Cheapflation Cycles

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.

Within-Category Fluctuations in Inflation Inequality

- Inflation differs across households due to composition of expenditures.
- Large literature: Inflation heterogeneity due to spending shares across categories.
  - E.g., low-income households devote larger budget share to necessities like food, energy.
    E.g., Hobijn and Lagakos (2005), Orchard (2022), Jaravel (2024).
- This paper: New source of fluctuations in inflation inequality *within* product categories.

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1. Complete pass-through in levels of input cost increases to prices.
2. Same absolute price increase $\Rightarrow$ higher inflation for low-priced varieties in category.
3. Low-income households buy lower-price varieties, and thus face higher inflation.

Post-Pandemic “Cheapflation”

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

- Discussion: “supermarkets are recouping their margins on value/budget products” or “targeted fiscal stimulus increased demand at low-end.”

Within-Category Fluctuations in Inflation Inequality

- Parsimoniously accounts for “cheapflation” and inflation inequality.
  - Explains 70% of variation in food-at-home inflation inequality over 18 year period.
  - Explains cheapflation & inflation inequality during Great Recession and 2021–2023.
    Li (2019), Argente and Lee (2021); Cavallo and Kryvtsov (2024), Chen et al. (2024).
  - Little need for other channels (price-gouging / elevated demand at low end).
- Official statistics understate gaps in inflation across income groups by 70–90%.
  - Even the most granular BLS data aggregate inflation across varieties within category.
  - Miss systematic differences in inflation across varieties due to pass-through in levels.
- Welfare implications accounting for substitution, nonhomotheticity.
- Evidence that channel applies beyond food at home.

Selected Related Literature

- **Inflation inequality**:
  - *Using differences in spending across categories*: Michael (1979), Hagemann (1982), Garner et al. (1996), Hobijn and Lagakos (2005), Hobijn et al. (2009), Klick and Stockburger (2021, 2024), Orchard (2022), Hochmuth et al. (2022), Pallotti et al. (2023), Cavallo (2024), Jaravel (2024), Lan et al. (2024), Olivi et al. (2024), Lokshin et al. (2025).
    - Del Canto et al. (2025): "Prior work has found that households at different income levels experience different trend inflation in consumption prices, and that this difference is driven by differences within fine product groups. [...However,] there is no a priori reason to think inflation rates of finer product categories should be differentially responsive to short-run shocks. We therefore limit attention to the 25 CPI groups."
  - *Scanner data, secular trend*: Kaplan and Schulhofer-Wohl (2017), Jaravel (2019).
  - *Scanner data, specific episodes*: *Great Recession*: Argente and Lee (2021), Li (2019). *Post-Pandemic*: Weber et al. (2023), Cavallo and Kryvtsov (2024), Chen et al. (2024).
- **Pass-through**:
  - Bulow and Pfleiderer (1983), Nakamura and Zerom (2010), Weyl and Fabinger (2013), Mrázová and Neary (2017), Amiti et al. (2019), Butters et al. (2022), Sangani (2025).

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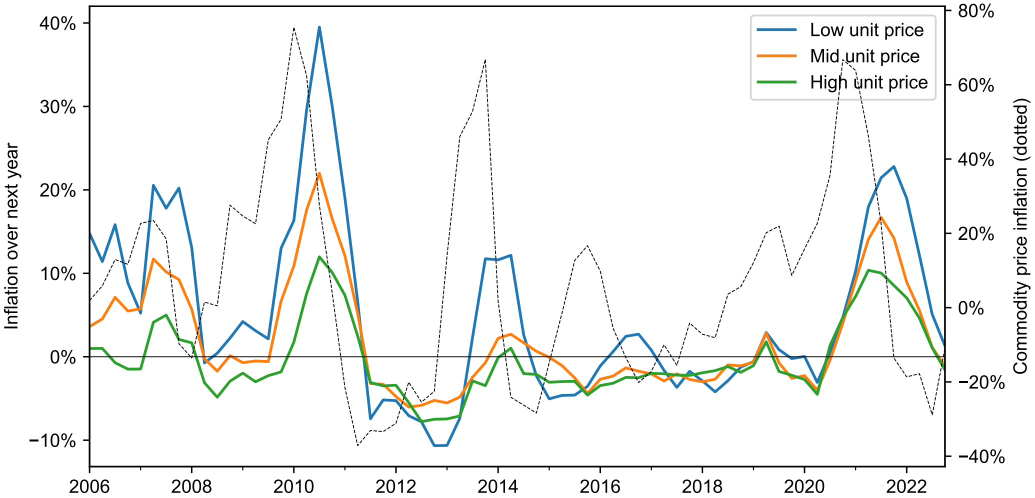
Coffee: A case study

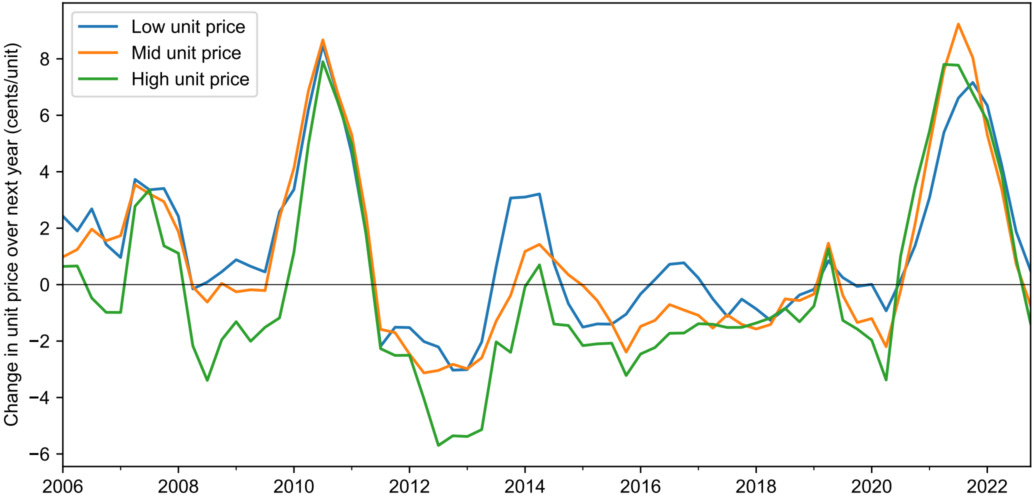
- Roasted coffee as a laboratory, after Nakamura and Zerom (2010), Sangani (2025).
- Primary input, green coffee beans, traded on global commodity markets, with large fluctuations over 2006–2023.
- NielsenIQ Retail Scanner ($>$30,000 participating U.S. retail stores) for retail prices.

