Inflation and Price Dispersion: New Cross-Sectoral and International Evidence

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Very preliminary results

Motivation

In standard New Keynesian models: (Nakamura, Steinsson, Sun, and Villar, 2018)

$$A_t(\bar{\pi}) = \left[\int_0^1 \left(\frac{p_{it}}{P_t} \right)^{-\theta} A_{it}^{-1} di \right]^{-1}$$

Inflation → Inefficient price dispersion → Misallocation → Lower welfare and productivity (A_t)

↪ time-dependent pricing: inflation rise from 0% to 10% → welfare loss > 2%

↪ fixed menu costs: almost no effect

Does high inflation distort relative prices? Does Inflation → Inefficient price dispersion?

Why do we care?

- ⋆ last decade discussions on rising inflation target to avoid ZLB
- ⋆ current high inflation
- ⋆ little and mixed evidence on inefficient price dispersion

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In this project: study the link between inflation and the inefficient dispersion of relative prices across countries, sectors and time

How: Analyze weekly product level (big) data for restaurants and supermarkets (multisector) for 16 countries with very different inflation rates ranging between 0% and 18%

Contribution: new international estimates of the (cross-sectoral heterogeneous) relation of inefficient price dispersion and inflation within very narrow categories and cities for a first time during a period with high inflation

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Literature

Issue: separate desired from inefficient price dispersion. Papers partially solving this issue:

1. Papers focussing on the cross-sectional dispersion of relative prices
   - ↪ Sheremirov (2020) using same product across U.S. supermarkets during 2001-2011 finds **weak positive correlation between price dispersion and inflation**
   - ↪ Sara-Zaror (2021) same approach, **at inflation levels of 2% y-o-y this relation flattens**, "Υ" relationship
   - ↪ Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2019) micro-level CPI price data from Argentina, **elasticity of price dispersion is zero for inflation below 10%**
2. Adam, Alexandrov, and Weber (2023) U.K. CPI micro data with novel structural approach, **sub-optimal inflation is associated with relative prices distortions**
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Data

To separate desired vs inefficient price dispersion using price data we optimally need:
1 narrow categorization of products, **2** periods of high and low inflation, **3** high frequency

Used data: web scraped data of restaurants and supermarkets prices from the delivery company Glovo

- weekly prices and daily opening information from March 2023 onwards (high frequency)
- >40'000 restaurants and supermarkets (heterogeneous stickiness, many price-setters)
- 16 countries/18 cities in Africa, Asia and Europe (very different inflation levels) AM, CI, ES, GE, GH, HR, IT, KE, KG, KZ, MA, PL, RO, SI, UA, UG
- >9 million products
- >160 million entries
- products classified into 330 narrow categories (burger with fries, coke, apples) using Google Translate Cloud and **fine-tunned OpenAI model** (narrow categories)

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Methodology – suboptimal inflation and product level price distortions

We can assume that the optimal flexible relative price $p^*_{it} = P^*_{it}/P^*_t$, evolves according to,

$$\ln p^*_{it} = \ln p^*_i - t \ln \Pi^*_i \tag{1}$$

where p^*_i is the product introduction price and Π^*_i a product-specific time trend. (Adam, Alexandrov, and Weber, 2023)

- With gross inflation rate $\ln \Pi = \ln \Pi^*_i \rightarrow$ no need to adjust prices.
- With $\ln \Pi \neq \ln \Pi^*_i +$ price rigidities $\rightarrow$ a gap might arise: $\ln p_{it} = \ln p^*_i - t \ln \Pi^*_i + gap_{it}$

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In a first-stage we can estimate (product i, category g, city c)

$$\ln p_{igct} = \ln a_{igc} - (\ln b_{igc})t + u_{igct} \quad (2)$$

with $\widehat{lna_{igc}} \rightarrow \ln p^*_{igc}$ and $\widehat{\ln b_{igc}} \rightarrow \ln \Pi^*_{igc}$

