Accounting for Incomplete Pass-Through

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Theoretical Explanations for Incomplete Pass-Through:

- Oligopolistic mark-up adjustment
  - Dornbusch (1987), Knetter (1989), Bergin and Feenstra (2001)
- Local Costs
  - Sanyal and Jones (1982), Burnstein et al. (2003), Corsetti and Dedola (2004), Goldberg and Campa (2006)
- Dynamic Factors - Barriers to price adjustment such as menu costs, pre-determined prices etc.
  - Kasa (1992), Ghosh and Wolf (1994), Devereux and Yetman (2003)

Pass-through in the Coffee Market

- Coffee is world's second most traded commodity (after oil)
- Coffee commodity costs are highly volatile: lost almost 2/3 of value over 2000 – 2002
  - Volatility driven by weather, planting cycles, new entrants
- Industry estimates suggest that green bean coffee (imported input) accounts for more than half of marginal costs

Outline

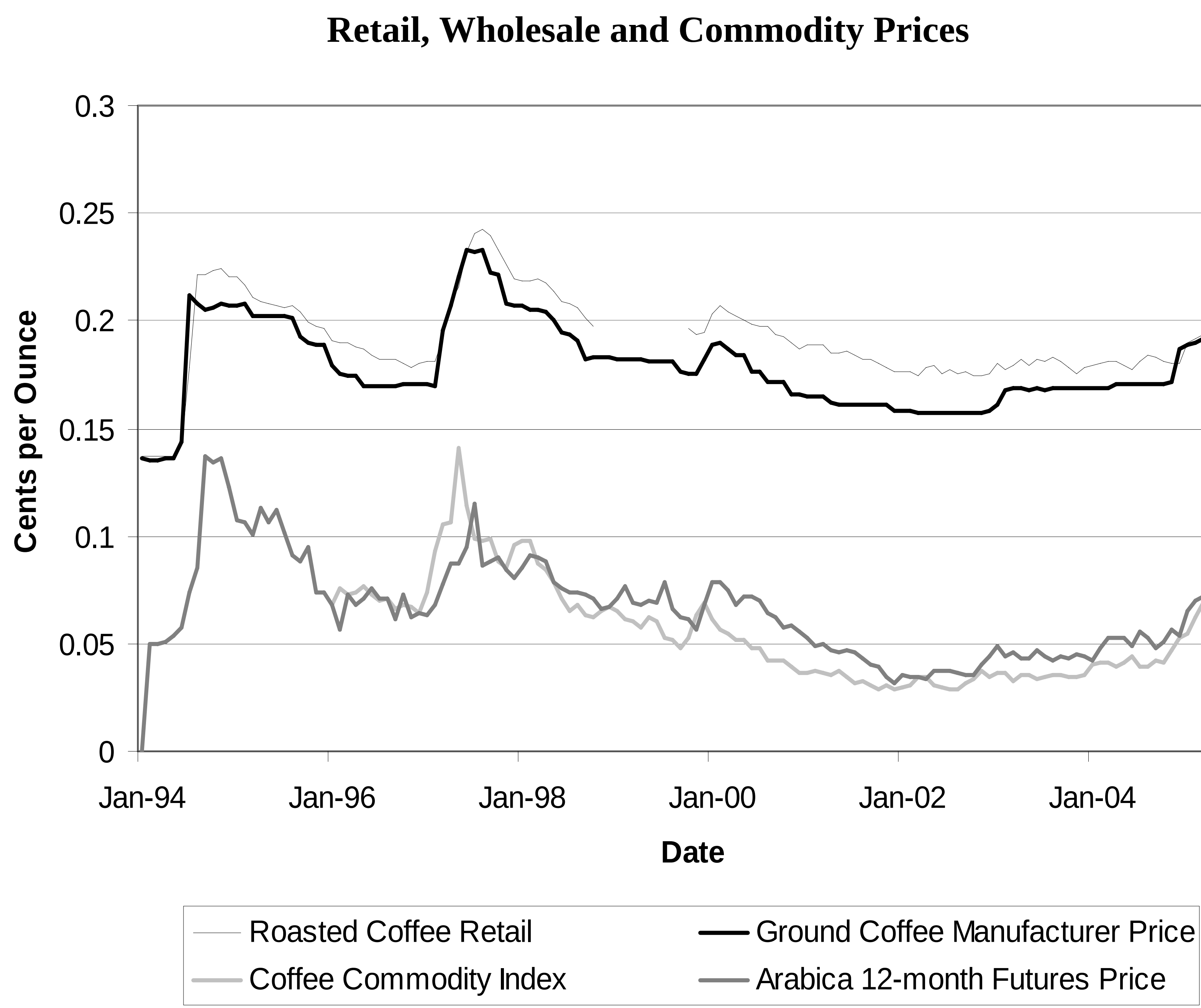
- Document facts about pass-through
- Develop structural pricing model
- Can the model “account” for the observed degree of incomplete pass-through?
- How important are mark-up adjustment, local costs, menu costs?