1. Complete pass-through in levels of input cost increases to prices.
2. Same absolute price increase $\Rightarrow$ higher inflation for low-priced varieties in category.
3. Low-income households buy lower-price varieties, and thus face higher inflation.

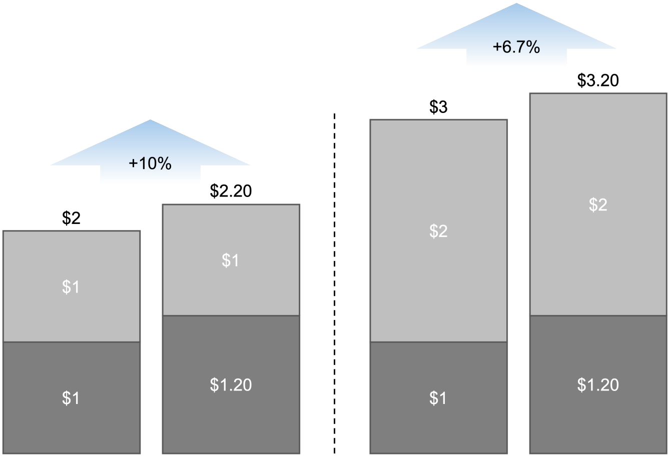
Low-priced products exhibit greater sensitivity of inflation to costs



Differences disappear when measuring price changes in levels



Pass-through in levels and cheapflation: Intuition



- Suppose input price rises from \$1/oz to \$1.20/oz. (+20%).
- L price increases from \$2 to \$2.20. (+10%).
- H price increases from \$3 to \$3.20. (+6.7%).
- Log pass-through: $L = 0.5 > H = 0.33$.

Canonical approach to measure pass-through of commodity cost changes

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

- Long-run pass-through in levels $\sum_{k=1}^{K} b_k$ using:

$$\Delta p_{irt} = a_{ir} + \sum_{k=0}^{K} b_k \Delta c_{t-k} + \sum_{k=1}^{4} d_k q_t + \varepsilon_{irt}.$$

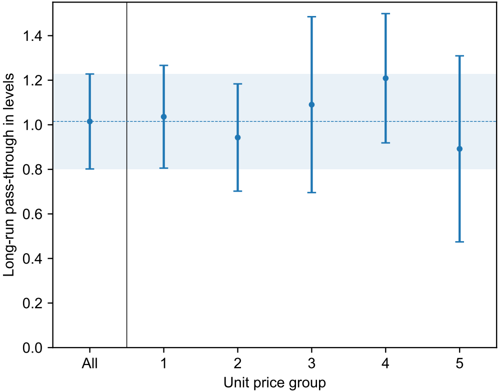
  - Absorb product-retailer trends a_{ir} and seasonal effects with quarter-of-year dummies q_t.
  - Horizon of $K = 6$ quarters, following Nakamura and Zerom (2010).

- Long-run pass-through in logs $\sum_{k=1}^{K} \beta_k$ from analogous specification,

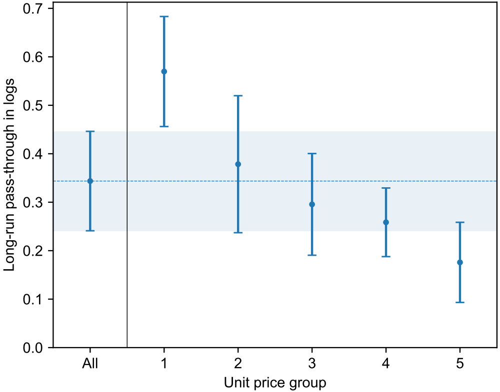
$$\Delta \log p_{irt} = \alpha_{ir} + \sum_{k=0}^{K} \beta_k \Delta \log c_{t-k} + \sum_{k=1}^{4} \delta_k q_t + \varepsilon_{irt}.$$

Complete pass-through in levels → heterogeneous log pass-through

- Pass-through in levels is 1.01 (se: 0.11) and uniform across unit price groups.
- Pass-through in logs is incomplete (0.34; se: 0.05) and decreasing with unit price.



(a) Pass-through in levels.



(b) Pass-through in logs.

Robustness

Unit price group	Panel A. Pass-through in levels					
	Baseline	IV: Exchange rates	IV: Weather shocks	Product-quarter FEs	$K = 4$	$K = 8$
1	0.13	0.10	0.25	0.22	0.23	–0.38
2	–0.44	–0.42	–0.17	–0.64	–0.40	0.18
3	0.33	0.52	0.24	–0.02	–0.15	0.06
4	1.06	0.85	–0.32	1.42	1.13	1.30
5	–0.51	–0.36	–0.30	–0.36	–0.52	–0.18
Unit price group	***Panel B. Pass-through in logs***					
	Baseline	IV: Exchange rates	IV: Weather shocks	Product-quarter FEs	$K = 4$	$K = 8$
1	2.90**	2.21**	1.70*	2.81**	2.57**	2.30**
2	0.39	0.35	0.13	0.25	0.14	1.05
3	–0.64	–0.35	–0.53	–0.88	–0.88	–0.76
4	–1.34	–1.14	–2.04**	–1.02	–0.76	–0.89
5	–2.50**	–2.33**	–2.05**	–2.28**	–2.22**	–2.32**

- Difference in pass-through relative to all products: $(\rho_i - \rho_{\text{all}})/(\text{SE}_i^2 + \text{SE}_{\text{all}}^2)^{1/2}$.
- Result: Uniform pass-through in levels, higher log pass-through for low-price varieties.

Why pass-through in levels?

- One explanation: Perfect competition.
  - Differences in prices due to non-commodity input costs. (E.g., Cravino and Levchenko 2017.)
  - At odds with other features of the data: differentiation (e.g., Peets vs. Folgers), price dispersion for identical products, sluggish price adjustment, finite demand elasticities.
- Imperfect competition: pass-through depends on how markups adjust to cost changes.
- No guarantee that firms should exhibit complete pass-through in levels.
- One option: Shift-invariant demand systems. (Sangani 2025.)
  - Class of demand systems that generates pass-through in levels of common cost shocks.
  - Includes e.g., nested/mixed logit demand (with no outside option), address models.

From cheapflation to inflation inequality

- Inflation rates by income group: Merge NielsenIQ Homescan to Retail Scanner data.

- Sort Homescan panelists into income quintiles.
  - Order by income bin and expenditures$/\sqrt{\text{household size}}$ within bin. (Handbury 2021).
  - Split into five groups using Nielsen-IQ provided projection weights.

