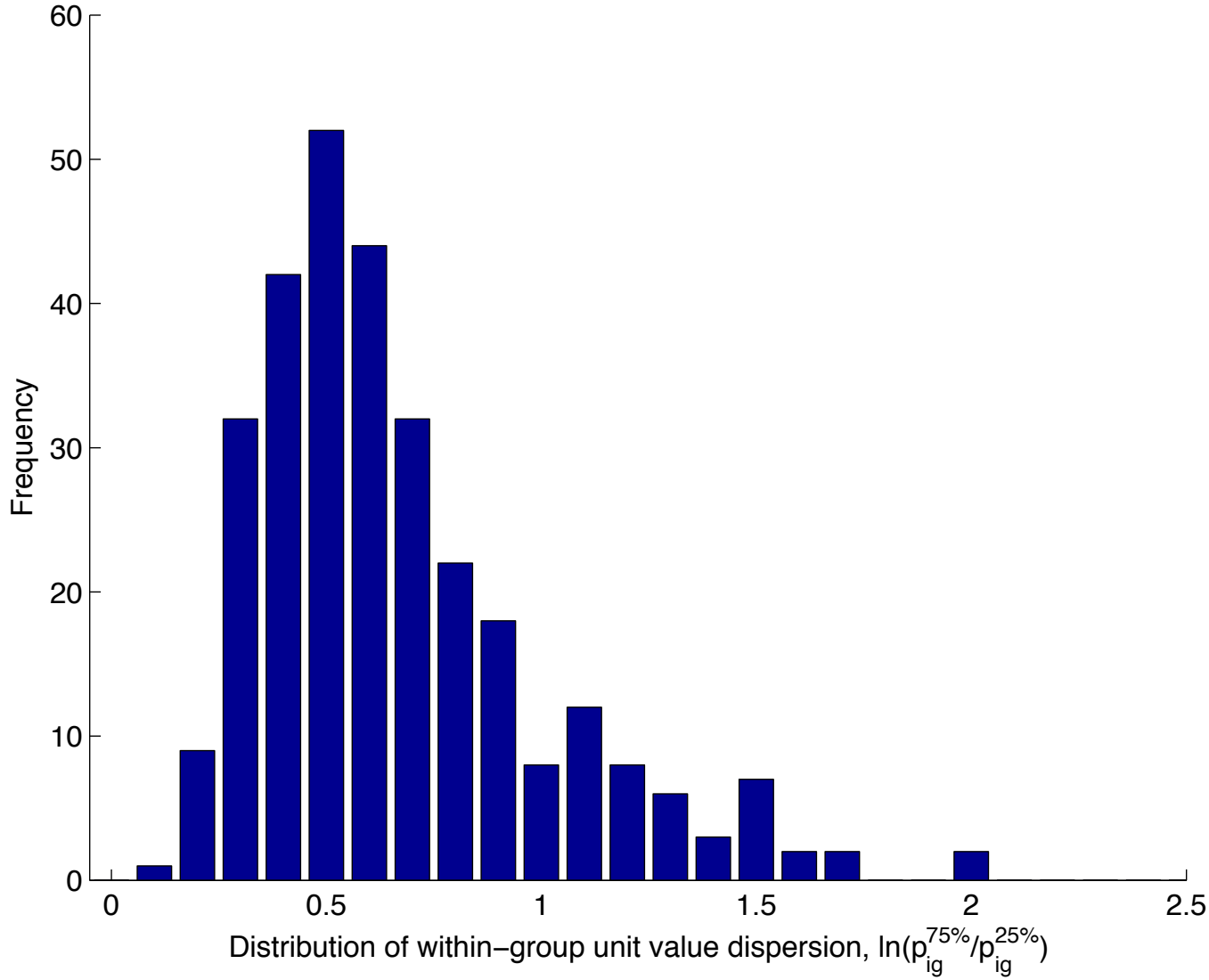
  Notation:

  - p_{igt}: unit value of item i in group g
  - q_{igt}: units (e.g., kg) sold for item i in group g
  - $V_{gt}^{j} = \sum_{i \in I_{gt}^{j}} \phi_{igt} p_{igt}$, where $\phi_{igt} = q_{igt} / \sum_{i \in I_{gt}^{j}} q_{igt}$

- Unit values exhibit:
  - Large dispersion across items: $p_{igt}^{75\%} / p_{igt}^{25\%} = 1.70$
  - Larger values for imports on average: $V_{gt}^{F} / V_{gt}^{D} = 1.33$