$\hookrightarrow$ u_{igct} doesn't identify gap_{igct} due to possible idiosyncratic shocks included

Test if suboptimal inflation is related to product level relative price distortions:

$$\widehat{\text{Var}}_{(i)}(u_{igct}) = v_{gc} + c_{gc}(\ln \widehat{\Pi_{gc}/\Pi^*_{igc}})^2 + \epsilon_{igc} \quad (3)$$

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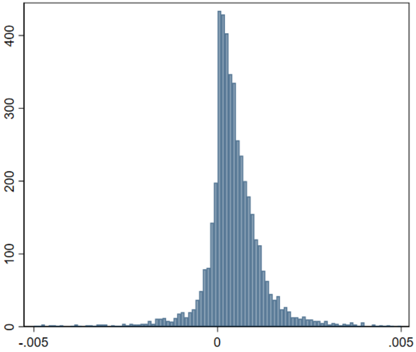
Results – first stage regressions

First-stage for obtaining $\ln\widehat{\Pi_{gc}/\Pi^*_{igc}}$ (on >100 million product-weeks, 4,512 category-cities):

$$\ln P_{igct} = \ln\tilde{a}_{igc} + \ln(\Pi_{gc}/\Pi^*_{igc})t + \tilde{u}_{igct}$$

↪ suboptimal inflation >0 for 81% of city-categories (different than in prev. literature)



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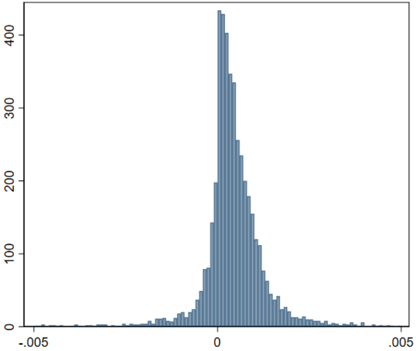

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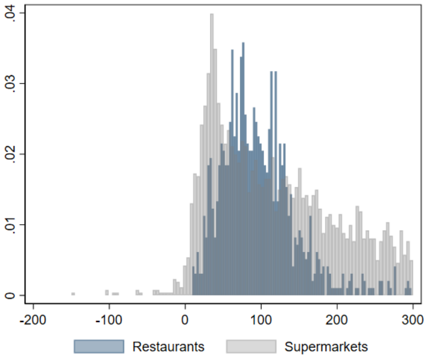
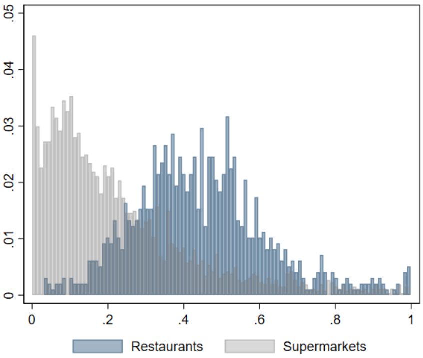
c_{gc} estimates



Second-stage R^2



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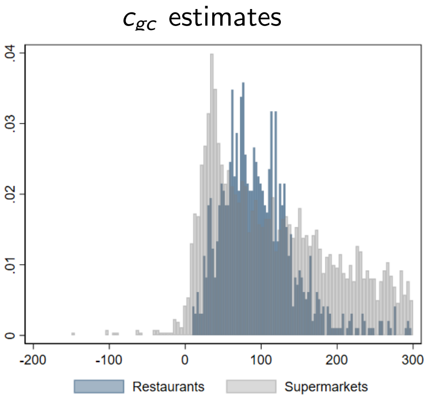

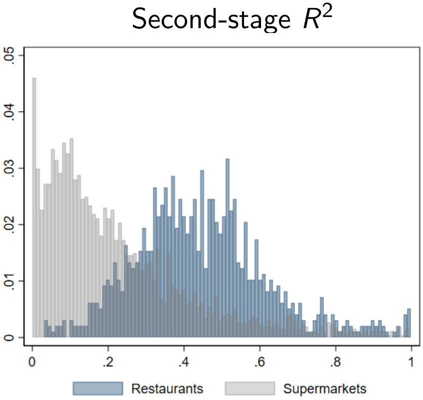

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One can show that

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meaning that at least one share ($\approx 93\%$) is not inefficient.

