Complete Pass-Through in Levels

Kunal Sangani

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Disclaimer

This presentation contains my own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the author and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

Pass-Through in Logs and Levels

- Incomplete long-run pass-through of input cost changes.
  E.g., Peltzman (2000), Kim and Cotterill (2008), Nakamura and Zerom (2010), Hong and Li (2017).
  - When costs increase 10%, firms raise prices $<$10%.
  - Incomplete even after accounting for input cost share and at long horizons.
  - Prevailing explanation: “Superelasticity” of demand leads to markup adjustment.

Pass-Through in Logs and Levels

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  - When costs increase 10%, firms raise prices $<$10%.
  - Incomplete even after accounting for input cost share and at long horizons.
  - Prevailing explanation: “Superelasticity” of demand leads to markup adjustment.
- Today: Measure pass-through on a dollars-and-cents basis.
- Result: Firms exhibit complete pass-through in levels.
  - \$1/unit increase in cost leads firms to increase prices \$1/unit. Looks incomplete in logs.
  - Pass-through in levels explains variation in “log pass-through” across products/firms.
  - Pattern spans many markets (gas stations, food products, manufacturing industries).

Explaining Pass-Through in Levels

- In workhorse macro models, pass-through in levels should equal the markup, $\mu > 1$.
  - For CES demand. (E.g., Dixit and Stiglitz 1977, Melitz 2003.)
  - For richer **homothetic** demand systems, for cost shocks that affect all firms in industry. (E.g., Kimball 1995; Atkeson and Burstein 2008; HSA from Matsuyama and Ushchev 2022.)

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- In workhorse macro models, pass-through in levels should equal the markup, $\mu > 1$.
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  - For richer **homothetic** demand systems, for cost shocks that affect all firms in industry. (E.g., Kimball 1995; Atkeson and Burstein 2008; HSA from Matsuyama and Ushchev 2022.)
- Discipline departure from homotheticity using discrete choice framework for demand.
  - Parameter η dictates intensive margin elasticity of demand.
  - Demand within industry is homothetic (e.g., CES) iff $\eta = 1$.
  - Result: Pass-through in levels of aggregate cost shocks whenever $\eta = 0$.
  - Identifies class of models that generate pass-through in levels. E.g., Heterogeneous coefficient logit (Berry, Levinsohn, and Pakes 1995); probit demand; spatial competition (Hotelling 1929; Salop 1979; Barro 2024).

Macro Implications

1. Asymmetry, convexity, and heterogeneity in "log pass-through."
2. Differential pass-through of unit labor costs relative to materials costs (Okun 1981).
3. Response of industry gross margins, profits, and entry to upstream costs.
4. Low volatility of consumer inflation relative to commodity costs.
5. Fluctuations in inflation inequality over commodity cost cycle.
   - Explains "cheapflation" during recent inflation without price gouging / excess demand.
   - Absent this channel, inflation inequality from 2020–2023 would have been 1/3 as large.

Selected Related Literature

- **Theoretical and empirical determinants of pass-through**:
  - E.g., Bulow and Pfleiderer (1983); Nakamura and Zerom (2010); Weyl and Fabinger (2013); Hong and Li (2017); Minton and Wheaton (2022); Mongey and Waugh (2023); (*Exchange rates*) Campa and Goldberg (2005); Burstein et al. (2006); Burstein and Gopinath (2014); Fitzgerald and Haller (2014); Amiti et al. (2019).
  - Abstract from (1) asymmetry in speed of adjustment (Borenstein et al. 1997; Peltzman 2000; Benzarti et al. 2020) and (2) firm-specific shocks (e.g., Amiti et al. 2019).
- **Studies that measure pass-through in levels (not exhaustive)**:
  - *Retail Gasoline*: (*Pass-through asymmetry*) Karrenbrock (1991), Borenstein et al. (1997), Lewis (2011) (*Cycles*) Wang (2009), Noel (2009, 2015), Lewis and Noel (2011), Atkinson et al. (2014), Byrne and de Roos (2017, 2019).
  - *Food*: (*Coffee*) Bettendorf and Verboven (2000), Leibtag et al. (2007), Nakamura and Zerom (2010), Bonnet et al. (2013), (*Cheese*) Kim and Cotterill (2008), (*Spirits*) Conlon and Rao (2020), (*Cigarettes, Beer, Milk*) Butters et al. (2022).

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Simple Example

Empirical Evidence

- Food products
- Manufacturing industries

Explaining Pass-Through in Levels

Implications

- Asymmetry, convexity, and heterogeneity in “log pass-through”
- Differential pass-through of labor costs
- Industry profits, margins, and entry
- Stability of consumer price index
- Inflation inequality

Pass-Through in Levels: Example

- Leontief production in commodity (\$1/unit) and other variable costs (\$1/unit).

Cost per unit	Baseline
Commodity	\$1
Other components of marginal cost	\$1
Total marginal cost	\$2
Price	\$4

Pass-Through in Levels: Example

- Leontief production in commodity ($1/unit) and other variable costs ($1/unit).

Cost per unit	Baseline	
Commodity	$1	+$0.20
Other components of marginal cost	$1	
Total marginal cost	$2	+$0.20
Price	$4	

Pass-Through in Levels: Example

- Leontief production in commodity ($1/unit) and other variable costs ($1/unit).

Cost per unit	Baseline		New
Commodity	$1	+$0.20	$1.20
Other components of marginal cost	$1		$1.00
Total marginal cost	$2	+$0.20	$2.20
Price	$4	?	?

Pass-Through in Levels: Example

- Leontief production in commodity ($1/unit) and other variable costs ($1/unit).

Cost per unit	Baseline		New	*% Change*
Commodity	$1	+$0.20	$1.20	*+20%*
Other components of marginal cost	$1		$1.00	
Total marginal cost	$2	+$0.20	$2.20	*+10%*
Price	$4	?	?	

Pass-Through in Levels: Example

- Leontief production in commodity ($1/unit) and other variable costs ($1/unit).

Cost per unit	Baseline		New	*% Change*
Commodity	$1	+$0.20	$1.20	*+20%*
Other components of marginal cost	$1		$1.00	
Total marginal cost	$2	+$0.20	$2.20	*+10%*
Price	$4	+$0.40	$4.40	*+10%*

- Complete pass-through in logs: $p = \mu(c + w) \;\Rightarrow\; \Delta p = \mu \cdot \Delta c$.

Pass-Through in Levels: Example

- Leontief production in commodity ($1/unit) and other variable costs ($1/unit).

Cost per unit	Baseline		New	*% Change*
Commodity	$1	+$0.20	$1.20	*+20%*
Other components of marginal cost	$1		$1.00	
Total marginal cost	$2	+$0.20	$2.20	*+10%*
Price	$4	+$0.20	$4.20	*+5%*

- Complete pass-through in logs: $p = \mu(c+w) \;\Rightarrow\; \Delta p = \mu \cdot \Delta c$.
- Complete pass-through in levels: $p = (c+w) + m \;\Rightarrow\; \Delta p = \Delta c$.
  Appears incomplete in logs, even relative to cost share ($0.25 < 0.5$).

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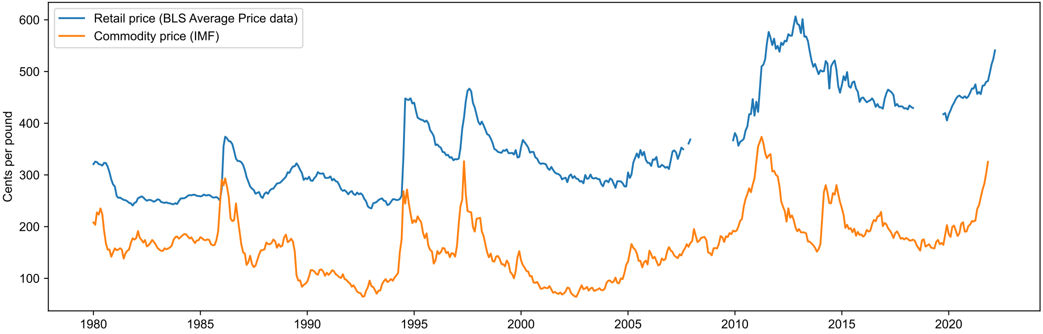
Pass-through for six staple food products

- BLS tracks price levels for staple food products (Average Price Data program).
- Identify six products where we can match units and prices of commodity inputs.
  - Coffee, sugar, beef, rice, flour, frozen orange juice concentrate.

Figure: Arabica coffee commodity costs (IMF) and retail ground coffee prices (BLS).



Canonical approach to measure pass-through of cost changes

- Specification à la Campa and Goldberg (2005), Nakamura and Zerom (2010), etc.

- Price change at time t in market m due to commodity cost changes in last K periods:

$$\Delta p_{m,t} = a_m + \sum_{k=0}^{K} b_k \Delta c_{m,t-k} + \varepsilon_{m,t}.$$

  Long-run pass-through is $\sum_{k=0}^{K} b_k$.

- Details:
  - For large K, long-run pass-through estimates gross markup if c is unit root.
  - All commodity series used appear unit root (autocorrelation coefficients 0.967–0.997).
  - Ensure one way Granger causality from Δc to Δp.
  - Use $K = 8$ weeks for gasoline, $K = 12$ months for all other products.

