Price setting in Chile:

Micro micro evidence from consumer on-line prices during the social outbreak and Covid-19

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Banca d'Italia and Federal Reserve Board Joint Conference
Nontraditional Data & Statistical Learning with Applications to Macroeconomics

November 12, 2020

Overview

Motivation

- There is a renewed and increasing interest in understanding price setting from a micro perspective $\rightarrow$ implications for monetary policy.
- Micro data provides info on price rigidities, how rigidities evolve over time, etc. $\rightarrow$ welfare implications of price stickiness.
- There are several initiatives to exploit micro data:
  - Billion Prices Project (BPP) $\rightarrow$ led by Cavallo and Rigobon.
  - Price Setting Micro Analysis Network (PRISMA) $\rightarrow$ led by the European Central Bank (ECB) wide coverage: micro data from NSO (time lags), scanner data (expensive) and on-line data obtained through webscraping techniques (cheap, timeliness, coverage concerns though).

Our contribution

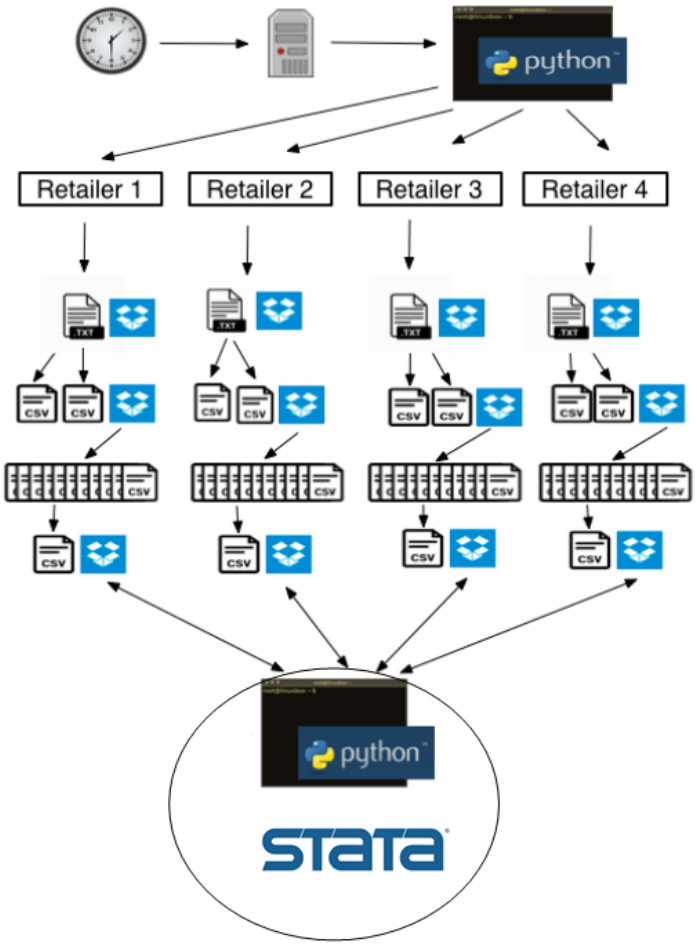
- We use web scraped data for the Chilean economy to characterize the price-setting behavior in supermarkets, pharmacy and car sales.
- We compile a dataset from the largest Chilean retailers from July 2019 till September 2020, with ongoing up-dates $\rightarrow$ daily frequency.
- Short time span (440 days for the moment) but covers two major events: Social Outbreak (Oct-2019) and Covid-19 (March-2020).
- Product coverage up to 21% of the CPI basket.
- This is an update of other works studying price setting in Chile:
  - Data underlying official price indexes (INE) $\rightarrow$ Medina et al. (2007) and Canales and López (2020).
  - Scanner data from Nielsen $\rightarrow$ Chaumont et al. (2010) $\rightarrow$ 7.23% of CPI basket.
  - Online prices $\rightarrow$ **This project!**
- **First goal:** obtain main stylized facts for Chile.

Price Project Central Bank of Chile

- By June 2019 the "Online CPI Project" was initiated by Central Bank of Chile, with objective of collecting prices posted online by main retailers in Chile.
- **To select which products to track, the following criteria must be met:** (1) the product should be from a retailer with a high market share and (2) this retailer should exploit different channels to sell their products (multi-channel).
- **Coverage:** 2 fast-moving consumer good retailers, 1 pharma, and car dealers.
- **Web scrapping:** We have collected information through web scraping techniques conducted in Python using Selenium, Beautiful Soup as well as auxiliary libraries to fetch and process data.
- **Frequency:** Daily

Methodology

STEP1: Schematic process of obtaining data



The dataset

The database compiles information on on-line prices for approx. 4,750 product varieties, divided into 47 products, 5 divisions that account for 21.1% of the Chilean CPI basket:

Div	Name	CPI Weight	WS Coverage
1	Food and Beverages	19.30	12.1
2	Alcoholic Beverages and Tobacco	4.77	2.88
5	Household maintenance appliances	6.52	0.87
6	Health	7.76	2.43
7	Transport	13.12	2.86
TOTAL		69.8	21.1
products		166	47

The dataset II

The ✓ indicates the data we have treated, in ✓ pending to be included in the dataset and analysis.