Relation of inflation and inefficient price dispersion

$$\mathrm{SD}_t^g(u_{irgct}) = \gamma_{gc} + \beta|\Pi_{gct-4}| + \epsilon_{gct}. \tag{5}$$

$\mathrm{SD}_t^g(u_{igct})$ from the previously estimated u_{igct} and $|\Pi_{gct-4}|$ is category absolute inflation

Alternatives to u_{igct}:

- ↪ ε_{igct} obtained using category, city, retailer FEs (see Sheremirov (2020) and appendix)
- ↪ Δp_{vgct} where is the price dispersion for beverage category g and volume v in city c
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Table: Price Dispersion and Inflation Comovement

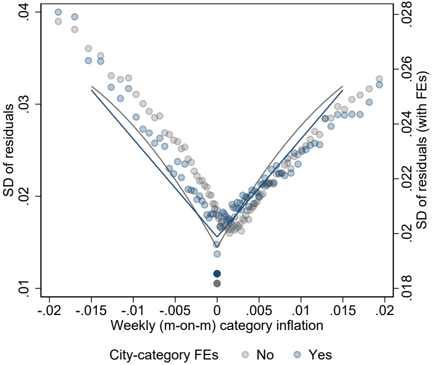
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\|\Delta p_{gct-4}\|$	0.638***	0.353***		0.645***	0.559***	15.088***	40.535***	0.779***		
	(0.00)	(0.00)		(0.01)	(0.01)	(0.27)	(3.24)	(0.01)		
$\|\Delta p_{gct}\|$			0.810***							0.647***
			(0.01)							(0.03)
$\|\Delta p_{vgct-4}\|$									0.808***	
									(0.09)	
Dep. variable	$SD_t^g(u_{irgct})$	$SD_t^g(u_{irgct})$	$SD_t^g(u_{irgct})$	$SD_t^g(u_{irgct})$	$SD_t^g(u_{irgct})$	$\log(SD_t^g(u_{irgct}))$	$\log(SD_t^g(u_{irgct}))$	$SD_t^g(\epsilon_{irgct})$	$SD_t^{vg}(\ln p_{irgct})$	$\Delta SD_t^g(p_{irgct})$
Sector	Both	Both	Both	Supermarkets	Restaurants	Supermarkets	Restaurants	Both	Both	Both
Category FEs	Y	N	Y	Y	Y	Y	Y	Y	Y	N
Category × City FEs	N	Y	N	N	N	N	N	N	N	N
N	257959	255926	270459	197871	60088	199140	59907	261108	14678	143597
R^2	0.28	0.51	0.27	0.25	0.10	0.10	0.07	0.18	0.56	0.04

↪ an increase of annualized inflation from zero to 12.7 percent, increases inefficient price dispersion for restaurants by 40.5% and by 15.1% for supermarkets

Results – inflation dispersion relation does not flatten

Binscatter: average price dispersion for 100 equally sized inflation bins

↪ approximately 215,000 category × city × week combinations, one bin >2,000 observations

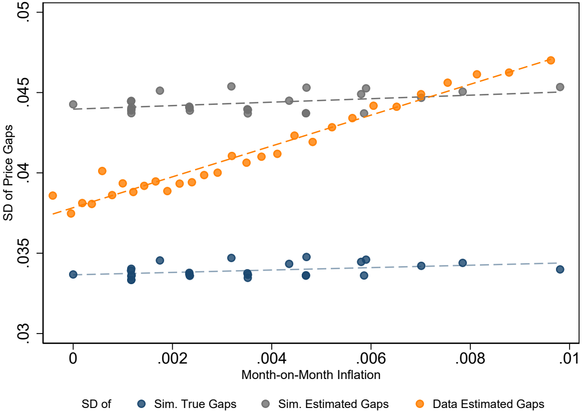


$\text{SD}_t^g(u_{igct})$

→ relation seems to maintain for high inflation

Theory Meets Data

I calibrate a standard NK menu cost model using moments from my data and simulate data