Example: Pass-through of coffee commodity costs to CPI

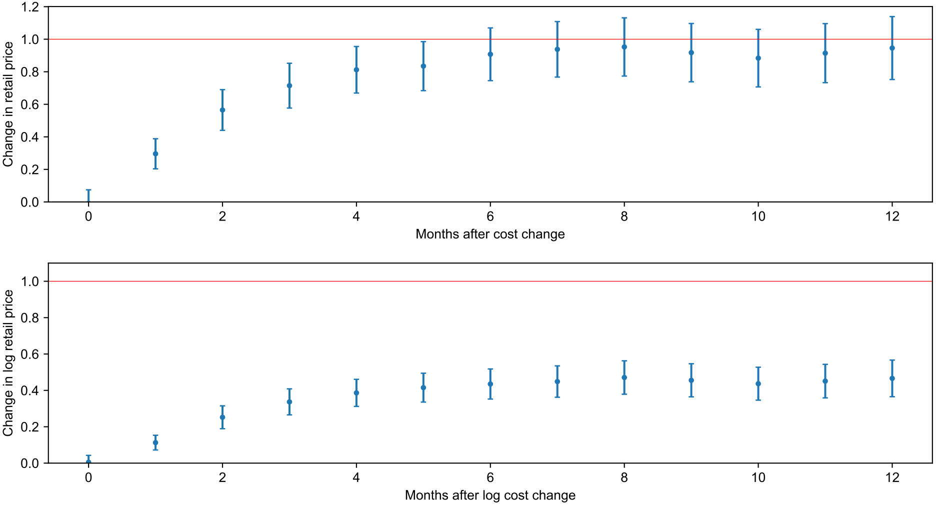


Figure: Passthrough in levels (top) and in logs (bottom).

Pass-through for six food products matched to commodities

Commodity (IMF)	Final Good (BLS)
Arabica coffee price, per lb.	Coffee, 100%, ground roast
Sugar, No. 16, per lb.	Sugar, white, per lb.
Beef, global price, per lb.	Ground beef, 100% beef
Rice, Thailand, per metric ton	Rice, white, long grain, uncooked
Wheat, global price, per metric ton	Flour, white, all purpose
Frozen orange juice solids, per lb.	Orange juice, frozen concentrate

- Monthly commodity prices (IMF), retail prices (BLS Average Price Data), 1990–2020.
- Match units (e.g., lbs flour per bushel of wheat) using USDA conversion tables.

Pass-through for six food products matched to commodities

Commodity (IMF)	Final Good (BLS)	Pass-through (12 mos.) Logs		Levels	
Arabica coffee price, per lb.	Coffee, 100%, ground roast	0.466	(0.051)	**0.946**	**(0.099)**
Sugar, No. 16, per lb.	Sugar, white, per lb.	0.370	(0.035)	0.691	(0.072)
Beef, global price, per lb.	Ground beef, 100% beef	0.410	(0.068)	**0.899**	**(0.126)**
Rice, Thailand, per metric ton	Rice, white, long grain, uncooked	0.307	(0.049)	**0.882**	**(0.169)**
Wheat, global price, per metric ton	Flour, white, all purpose	0.240	(0.048)	**0.865**	**(0.160)**
Frozen orange juice solids, per lb.	Orange juice, frozen concentrate	0.327	(0.040)	**0.974**	**(0.111)**

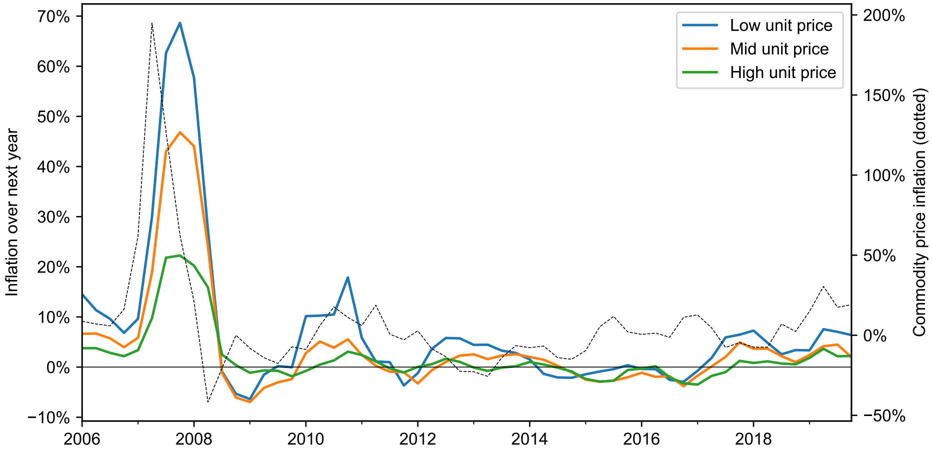
- Monthly commodity prices (IMF), retail prices (BLS Average Price Data), 1990–2020.
- Match units (e.g., lbs flour per bushel of wheat) using USDA conversion tables.
- **Cannot reject complete pass-through in levels for 5 of 6.** (Reject in logs for all.)

Further exploiting cross-sectional variation

- We see complete pass-through in levels across seemingly different products.
- Exploit UPC-level data from NielsenIQ for three food products (flour, rice, coffee).
  - Low-priced products have systematically lower "log pass-through."
  - Explained by similar pass-through in levels across all products.
- Exploit variation across retailers for broader set of products:
  - Retailers selling same UPC at lower price systematically have lower "log pass-through."
  - Explained by similar pass-through in levels across all retailers.
  - Holds for universe of food products in NielsenIQ data ($>$\$2T in sales, 235 retail chains).

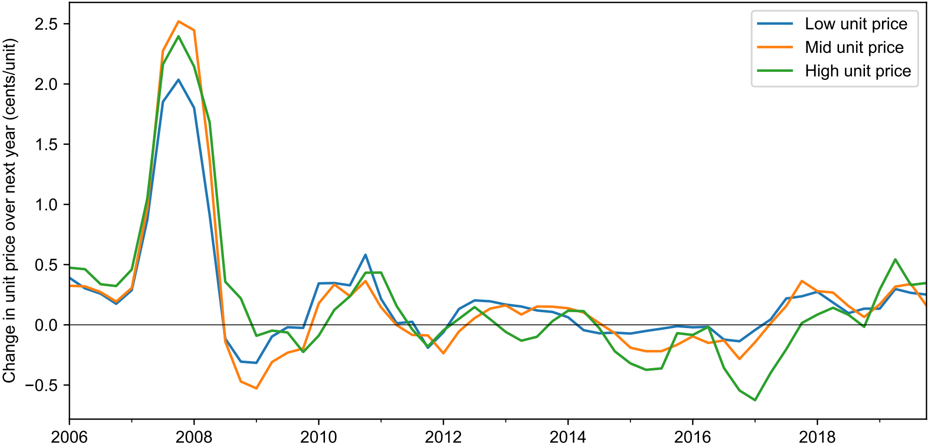
High-price products within category lower “log pass-through”

Figure: Inflation of Rice products in Nielsen data, split by tercile of unit price.



Differences in pass-through disappear in absolute terms (levels)

Figure: Change in unit price of Rice products in Nielsen data, split by tercile of unit price.



All categories: High-price items have systematically lower "log pass-through"

$$\Delta \log p_{it} = \alpha_i + \beta_1 \Delta \log c_t + \sum_{g=2}^{3} \beta_g \left(1\{G(i,t) = g\} \times \Delta \log c_t\right) + \varepsilon_{it}.$$

Panel A: In percentages

	Retail price inflation		
	Rice	Flour	Coffee
Commodity Inflation × Mid Unit Price	−0.075**	−0.007	−0.064**
	(0.014)	(0.009)	(0.015)
Commodity Inflation × High Unit Price	−0.150**	−0.045**	−0.091**
	(0.022)	(0.009)	(0.017)
UPC FEs	Yes	Yes	Yes
N (thousands)	399.4	101.4	1570.0
R^2	0.15	0.05	0.14

All categories: No systematic differences in pass-through in levels

$$\Delta p_{it} = \alpha_i + \beta_1 \Delta c_t + \sum_{g=2}^{3} \beta_g \left(1\{G(i,t) = g\} \times \Delta c_t\right) + \varepsilon_{it}.$$

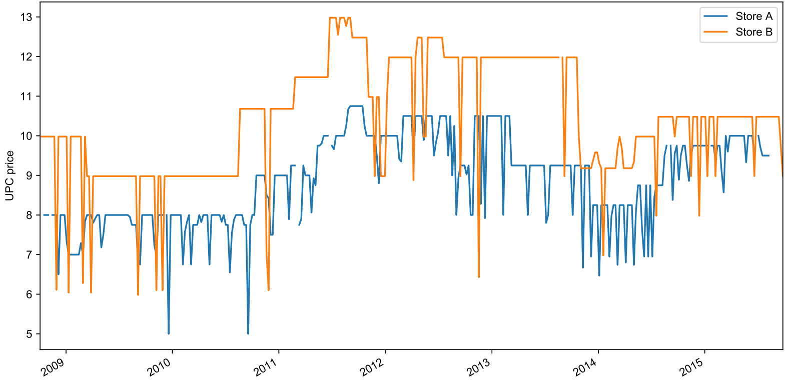
Panel B: In levels			
	Δ Retail price		
	Rice	Flour	Coffee
Δ Commodity Price $\times$ Mid Unit Price	0.059	0.027	-0.069
	(0.052)	(0.040)	(0.046)
Δ Commodity Price $\times$ High Unit Price	0.042	-0.067	-0.099*
	(0.100)	(0.044)	(0.058)
UPC FEs	Yes	Yes	Yes
N (thousands)	399.4	101.4	1570.0
R^2	0.07	0.05	0.14

- No systematic difference in pass-through in levels across unit price groups.

