Small Price Changes, Sales Volume and Menu Cost

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In a Nutshell

- **A simple explanation for a puzzle:**
- **Small price changes' coexistence with menu costs**

- **Theory: Based on Barro (1972)**
- **Empirics: Large US supermarket dataset**

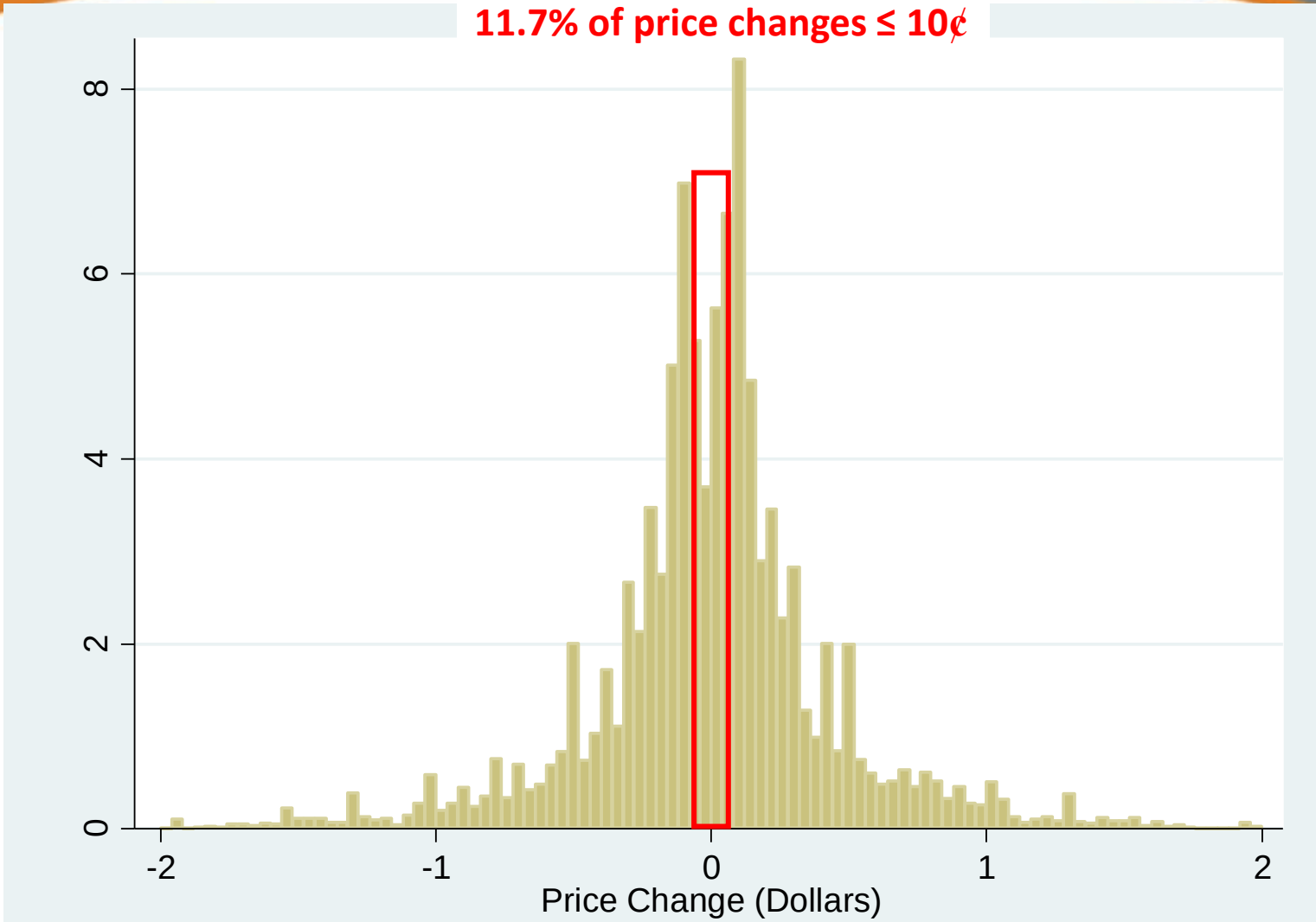
Menu Cost

- **"A leading explanation [for monetary non-neutrality]… is a menu cost…" (Anderson et al. 2015)**
- **Price changes entail fixed costs**
  - **Printing price labels**
  - **Informing consumers**
- **Price changes occur infrequently**
- **Price changes are relatively large**