→ Standard menu cost models fail to replicate this strong positive relation

→ The methodology might not get the level right, but it does not distort the slope

Taking stock

Preliminary results:

1. Marginal effect of suboptimal inflation on product-level distortions is positive and significant
2. An increase of annualized inflation from zero to 12.7 percent, increases inefficient price dispersion for restaurants by 40.5% and by 15.1% for supermarkets
3. Relationship between price dispersion and inflation maintains a distinct "V" shape, even at higher levels of inflation
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References I

Adam, K., A. Alexandrov, and H. Weber (2023): *Inflation Distorts Relative Prices: Theory and Evidence*. Centre for Economic Policy Research.

Alvarez, F., M. Beraja, M. Gonzalez-Rozada, and P. A. Neumeyer (2019): "From hyperinflation to stable prices: Argentina's evidence on menu cost models," *The Quarterly Journal of Economics*, 134(1), 451–505.

Nakamura, E., J. Steinsson, P. Sun, and D. Villar (2018): "The elusive costs of inflation: Price dispersion during the US great inflation," *The Quarterly Journal of Economics*, 133(4), 1933–1980.

Sara-Zaror, F. (2021): "Expected inflation and welfare: The role of consumer search," *Available at SSRN 4127502*.

Sheremirov, V. (2020): "Price dispersion and inflation: New facts and theoretical implications," *Journal of Monetary Economics*, 114, 59–70.

Data - descriptive statistics

	Restaurants					Supermarkets				
	Firms	Products	Inflation	Duration	Mean Abs. Adj.	Firms	Products	Inflation	Duration	Mean Abs. Adj.
AM	796	100,599	2.82	24.95	16.70	121	526,982	-1.38	10.09	18.11
CI	1,423	51,118	6.34	15.59	24.66	56	83,183	5.31	4.08	13.34
ES	9,621	770,638	3.90	13.11	12.37	537	397,742	5.53	1.83	9.82
GE	1,865	110,383	6.13	12.28	15.61	372	1,021,904	0.72	6.04	18.31
GH	524	20,313	15.52	11.16	16.74	24	29,388	2.79	3.38	21.91
HR	811	85,975	8.27	12.77	13.73	135	89,833	4.02	2.85	18.59
IT	9,869	881,331	3.37	26.80	16.66	643	289,951	1.74	2.40	13.17
KE	1,122	74,842	6.64	15.42	16.12	244	269,901	8.45	3.54	12.36
KG	753	71,447	8.62	9.97	12.04	97	39,755	2.90	3.49	8.83
KZ	1,598	167,832	7.86	12.24	14.01	128	137,018	0.89	1.97	16.29
MA	1,928	134,765	5.37	13.87	15.39	244	234,239	2.77	1.51	14.46
PL	3,042	254,317	8.44	8.91	12.71	150	216,429	2.60	1.54	14.13
RO	2,717	260,909	10.76	9.07	16.05	295	164,600	3.64	1.39	13.66
SI	448	24,363	5.71	20.03	11.48	49	14,595	1.87	2.18	21.47
UA	4,654	623,494	9.49	9.10	15.17	353	1,933,428	2.77	1.35	15.68
UG	1,257	70,147	11.72	15.12	20.18	211	153,018	2.16	4.98	13.24
All	48,104	3,992,260	7.48	14.40	15.63	3,953	5,791,011	2.90	3.29	15.17

Notes: the following countries are included (same order): Armenia, Côte d'Ivoire, Spain, Georgia, Ghana, Croatia, Italy, Kenya, Kyrgistan, Kazakhstan, Morocco, Poland, Romania, Slowenia, Ukraine and Uganda. Inflation computed transforming average weekly inflation in yearly inflation. Mean absolute adjustment only includes adjusting prices. The duration is estimated by first computing the (weekly) frequency of adjustment in products observed more than four weeks, then taking the unweighted average across products, and finally transforming it to a monthly duration: $(-1/(ln(1-freq)))/4$.