Exploiting variation in markups across retailers

- Consider two retailers selling a UPC at low vs. high markup.
- Test: When UPC cost rises, high-markup retailer should increase price more in levels.

Figure: Prices of identical coffee UPC in two stores in same 3-digit ZIP code in Philadelphia, PA.



Exploiting variation in markups across retailers: Predictions

$$\Delta p_{ikt} = \beta^{\text{level}} (\Delta \bar{p}_{kt} \times \text{RelativePrice}_{ikt}) + \delta \text{RelativePrice}_{ikt} + \alpha_{kt} + \varepsilon_{ikt}, \tag{1}$$

$$\Delta \log p_{ikt} = \beta^{\log} (\Delta \log \bar{p}_{kt} \times \text{RelativePrice}_{ikt}) + \tilde{\delta} \text{RelativePrice}_{ikt} + \tilde{\alpha}_{kt} + \varepsilon_{ikt}, \tag{2}$$

- Δp_{ikt} is change in price of UPC k at retailer i from t to $t+4$.
- $\Delta \bar{p}_{kt}$ is average change in UPC k's price across all retailers.
- $\text{RelativePrice}_{ikt} = \log(p_{ikt}/\bar{p}_{kt})$ is retailer's price relative to others.

	Fixed percentage markup $p_i = \mu_i c$	Fixed unit margin $p_i = c + m_i$
Price change relative to average:		
Levels ($dp_i/d\bar{p}$)	$\approx 1 + \log(p_i/\bar{p})$	1
Logs ($d \log p_i / d \log \bar{p}$)	1	$\approx 1 - \log(p_i/\bar{p})$
Predicted interaction coefficient:		
Levels specification (1), β^{level}	1	0
Logs specification (2), $\beta^{\log}$	0	-1

Exploiting variation in markups across retailers

	Δ UPC Price (Δp_{irt})			
	Rice	Flour	Coffee	All
	(1)	(2)	(3)	(4)
Δ Price$_{it}$ $\times$ Markup$_{irt}$	-0.022	0.058	0.192	-0.001
	(0.141)	(0.209)	(0.170)	(0.839)
UPC-Quarter FEs	Yes	Yes	Yes	Yes
N (millions)	0.399	0.101	1.570	100.4
R^2	0.46	0.48	0.51	0.59

- Result: $\beta^{\text{level}} \approx 0 \Rightarrow$ retailers change UPC price by same amount in *levels*.

Exploiting variation in markups across retailers

	Δ UPC Price (Δp_{irt})				Δ Log UPC Price ($\Delta \log p_{irt}$)			
	Rice	Flour	Coffee	All	Rice	Flour	Coffee	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ Price$_{it}$ $\times$ Markup$_{irt}$	-0.022	0.058	0.192	-0.001				
	(0.141)	(0.209)	(0.170)	(0.839)				
Δ Log Price$_{it}$ $\times$ Markup$_{irt}$					-1.004**	-1.014**	-1.261**	-1.043**
					(0.125)	(0.184)	(0.084)	(0.073)
UPC-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N (millions)	0.399	0.101	1.570	100.4	0.399	0.101	1.570	100.4
R^2	0.46	0.48	0.51	0.59	0.62	0.61	0.58	0.61

- Result: $\beta^{\text{level}} \approx 0 \Rightarrow$ retailers change UPC price by same amount in *levels*.
- Makes "log pass-through" fall with markup. ($\beta^{\log} \approx -1$.)
- Holds for broader sample of nearly 1M UPCs across 235 retail chains!

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- Inflation inequality

Manufacturing Industries

- NBER-CES Manufacturing Data: 459 four-digit SIC industries from 1958–2018.
  - Sales (shipments) and input costs: materials, energy, and production labor.
  - Price indices for output, materials, energy, labor from BLS PPI, BEA make-use tables.
- Challenge: Price indices, not price levels! But starting from pass-through in levels,

$$\rho^{\text{level}} \equiv \frac{\Delta p}{\Delta c} \qquad \Rightarrow \qquad \frac{\Delta p}{p} = \rho^{\text{level}} \left(\frac{cy}{py} \right) \frac{\Delta c}{c}.$$

  So we can estimate ρ^{level} using

$$\Delta \log p_{it} = \beta \left(\Delta \log c_{it} \times (\text{InputCosts}/\text{Sales})_{it-1} \right) + \varepsilon_{it}.$$

- Multiplicative markups imply $\beta = \mu > 1$, while pass-through in levels implies $\beta \approx 1$.

Manufacturing Industries: Pass-Through

	Δ *Log Output Price$_t$*					
Inputs:	Materials		$+$ Energy		$+$ Production Labor	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log Input Price$_t$	0.690**	0.079	0.704**	0.005	0.796**	0.052
	(0.072)	(0.132)	(0.073)	(0.134)	(0.083)	(0.232)
$(\text{InputCost}/\text{Sales})_{t-1}$		0.004		0.008		0.023**
		(0.011)		(0.011)		(0.011)
Δ Log Input Price$_t$ $\times$ $(\text{InputCost}/\text{Sales})_{t-1}$		0.947**		1.041**		0.984**
		(0.203)		(0.201)		(0.286)
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
N	27 381	27 381	27 381	27 381	27 381	27 381
R^2	0.40	0.42	0.40	0.42	0.41	0.42

- Estimate $\beta \approx 1$ (complete pass-through in levels). Variation in InputCosts/Sales leads to incomplete log pass-through.
- Similar results with commodity price IV for input costs, horizons $1, \ldots, 5$ years.

Taking Stock of the Empirical Evidence

- Retail gasoline. [in paper]
  - Pass-through in levels explains variation in “log pass-through” across stations.
- Food products.
  - Pass-through in levels across nearly all markets.
  - Explains variation in “log pass-through” across products within category.
  - Explains variation in “log pass-through” across retailers.
- Manufacturing industries.
  - Pass-through in levels across broad set of industries.
- Previous literature. [in paper]
  - Survey of papers that estimate pass-through in levels of aggregate cost shocks.
  - Weight of evidence points toward complete pass-through in levels of commodity/input/shipping costs, excise taxes.

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Homothetic demand systems violate complete pass-through in levels

- Workhorse models in macroeconomics/trade use homothetic demand systems.
  E.g., CES, Kimball (1995), HSA (Matsuyama and Ushchev 2022), Atkeson and Burstein (2008).

- This class of models does not deliver pass-through in levels of aggregate cost shocks.

Homothetic demand systems violate complete pass-through in levels

- Workhorse models in macroeconomics/trade use homothetic demand systems.
  E.g., CES, Kimball (1995), HSA (Matsuyama and Ushchev 2022), Atkeson and Burstein (2008).
- This class of models does not deliver pass-through in levels of aggregate cost shocks.
- Firms $j \in \{1, ..., J\}$, each with constant marginal cost c_j, set prices p_j to max profits.
- Rep. household maximizes utility $U(q_1, ..., q_J)$ s.t. budget constraint $\sum_j p_j q_j = I$.

Proposition (Pass-through of aggregate shock with homothetic preferences)

Suppose U is homothetic. If all firms' marginal costs increase by $d\log c_j = d\log c$, then $\forall j$,

$$d\log p_j = d\log c, \qquad \Rightarrow \qquad dp_j = \mu_j dc_j .$$

That is, "log pass-through" is complete and pass-through in levels $\mu_j > 1$.

Departing from homothetic demand

- Depart from homotheticity using discrete choice model of industry demand.
  Anderson, Palma, and Thisse (1992).
- Parameter η will allow us to discriminate between demand systems.
  - Industry demand is homothetic (e.g., CES) iff $\eta = 1$.
  - Models with unit demand (e.g., heterogeneous coefficient logit, Hotelling) have $\eta = 0$.
- Equilibrium exhibits complete pass-through in levels whenever $\eta = 0$.

Discrete Choice Model of Industry Demand

- Mass M of consumers indexed by $i \in [0,1]$. Each consumer has income Y.
- Firms $j \in \{1, ..., J\}$. Consumers choose one firm to purchase from.
- Quasilinear preferences over q_{ij} and consumption of numeraire good q_{i0},

$$U_i = \max_{j, q_{ij}} \{u_{ij}\}, \qquad \text{where} \qquad u_{ij} = \delta_{ij} q_{ij} + q_{i0},$$

  subject to budget constraint, $p_j q_{ij} + p_0 q_{i0} \leq Y$.
- Tastes δ_{ij} drawn from arbitrary distribution without mass points.
- Impose $q_{ij} = \bar{q}(Y/p_j)^{\eta}$.
  - η is the intensive margin elasticity of consumption with respect to price.