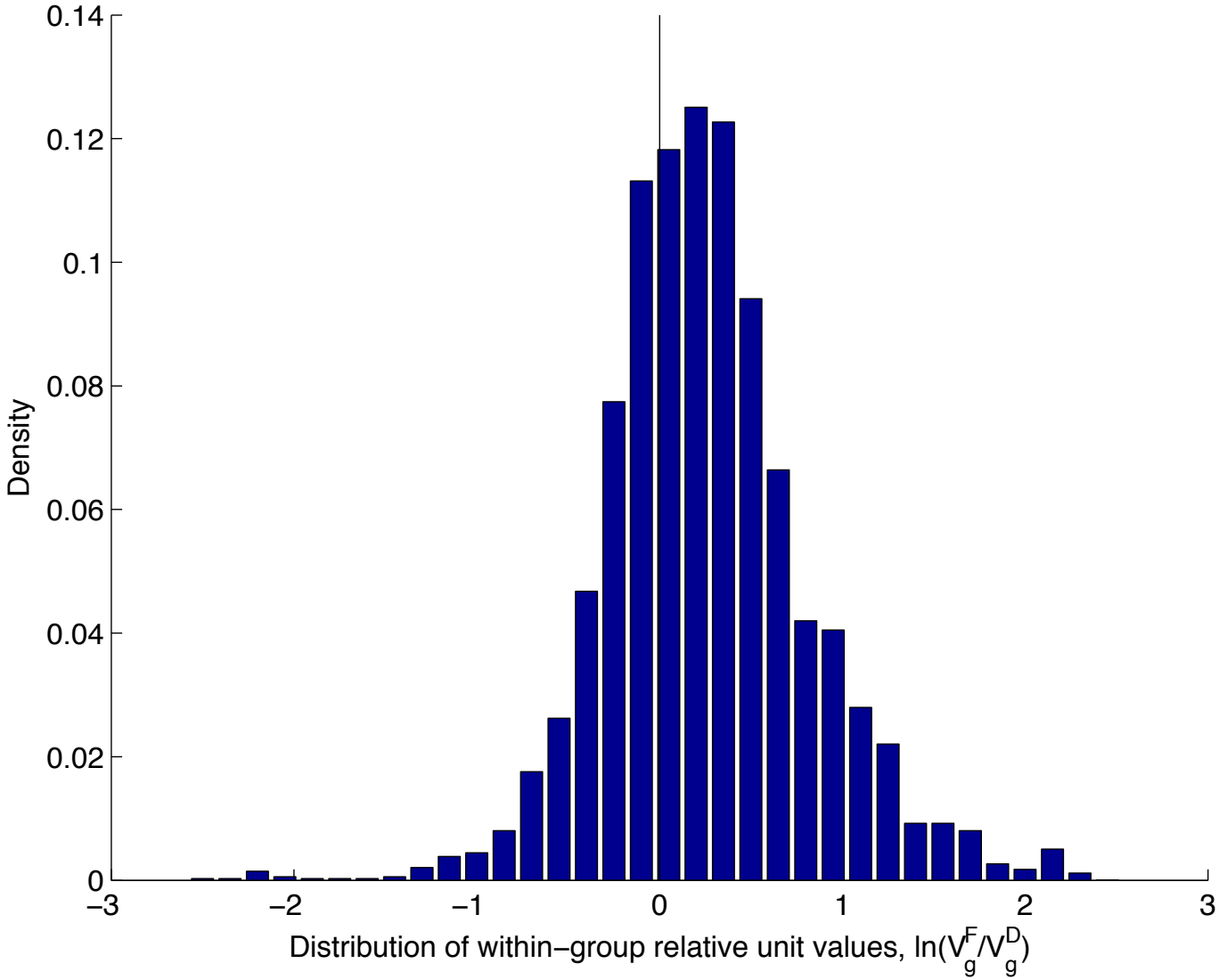
Finding 3. Within-group Unit Value Dispersion

Unit values exhibit large dispersion for median g



Finding 3. Foreign/Domestic Unit Value Dispersion

Unit values exhibit larger values for imports on average



Finding 3. Flight Towards Cheaper Substitutes

- Did consumers switch towards cheaper items during the crisis?
- For group g compare changes in average unit value and price index:

$$\Delta \ln W_{gt} = \Delta \ln V_{gt} - \Delta \ln P_{gt},$$

  where differences are due to
  - Changes in quantities consumed (item mix)
  - Entry/exit of items
- $\Delta \ln W_{gt}$ is an index of changes in consumed item mix within product groups (Boorstein and Feenstra, 1987)

Finding 3. Unit Value and Price Decomposition

- Average unit value:

$$\Delta \ln V_{gt} = \ln \sum_{i \in I_{gt/t-1}} \phi_{igt} p_{igt} - ln \sum_{i \in I_{gt/t-1}} \phi_{igt-1} p_{igt-1},$$

- Price index:

$$\Delta \ln P_{gt} = \frac{1}{w_{gt}} \sum_{i \in I^{j}_{gt/t-1}} w_{igt} \left(\ln p_{igt} - \ln p_{igt-1} \right)$$