- For each group g, let $\lambda_{igt} =$ expenditures on product i by group g in quarter t.

- Laspeyres inflation rate using inflation of posted prices for each product i,

$$\pi_{gt} = \sum_i \frac{\lambda_{igt}}{\sum_j \lambda_{ijt}} \pi_{it}, \qquad \text{where} \qquad \pi_{it} = p_{it+4}/p_{it} - 1.$$

For match to income groups, define product as a UPC (match 62% of expenditures).

From cheapflation to inflation inequality

1. High-income households buy higher-priced coffee varieties.

$$\text{LogUnitPrice}_{gt} = \sum_{q=1}^{5} \beta_q 1\{g = q\} + \phi_t + \varepsilon_{gt}.$$

   - β_q capture differences in relative prices of varieties bought by income quintile q.

2. High-income households face less inflation when coffee costs rise.

$$\text{CoffeeInflation}_{gt} = \sum_{q=1}^{5} \beta_q \left(\text{AvgCoffeeInflation}_t \times 1\{g = q\}\right) + \alpha_g + \phi_t + \varepsilon_{gt}.$$

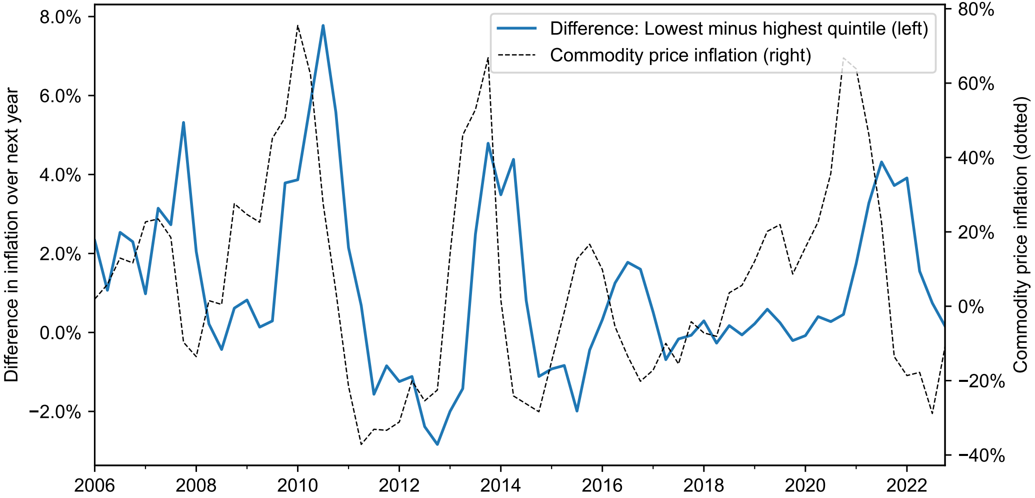
   - β_q capture differences in sensitivity of inflation experienced by income quintile q to overall coffee inflation rate.

From cheapflation to inflation inequality

- Construct inflation by income quintile using NielsenIQ Homescan panelist data.
- Low-income buy cheaper varieties $\Rightarrow$ more sensitive to inflation.

Panel A. Prices paid		*Panel B. Inflation sensitivity*		
	Log unit price		*Coffee inflation for income group*	
	(1)		(OLS)	(IV)
Income quintile 2	0.036**	Coffee inflation × Income quintile 2	−0.039**	−0.055**
	(0.000)		(0.002)	(0.018)
Income quintile 3	0.093**	Coffee inflation × Income quintile 3	−0.096**	−0.119**
	(0.001)		(0.004)	(0.030)
Income quintile 4	0.157**	Coffee inflation × Income quintile 4	−0.155**	−0.201**
	(0.005)		(0.008)	(0.050)
Income quintile 5	0.236**	Coffee inflation × Income quintile 5	−0.270**	−0.322**
	(0.006)		(0.017)	(0.024)
Time FEs	Yes	Time FEs	Yes	Yes
N	360	N	340	340
R^2	0.99	R^2	1.00	0.99
Within R^2	0.93	Within R^2	0.80	0.19

Fluctuations in within-category inflation inequality



- BLS has one ELI for “roasted and instant coffee.” Misses all variation within coffee!

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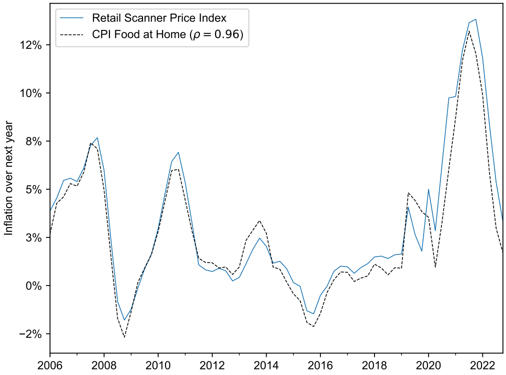
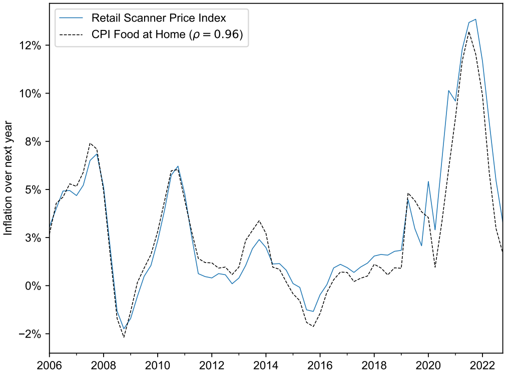
Does mechanism extend to rest of food at home?

- Use UPCs from all food departments to reconstruct food-at-home inflation.
- Can deconstruct food-at-home inflationt by unit price group and income group.