Special Cases of Demand

- Fixed budget ($\eta = 1$):
  - Constant elasticity of substitution (e.g., Dixit and Stiglitz 1977):

$$\delta_{ij} = \beta_j \varepsilon_{ij},$$

    where β_j are taste shifters and ε_{ij} are i.i.d. Frechet shocks.

- Unit demand ($\eta = 0$):
  - Heterogeneous coefficient logit demand (e.g., BLP 1995; Nevo 2001):

$$\delta_{ij} = \xi_{ij} + \varepsilon_{ij},$$

    where ξ_{ij} are systematic tastes and ε_{ij} are i.i.d. Type 1 Extreme Value shocks.
  - Hotelling (1929) model of spatial differentiation (e.g., Salop 1979, Barro 2024):

$$\delta_{ij} = t|i - j|.$$

Firm Pricing

- Firm j produces with constant marginal cost c_j.
- Demand curve for firm j is

$$D_j(p) = \int_0^1 1\{u_{ij} \geq u_{ik}, \forall k \neq j\}\, q_{ij}\, M\, di.$$

- Firms choose p_j to maximize variable profits, taking tastes and other prices as given,

$$\max_{p_j} (p_j - c_j) D_j(p).$$

Pass-Through in Logs and Levels

Proposition (Pass-Through in Logs)

Suppose all marginal costs increase $d\log c_j = d\log c$. If $\eta = 1$, then pass-through in logs

$$d\log p_j = d\log p = d\log c,$$

is an equilibrium solution.

- Intuition: With $\eta = 1$, consumer choice depends on comparison of δ_{ij}/p_j across all j.
- If we multiply all p_j by same proportion, no change to consumer choices.
- No change to elasticity of demand $\Rightarrow$ no change to desired markup.

Pass-Through in Logs and Levels

Proposition (Pass-Through in Levels)

Suppose all marginal costs increase $dc_j = dc$. If $\eta = 0$, then pass-through in levels

$$dp_j = dp = dc,$$

is an equilibrium solution.

- Intuition: With $\eta = 0$, consumer choice depends on comparison of $\delta_{ij} - p_j$ across all j.
- If we increase all p_j by dp, no change to consumer choices and desired margin.
- Any model with $\eta = 0$ generates pass-through in levels of aggregate cost shocks.

Example: Symmetric Firms

Proposition (Prices with symmetric firms)

If firms are symmetric ($c_j = c$ for all j and δ_{ij} are i.i.d. draws from F), prices solve

$$(p-c)\left((1-\eta)\frac{\phi_0}{p_0}+\eta\frac{\phi_1}{p}\right)=1,$$

where ϕ_0, ϕ_1 are constants that depend on the number of firms J and taste distribution F.
If $\eta = 1$, price equals cost c times a percentage markup,

$$p = \frac{\phi_1}{\phi_1 - 1}c.$$

If $\eta = 0$, price equals cost c plus a margin (priced relative to the numeraire p_0),

$$p = c + \frac{p_0}{\phi_0}.$$

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- Differential pass-through of labor costs
- Industry profits, margins, and entry
- Stability of consumer price index
- Inflation inequality

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Misspecification in measuring "log pass-through"

- Previous work finds "log pass-through" is **asymmetric**, **convex**, and **falls with firm size / product quality**.

  (Asymmetry: Peltzman 2000; Size: Berman et al. 2012; Amiti et al. 2019; Gupta 2020; Quality: Chen and Juvenal 2016; Auer et al. 2018).

- If $\eta = 0$ and firms set prices $p = c + p_0/\phi_0$, to a second order

$$\hat{\rho}^{\log} = \frac{\Delta \log p}{\Delta \log c} \approx \frac{c}{p}\left(1 + \frac{p_0/\phi_0}{p}\Delta \log c\right).$$

  - **Asymmetry**: Positive shocks appear to have higher pass-through: $\hat{\rho}^{\log}(\Delta \log c) > \hat{\rho}^{\log}(-\Delta \log c)$.
  - **Convexity**: Large positive shocks appear to have higher pass-through than small shocks: $\hat{\rho}^{\log}(\Delta \log c_H) > \hat{\rho}^{\log}(\Delta \log c_L)$ if $\Delta \log c_H > \Delta \log c_L$.
  - **Heterogeneity**: If markups increase with firm size / quality, $\hat{\rho}^{\log}$ falls with both.

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Okun (1981) on materials costs

- Okun (1981) speculates a “special role for materials costs.”
  - “Some views of marking up direct costs distinguish increases in the costs of purchased materials from increases in standard unit labor costs, implying that the former are likely to be passed through to customers essentially on a dollars-and-cents basis, while the latter are passed through with a percentage markup.”
- Okun (1981) was right! Labor costs appear to be passed-through at higher rate.
- But Okun (1981) was wrong.
  - Not material costs that are special, but labor that is special!
  - In GE, wages can determine numeraire price p_0 and thus additive margin.
  - Correct for this, and we restore equal pass-through in levels of labor vs. other costs.

Okun's "special role": Empirical evidence

	Δ Log Output Price$_t$		
	(1) Cost Shares	(2) Sales Shares	(3) Sales Shares
Δ Log Material Price$_t$ $\times$ Material Share$_{t-1}$	0.798**	1.046**	
	(0.085)	(0.108)	
Δ Log Energy Price$_t$ $\times$ Energy Share$_{t-1}$	0.715**	0.859**	
	(0.271)	(0.378)	
Δ Log Production Wage$_t$ $\times$ Labor Share$_{t-1}$	1.070**	2.095**	
	(0.217)	(0.281)	
Δ Log Production Wage$_t$ $\times$ (Labor + Margin) Share$_{t-1}$			
Industry FEs	Yes	Yes	
Year FEs	Yes	Yes	
N	27374	27374	
R^2	0.49	0.50	

- Labor costs appear to be passed through completely in percentages, $>$ 1:1 in levels.

Okun's "special role": Empirical evidence

	Δ Log Output Price$_t$		
	(1) Cost Shares	(2) Sales Shares	(3) Sales Shares
Δ Log Material Price$_t$ $\times$ Material Share$_{t-1}$	0.798**	1.046**	1.049**
	(0.085)	(0.108)	(0.109)
Δ Log Energy Price$_t$ $\times$ Energy Share$_{t-1}$	0.715**	0.859**	0.997**
	(0.271)	(0.378)	(0.362)
Δ Log Production Wage$_t$ $\times$ Labor Share$_{t-1}$	1.070**	2.095**	
	(0.217)	(0.281)	
Δ Log Production Wage$_t$ $\times$ (Labor $+$ Margin) Share$_{t-1}$			0.951**
			(0.209)
Industry FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
N	27374	27374	27374
R^2	0.49	0.50	0.49

- Labor costs appear to be passed through completely in percentages, $>$ 1:1 in levels.
- Corrected when we assume that additive margin is priced relative to wage.

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Response of industry profits and entry to cost changes

- With percentage markups, variable profits per unit increase with upstream costs.
- If aggregate industry demand is relatively inelastic, either **operating profits** must increase or **entry** must increase.
- Puzzle: Neither appears in the data.

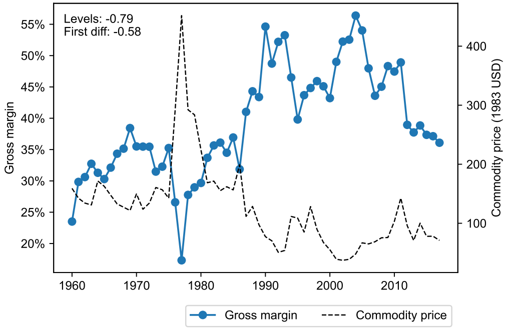
Dep var:	Δ *Log Operating Margin* (1)	Δ *Log Number of Establishments* (2)
Δ Log Input Price$_t$	-0.122	0.007
	(0.079)	(0.013)
Industry FEs	Yes	Yes
Year FEs	Yes	Yes
N	27 305	18 201
R^2	0.02	0.22

With pass-through in levels, gross margin instead adjusts

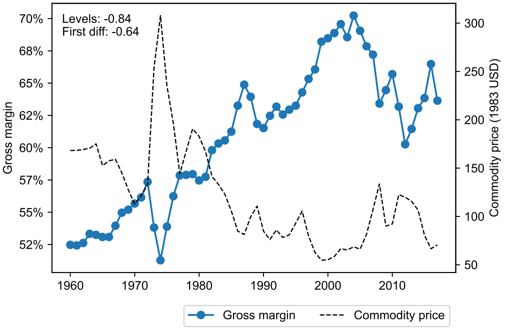
- Embed our demand system in standard monopolistic competition setup.
  - Mass N of symmetric firms, marginal cost c. Fixed entry cost f_e. Overhead cost f_o.
  - Aggregate industry demand inelastic, $Q = p^{-\theta}$, with $\theta < 1$.
  - Gross and operating margins $=$ variable / operating profits as % of sales.
  - ζ is elasticity of entry to economic profits ($\zeta = 0$: fixed mass, $\zeta \to \infty$: free entry).