Small Price Changes

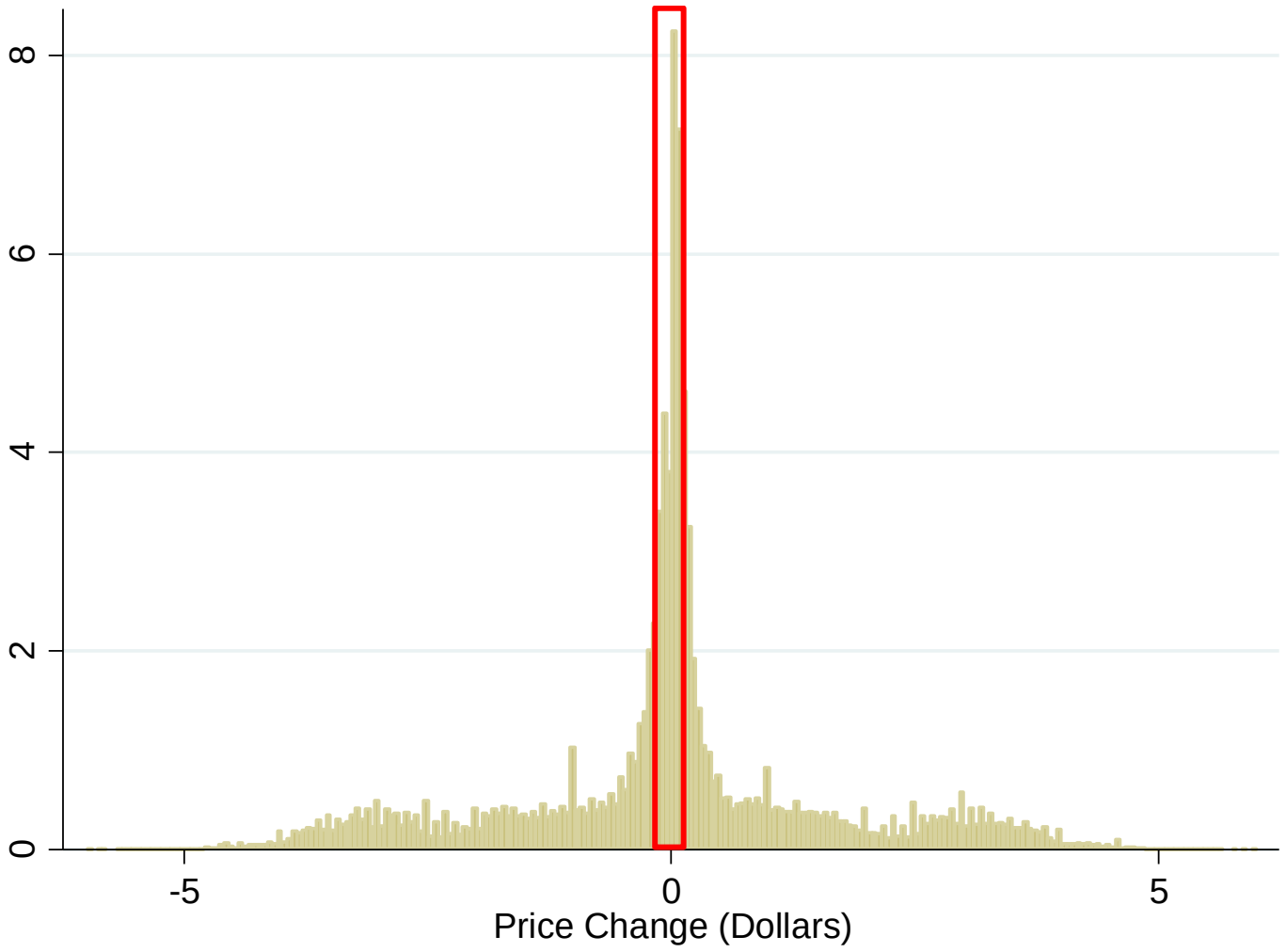
- **Klenow and Malin (2011):**
  - **Price changes are big on average, but many small changes occur**
- **Midrigan (2011):**
  - **≈ 20% of price changes are less than 10¢**