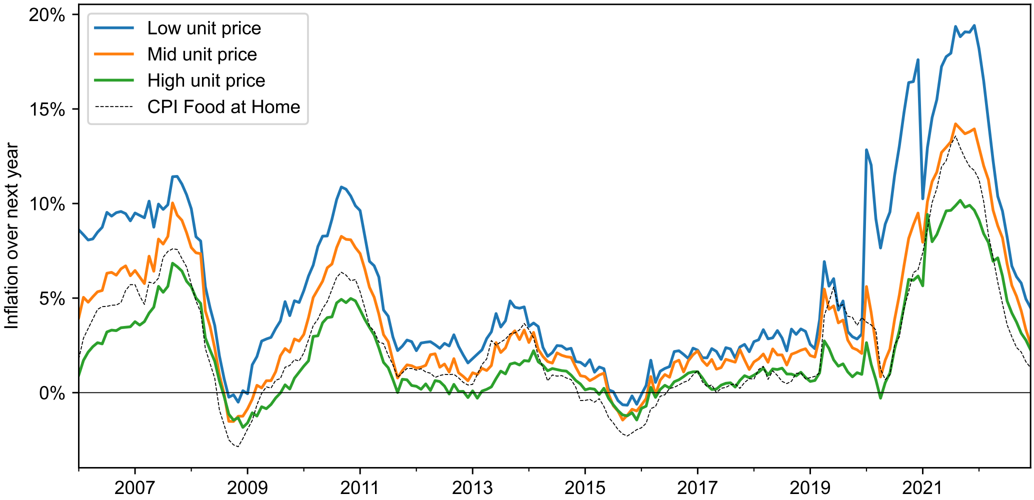
(a) Level of aggregation: Retailer-UPC



(b) Level of aggregation: UPC

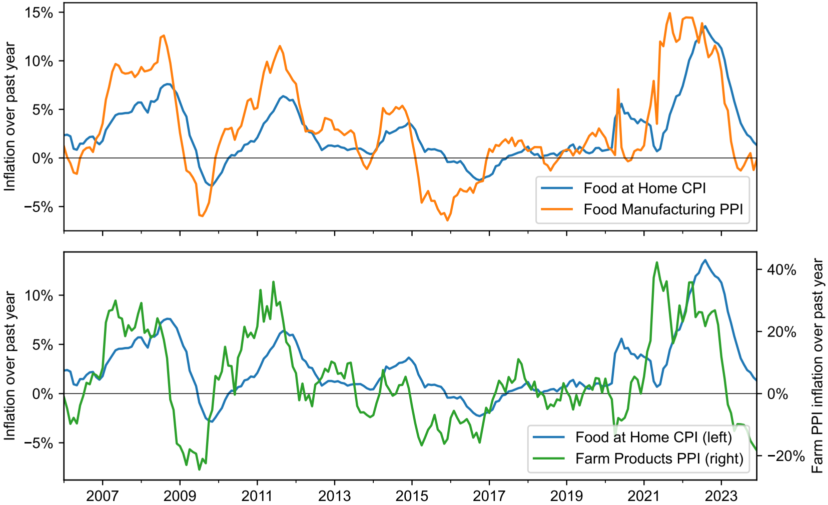
Cycles in food-at-home cheapflation

- Inflation for lower-priced varieties more sensitive to aggregate inflation rate.



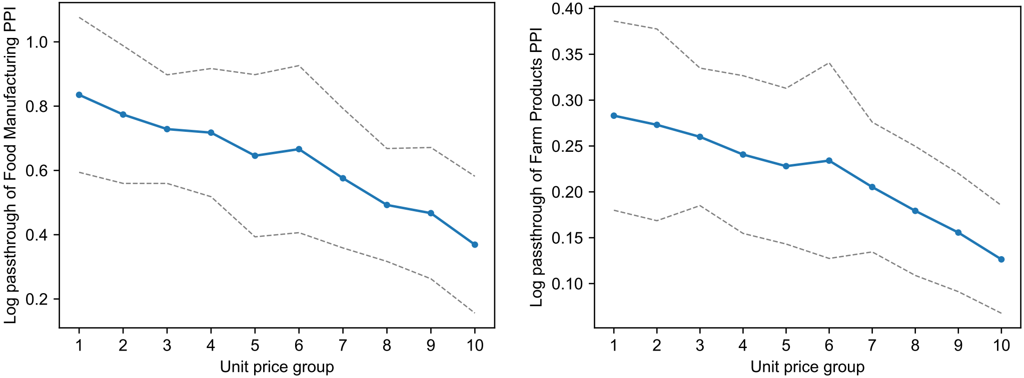
Are cheapflation cycles due to pass-through?

- Log pass-through of Food Mfg. & Farm Products PPI to inflation by unit price group.



Driven by differential log pass-through of upstream costs

$$\Delta \log p_{it} = \alpha_i + \sum_{k=0}^{K} \beta_k \Delta \log \mathrm{PPI}_{t-k} + \sum_{k=1}^{4} \delta_k q_k + \varepsilon_{it}.$$



(a) Food Manufacturing PPI. (b) Farm Products PPI.

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Testing for pass-through in levels

- How do we know declining log pass-through is due to complete pass-through in levels?

- Suppose each module consists of varieties indexed by i, with unit prices

$$p_i = m + b_i w.$$

$\Rightarrow$ Complete pass-through in levels of changes in material price m.

  - Assumption 1: A unit of each variety contains the same quantity of material input.
  - Assumption 2: Demand system generates additive markup priced relative to labor w. E.g., under generalized logit

$$q_i = \frac{\exp\left(\delta_i - b_i p_i / w\right)}{\int_j \exp\left(\delta_j - b_i p_j / w\right) dj}.$$

One form of *shift-invariant demand* that explains pass-through in levels (Sangani 2025).

Testing for pass-through in levels

- Variety i sets price,

$$p_i = m + b_i w.$$

- To a first order, the gap between module inflation rates for groups L and H is

$$\pi^L - \pi^H = \underbrace{\left(\frac{p}{p^L} - \frac{p}{p^H}\right)}_{\text{Price gap}} \times \underbrace{\left(\pi^{\text{all}} - \pi^w\right)}_{\text{Excess inflation}},$$

  - p is the average module unit price, and p^L, p^H are the avg unit prices paid by L and H.
  - $\pi^{\text{all}} - \pi^w$ is the difference between the module inflation rate and wage inflation.

- Empirical specification: Indexing modules m and quarters t, we predict $\beta \approx 1$:

$$\text{Cheapflation}_{mt} = \beta\left(\text{PriceGap}_{mt} \times \text{ExcessModuleInflation}_{mt}\right) + \varepsilon_{mt}.$$

Testing for pass-through in levels

- We find $\beta \approx 1$.

	Inflation of lowest-price decile − highest-price decile					
	(1)	(2)	(3)	(4)	(5)	(6)
Excess module inflation × Price gap	1.183**		1.188**		1.194**	
	(0.027)		(0.025)		(0.019)	
Module inflation × Price gap		1.186**		1.188**		1.194**
		(0.025)		(0.025)		(0.019)
Wage inflation × Price gap		-1.657**		-1.047**		-1.540**
		(0.335)		(0.299)		(0.453)
Post-2020			-0.067**	-0.073**		
			(0.018)	(0.024)		
Time FEs					Yes	Yes
Product Module FEs					Yes	Yes
N	42137	42137	42137	42137	42137	42137
R^2	0.92	0.92	0.92	0.92	0.93	0.93

Testing for pass-through in levels

- We find $\beta \approx 1$. Predictions also hold if we split module vs. wage inflation.