Terminology

Retail Price: Supermarket price

Wholesale Price: Manufacturer Price (i.e. Folgers, Maxwell House etc.)

Coffee Commodity Price: Index of green bean coffee on New York physicals market



Retail, Wholesale and Commodity Prices
0.3
0.25
0.2
0.15
0.1
0.05
0
Cents per Ounce
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Date
Roasted Coffee Retail
Ground Coffee Manufacturer Price
Coffee Commodity Index
Arabica 12-month Futures Price

Data on Coffee

- Retail price data: AC Nielsen monthly average prices and sales by UPC for ground (supermarket) coffee in 50 major US markets
- Wholesale price data: Promodata weekly UPC-level prices in up to 30 US markets (varied time periods)
  - Data collected from largest wholesaler in a given market
- Other data: Advertising data (AdDollars Database), Weather

1. Cost Pass-Through Regressions

$$\Delta \log p_{jmt} = a + \sum_{k=1}^{6} b_k \Delta \log C_{t-k} + \sum_{k=1}^{4} d_k q_k + \epsilon,$$

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p_{jmt}: Price per ounce of ground coffee

C_t: Commodity cost per ounce of ground coffee

Define long run pass-through as $\sum_{k=1}^{6} b_k$

Specification motivated by the fact that a unit root cannot be rejected for commodity costs (Goldberg and Campa, 2006)

Cost Pass-Through Regressions

- 1% increase in coffee commodity index yields long-run 0.3% increase in wholesale and retail prices
- Approximately cent-for-cent pass-through in levels
- More than half of pass-through occurs in the quarters after a change in cost

2. Retail versus Wholesale Pass-through

$$\Delta p^r_{jmt} = \alpha^r + \sum_{k=0}^{2} \beta^r_k \Delta p^w_{jmt-k} + \sum_{k=1}^{4} \gamma^r_k q_k + \epsilon,$$

- IV Regression: commodity costs as instruments (motivated by measurement error in wholesale prices)
- Find that retail prices adjust rapidly and approximately cent-for-cent to changes in wholesale prices
- Delayed pass-through occurs almost entirely at the wholesale level