Dominick's Data: Cookies



Dominick's Data: Cereals

30.6% of price changes ≤ 10¢



Existing Explanations

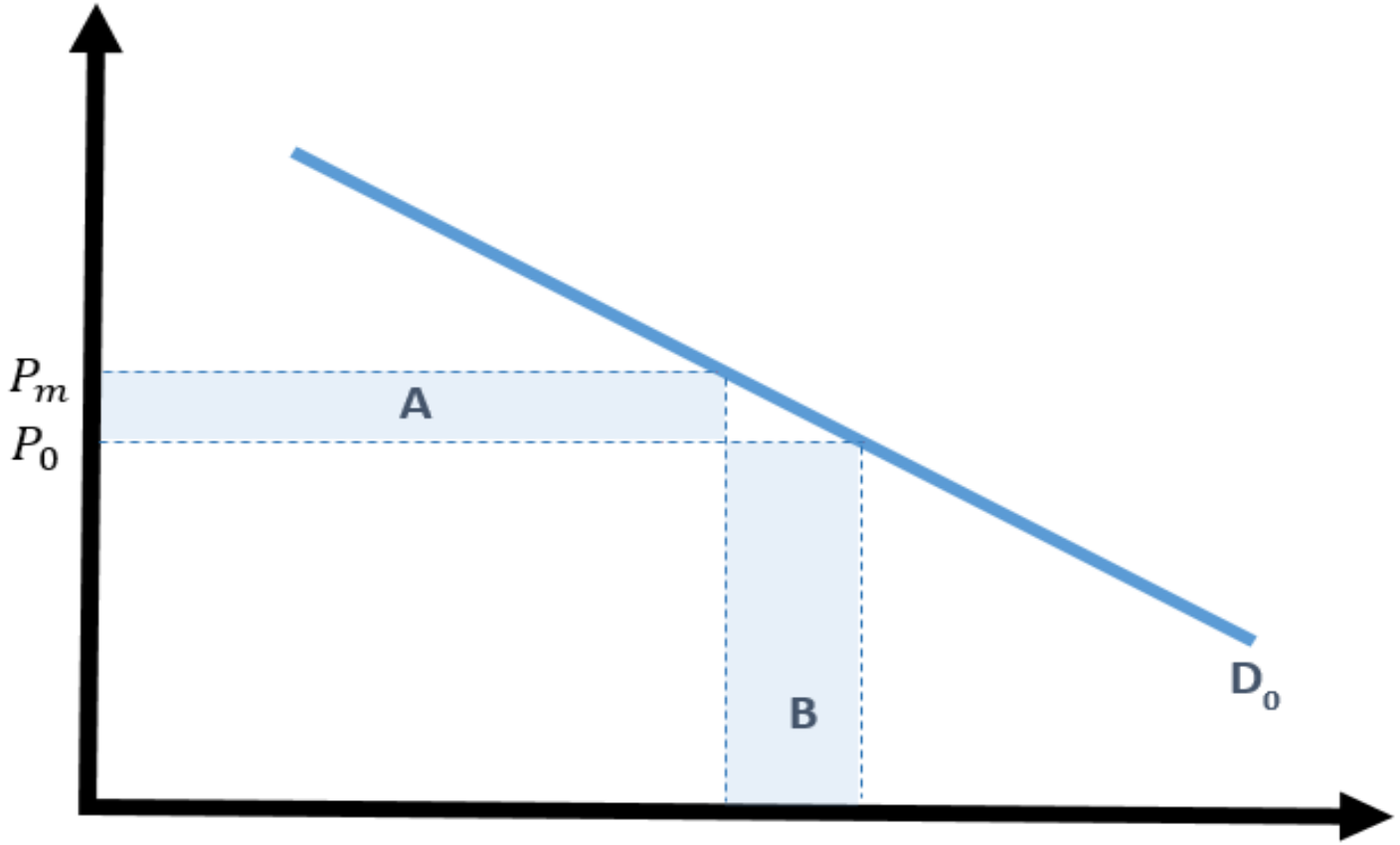
- **Dotsey et al. (1999): Stochastic menu costs**
- **Lach and Tsiddon (2007), Midrigan (2011): Economies of scale**
- **Gertler and Leahy (2008): Small menu costs with infrequent shocks**
- **Woodford (2009): Information constraints**
- **Eichenbaum et al. (2014): Large share of the small price changes are measurement errors**

Our Explanation: Intuition

- **Recall: Mankiw (1985)**
- **Monopoly producer**
- **Fixed marginal cost, $k = 0$**
- **Producer sets the price in advance, P_0**
- **Demand is stochastic; profit maximizing price, P_m is higher than P_0**
- **Changing the price entails a menu cost, z**