	Inflation of lowest-price decile − highest-price decile					
	(1)	(2)	(3)	(4)	(5)	(6)
Excess module inflation × Price gap	1.183**		1.188**		1.194**	
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Time FEs					Yes	Yes
Product Module FEs					Yes	Yes
N	42137	42137	42137	42137	42137	42137
R^2	0.92	0.92	0.92	0.92	0.93	0.93

Testing for pass-through in levels

- We find $\beta \approx 1$. Predictions also hold if we split module vs. wage inflation.
- No excess cheapflation from 2021–2023. Little add'l time variation in cheapflation.

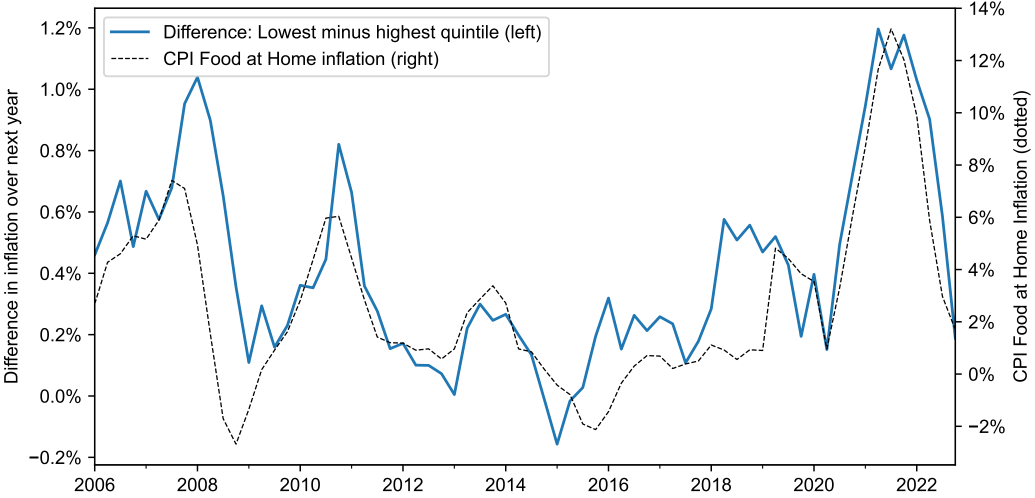
	Inflation of lowest-price decile − highest-price decile					
	(1)	(2)	(3)	(4)	(5)	(6)
Excess module inflation × Price gap	1.183**		1.188**		1.194**	
	(0.027)		(0.025)		(0.019)	
Module inflation × Price gap		1.186**		1.188**		1.194**
		(0.025)		(0.025)		(0.019)
Wage inflation × Price gap		-1.657**		-1.047**		-1.540**
		(0.335)		(0.299)		(0.453)
Post-2020			-0.067**	-0.073**		
			(0.018)	(0.024)		
Time FEs					Yes	Yes
Product Module FEs					Yes	Yes
N	42137	42137	42137	42137	42137	42137
R^2	0.92	0.92	0.92	0.92	0.93	0.93

From cheapflation to inflation inequality

- Low-income buy cheaper varieties across food-at-home. (Handbury 2021; Sangani 2022).
- $\Rightarrow$ Low-income inflation rates more sensitive to category-level inflation.

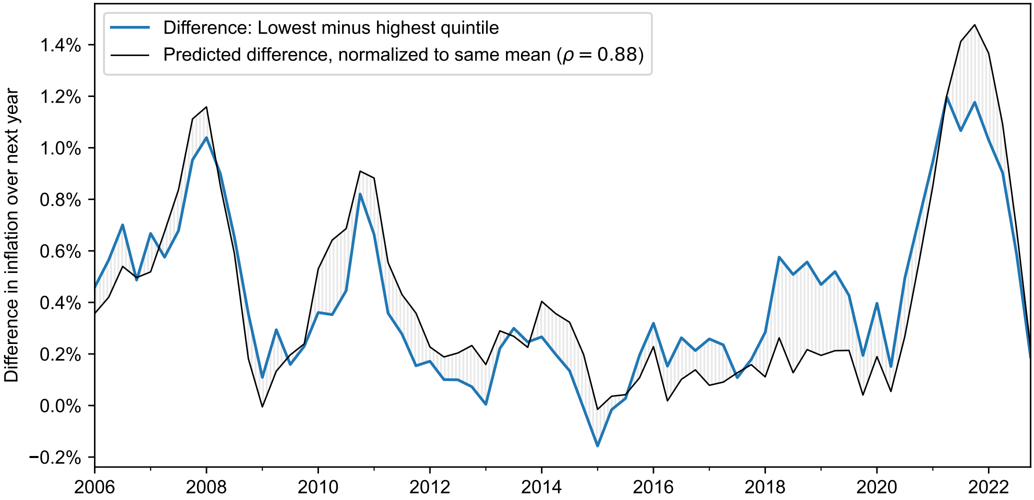
Panel A. Prices paid		*Panel B. Inflation sensitivity*	
	Log unit price (1)		*Module inflation for income group* (2)
Income quintile 2	0.012**	Avg. module inflation × Income quintile 2	0.000
	(0.003)		(0.003)
Income quintile 3	0.027**	Avg. module inflation × Income quintile 3	−0.008*
	(0.004)		(0.004)
Income quintile 4	0.049**	Avg. module inflation × Income quintile 4	−0.025**
	(0.006)		(0.006)
Income quintile 5	0.082**	Avg. module inflation × Income quintile 5	−0.052**
	(0.008)		(0.010)
Module-Time FEs	Yes	Module-Time FEs	Yes
N	213971	N	201667
R^2	1.00	R^2	0.99
Within R^2	0.19	Within R^2	0.08

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



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

- Predicted gap $=$ diff within-module infl (pass-through in levels) $+$ diff spending shares.



Explaining variation in inflation inequality over time

	Variance of inflation gap (pp^2)	*Excess inflation inequality relative to full sample average* (percentage points)	
	All Years	2008–2011	2021–2023
Actual	0.100	0.122	0.323
After accounting for pass-through in levels	0.043	0.002	0.117
After accounting for pass-through in levels and module expenditure shares	0.030	−0.041	−0.043

- Predicted gap explains 70% of variation in inflation inequality over time.
- Accounts for excess inflation inequality during Great Recession ('08–11) and Post-Pandemic Inflation ('21–23).