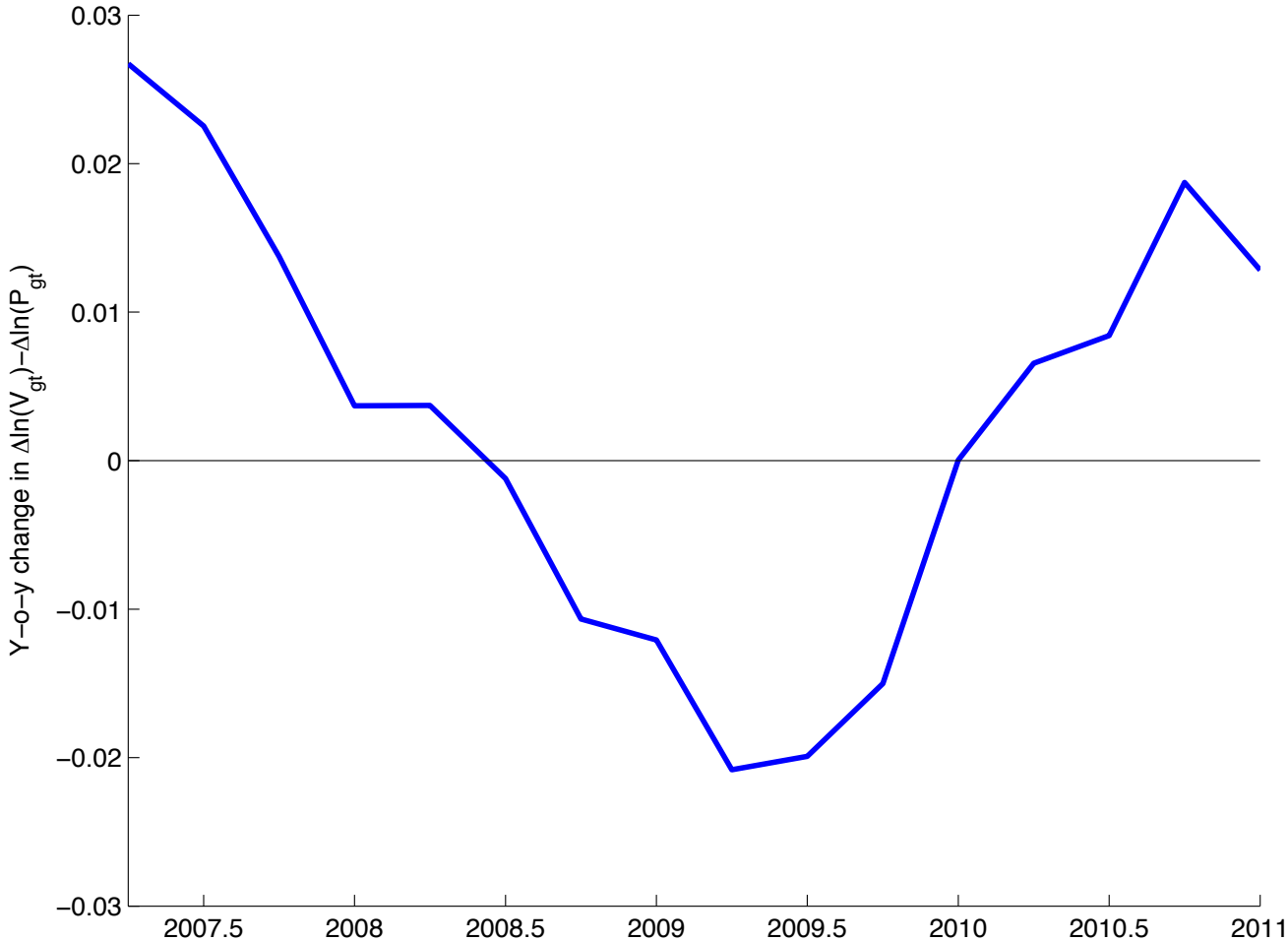
Finding 3. Unit Value and Price Decomposition

The decomposition has the following implications

- $\Delta \ln P_{gt}$ is calculated keeping weights fixed
  - Shift in item mix, $\phi_{igt} - \phi_{igt-1} \gtrless 0$, is *not* captured
- If item mix shifts systematically towards *lower* unit values, then $\Delta \ln V_{gt} < 0$, but $\Delta \ln P_{gt} = 0$
  - $\Delta W_{gt} < 0$

Finding 3. Flight Towards Cheaper Substitutes

Consumer switched to **cheaper substitute** items



Finding 3. Implications for Expenditure Switching

- Did the shift in item mix induce expenditure switching?
- Consider a partial price index that imposes homogeneity within Foreign/Domestic items in each product group:

$$\Delta \ln P_{gt}^{F/D} = \sum_{j} w_{gt}^{j} \Delta \ln V_{gt}^{j}$$

and a unit value for each D and F, respectively:

$$\ln V_{gt}^{j} = \ln \sum_{i \in I_{gt/t-1}^{j}} \left(\phi_{igt} p_{igt} - \phi_{igt-1} p_{igt-1} \right)$$