3. Price Rigidity

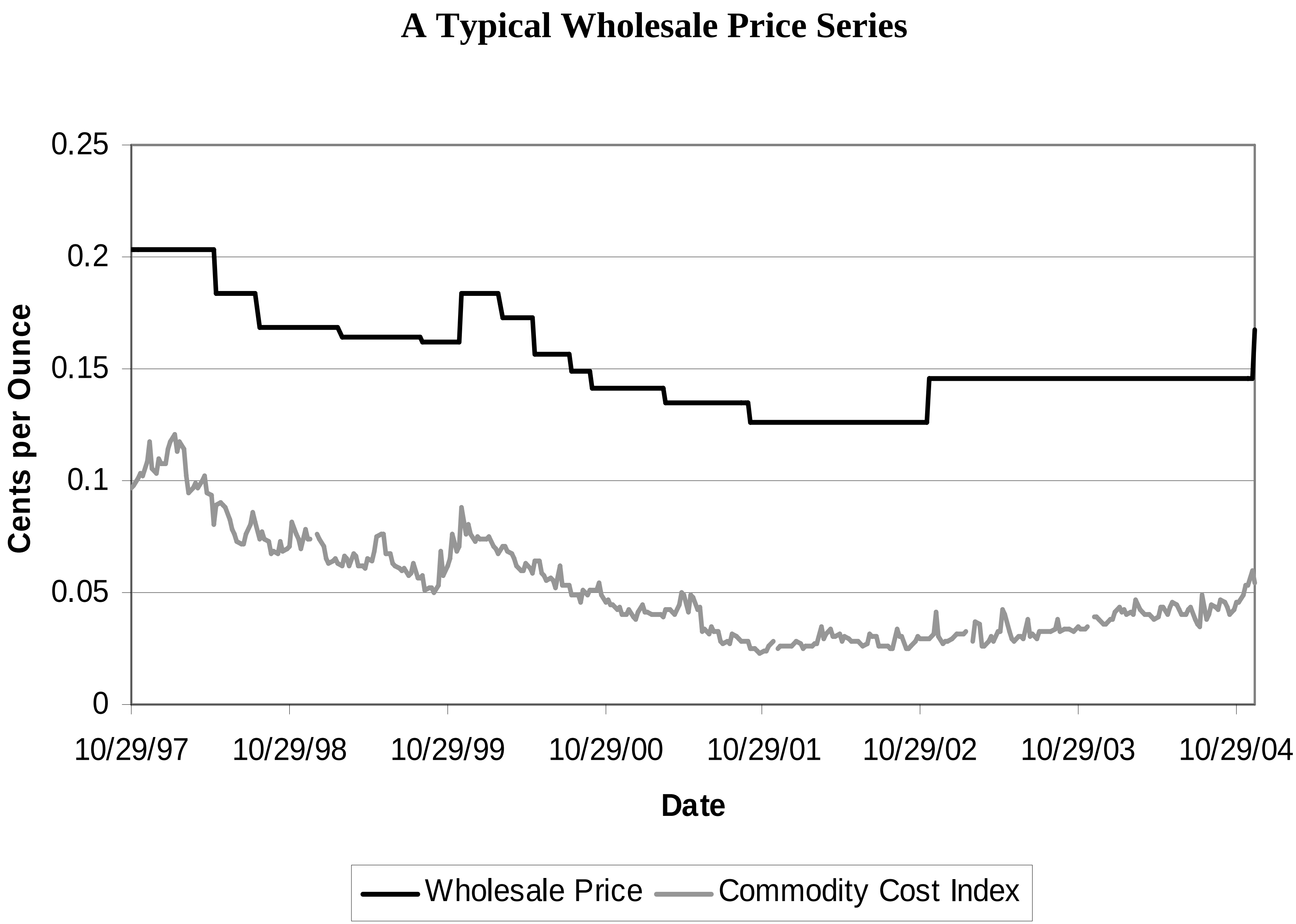
Annual frequency of price change in all markets (1997-2005):