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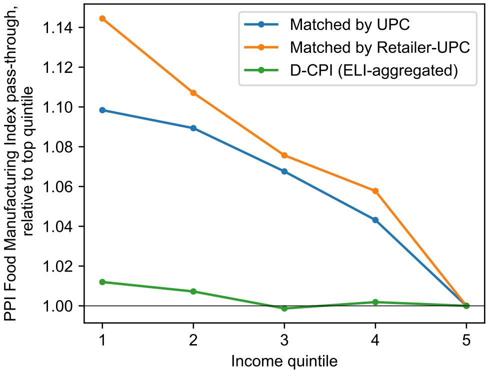
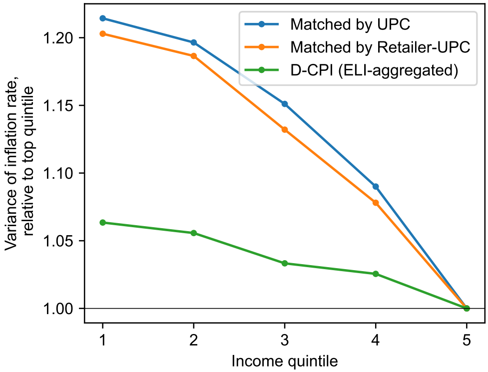
Official price indices do not capture ↑ volatility, sensitivity for low-income

- Food-at-home inflation for low-income more sensitive to upstream costs, more volatile.
- Inflation measures built on BLS ELI data (e.g., D-CPI) do not capture these effects.



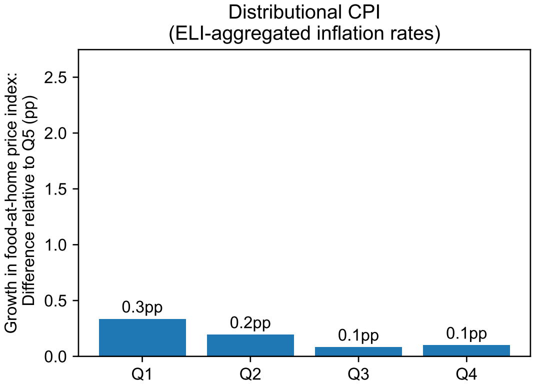
(a) Log pass-through of Food Manufacturing PPI.

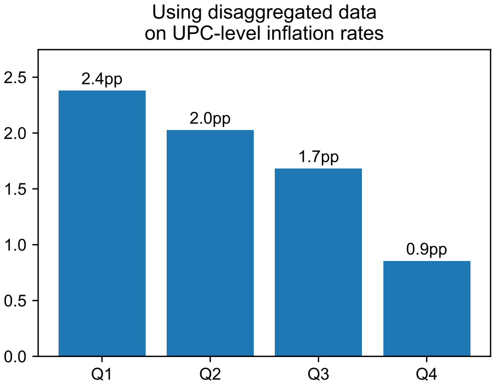


(b) Variance of annual inflation rates.

BLS data misses 86% of differential food-at-home inflation over 2021–2023

- Differences in food-at-home price growth by income quintile, 2020Q4 to 2023Q4.
- Average growth was 21pp over this period ⇒ ≈10% higher for low-income.





Official price indices understate gaps by 70–90%

- "BLS data" column uses most disaggregated official price indices available.
- Aggregation within BLS indices understates differences across income groups.

	Difference: 1st vs. 5th income quintile		
Measure	Scanner data	BLS data	Understatement in BLS data
Pass-through of Food Manufacturing PPI, 2006–2020	9.8%	1.2%	88%
Pass-through of Farm Products PPI, 2006–2020	5.8%	1.6%	72%
Variance of food-at-home inflation rates, 2006–2020	21.4%	6.3%	70%
Growth in food-at-home price index, 2020Q4–2023Q4	2.4pp	0.3pp	86%

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Accounting for substitution and nonhomotheticity

- So far we have used Laspeyres price indices to measure inflation,

$$\underbrace{\Delta \log P_t}_{\substack{\text{Change in}\\ \text{cost of living}}} \approx \sum_i \underbrace{\lambda_{it-1}}_{\substack{\text{Initial}\\ \text{exp. shares}}} \times \underbrace{\Delta \log p_{it}}_{\substack{\text{Subsequent}\\ \text{price change}}} .$$

- Change in cost of living may differ from Laspeyres first-order approx for two reasons:
    1. Substitution: Households may substitute to products with smaller price increases.
    2. Nonhomotheticity: Households' spending shares may change with real income.

Accounting for substitution and nonhomotheticity

- So far we have used Laspeyres price indices to measure inflation,

$$\underbrace{\Delta \log P_t}_{\substack{\text{Change in} \\ \text{cost of living}}} \approx \sum_i \underbrace{\lambda_{it-1}}_{\substack{\text{Initial} \\ \text{exp. shares}}} \times \underbrace{\Delta \log p_{it}}_{\substack{\text{Subsequent} \\ \text{price change}}} .$$

- Change in cost of living may differ from Laspeyres first-order approx for two reasons:
  1. Substitution: Households may substitute to products with smaller price increases.
  2. Nonhomotheticity: Households' spending shares may change with real income.

- Approach:
  1. Törnqvist price index accounts for changes in spending shares.

$$\pi_t^{\text{Törnqvist}} = \prod_i (1 + \pi_{it})^{\frac{1}{2}(\lambda_{it-1} + \lambda_{it})} - 1.$$

  2. Nonhomothetic adjustment from Jaravel and Lashkari (2024), which uses variation in inflation across hh's with different real consumption.

Accounting for substitution and nonhomotheticity

	Panel A. Growth in food-at-home price index from 2020Q4–2023Q4 (pp)			*Panel B. Variance of food-at-home inflation rates from 2006–2020 (pp^2)*		
Income	Homothetic		Nonhomothetic	Homothetic		Nonhomothetic
quintile	Laspeyres	Törnqvist	(Base=2020Q4)	Laspeyres	Törnqvist	(Base=2006Q1)
	(1)	(2)	(3)	(4)	(5)	(6)
1	27.27	25.43	27.01	4.69	4.67	4.89
2	26.92	24.90	26.41	4.62	4.59	4.92
3	26.57	24.52	25.99	4.45	4.43	4.78
4	25.74	23.87	25.27	4.21	4.23	4.55
5	24.89	23.13	24.45	3.86	3.90	4.15
Q1/Q5	1.10	1.10	1.10	1.21	1.20	1.18

- Substitution dampens inflation volatility, $\approx$ proportionately across incomes.
- Nonhomotheticity amplifies volatility: households trade down to low-price goods that inflate the fastest.