Response to cost increase, $dc > 0$			Gross margins dm^{gross}	Operating margins dm^{op}	Mass of firms $d \log N$
$\eta = 1$	$\zeta = 0$	(Fixed mass)	0	> 0	0
$\eta = 1$	$\zeta \in (0, \infty)$		0	> 0	> 0
$\eta = 1$	$\zeta \to \infty$	(Free entry)	0	0	> 0
$\eta = 0$	$\zeta = 0$	(Fixed mass)	< 0	≤ 0	0
$\eta = 0$	$\zeta \in (0, \infty)$		< 0	≤ 0	≤ 0
$\eta = 0$	$\zeta \to \infty$	(Free entry)	< 0	0	≤ 0

Gross margins exhibit strong negative correlation with input costs



(a) Roasted coffee mfg vs. coffee.



(b) Bread, cake & related products mfg vs. wheat.

- In contrast to $\eta = 1$, gross margins for NBER-CES industries are not constant.
- Exhibit strong negative correlation with commodity input prices.

In data, adjustment along gross margins

Panel A: Retail Gasoline	Δ *Log Gross Margin*		Δ *Log Oper. Margin*		Δ *Log Num. Estabs*	
Source:	ARTS	IRS	ARTS	IRS	BDS	SUSB
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log Wholesale Price$_t$	-0.263^{**}	-0.291^{**}	0.218	-0.167	-0.002	0.001
	(0.045)	(0.061)	(0.377)	(0.331)	(0.006)	(0.007)
N	39	26	15	26	39	24
R^2	0.54	0.49	0.04	0.01	0.00	0.00
Panel B: Manufacturing Industries	Δ *Log Gross Margin*		Δ *Log Oper. Margin*		Δ *Log Num. Estabs*	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log Input Price$_t$	-0.188^{**}	0.154	-0.122	0.095	0.007	-0.028
	(0.039)	(0.103)	(0.079)	(0.211)	(0.013)	(0.044)
Δ Log Input Price$_t$ $\times$ Inputs/Sales$_{t-1}$		-0.504^{**}		-0.285		0.049
		(0.188)		(0.376)		(0.063)
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
N	27381	27381	27305	27305	18201	18201
R^2	0.05	0.11	0.02	0.06	0.22	0.23

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Low volatility of consumer inflation

- Volatility of PCE / CPI is too high with $\eta = 1$ compared to the data.

	Std. deviation of inflation, 1982–2018		Cost-weighted avg. markup
PCE Chain-Type Price Index (BEA)	1.1%		
Consumer Price Index (BLS)	1.3%		
Model:	Flexible	Calvo	
$\eta = 1$, Variable costs $=$ Materials	6.0%	2.2%	2.19

Simulation using BEA 402-industry I-O table, taking PPI for upstream commodities ("Stage 1 Intermediates") as exogenous.

Calvo model uses industry-level frequency of price adjustment from Pasten, Schoenle, and Weber (2020).

Low volatility of consumer inflation

- Volatility of PCE / CPI is too high with $\eta = 1$ compared to the data.
- Reduce volatility by assuming more costs variable. But need low markups.

	Std. deviation of inflation, 1982–2018		Cost-weighted avg. markup
PCE Chain-Type Price Index (BEA)	1.1%		
Consumer Price Index (BLS)	1.3%		
Model:	Flexible	Calvo	
$\eta = 1$, Variable costs $=$ Materials	6.0%	2.2%	2.19
$\eta = 1$, Variable costs $=$ Materials $+$ wages	2.9%	1.6%	1.31
$\eta = 1$, Variable costs $=$ Materials $+$ wages $+$ consumption of capital	2.4%	1.5%	1.17

Simulation using BEA 402-industry I-O table, taking PPI for upstream commodities (“Stage 1 Intermediates”) as exogenous.

Calvo model uses industry-level frequency of price adjustment from Pasten, Schoenle, and Weber (2020).

Low volatility of consumer inflation

- Volatility of PCE / CPI is too high with $\eta = 1$ compared to the data.
- Reduce volatility by assuming more costs variable. But need low markups.
- Additive margins ($\eta = 0$) reconciles low volatility of agg. inflation with large markups.

	Std. deviation of inflation, 1982–2018		Cost-weighted avg. markup
PCE Chain-Type Price Index (BEA)	1.1%		
Consumer Price Index (BLS)	1.3%		
Model:	Flexible	Calvo	
$\eta = 1$, Variable costs $=$ Materials	6.0%	2.2%	2.19
$\eta = 1$, Variable costs $=$ Materials $+$ wages	2.9%	1.6%	1.31
$\eta = 1$, Variable costs $=$ Materials $+$ wages $+$ consumption of capital	2.4%	1.5%	1.17
$\eta = 0$, Additive margins	1.9%	1.3%	1.0–2.2

Simulation using BEA 402-industry I-O table, taking PPI for upstream commodities ("Stage 1 Intermediates") as exogenous.

Calvo model uses industry-level frequency of price adjustment from Pasten, Schoenle, and Weber (2020).

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Attention to heightened inflation of low-end products in 2021

Jack Monroe
@BootstrapCook

Woke up this morning to the radio talking about the cost of living rising a further 5%. It infuriates me the index that they use for this calculation, which grossly underestimates the real cost of inflation as it happens to people with the least. Allow me to briefly explain.

7:30 AM · Jan 19, 2022

37.1K Retweets 9,873 Quote Tweets 82.7K Likes

Jack Monroe @BootstrapCook · Jan 19, 2022
Replying to @BootstrapCook
This time last year, the cheapest pasta in my local supermarket (one of the Big Four), was 29p for 500g. Today it's 70p. That's a 141% price increase as it hits the poorest and most vulnerable households.

171 3,532 16.5K

Jack Monroe @BootstrapCook · Jan 19, 2022
This time last year, the cheapest rice at the same supermarket was 45p for a kilogram bag. Today it's £1 for 500g. That's a 344% price increase as it hits the poorest and most vulnerable households.

119 2,785 13.5K

Jack Monroe @BootstrapCook · Jan 19, 2022
Baked beans: were 22p, now 32p. A 45% price increase year on year.

46 1,164 9,532

Office for National Statistics

Article

Tracking the price of the lowest-cost grocery items, UK, experimental analysis: April 2021 to September 2022

How the prices of the lowest-cost products for 30 everyday items have changed since April 2021.

Contact:
Emily Hopson
cpi@ons.gov.uk
+44 1633 455 592

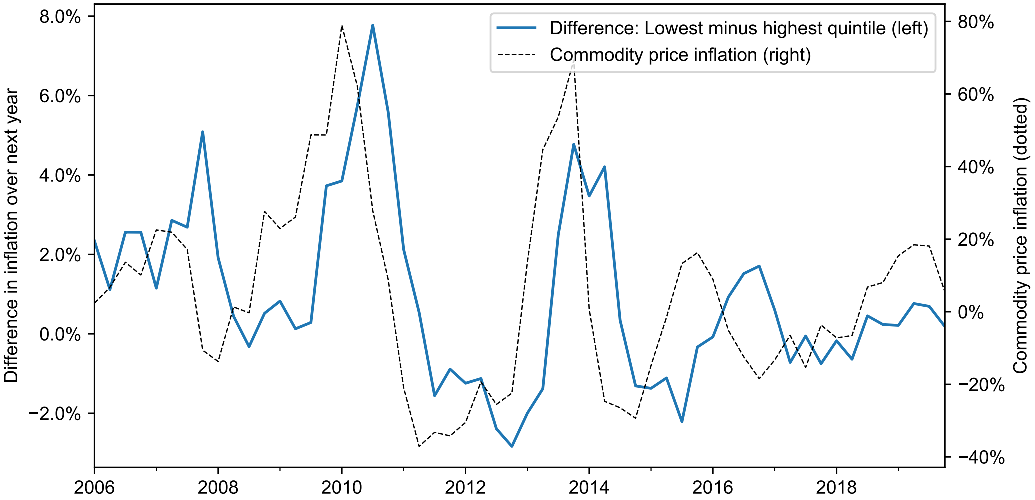
Release date:
25 October 2022

Next release:
To be announced

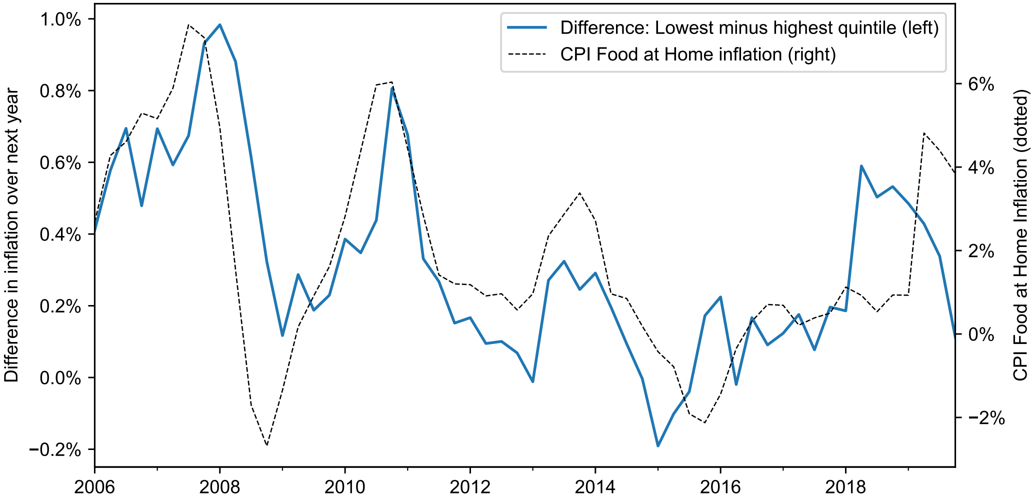
- "Supermarkets recouping margins on budget products" / elevated demand at low-end.
- Simpler explanation: Pass-through in levels $\rightarrow$ rising costs increase inflation inequality.