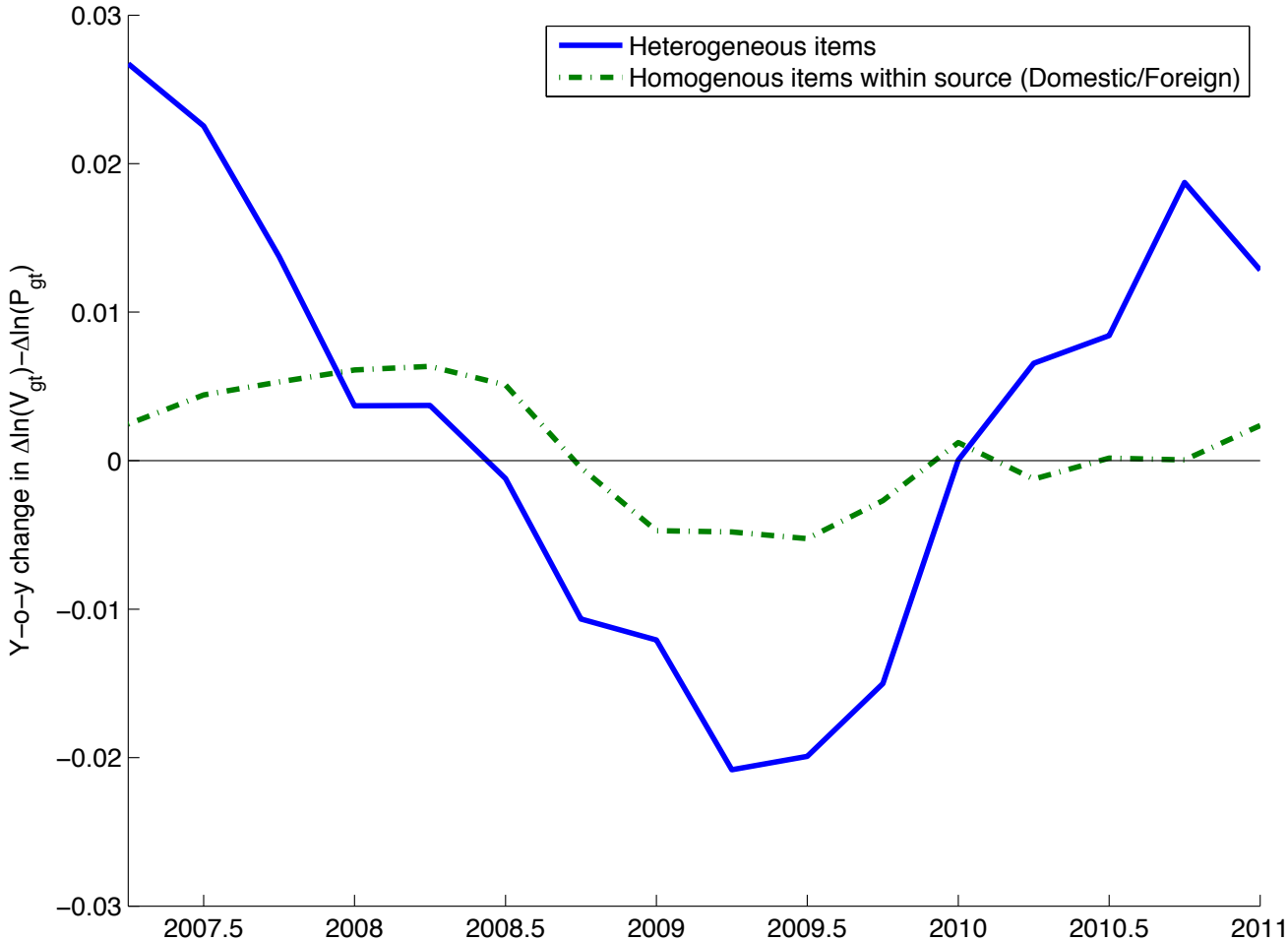
Finding 3. Implications for Expenditure Switching

The decomposition has the following implications

- $\Delta \ln V_{gt} - \Delta \ln P_{gt}^{F/D} = 0$ if
  - $w_{gt}^{j} = \{0, 1\}$ or
  - $V_{gt}^{F} = V_{gt}^{D}$
- $\Delta \ln V_{gt} - \Delta \ln P_{gt}^{F/D} < 0$ if
  - $V_{gt}^{F} > V_{gt}^{D}$ and
  - $\phi_{gt}^{F} - \phi_{gt-1}^{F} < 0$, where $\phi_{gt}^{F} = \sum_{i \in I_{gt}^{F}} \phi_{igt}$

Finding 3. Flight Towards Cheaper Domestic Substitutes

Consumer switched to **cheaper domestic substitute** items



Summary of Empirical Findings

- **Across:**
  - Prices adjusted, but very little expenditure switching
  - Likely more important when $\Delta NEER >> 0$
- **Within:**
  - Expenditure switching, but no relative price adjustment
  - A puzzle for conventional macro
  - Consumers switched to cheaper domestic substitutes

Theoretical Framework: Demand System

- Goal: quantify the role of prices and income in expenditure switching
- **Expenditure allocation problem** of a representative consumer
  - Given C_t and p_{igt}, allocate expenditures across and within product groups
  - Focus on *within* product groups
  - Changes in income induce substitution between high and low unit value items