The Monopolist's Problem

Change price to P_m if A – B > z



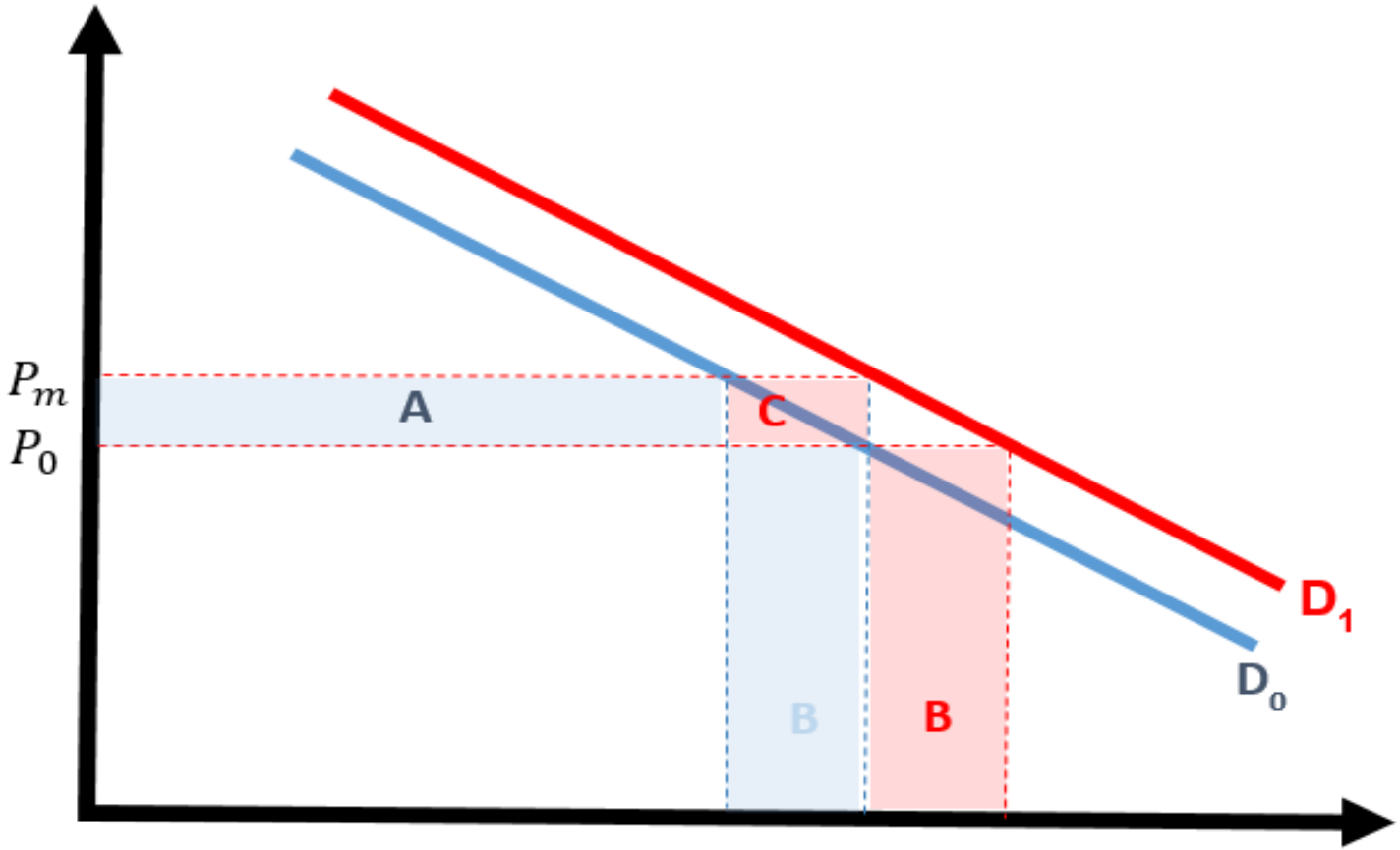
Consider a Higher Demand

- **Demand: Same slope**
- **Same initial price, P_0**
- **Same shock, so P_M is the same**

Greater Sales Volume, More Small Price Changes

The B area is unchanged.

But now change price if A + C – B > z



Menu Cost Model

- **A monopolist's problem (Barro, 1972):**

- $$\begin{cases} max\left[PY - \left(a + bY + cY^2\right)\right] \\ s.t \;\; Y = \alpha - \beta P + u \end{cases}$$

- **The optimal (*S*,*s*) band is symmetric, given by** $(\hat{h}, -\hat{h})$

The Effect of Sales Volume on the (*S*,*s*) Band

- **Straightforward algebra yields:**
- $\widehat{h} = \sqrt{\sigma}\left\{6\gamma(Y^*|_{u=0})^{-1}\left[\frac{(1+2c\beta)^2}{2\beta(\alpha-\beta b)}\right]^{-1}\right\}^{\frac{1}{4}}$
  - $Y^*|_{u=0}$ **- Expected demand in disturbance free equilibrium**
- **Therefore,** $\frac{d\widehat{h}}{d(Y^*|_{u=0})} < 0$
- **The greater** Y^***, the narrower the (*S*,*s*) band**
  - **Price changes are smaller**

Data

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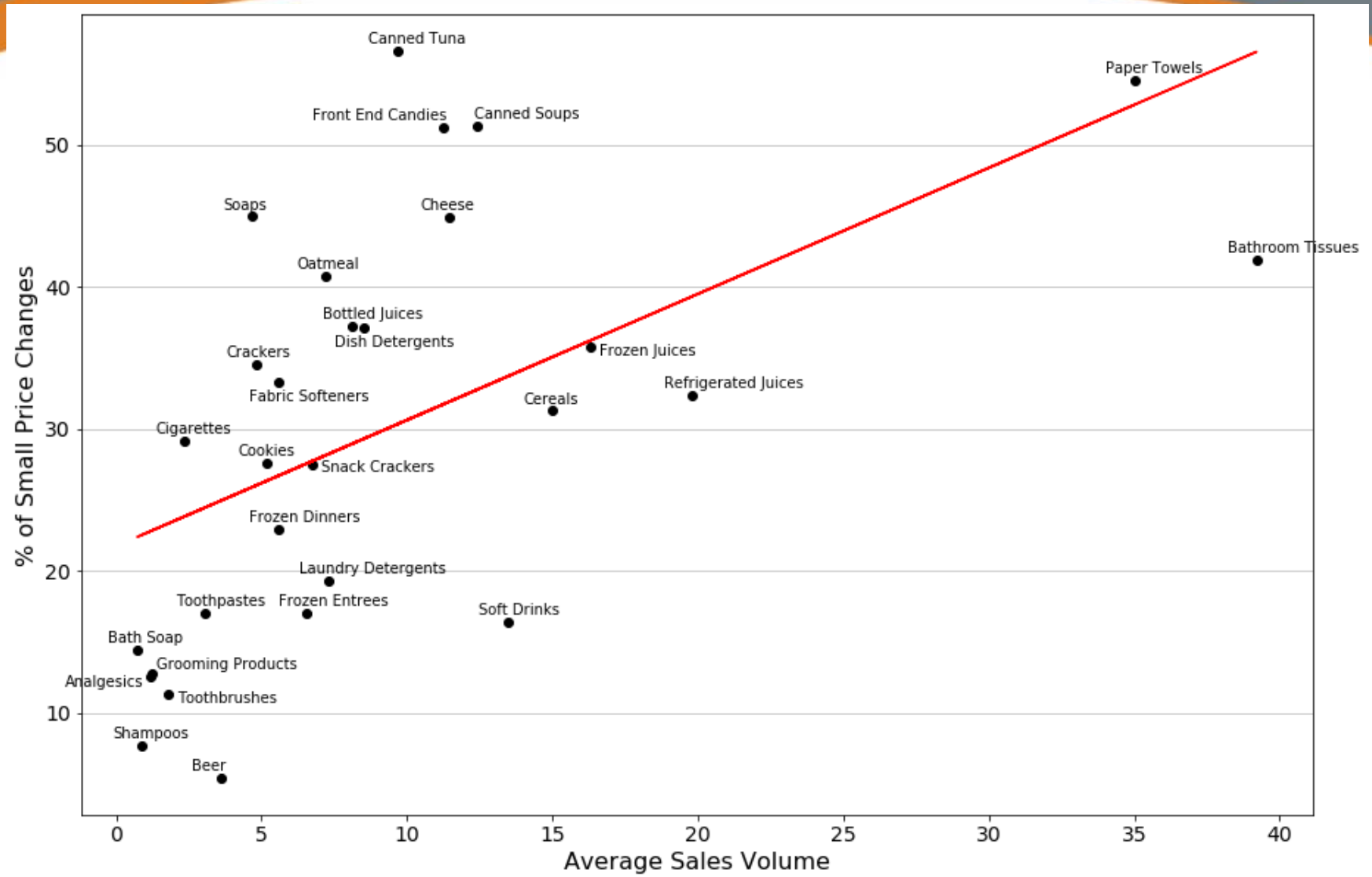
Finer Food
- 93 stores
- 29 Product categories
- 18,037 products
- 98.7 million observations
  - Weekly prices and quantities sold
- 8 years of weekly data: 1989–1997