Wholesale prices: 1.3 times per year

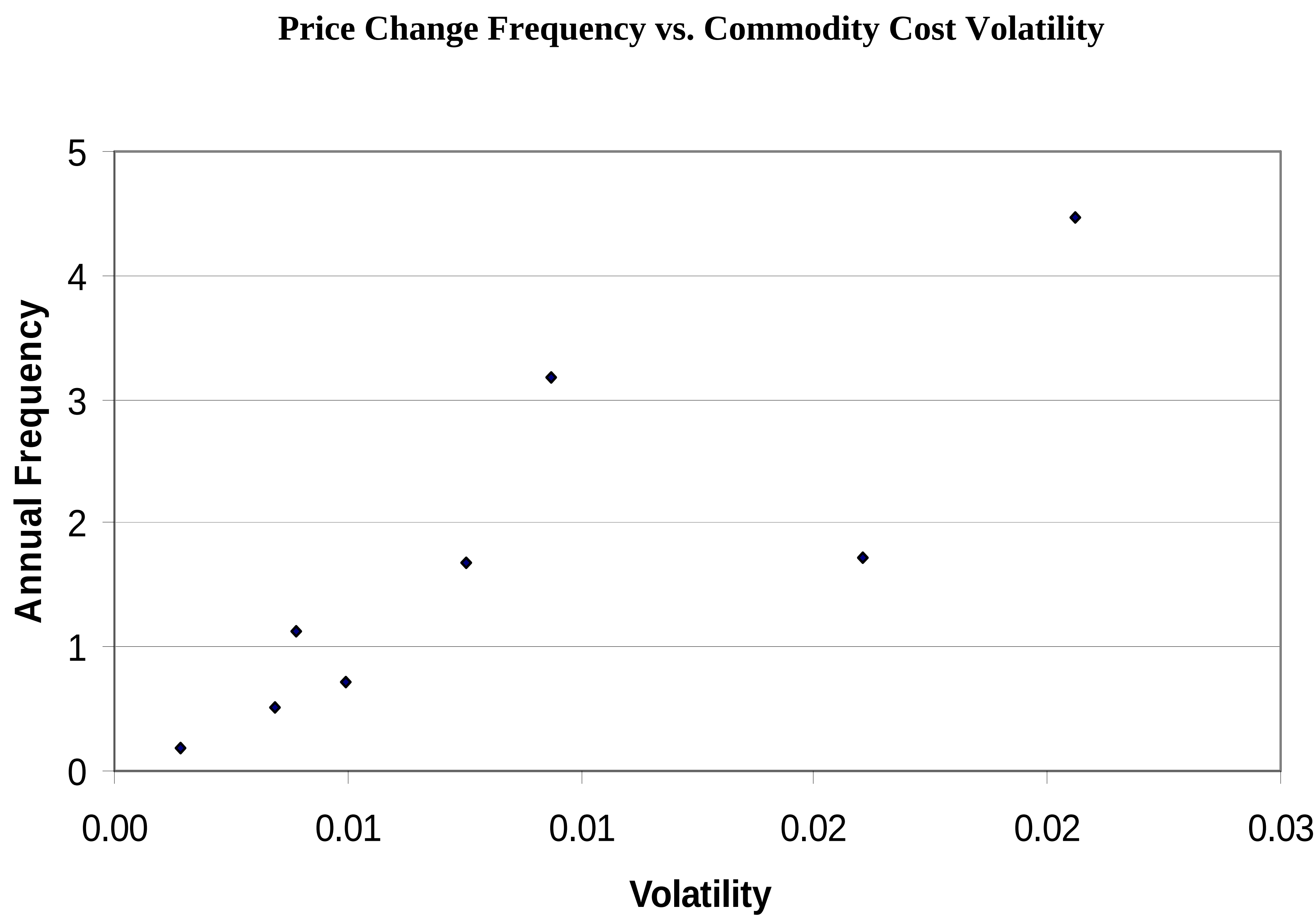
Retail Prices (without sales): 1.5 times per year

Retail prices (with sales): 3.1 times per year

Similar pattern in price rigidity to what we observe in aggregate US micro-data (Nakamura and Steinsson, 2007)



A Typical Wholesale Price Series
0.25
0.2
0.15
0.1
0.05
0
Cents per Ounce
10/29/97
10/29/98
10/29/99
10/29/00
10/29/01
10/29/02
10/29/03
10/29/04
Date
Wholesale Price
Commodity Cost Index


Price Change Frequency vs. Commodity Cost Volatility
Annual Frequency
0
1
2
3
4
5
0.00
0.01
0.01
0.02
0.02
0.03
Volatility

Summary:

- Long-run pass-through is about 0.3
- More than half of pass-through occurs in the quarters after the cost shock
- Delayed pass-through occurs almost entirely at the wholesale rather than the retail level
- Wholesale prices adjust infrequently; more frequent adjustment when commodity costs are volatile

Potential empirical issues:

1. Do rigid wholesale prices actually determine retail prices?

   Since manufacturers and retailers interact repeatedly,wholesale prices may not be "allocative" (Barro, 1977)

   - No evidence that retail prices adjust to commodity costs above and beyond adjustments in wholesale prices

2. Do commodity costs reflect marginal costs?

   What if manufacturers enter hedging contracts or long-term purchasing contracts?