Table: Data coverage

Division	R1	R2	R3	R4	R5
1. Food and Beverages	✓	✓			
2. Alcoholic Beverages	✓	✓			
3. Clothing and footwear				✓	
5. Household maintenance appliances	✓				
6. Health			✓		
7. Transport	✓				✓
The start of collecting online data	Jul/19	Dec/19	Nov/19	Dec/19	Dec/19

Methodology

The analysis focuses on two dimensions that are usually found in studies of this nature:

1. Measures of price rigidities
   - Frequency
   - Duration
2. The size of price changes

Data processing requires some cleaning and filtering, so we work with several samples:

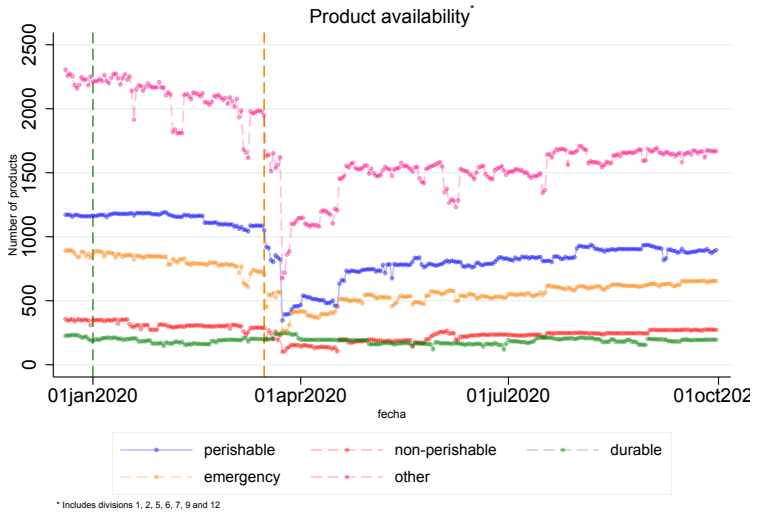
- Raw data.
- Filters to account for sales and promotions: Bils and Klenow (2004) and Nakamura-Steinsson (2008)

▸ CPI

Product availability

We observe a sharp decline after March 18 $\rightarrow$ In line with the evidence on natural disasters (Cavallo et al, 2014) availability after 2010 earthquake fell by 32%.

This figure plots the evolution of the number of varieties offered on-line by all divisions and retailers.