Inflation inequality moves with commodity costs within category (e.g. coffee)

- **Coffee**: Same Δp across products $\rightarrow$ higher % inflation for low-price products.



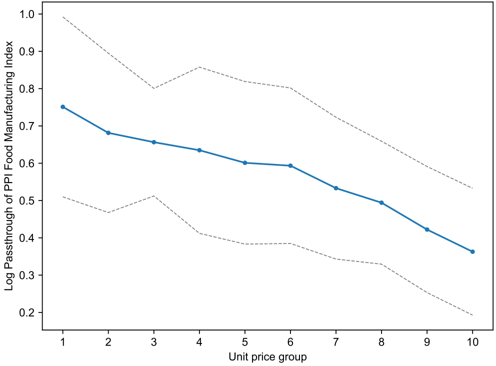
Cycles in inflation inequality over entire food-at-home bundle



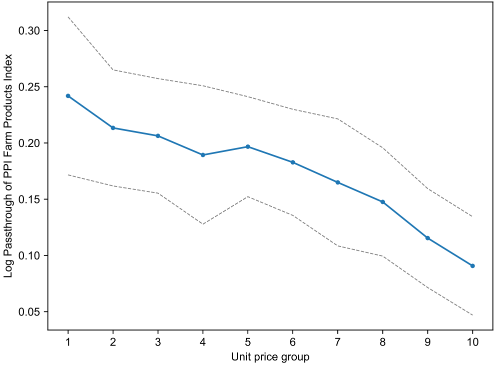
Can pass-through in levels explain recent “cheapflation”?

- Approach: split each product category into 10 groups by relative price.
- Fit pass-through of upstream costs to prices over 2006–2019, then extrapolate using 2020–2023 increase in costs.

(a) Log pass-through of Food Manufacturing PPI.



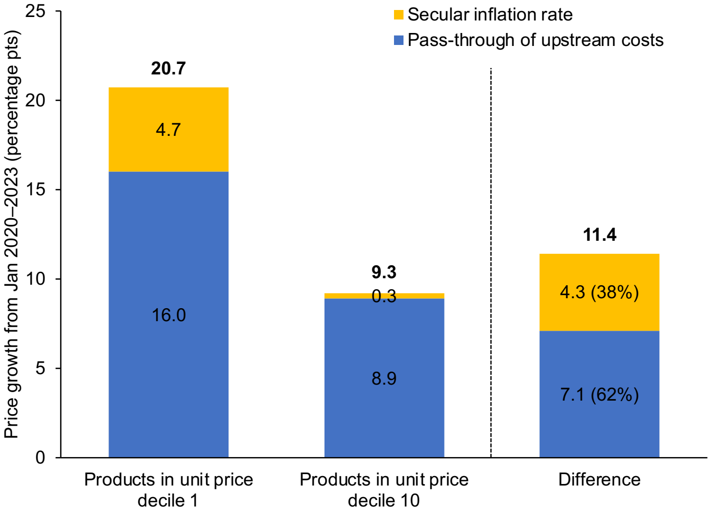
(b) Log pass-through of Farm Products PPI.



Predictions for food-at-home inflation, 2020–2023

- 20pp (11pp) price growth for high- (low-) price products.
- 3x higher than implied by secular inflation diffs. (Jaravel 2019).
- Magnitude similar to recent estimates.

  Cavallo and Kryvtsov (2024), Chen et al. (2024).



Conclusion

- Empirical evidence: Pass-through of costs tends to be complete in *levels*.
- Not consistent with homothetic models of demand used in workhorse models.
- Class of demand systems with $\eta = 0$ can explain pass-through behavior.
- Helps us understand dynamics of prices and industry outcomes:
  - Incomplete log pass-through $+$ asymmetry, convexity, heterogeneity.
  - Differential pass-through of unit labor costs.
  - Dynamics of industry profits, margins, and entry.
  - Low volatility of aggregate inflation, despite substantial markups.
  - "Cheapflation" & unequal incidence of commodity inflation across income distribution.

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Misspecification in "log pass-through": Positive squared $\Delta \log(c)$ term

	Unleaded petrol (ULP)		Premium (PULP)	
$\Delta \log(\text{Price})_{it}$	(1)	(2)	(3)	(4)
$\Delta \log(\text{Cost})_t$	0.870^{**}	0.889^{**}	0.865^{**}	0.881^{**}
	(0.031)	(0.024)	(0.032)	(0.025)
$(\Delta \log(\text{Cost})_t)^2$		0.155^{**}		0.147
		(0.068)		(0.097)
N	312215	312215	259437	259437
R^2	0.88	0.89	0.87	0.87

- Since cost share varies with commodity cost, misspecification in log regression.

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Station-level panel dataset of gas prices in Perth, Australia

- 2.3M price observations (2001–present) for 875 stations in Perth metropolitan area.
- Spot price sold to retailers (Terminal Gate Price) available daily.

1. Pass-through is complete in levels.
2. No apparent heterogeneity in pass-through in levels.
3. Pass-through in levels + margins explains incomplete "log pass-through" and cross-sectional heterogeneity.

Pass-through of terminal gas price to station gas prices: Unleaded

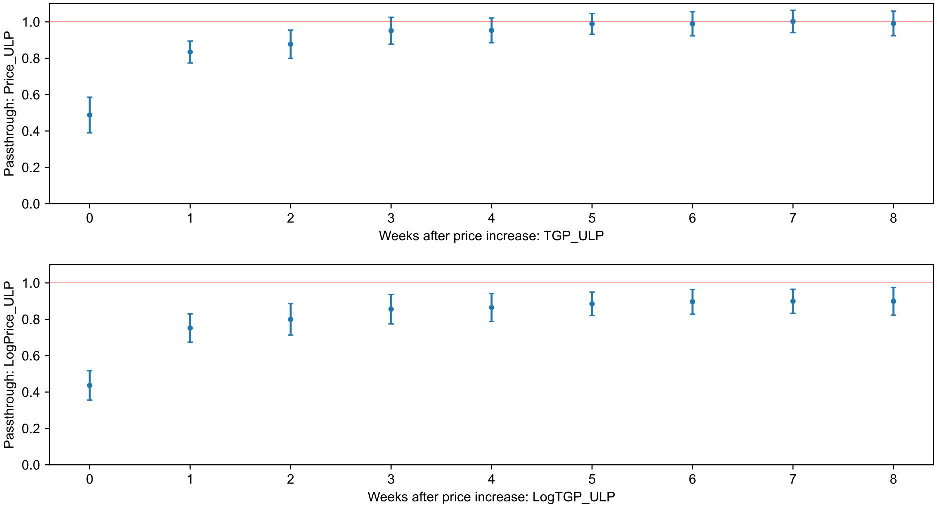

Figure: Passthrough in levels (top) and in logs (bottom). SEs two-way clustered by postcode $\times$ year.

Summary of retail gasoline pass-through estimates

Description	Pass-through (8 weeks) Logs		Levels	
Australia, station-level, 2001–2022				
Terminal to retail, Unleaded	0.899	(0.043)	**0.991**	(0.038)
Terminal to retail, Premium Unleaded	0.887	(0.041)	**0.985**	(0.036)
Canada, city-level, 2007–2022				
Crude to wholesale	0.553	(0.098)	**0.927**	(0.100)
Wholesale to retail (excl. taxes)	0.859	(0.016)	**1.008**	(0.022)
South Korea, station-level, 2008–2022				
Refinery to retail, Unleaded	0.926	(0.044)	**0.997**	(0.052)
United States, national, 1990–2022				
NY Harbor spot price to retail	0.570	(0.051)	**0.954**	(0.053)

- **Cannot reject complete pass-through in levels**. (Reject in logs for all.)

Exploiting variation in markups

- Low markups, hard to differentiate pass-through in levels of 1 from 1.02–1.05.
- Test: Pass-through in levels should be higher for stations with 5% vs. 2% markup.

$$\Delta p_{it} = \alpha + \beta_1 \Delta c_{it} + \delta \text{AvgMarkup}_{it} + \beta_2 \left(\Delta c_{it} \times \text{AvgMarkup}_{it} \right) + \varepsilon_{it},$$

  - where $\Delta p_{i,t}$, $\Delta c_{i,t}$ are change in station retail price and wholesale cost over 16 weeks.
  - Exploit cross-sectional / time series variation in AvgMarkup_{it}, with IVs to isolate markups.
- Prediction: If constant multiplicative markup, $\beta_2 > 0$.