Theoretical Framework: Demand System

- Preferences:

$$\text{ACROSS}: U_t = \left(\sum_{g=1}^{G} \omega_{gt}^{\frac{1}{\rho}} c_{gt}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

$$\text{WITHIN}: c_{gt} = \left(\left(\frac{1}{N_{gt}} \right)^{\frac{1}{\sigma_g}} \sum_{i \in I_{gt}} \widehat{c}_{igt}^{\frac{\sigma_g-1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g-1}}$$

  where $\widehat{c}_{igt} = \theta_{ig}^{\lambda_g(C_t)} c_{igt}$, and $\sum_g \sum_i p_{igt} c_{igt} = C_t$

- c_{igt} : quantity of item i
- θ_{ig} : quality of item i, which depends on income $\lambda_g(C_t)$ (Hallak, 2006)

Theoretical Framework: Demand System

- Solving the demand system subject to a consumer's budget constraint yields the across and within expenditure shares:

$$s_{gt} \equiv \frac{p_{gt} c_{gt}}{P_t C_t} = \omega_{gt} p_{gt}^{(1-\rho)} \qquad \text{(Across)}$$

$$\varphi_{igt} \equiv \frac{p_{igt} c_{igt}}{p_{gt} c_{gt}} = \frac{1}{N_{gt}} \left(\frac{\frac{p_{igt}}{\theta_{ig}^{\lambda_g(C_t)}}}{p_{gt}} \right)^{1-\sigma_g} \qquad \text{(Within)}$$

Estimation Strategy

1. Model yields an estimable equation of an item's *within* share as a function of (i) relative prices, and (ii) income

2. Aggregate predicted item expenditure shares to predict switching between foreign/domestic goods

3. Do steps (1) and (2) for a standard homothetic model (CES) and the non-homothetic model (NH) and compare predictions with data

Estimation Strategy

- Take first differences of log of Within share:

$$\Delta \ln \varphi_{igt} = \Delta \ln N_{gt} + (1-\sigma_g)\Delta \ln \left(\frac{p_{igt}}{P_{gt}}\right) + (\sigma_g - 1)\Delta\lambda_g(C_t) \ln \theta_{ig}$$

- Assume that $\lambda_g(C_t) = \eta_g + \mu_g \ln C_t$ (Hallak, 2006):

$$\Delta \ln \varphi_{igt} = \Delta \ln N_{gt} + (1-\sigma_g)\Delta \ln \left(\frac{p_{igt}}{P_{gt}}\right) + (\sigma_g - 1)\mu_g \ln \theta_{ig} \Delta \ln C_t$$

Estimation Strategy

- Estimation equation

$$\Delta \ln \varphi_{igt} = \alpha_{gt} + \beta_{1g} \ln \Delta \left(\frac{p_{igt}}{p_{gt}} \right) + \beta_{2g} \ln \bar{p}_{ig} \Delta \ln C_t + \varepsilon_{igt}$$