   - Hedging contracts etc. affect the average cost, but not the marginal cost of coffee beans

Overview of Structural Model

Demand

- Random coefficients discrete choice model (BLP, 1995)
- Estimate using data on prices, market shares
- Identify consumer heterogeneity using market shares for particular demographic groups

Supply

- Oligopoly menu cost model
- Multi-product asymmetric firms: model matches observed industry structure
- Important Related Work: Goldberg and Verboven (2001), Hellerstein (2006), Goldberg and Hellerstein (2007)

Demand Estimation

1. Simultaneity problem

- Include brand-region dummies in x_j to flexibly account for constant differences in product quality (Nevo, 2001)
- Instrument for prices using weather in Brazil and Colombia (major coffee producing countries)
  - Instruments explain about 1/3 of the variation in commodity prices

2. Heterogeneity

Allow for heterogeneity in price elasticities across consumers

Demand Estimates

			Logit			Random Coefficients
	OLS1	OLS2	IV1	IV2	IV3	IV
Brand x Region dummies	NO	YES	YES	YES	YES	YES
Instrument			Hausman	Commodity Cost	Weather	Weather
Median Price Elasticity	**0.54**	**1.96**	**3.02**	**2.69**	**3.20**	**3.46 [2.59 4.48]**

Oligopoly Menu Cost Model

<u>Demand Side</u>

Estimated random coefficients demand model

<u>Supply Side</u>

Focus on representative market (Syracuse)

Market structure: Folgers, Maxwell House, Hills Bros.

Firm j seeks to maximize the discounted expected sum of future profits

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\pi_{jt}(p_t^r, C_t) - \gamma_{jt} 1(\Delta p_{jt}^w \neq 0) \right],$$

Menu Costs: Assume that firms face a random menu cost γ_{jt} of adjusting their prices

Asymmetric information: Firms do not know competitors' menu costs when choosing prices (helps smooth policy functions)

Model Solution

In equilibrium every firm chooses prices optimally:

$$p_t = \begin{cases} p_{t-1} & \text{if } \Delta W < \gamma_t \\ p^* & \text{otherwise} \end{cases} \tag{1}$$

where $\Delta W = W_{ch} - W_{nch}$ and:

$$p^* = \arg\max_p E_t \left[\pi(p, C) + \beta V_j(p, C, \gamma) \right]. \tag{2}$$