Exploiting variation in markups

ΔPrice_{it}	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
ΔCost_t	0.950^{**}				
	(0.021)				
$\Delta\text{Cost}_t \times$ Avg. Station Markup_i (Net %)					
$\Delta\text{Cost}_t \times$ Avg. Quarter Markup_t (Net %)					
N	312215				
R^2	0.89				

Exploiting variation in markups

ΔPrice_{it}	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
ΔCost_t	0.950^{**}	0.989^{**}			
	(0.021)	(0.037)			
$\Delta \text{Cost}_t \times$ Avg. Station Markup$_i$ (Net %)		-0.005			
		(0.003)			
$\Delta \text{Cost}_t \times$ Avg. Quarter Markup$_t$ (Net %)					
N	312215	312215			
R^2	0.89	0.89			

- Stations with higher markups do not have higher pass-through in levels ($\beta_2 \approx 0$).

Exploiting variation in markups

ΔPrice_{it}	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
ΔCost_t	0.950^{**}	0.989^{**}	0.952^{**}		
	(0.021)	(0.037)	(0.044)		
$\Delta \text{Cost}_t \times$ Avg. Station Markup_i (Net %)		-0.005	-0.000		
		(0.003)	(0.005)		
$\Delta \text{Cost}_t \times$ Avg. Quarter Markup_t (Net %)					
N	312215	312215	312215		
R^2	0.89	0.89	0.89		

- Stations with higher markups do not have higher pass-through in levels ($\beta_2 \approx 0$).

Exploiting variation in markups

ΔPrice_{it}	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
ΔCost_t	0.950^{**}	0.989^{**}	0.952^{**}	0.987^{**}	0.971^{**}
	(0.021)	(0.037)	(0.044)	(0.034)	(0.043)
$\Delta \text{Cost}_t \times$ Avg. Station Markup$_i$ (Net %)		-0.005	-0.000		
		(0.003)	(0.005)		
$\Delta \text{Cost}_t \times$ Avg. Quarter Markup$_t$ (Net %)				-0.003	-0.002
				(0.003)	(0.004)
N	312215	312215	312215	312215	312215
R^2	0.89	0.89	0.89	0.89	0.89

- Stations with higher markups do not have higher pass-through in levels ($\beta_2 \approx 0$).

Pass-through in levels explains extent & variation of “log pass-through”

$\Delta \log(\text{Price})_{it}$	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
$\Delta \log(\text{Cost})_t$	0.870^{**}				
	(0.031)				
$\Delta \log(\text{Cost})_t \times$ Avg. Station Markup$_i$ (Net %)					
$\Delta \log(\text{Cost})_t \times$ Avg. Quarter Markup$_t$ (Net %)					
N	312215				
R^2	0.88				

Pass-through in levels explains extent & variation of “log pass-through”

$\Delta\log(\text{Price})_{it}$	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
$\Delta\log(\text{Cost})_t$	0.870**	0.998**	0.968**	0.977**	0.967**
	(0.031)	(0.035)	(0.041)	(0.026)	(0.033)
$\Delta\log(\text{Cost})_t \times$ Avg. Station Markup$_i$ (Net %)		-0.015**	-0.011**		
		(0.003)	(0.004)		
$\Delta\log(\text{Cost})_t \times$ Avg. Quarter Markup$_t$ (Net %)				-0.010**	-0.010**
				(0.002)	(0.003)
N	312215	312215	312215	312215	312215
R^2	0.88	0.89	0.89	0.89	0.89

- As a result, stations with high margins appear to have “incomplete” pass-through.

Pass-through in levels explains extent & variation of "log pass-through"

$\Delta \log(\text{Price})_{it}$	(1) (OLS)	(2) (OLS)	(3) (IV1)	(4) (OLS)	(5) (IV2)
$\Delta \log(\text{Cost})_t$	0.870**	0.998**	0.968**	0.977**	0.967**
	(0.031)	(0.035)	(0.041)	(0.026)	(0.033)
$\Delta \log(\text{Cost})_t \times$ Avg. Station Markup$_i$ (Net %)		-0.015**	-0.011**		
		(0.003)	(0.004)		
$\Delta \log(\text{Cost})_t \times$ Avg. Quarter Markup$_t$ (Net %)				-0.010**	-0.010**
				(0.002)	(0.003)
N	312215	312215	312215	312215	312215
R^2	0.88	0.89	0.89	0.89	0.89

- As a result, stations with high margins appear to have "incomplete" pass-through.
- Intercept: Pass-through is complete as Net Markup$_{i,t} \to 0$.

Retail Gasoline: Taking Stock

1. Pass-through complete in levels.
2. Pass-through incomplete in logs, even accounting for cost share of gasoline.
3. No apparent heterogeneity in pass-through in levels.
4. Differences in margins rationalize cross-sectional heterogeneity in log pass-through.

- In paper: Similar results from other geographies (Canada, South Korea, U.S.).
- Similar results using Känzig (2021) OPEC announcement IV for upstream costs.

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Explaining Okun (1981): Setup

- Continuum of products indexed by ω.
- Households choose which varieties $j(\omega)$ to buy and total mass of products Ω,

$$Y = \max_{\Omega, j(\omega)} \int_0^{\Omega} \delta_{ij(\omega)} q_{ij(\omega)} d\omega, \qquad \text{s.t.} \qquad \int_0^{\Omega} p_{j(\omega)} q_{ij(\omega)} = I.$$

- Production of each product ω is Leontief in labor (wage w) and commodity (cost c),

$$\text{mc}(\omega) = \beta(\omega) w + (1 - \beta(\omega)) c.$$

- We will assume for simplicity:
  - Identical firms selling each variety ($\Rightarrow$ symmetric prices $p_{j(\omega)} = p_\omega$).
  - Each $\delta_{ij(\omega)}$ drawn i.i.d. from same distribution across all i, j, ω.

Numeraire determined endogenously

- The change in welfare from purchasing some product ω from firm $j(\omega)$ is

$$dY \approx q_{j(\omega)} d\omega \left[d\delta_{ij(\omega)} - \left[\eta \frac{\delta_{ij(\omega)}}{p_{j(\omega)}} + (1-\eta) \frac{\delta_{\Omega}}{p_{\Omega}} \right] dp_{j(\omega)} \right].$$

Note: "Numeraire" price determined by price/taste of marginal product Ω.

- When $\eta = 0$, each product's price is given by

$$p(\omega) = \mathrm{mc}(\omega) + \underbrace{(\mu(\Omega) - 1)\,\mathrm{mc}(\Omega)}_{\substack{\text{Additive margin} \\ \text{depends on } \mathrm{mc}(\Omega),\, \mu(\Omega)}}.$$

Pass-through of commodity vs. wage changes

- Pass-through of change to unit commodity costs and wage costs:

$$\frac{\Delta p}{(1-\beta(\omega))\,\Delta c} = 1 + (\mu(\Omega) - 1)\,\frac{1-\beta(\Omega)}{1-\beta(\omega)},$$

$$\frac{\Delta p}{\beta(\omega)\,\Delta w} = \mu(\omega) + (\mu(\Omega) - 1)\left[\frac{\beta(\Omega)-\beta(\omega)}{\beta(\omega)}\right]\frac{c}{\mathrm{mc}(\omega)}.$$

- If marginal product Ω does not use commodity, i.e. $\beta(\Omega) = 1$, we get
  - Complete pass-through in levels for commodity input.
  - (Slightly more than) complete "log pass-through" for wages.
- Okun's (1981) "special role" actually is a special role of labor costs!