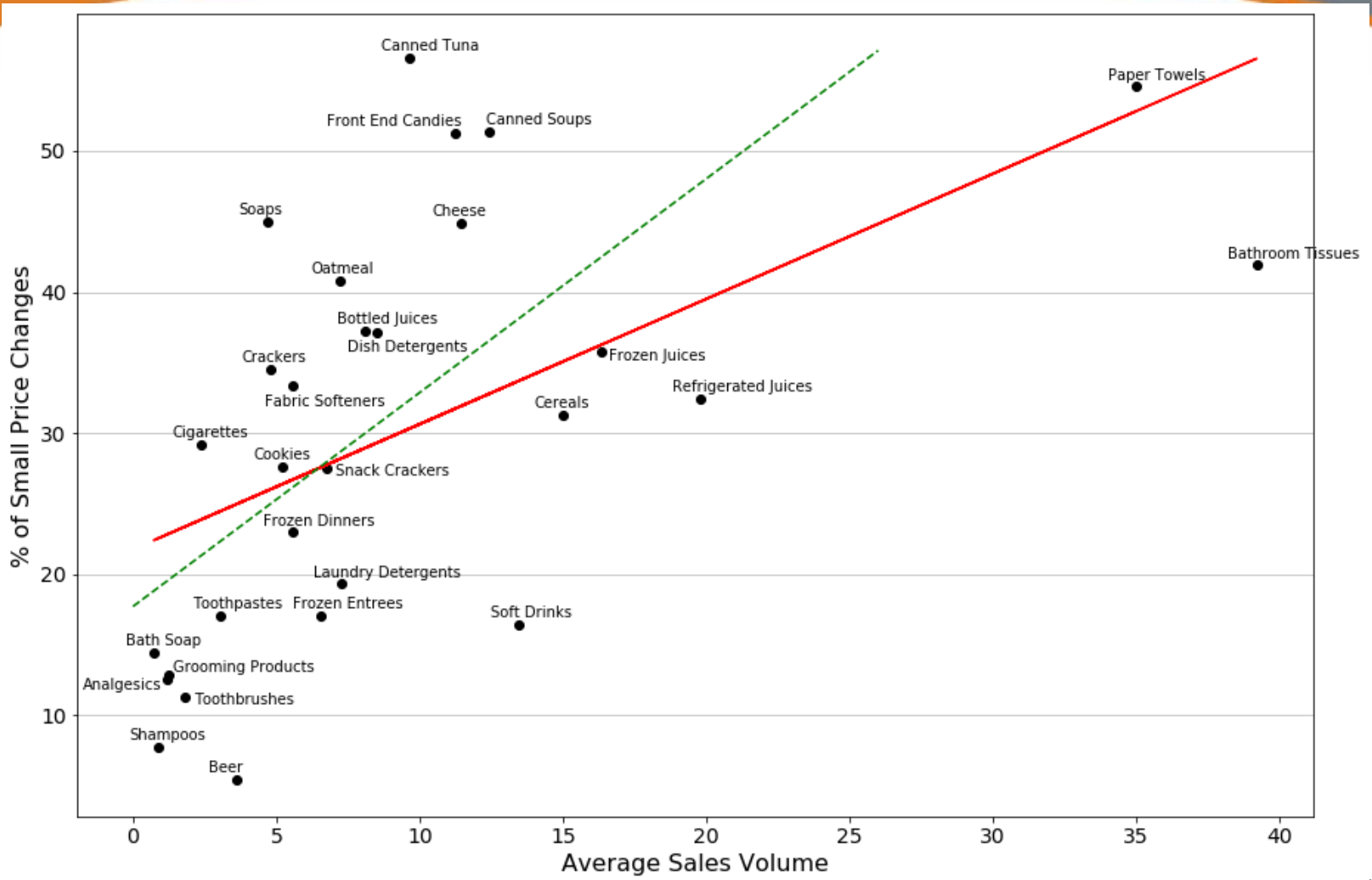
Category level Small Price Changes (≤10¢)