Model Solution cont'd

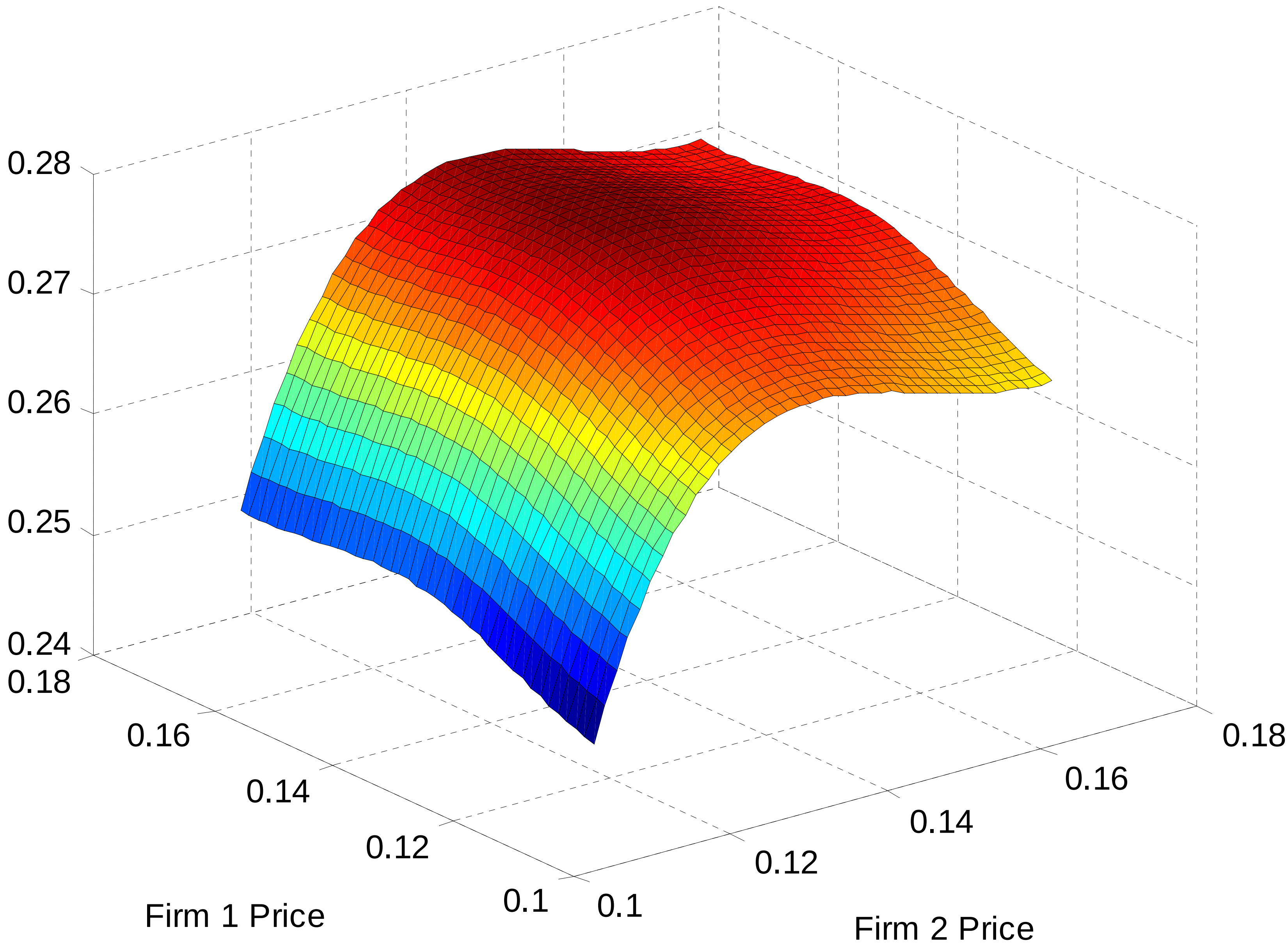
Markov Perfect Equilibrium

- Assume strategies depend only on payoff-relevant variables

Solve using numerical methods (Pakes and Mcguire, 1994)

- Search for fixed point of policy functions across firms
- No guarantee of convergence, uniqueness

Figure 6: Probability of Adjustment as a Function of Competitors' Prices



Parameterization:

Use estimated demand system, local costs etc.

Estimate mean of menu cost distribution using simulated method of moments:

$$\hat{\sigma} = \min_{\sigma} (f - \hat{f})^2$$

f: Empirical frequency of wholesale price change

$\hat{f}$: Frequency of price change implied by the model given actual cost series

Commodity costs: random walk

Production function: partially known

Results

1. Markups

- Median percentage markup: 58.3%
  - Similar to Foster et al. (2005) for ground coffee
- Median fraction of local (non-coffee bean) costs: 52%
  - Similar to estimates on average fraction of non-coffee variable costs from the Survey of Manufacturers

Not clear that static estimates will equal dynamic estimates $\rightarrow$ Also consider alternative dynamic procedure