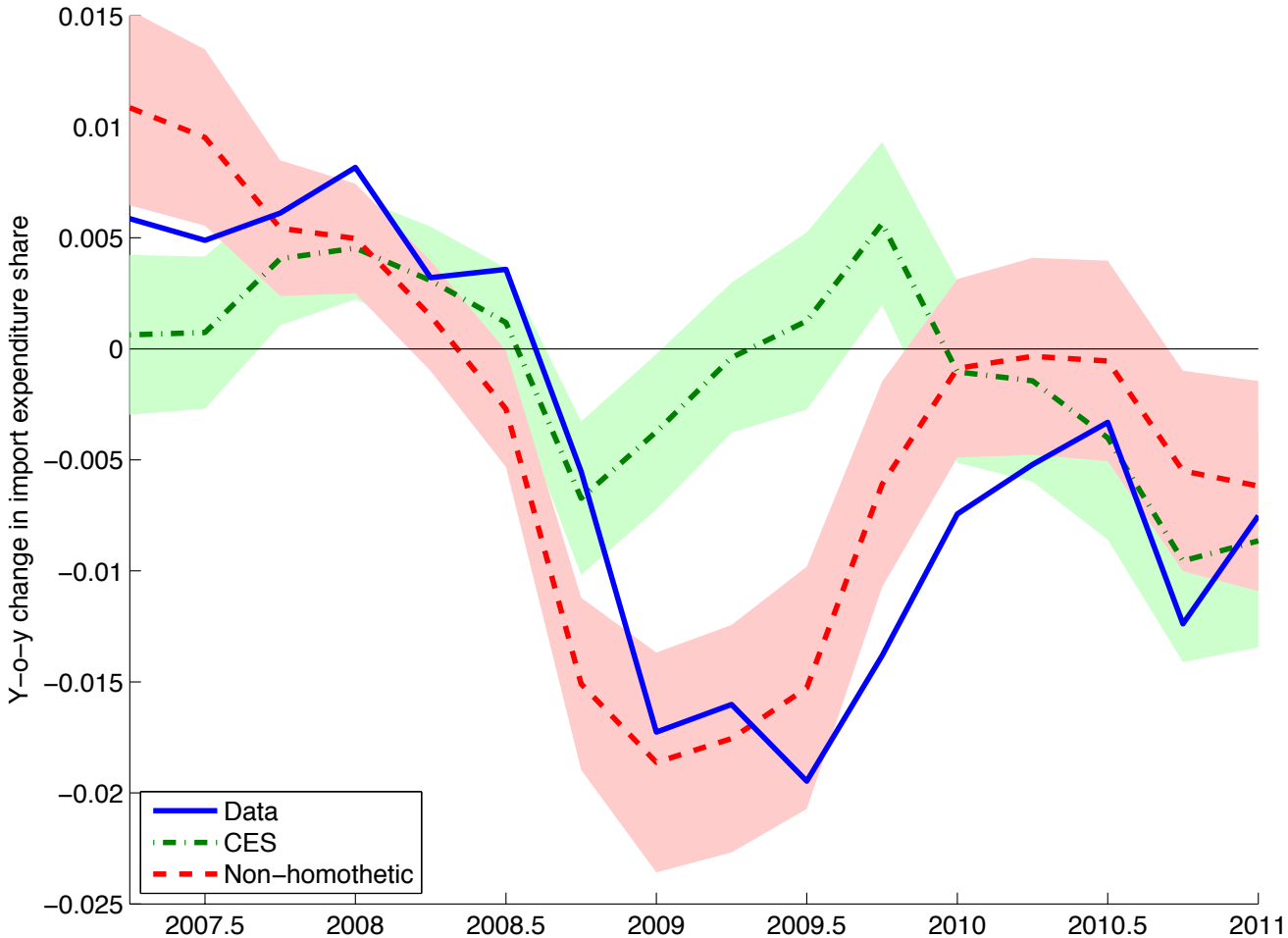
  - α_{gt}: 4-digit product group$\times$time fixed effect
  - $\bar{p}_{ig}$: item's median relative unit value, p_{igt}/V_{gt} (quality)
  - C_t: total real per capita household spending
  - ε_{igt} : random disturbance term

- Homothetic (CES) model restricts $\beta_{2g} = 0$

Estimation Strategy

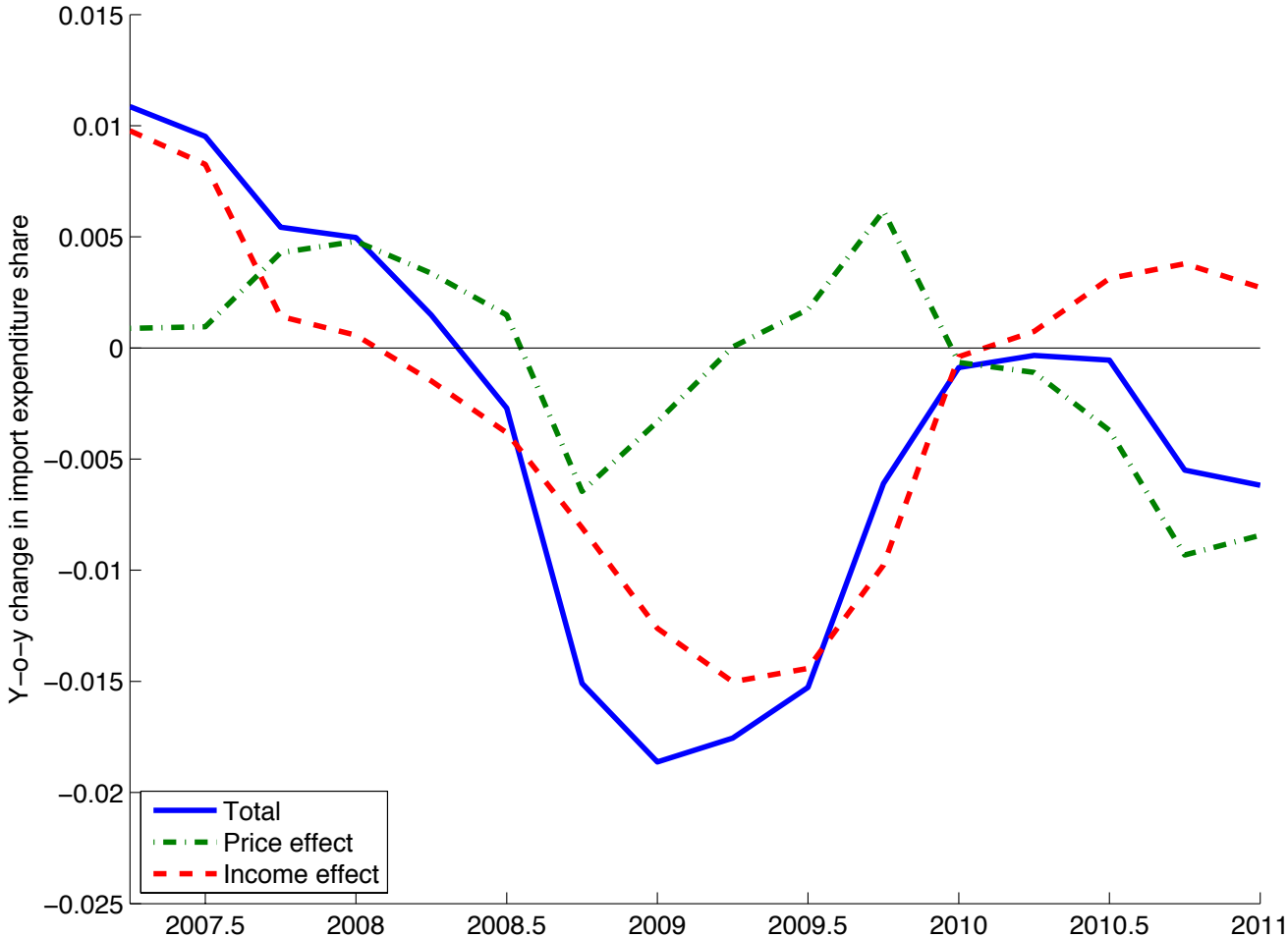
- Calculate the predicted expenditure switching between τ and $\tau - 1$ as follows:
  1. Given $\widehat{\beta}$s, calculate $\widehat{\Delta \ln \varphi_{ig\tau}}$, excluding fixed effects
  2. Calculate $\widehat{\varphi}_{ig\tau} = \exp(\widehat{\Delta \ln \varphi_{ig\tau}})\varphi_{ig\tau-1}$
  3. Calculate $\widehat{\varphi}^F_{g\tau} = \sum_{i \in I^F_{g\tau}} \widehat{\varphi}_{ig\tau}$
  4. Calculate $\widehat{(s^F_t - s^F_k)}^{\text{Within}} = \sum_{\tau=k}^{t} \sum_g s_{g\tau-1}(\widehat{\varphi}^F_{g\tau} - \varphi^F_{g\tau-1})$, for $k = t - 3$ (y-on-y change)