Why does non-homotheticity amplify volatility / welfare cost?

- In the cross-section, low-income households buy lower-price varieties.
- Thus, cross-section implies that when real consumption falls, preferred spending shares shift to less expensive varieties.
- When prices rise, real consumption falls $\Rightarrow$ households want to trade down.
- But, pass-through in levels means households trade down to exactly those varieties that experience the greatest inflation!

Nonhomotheticity adjustment: Robustness to base period

	Panel A. Growth in food-at-home price index from 2020Q4–2023Q4 (pp)			*Panel B. Variance of food-at-home inflation rates from 2006–2020 (pp^2)*		
		Nonhomothetic			Nonhomothetic	
Income quintile	Baseline	(b=2020Q4)	(b=2023Q4)	Baseline	(b=2006Q1)	(b=2020Q4)
	(1)	(2)	(3)	(4)	(5)	(6)
1	27.27	27.01	27.02	4.69	4.89	5.04
2	26.92	26.41	26.35	4.62	4.92	4.84
3	26.57	25.99	25.91	4.45	4.78	4.62
4	25.74	25.27	25.18	4.21	4.55	4.41
5	24.89	24.45	24.42	3.86	4.15	4.09
Q1/Q5	1.10	1.10	1.11	1.21	1.18	1.23

- Similar results using end of period as base.

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Cheapflation and inflation inequality beyond food at home

- Highly disaggregated purchase data for food-at-home / fast-moving consumer goods.
- Does pass-through in levels affect inflation inequality in other categories? Should if:
  - Firms have other input costs besides labor,
  - Firms exhibit complete pass-through in levels of these input costs to prices,
  - Consumers purchase differently-priced varieties.
- Two strategies using cross-city variation.
  1. Cheapflation across cities.
  2. Unequal incidence of inflation across cities with different incomes.
- [In paper]: Evidence from vehicle purchases and prices.

Evidence on cheapflation from Cost of Living Index (COLI) data

- Cost of Living Index (COLI) price data from 300 cities over 1990–2010.
  - Covers grocery items, apparel, other nondurables (e.g., aspirin, newspaper subscription, can of tennis balls), and services (e.g., haircut, movie ticket, pizza at restaurant).
  - Products chosen to be as standardized as possible across cities.
  - $\Rightarrow$ Prices not necessarily representative of product mix across cities.

- Test for cheapflation using prices of same product i across cities c:

$$\text{Inflation}_{ict} = \beta \left(\text{AvgProductInflation}_{it} \times \text{RelativePrice}_{ict} \right) + \alpha_{it} + \delta_{ic} + \kappa_{ct} + \varepsilon_{ict},$$

  - $\text{RelativePrice}_{ict} = \log p_{ict} - \log \bar{p}_{it}$ is relative price of product i in city c in quarter t.
  - Absorb product-quarter, product-city, and city-quarter FEs $\alpha_{it}, \delta_{ic}, \kappa_{ct}$.
  - Lower-priced products more sensitive to inflation (“cheapflation”) implies $\beta < 0$.

Evidence on cheapflation from Cost of Living Index (COLI) data

Category	Products
Grocery	Baby food, Bacon, Bananas, Beer, Chunk light tuna, Coffee, Corn flakes, Eggs, Fresh orange juice, Fried chicken, Frozen corn, Frozen meal, Frozen orange juice, Ground beef, Lettuce, Liquor, Margarine, Parmesan cheese, Peaches, Potato chips, Potatoes, Sausage, Shortening, Soft drink, Sugar, Sweet peas, T-bone steak, Tomatoes, White bread, Whole milk, Wine
Apparel	Boys' jeans, Boys' underwear, Men's denim jeans, Men's dress shirt, Men's slacks, Women's slacks
Other Goods	Aspirin, Board game, Cigarettes, Detergent, Facial tissues, Gasoline, Ibuprofen, Lipitor, Newspaper, Polysporin, Shampoo, Tennis balls, Toothpaste
Services	Beauty salon, Bowling, Commuter fare, Dental visit, Doctor visit, Dry cleaning, Fried chicken (at fast food restaurant), Haircut, Hamburger (at fast food restaurant), Hospital room, Movie ticket, Optometrist visit, Pizza (at restaurant), Tire balancing, Veterinary services, Washer repair
Housing & Utilities	Apartment rent, Electricity (both for all-electric homes and for homes using other types of energy), Home price, Monthly payment, Mortgage rate, Other energy, Telephone bill, Total energy

Evidence on cheapflation from Cost of Living Index (COLI) data

	Product Inflation in City					
	All	Grocery	Apparel	Other Goods	Services	Housing & Utilities
	(1)	(2)	(3)	(4)	(5)	(6)
Avg. Product Infl. × Relative Price	−1.565**	−1.496**	−2.440**	−1.343**	−5.181**	−0.586*
	(0.250)	(0.329)	(0.522)	(0.366)	(1.996)	(0.274)
Product-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Product-City FEs	Yes	Yes	Yes	Yes	Yes	Yes
City-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
N	1 164 952	516 770	55 111	183 189	262 382	147 500
R^2	0.35	0.38	0.55	0.55	0.27	0.55

- Cheapflation extends beyond grocery to apparel, other nondurables, and services.

Evidence on inflation inequality from BLS metro area data

- BLS collects price quotes and reports price indices for 32 metropolitan areas.
- Differences in price indices across cities reflect:
  - Differences in product mix and product-level inflation. $\Leftarrow$ Our mechanism.
  - Differences in expenditure shares across categories.
- Test for lower sensitivity to inflation in low-income cities:

$$\text{Inflation}_{mt} = \beta\left(\text{USInflation}_t \times \text{LogIncome}_{mt}\right) + \gamma \text{LogIncome}_{mt} + \alpha_m + \delta_t + \varepsilon_{mt},$$