Moments for calibrated model

	Mean Frac. Δp	Median Frac. Δp	Share Adj $\Delta p > 0$	Mean $\lvert\Delta p\rvert$	Median $\lvert\Delta p\rvert$	Mean Δp	std. dev. Δp	Kurtosis Δp	Mean Δp_g	std. dev. Δp_g
AM	0.034	0.031	0.665	0.135	0.109	0.037	0.170	3.503	-0.000	0.018
CI	0.111	0.104	0.623	0.131	0.101	0.033	0.164	3.519	0.003	0.020
ES (Madrid)	0.108	0.102	0.591	0.095	0.072	0.029	0.120	3.564	0.003	0.020
ES (Barcelona)	0.086	0.084	0.639	0.105	0.081	0.033	0.133	3.672	0.003	0.017
GE	0.078	0.067	0.648	0.146	0.113	0.036	0.186	3.487	0.001	0.021
GH	0.128	0.113	0.637	0.182	0.139	0.048	0.233	3.268	0.003	0.027
HR	0.097	0.085	0.721	0.132	0.098	0.047	0.164	3.668	0.003	0.017
IT (Rome)	0.058	0.058	0.630	0.128	0.095	0.034	0.165	3.770	0.001	0.011
IT (Milan)	0.064	0.062	0.642	0.124	0.094	0.039	0.157	3.802	0.001	0.012
KE	0.134	0.122	0.642	0.122	0.098	0.037	0.149	3.358	0.005	0.019
KG	0.112	0.095	0.710	0.085	0.068	0.042	0.104	4.010	0.003	0.015
KZ	0.140	0.129	0.620	0.138	0.102	0.028	0.180	3.560	0.001	0.021
MA	0.140	0.122	0.571	0.149	0.109	0.018	0.199	3.674	0.001	0.022
PL	0.139	0.127	0.690	0.106	0.078	0.034	0.138	4.020	0.002	0.026
RO	0.183	0.195	0.617	0.120	0.089	0.030	0.157	3.650	0.002	0.027
SI	0.085	0.083	0.694	0.155	0.128	0.038	0.191	2.704	0.002	0.026
UA	0.131	0.085	0.725	0.137	0.097	0.039	0.178	3.556	0.003	0.020
UG	0.106	0.100	0.637	0.120	0.085	0.039	0.158	4.696	0.002	0.015
All (mean)	0.107	0.098	0.650	0.128	0.098	0.036	0.164	3.638	0.002	0.020

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Methodology – remove desired price dispersion

Correct for desired price dispersion using FEs (Sheremirov (2020) and Alvarez, Beraja, Gonzalez-Rozada, and Neumeyer (2019)) estimating the equation

$$\ln P_{irgct} = \alpha_g + \delta_{ct} + \gamma_{rct} + \eta_{irgc} + \varepsilon_{irgct} \tag{6}$$

P_{irgct} is the price of product i, sold by restaurant r, classified in category g, in country and week c and t.

FEs capture "desired" price dispersion: η_{irgc} captures that one specific product has a constant higher price (eg because of larger package size), γ_{rct} captures that all products of a given firm increased prices (eg because firm shock), ε_{irgct} unexplained relative price

- ↪ partially criticised because firm idiosyncratic shocks can strongly move desired prices
  - ⋆ arguably not a big issue when using weekly data, short period, and focusing on city-specific price dispersion (no local demand shocks) back