Expenditure Switching (Within): Data, CES, and NH



▸ Regressions

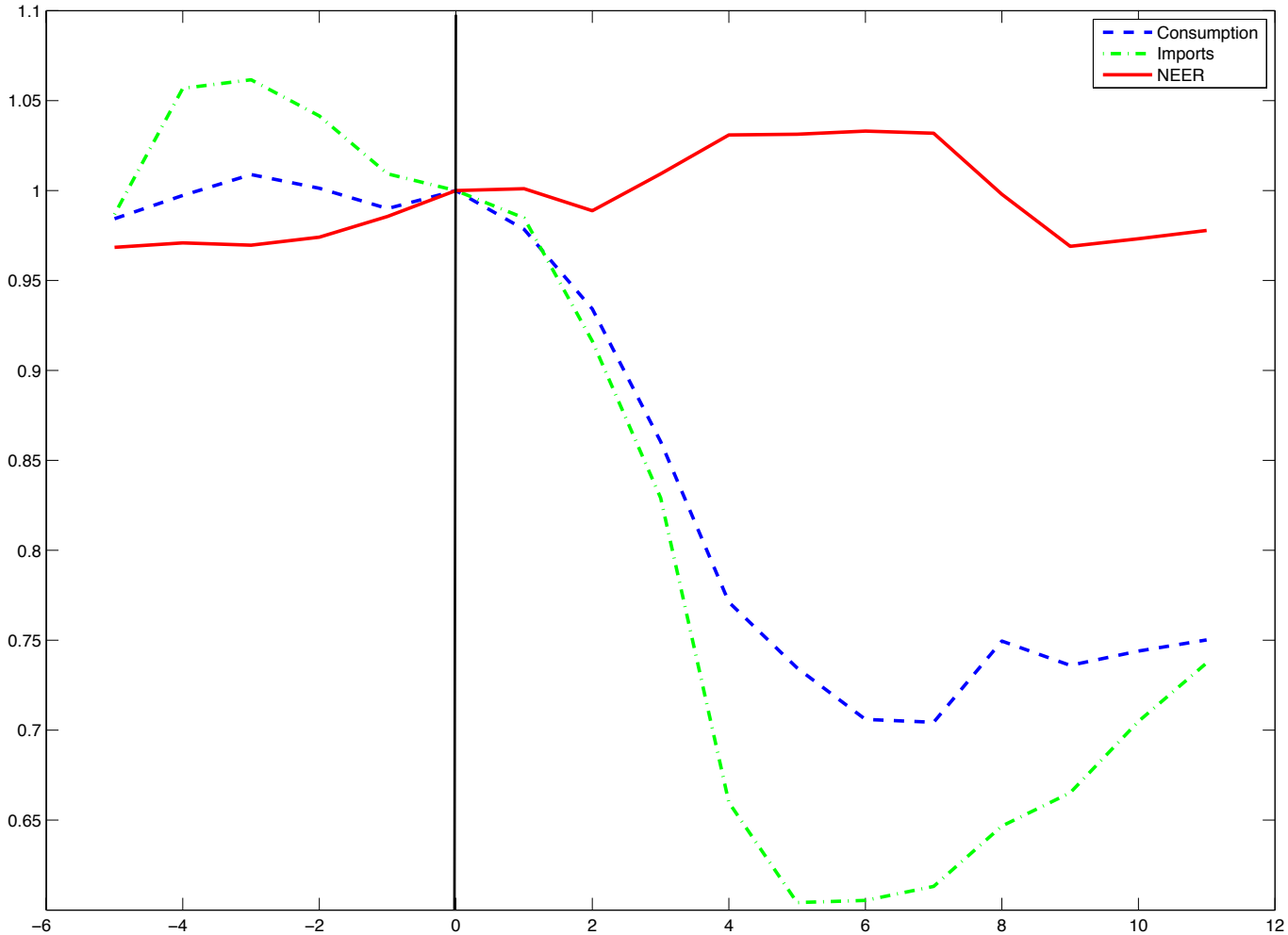
NH Model Within: Total, Price and Income Effects