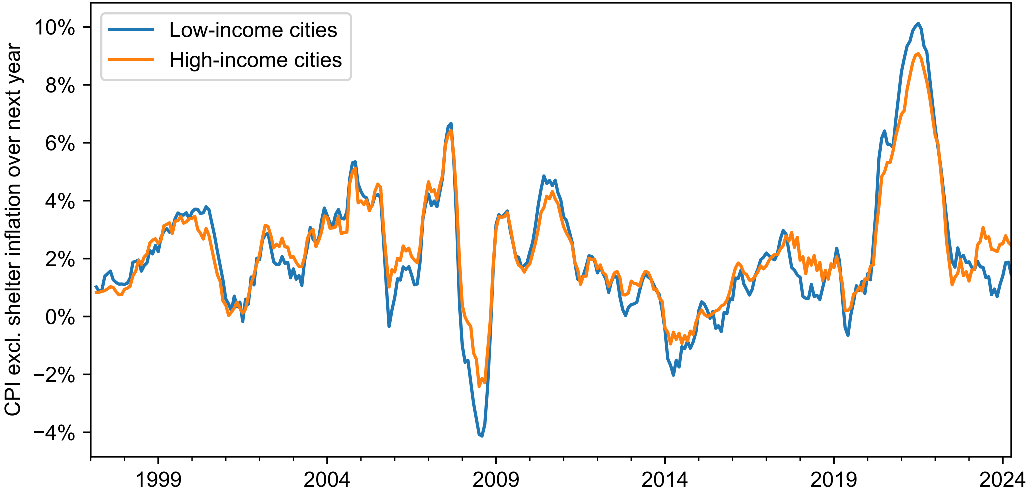
  - USInflation_t is inflation in a U.S. city average (nationwide average).
  - LogIncome_{mt} is log MSA income from BEA.
  - Low-income more sensitive to inflation implies $\beta < 0$.
  - Test within categories to ensure not driven by category expenditure shares.

Inflation inequality across U.S. metros

	Inflation in Metropolitan Area					
Series	CPI	CPI Ex. Shelter	All Food	Food Away from Home	Goods Ex. Food	Services Ex. Shelter
BLS Code	`SA0`	`SA0L2`	`SAF1`	`SEFV`	`SACL1`	`SASL2RS`
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. Avg. Inflation $\times$ Log Income	-0.970^{**}	-0.452^{**}	-0.258^{**}	-0.589^{**}	-0.227^{**}	-0.271^{*}
	(0.085)	(0.066)	(0.084)	(0.242)	(0.041)	(0.161)
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
Metropolitan Area FEs	Yes	Yes	Yes	Yes	Yes	Yes
N	3540	3534	3528	3515	3534	3534
R^2	0.85	0.89	0.75	0.42	0.92	0.57

- Higher sensitivity of inflation in lower-income cities.
- Beyond food-at-home, appears in food away from home, other goods, and services.

Inflation of CPI excluding shelter in high- and low-income cities



Differences in expenditure weights across categories explains only half

- BLS publishes expenditure weights across categories for metro areas.
- Construct MSA inflation rates w/ area weights $\times$ national category inflation.
- $\Rightarrow$ Sensitivity of actual MSA inflation rates varies 2x more with income, suggesting differences in within-category product mix and product-level inflation matter.

	Inflation in Metropolitan Area			
	CPI Data		Constructed with Area Weights	
	CPI	CPI Ex. Shelter	CPI	CPI Ex. Shelter
	(1)	(2)	(3)	(4)
U.S. Avg. Inflation $\times$ Log Income	-0.970^{**}	-0.452^{**}	-0.208^{**}	-0.224^{**}
	(0.085)	(0.066)	(0.035)	(0.030)
Time FEs	Yes	Yes	Yes	Yes
Metropolitan Area FEs	Yes	Yes	Yes	Yes
N	3540	3534	7452	7452
R^2	0.85	0.89	0.99	0.99

Conclusion

- A new source of fluctuations in cheapflation and inflation inequality.
- Pass-through in levels of cost changes $+$ diff varieties bought by income groups.
- Note: Mechanism applies to any units with different expenditures across varieties.
  - Cities with higher-priced varieties will have muted response to national cost shocks.
  - Countries that import high-price varieties will have less volatile import price inflation.
- Within-category inflation inequality invisible in official statistics due to aggregation.
- Substitution partially mitigates welfare costs, but nonhomotheticity amplifies costs.

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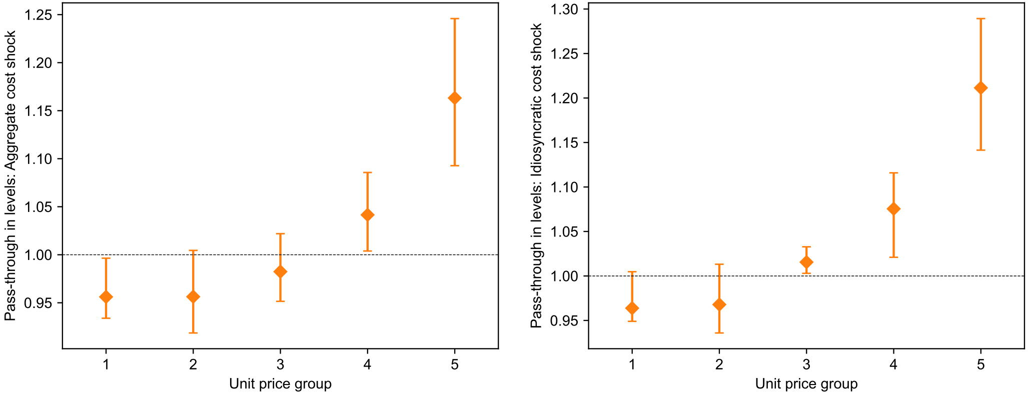
Pass-through in Nakamura and Zerom (2010) demand system

- Replicate Nakamura and Zerom (2010) demand system with 2006–2020 data.
- While aggregate price adjustment close to pass-through in levels, systematic differences in pass-through across unit price groups due to presence of outside option.



(a) Aggregate cost shock.

(b) Idiosyncratic cost shock.

Testing for pass-through in levels: Robustness with 5 groups

	Inflation of lowest-price quintile − highest-price quintile					
	(1)	(2)	(3)	(4)	(5)	(6)
Excess module inflation × Price gap	1.176**		1.181**		1.188**	
	(0.027)		(0.025)		(0.019)	
Module inflation × Price gap		1.178**		1.181**		1.188**
		(0.025)		(0.025)		(0.019)
Wage inflation × Price gap		-1.561**		-0.926**		-1.261**
		(0.299)		(0.243)		(0.336)
Post-2020			-0.048**	-0.056**		
			(0.011)	(0.014)		
Price gap	0.004	0.023*	0.012	0.001	0.051**	0.054**
	(0.010)	(0.011)	(0.007)	(0.006)	(0.007)	(0.013)
Time FEs					Yes	Yes
Product Module FEs					Yes	Yes
N	42405	42405	42405	42405	42405	42405
R^2	0.92	0.92	0.93	0.93	0.94	0.94

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