Product Category	All price changes (1)	Small price changes (2)	% of small price changes (3)	Average sales volume (4)
Analgesics	276,225	35,378	12.8	1.25
Bath soap	35,572	5,125	14.4	0.73
Bathroom tissues	325,837	136,493	41.9	39.21
Beer	45,9405	24,859	5.4	3.61
Bottled juices	962,368	358,443	37.3	8.12
Canned soups	950,357	488,159	51.4	12.4
Canned tuna	379,680	214,923	56.6	9.66
Cereals	724,013	226,449	31.3	14.98
Cheese	1,811,753	813,305	44.9	11.44
Cigarettes	56,000	16,327	29.2	2.37
Cookies	1,353,330	374,027	27.6	5.19
Crackers	476,008	164,529	34.6	4.81
Dish detergents	374,058	138,909	37.1	8.50
Fabric softeners	348,422	116,134	33.3	5.57
Front end candies	487,886	249,939	51.2	11.26
Frozen dinners	502,830	115,471	23.0	5.57
Frozen entrees	1,846,911	314,441	17.0	6.56
Frozen juices	658,225	235,246	35.7	16.32
Grooming products	659,842	82,759	12.5	1.21
Laundry detergents	559,576	107,931	19.3	7.29
Oatmeal	169,093	68,971	40.8	7.20
Paper towels	248,289	135,462	54.6	35.00
Refrigerated juices	800,280	259,263	32.4	19.82
Shampoos	701,813	54,068	7.7	0.87
Snack crackers	800,253	220,178	27.5	6.74
Soaps	324,724	145,984	45.0	4.69
Soft drinks	4,532,158	743,243	16.4	13.46
Toothbrushes	295,021	33,386	11.3	1.80
Toothpastes	588,261	100,141	17.0	3.07
Total	21,708,190	5,979,543	27.6	9.27

Category level: Small Price Changes and Sales Volumes

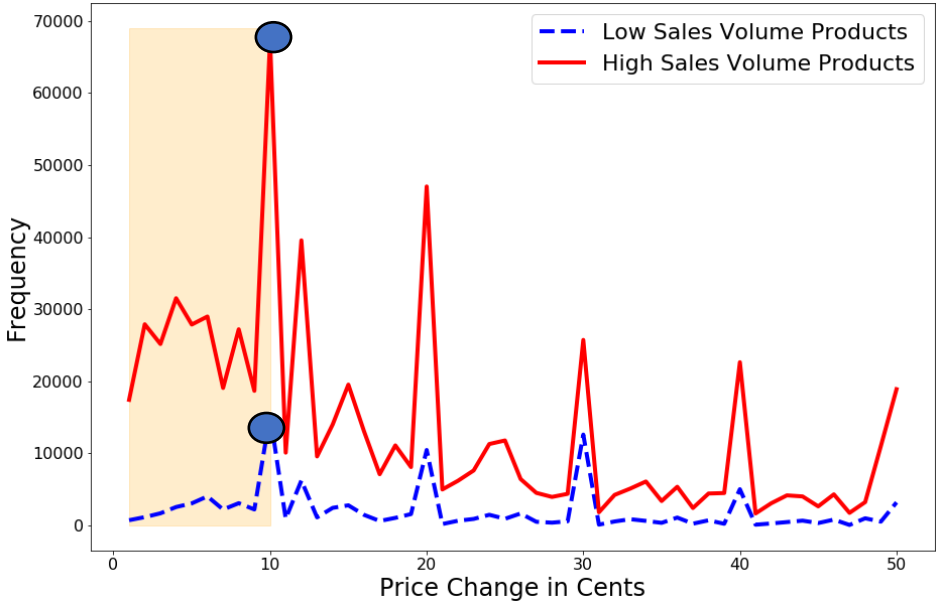


If we Ignore Outliers

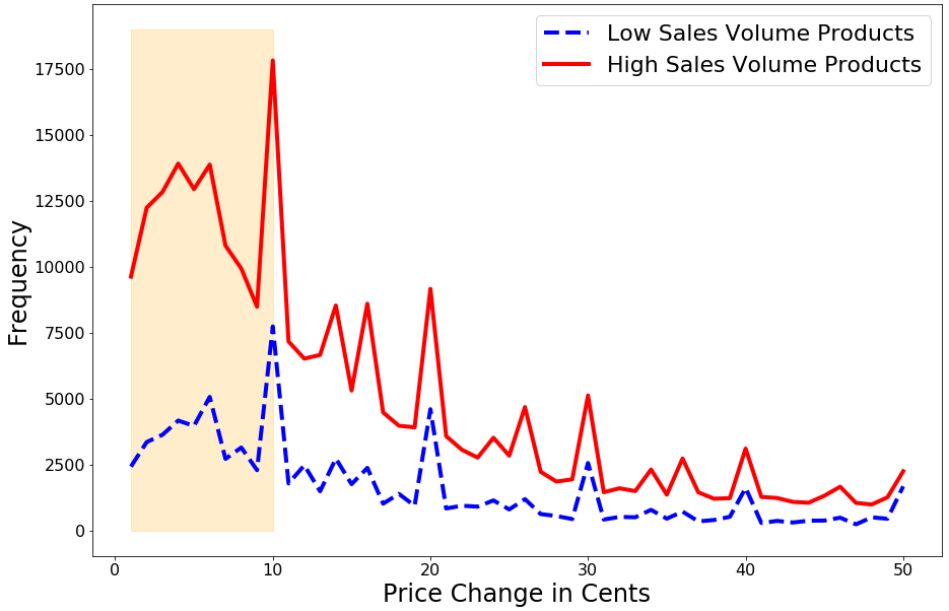


Within categories: High vs. Low Sales Volume

Cookies



Cereals



Regression Analyses

- **Linear Probability Models**
- **Dependent: Dummy for small price changes**
- **Independent: Log average sale volume per store**
- **Other Controls:**
  - **Log average price**
  - **Dummy for sale/bounce back prices**
  - **Log of absolute change in wholesale price**
  - **Fixed effects: Stores, UPCs, years and months**