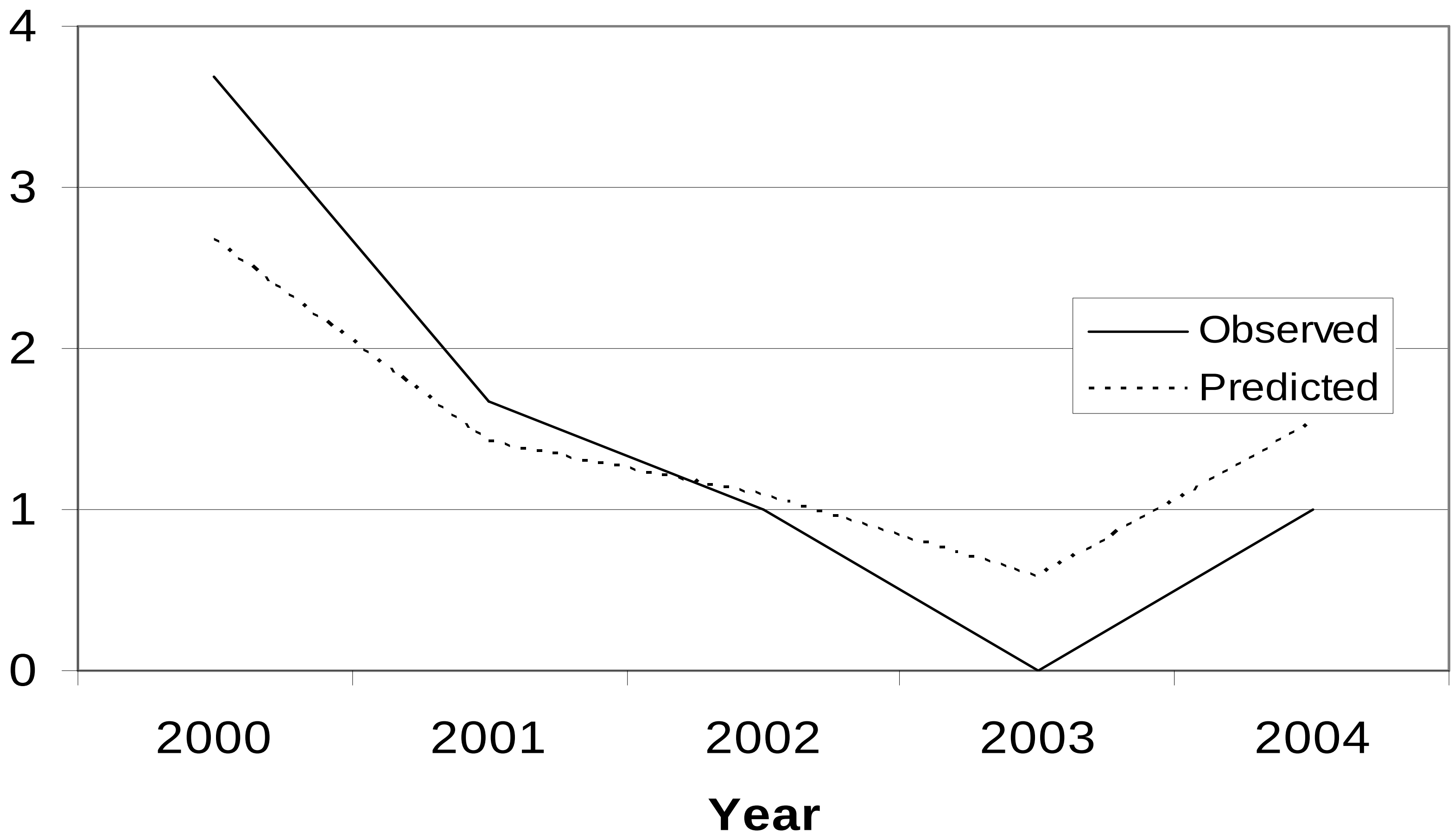
2. Menu Cost Estimates

Mean of menu cost: $\sigma = 0.22\%$ of average annual revenue

Smaller than existing estimates of average menu costs for supermarkets (Zbaracki et al., 2004)

Robustness check: estimate menu cost simultaneously with common component in costs as part of the dynamic estimation procedure: very similar results

Predicted vs. Observed Frequency of Price Change for Dynamic Model



3. Implications for Price Rigidity: Model vs. Data

- Model captures basic pattern in timing of price adjustments
- Somewhat less variation in frequency of price change implied by model vs. data

4. Implications for Pass-through: Model vs. Data

- Long-run pass-through is 0.269 in the model; 0.247 in the data
- Less than half of pass-through occurs in the first quarter

Accounting for Incomplete Pass-through:

Dixit-Stiglitz model

Dixit-Stiglitz model with local costs

Static random coefficients discrete choice model with local costs, mark-up adjustment

Oligopoly menu cost model with local costs, mark-up adjustment, menu costs

Pass-through Regressions for Simulated Data

Variable	Dixit-Stiglitz (no local costs)	Dixit-Stiglitz (local costs)	Static Discrete Choice	Dynamic Discrete Choice
Long-run Pass-through	1	0.426	0.284	0.269
Factors:		Local Costs	Local Costs, Markup Adj.	Local Costs Markup Adj. Menu Costs
Percent:		78%	20%	2%

Robustness:

Determinants of Pass-Through

- Persistence of marginal costs: Higher persistence $\uparrow$ PT
- Timing of price adjustments (menu cost vs. Calvo): Calvo $\downarrow$ PT
- Heterogeneity in price elasticities: Higher het. $\uparrow$ PT

Determinants of Price rigidity

- Persistence and volatility of marginal costs
- Forward-looking behavior

Conclusions

- Menu cost model provides quantitatively realistic account for pass-through, timing of price adjustments
- Dynamic model crucial for evaluating magnitude of menu costs, implications for pass-through
- Delays in pass-through occur almost entirely at the wholesale level
- Local costs and mark-up adjustment account for 78% and 20% of pass-through; while menu costs account for only 2%