Conclusion

- Expenditure switching driven by income effect, not changes in relative prices
- A more general phenomenon across countries during the crisis?
  - Fall in quality of European exports (Berthou & Emlinger, 2010)
  - Beginning a project with Bems and Shambaugh to investigate potential for asymmetries across countries in adjustment
- Policy implications
  - 'Successful internal devaluation?' We find no impact of an internal devaluation in the relative retail price of foreign/domestic goods
  - External sector adjustment without rebalancing? As income increases, expenditure switching is reversed

Latvian Experience During the Crisis



Note: Time 0 is 2008Q3

◂ Introduction

Two-Digit Product Group Summary Statistics

Code	Name	Share	Foreign Share	Code	Name	Share	Foreign Share
10	Meat, fresh and frozen	0.0100	0.0109	37	Pet foods	0.0134	0.8581
11	Fish	0.0200	0.1188	38	Pet accessories	0.0018	0.8455
12	Processed meat	0.0428	0.0320	40	Dry ingredients	0.0059	0.6770
13	Prepared food	0.0111	0.0331	41	Seasoning & preserve	0.0455	0.4278
14	Fresh bread	0.0766	0.0180	42	Sweets	0.0467	0.6632
21	Dairy products	0.0852	0.0159	43	Snacks	0.0085	0.4524
20	Eggs and eggs preparations	0.0198	0.0000	44	Dried fruit and nuts	0.0091	0.1788
22	Yogurts & dairy snacks	0.0491	0.1246	45	Natural & pharm. prods.	0.0020	0.7623
23	Edible fats	0.0157	0.1782	48	Brewery + mild alc. bevs.	0.0532	0.1595
24	Cheese	0.0464	0.1526	49	Alcoholic products	0.1497	0.6481
25	Frozen foods	0.0182	0.4035	50	Soft drinks	0.0372	0.4710
26	Ice cream	0.0139	0.0846	60	Tissues	0.0133	0.7304
30	Grain products	0.0264	0.3617	62	Disposable tableware, etc.	0.0074	0.7129
31	Biscuits and wafers	0.0163	0.1711	63	Intimate hygiene	0.0065	0.9836
32	Canned (jarred) foods	0.0231	0.3393	64	Body wash and care	0.0265	0.9771
33	Juices	0.0228	0.2136	65	Cosmetics	0.0064	0.8908
34	Hot drinks	0.0439	0.8580	66	Jewelry & optical prods.	0.0015	0.8145
35	Baby foods and drinks	0.0089	0.9993	68	Detergents	0.0006	0.5648
36	Baby care products	0.0145	0.9059		**Aggregate:**	**1.0000**	**0.3683**

Notes: This table presents summary statistics for two-digit product groups, aggregated across stores over the sample period May 2006–May 2011. The 'Share' column presents a product group's share of total sales over the sample period. The 'Foreign Share' column presents the share of foreign sales within a product group over the sample period. The 'Aggregate' foreign share is a 'Share'-weighted average of product groups' foreign shares.

◂ Data

CES and Non-Homothetic Models' Regression Results

	CES Model	**NH Model**	
	(1)	(2)	(3)
	β_{1g}	β_{1g}	β_{2g}
10th pctile	-3.595	-3.588	-3.547
25th pctile	-2.814	-2.837	-0.798
50th pctile	-1.925	-1.955	0.968
75th pctile	-1.115	-1.102	3.266
90th pctile	-0.067	-0.092	6.478
Observations	236,595	236,595	
Group×time pairs	7,294	7,294	
Groups	384	384	
R^2	0.099	0.103	

Notes: The number of coefficients significant at the 1In Column (1), 270 coefs are significant at the 10% level or lower; in Column (2), 273 coefs are significant at the 10% level or lower; in Column (3), 101 coefs are significant at the 10% level or lower.

◂ Figure