Regression Results

All coefficients are significant at 1%

Category	Baseline	Added Controls	N
Analgesics	0.038	0.031	276,225
Bath Soap	0.042	0.047	35,572
Bathroom Tissues	0.032	0.016	325,837
Beer	0.023	0.025	459,405
Bottled Juices	0.047	0.038	962,368
Canned Soups	0.024	0.016	950,357
Canned Tuna	0.037	0.027	379,680
Cereals	0.024	0.018	724,013
Cheese	0.037	0.022	1,811,753
Cigarettes	0.020	0.019	56,000
Cookies	0.044	0.038	1,353,330
Crackers	0.055	0.043	476,008
Dish Detergents	0.051	0.039	374,058
Fabric Softeners	0.043	0.032	348,422

Regression Results (Cont.)

All coefficients are significant at 1%

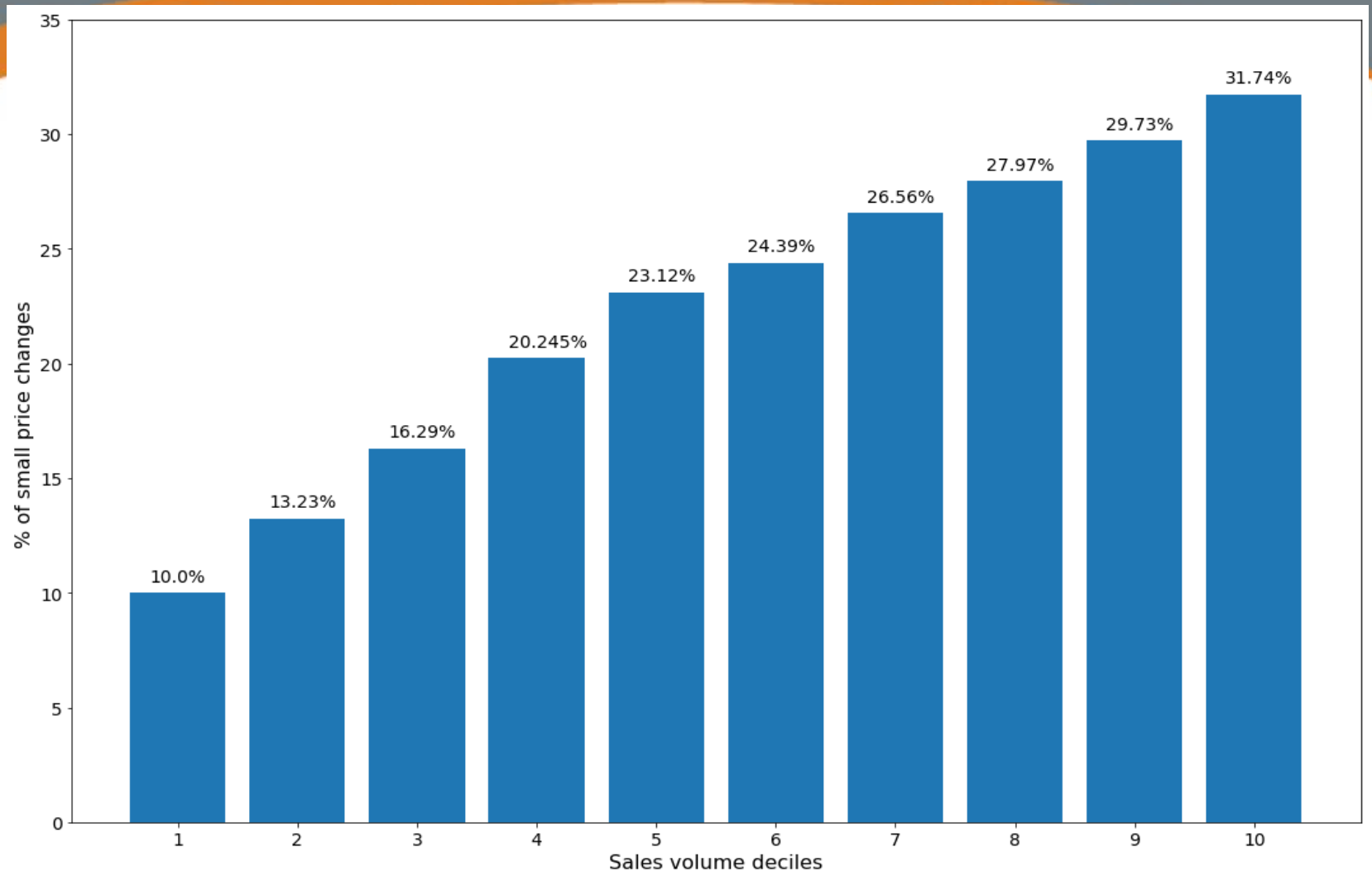
Category	Baseline	Added Controls	N
Front End Candies	0.004	0.008	487,886
Frozen Dinners	0.051	0.041	502,830
Frozen Entrees	0.033	0.033	1,846,911
Frozen Juices	0.033	0.026	658,225
Grooming Products	0.040	0.045	659,842
Laundry Detergents	0.032	0.023	559,576
Oatmeal	0.029	0.018	169,093
Paper Towels	0.035	0.028	248,289
Refrigerated Juices	0.031	0.021	800,280
Shampoos	0.031	0.038	701,813
Snack Crackers	0.043	0.039	800,253
Soaps	0.057	0.040	324,724
Soft Drinks	0.024	0.027	4,532,158
Toothbrushes	0.029	0.032	295,021
Toothpastes	0.029	0.029	588,261