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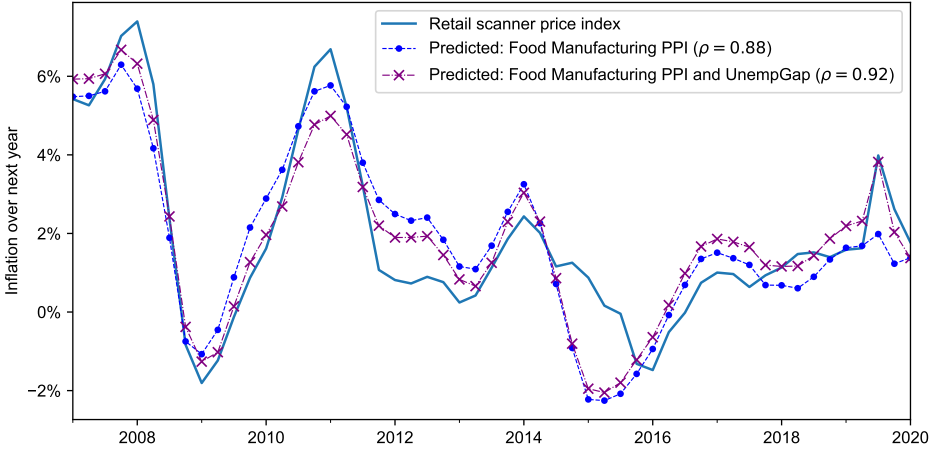
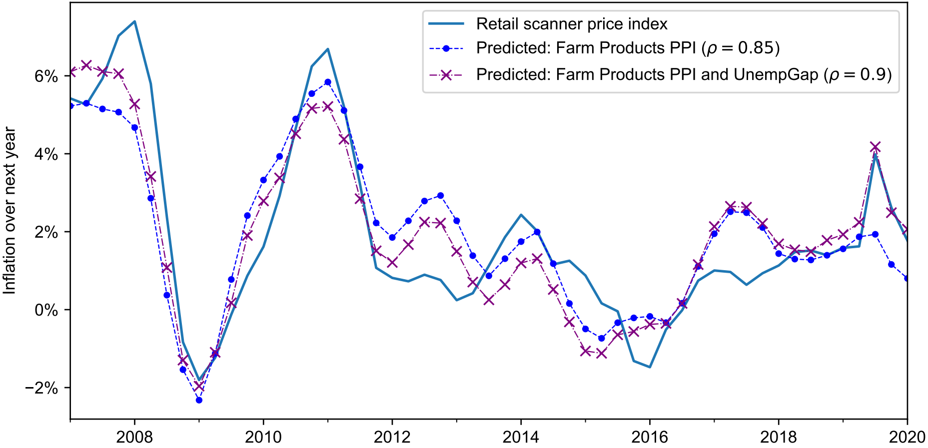
Backup: Upstream PPI explains food-at-home inflation well

Figure: Predicted Retail Scanner index inflation using Food Manufacturing PPI and unemp. gap.



Backup: Upstream PPI explains food-at-home inflation well

Figure: Predicted Retail Scanner index inflation using Farm Products PPI and unemp. gap.



Backup: Match rate of consumer expenditures to retail scanner infl. data

Table: Percent of expenditures matched to retail scanner and inflation data, by income group.

Income quintile	Matched to UPC		Matched to retailer-UPC	
	Total	With infl.	Total	With infl.
1	60.2	52.7	22.5	18.5
2	59.9	52.6	23.1	19.0
3	60.2	53.5	24.0	20.1
4	60.7	54.5	25.7	21.7
5	59.7	52.6	27.2	22.7

Backup: R^2 upstream PPI changes on inflation by income

Table: R^2 from long-term log pass-through regression.

	Food Manufacturing PPI		Farm Products PPI	
Index	UPC	Retailer-UPC	UPC	Retailer-UPC
Food-at-home CPI	0.59	0.59	0.42	0.42
Retail scanner index	0.58	0.62	0.50	0.51
All income groups	0.42	0.45	0.31	0.27
1st quintile	0.43	0.43	0.30	0.21
2	0.43	0.44	0.30	0.25
3	0.43	0.44	0.30	0.27
4	0.42	0.45	0.30	0.27
5th quintile	0.43	0.44	0.30	0.30

Backup: R^2 upstream PPI changes on inflation by unit price group

Table: R^2 from long-term log pass-through regression.

	Food Manufacturing PPI		Farm Products PPI	
Index	UPC	Retailer-UPC	UPC	Retailer-UPC
Food-at-home CPI	0.59	0.59	0.42	0.42
Retail scanner index	0.58	0.62	0.50	0.51
1st decile	0.61	0.58	0.55	0.42
2	0.41	0.49	0.34	0.34
3	0.34	0.64	0.27	0.51
4	0.41	0.54	0.33	0.46
5	0.46	0.50	0.42	0.49
6	0.42	0.55	0.40	0.42
7	0.47	0.52	0.47	0.39
8	0.40	0.52	0.23	0.43
9	0.38	0.46	0.38	0.43
10th decile	0.39	0.34	0.33	0.31

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Pass-through quotes

- "P&G, of Cincinatti, said Friday that it raised the list price of Folgers ground coffee by 28 cents per 11.5-ounce equivalent [...] to \$2.56 from \$2.28."
- "In futures trading Friday, arabica coffee beans for March delivery closed down 1.30 cents at \$1.3445 a pound on the New York Board of Trade. A Folgers spokeswoman said the last time the company changed retail coffee prices, in December, the contract was trading around 96 cents a pound."
- $\$0.28 \times (16/11.5 \text{ ounces}) = \$0.38$ per pound. *Wall Street Journal*.

Pass-through quotes

- “A weighted average price increase of approximately 8 percent across the company’s instant consumable, multi-pack, packaged candy and grocery lines is effective today. These changes will help offset part of the significant increases in Hershey’s input costs, including raw materials, packaging, fuel, utilities and transportation, which the company expects to incur in the future.” Source.
- “Kruger Products L.P. (“KPLP”), a company in which KP Tissue Inc. (TSX:KPT) holds a limited partnership interest, announced that it will increase the price of its consumer branded tissue products sold in Canada effective Sunday, October 14, 2018. The increase is required to offset unprecedented and sustained cost increases on input materials and freight with pulp costs being up over 23% since our last pricing announcement in July 2017.” Source. Article.
- “Mars Chocolate North America, the maker of M&M’s and Snickers, said on Wednesday that it will raise its prices by an average of 7 percent “to offset rising costs,” its first increase in three years.” Source.
- “Michael Bronner, president of California-based Dr. Bronner’s, said the natural-products company is increasing the price of soaps it sells to Whole Foods, Target Corp., Costco Corp., Walmart Inc. and other retailers by 3%. Prices for the

Kahneman et al. (1986) surveys on occasions for price changes

- **Price increases to offset cost increases are perceived as fair.**
  - “Suppose that, due to a transportation mixup, there is a local shortage of lettuce and the wholesale price has increased. A local grocer has bought the usual quantity of ltetuce at a price that is 30 cents per head higher than normal. The grocer raises the price of lettuce to customers by 30 cents per head.”
    Acceptable 79%, Unfair 21%.
  - “A landlord owns and rents out a single small house to a tenant who is living on a fixed income. A higher rent would mean the tenant would have to move. Other small rental houses are available. The landlord’s costs have increased substantially over the past year and the landlord raises rent to cover the cost increases when the tenant’s lease is due for renewal.”

    Acceptable 75%, Unfair 25%.
- **With inventories, fairness considerations delay pass-through.**
  - “A grocery store has several months supply of peanut butter in stock which it has on the shelves and in the storeroom. The owner hears that the wholesale price of peanut butter has increased and immediately raises the price on the current stock of peanut butter.”

    Acceptable 21%, Unfair 79%.
- **Price increases in response to demand shocks deemed unfair.**
  - “A severe shortage of Red Delicious apples has developed in a community and none of the grocery stores or produce markets have any of this type of apple on their shelves. Other varieties of apples are plentiful in all of the other stores. One grocer receives a single shipment of Red Delicious apples at the regular wholesale cost and raises the retail price of these Red Delicious apples by 25% over the regular price.”

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Food inflation exp. of low-income households more sensitive to inflation rate

	Food 1-yr Inflation Expectations		
Data	NY Fed, 2013–2023		
Aggregation	Median	Indiv.	Indiv.
	(1)	(2)	(3)
Mid-Income	-0.371**	-1.657**	-
	(0.160)	(0.078)	-
High-Income	-0.799**	-2.361**	-
	(0.223)	(0.093)	-
Food-at-home infl. over past year	0.430**	0.462**	0.215**
	(0.034)	(0.061)	(0.078)
Mid-Income $\times$ Food-at-home infl.	-0.255**	-0.163**	-0.075**
	(0.038)	(0.024)	(0.037)
High-Income $\times$ Food-at-home infl.	-0.293**	-0.250**	-0.129**
	(0.041)	(0.026)	(0.043)
Respondent FEs	No	No	Yes
N	360	133780	133780

- Food infl. exp. of low-income higher, but also more sensitive to past food-at-home infl.

Overall inflation exp. of low-income more sensitive to food-at-home infl.

	1-yr Inflation Expectations				
Data	NY Fed, 2013–2023			Michigan Survey, 1978–2024	
Aggregation	Median	Indiv.	Indiv.	Mean	Median
	(1)	(2)	(3)	(4)	(5)
Mid-Income	-0.885**	-1.647**	-	-0.779**	-0.775**
	(0.216)	(0.289)	-	(0.092)	(0.071)
High-Income	-0.984**	-3.130**	-	-1.430**	-1.244**
	(0.263)	(0.380)	-	(0.136)	(0.091)
Food-at-home infl.	0.258**	0.243**	0.129*	0.139**	0.104**
	(0.040)	(0.071)	(0.074)	(0.026)	(0.023)
Mid-Income $\times$ Food-at-home infl.	-0.142**	-0.055	-0.042	-0.027	-0.023*
	(0.036)	(0.042)	(0.039)	(0.024)	(0.013)
High-Income $\times$ Food-at-home infl.	-0.148**	-0.150**	-0.079	-0.060*	-0.044**
	(0.043)	(0.064)	(0.063)	(0.031)	(0.019)
Controls	CPI less food & energy infl., gas infl., income interactions				
Respondent FEs	-	No	Yes	-	-
N	360	153051	153051	1599	1599

- Overall infl. exp. more sensitive to food-at-home infl (not true for broader CPI or gas).

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