Summary of the Regression Results

- **29/29 positive coefficients**
- **Mean coefficient: 3.0%**

1% ⬆ sales volume ➡ 3.0% ⬆ likelihood of small price change (≤ 10¢)

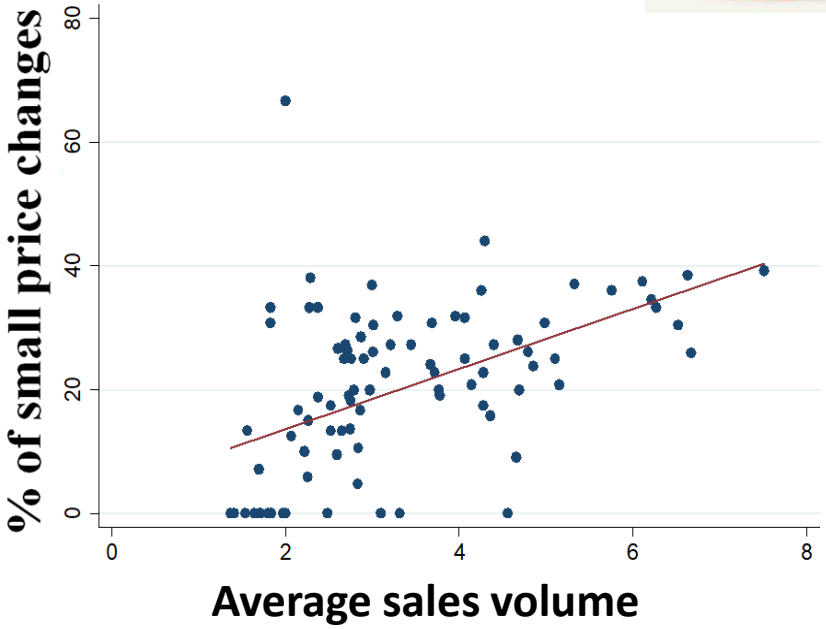
Individual Products: Frequency of Small Price Changes by Sales Volume Decile



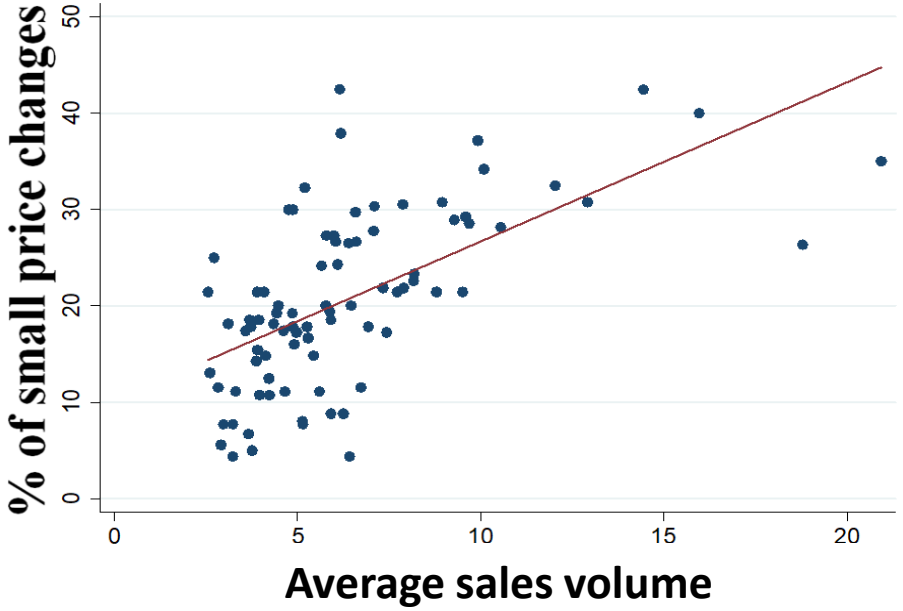
Small price changes ≤ 10¢

Variability Across Stores

1. Pepperidge Farm Nutty Del Gold



2. Archway Classic Soft Oatmeal Raisin Cookies, 11oz



Small price changes ≤ 10¢

Summary of the Results

- **Positive correlation: Sales volumes and small price changes**

- **Holds:**
  - **Cross categories comparisons**
  - **Within categories comparisons**
  - **Individual goods, across stores**

Conclusion

- **New explanation for small price changes**
  - **In a world with menu costs**
- **Small price changes: Consistent with menu costs**
  - **Depends on the sales volume**
- **Dominick's data: Consistent with this prediction**

Thank you!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