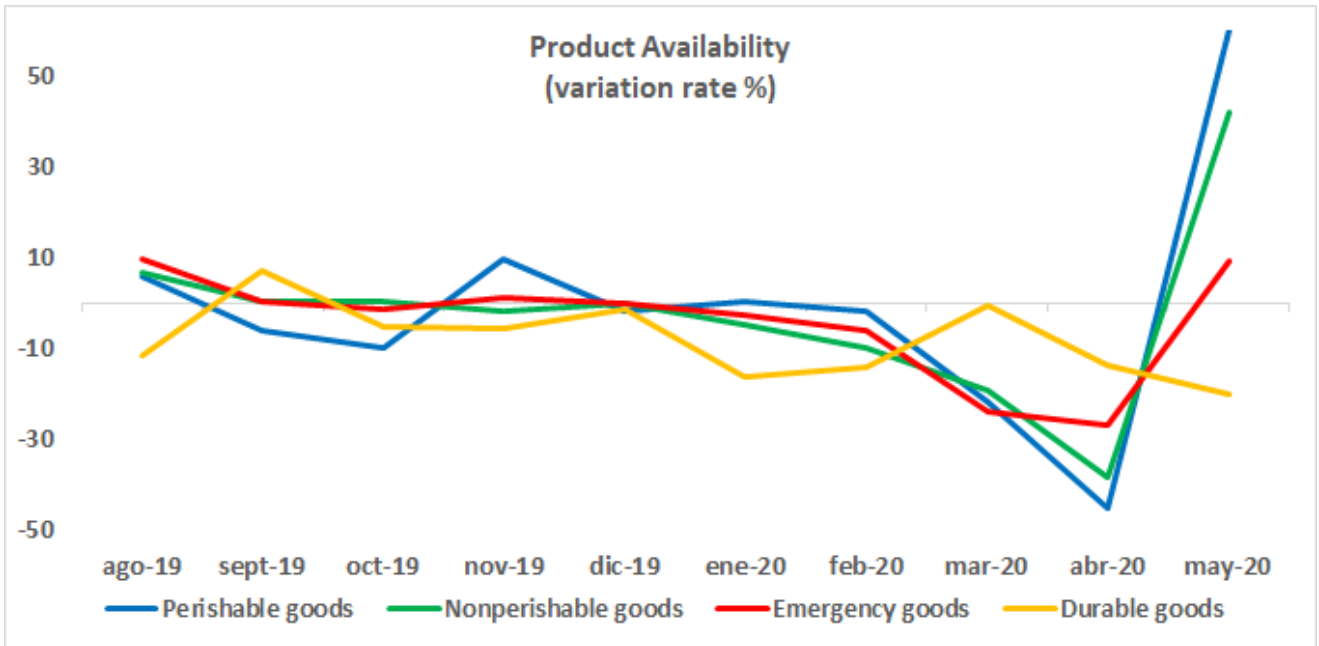


This figure plots the evolution of the number of product-varieties offered on-line by type of product.

Data source: ▸ Price Project Central Bank of Chile

Product availability II

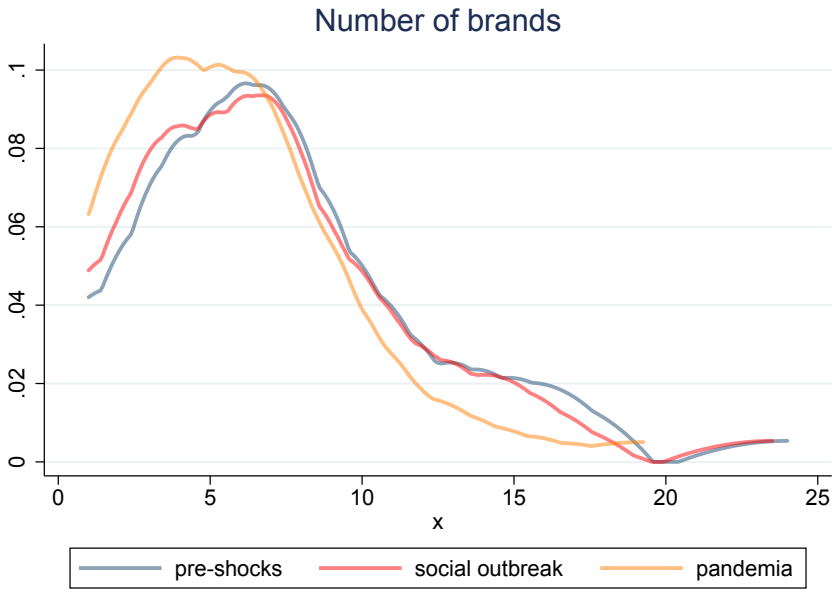
Goods that disappear quickly from the stores are mostly perishable and nonperishable items that people are likely to hoard in fear of future supply disruptions → A focus essential goods



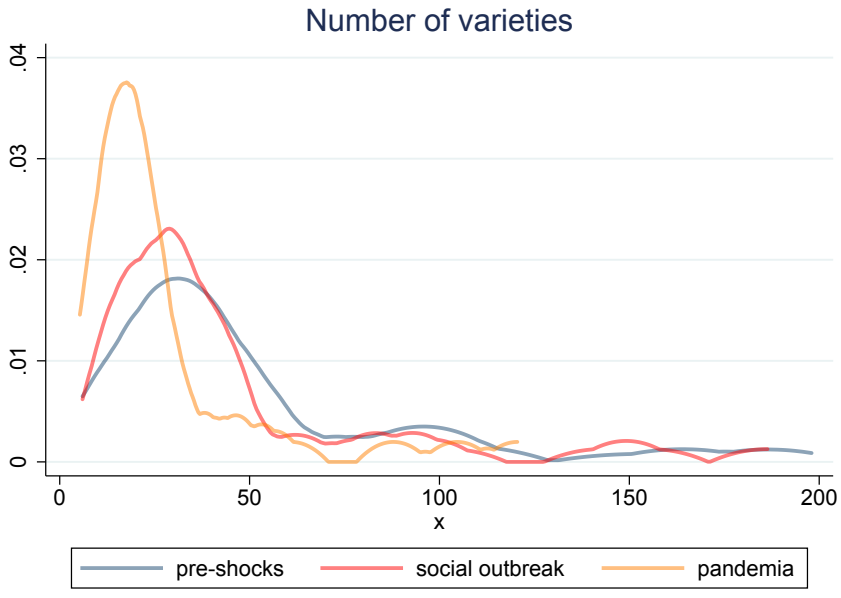
Note: **Perishable goods:** eggs, meat, milk, cheese, bread, juice and yogurt.**Emergency goods:** pasta, water, rice and flour **Nonperishable goods:** such as powdered milk, mashed potatoes,sodas,... **Durable goods:** beds, washing machine, refrigerators, stoves, water heaters, clothes iron, tv

Data source: ▸ Price Project Central Bank of Chile

Product availability III



The number of brands available for each division group did not change dramatically



But each brand supplied less varieties. There is anecdotal evidence on cutting fringe offerings ▸ Oreo

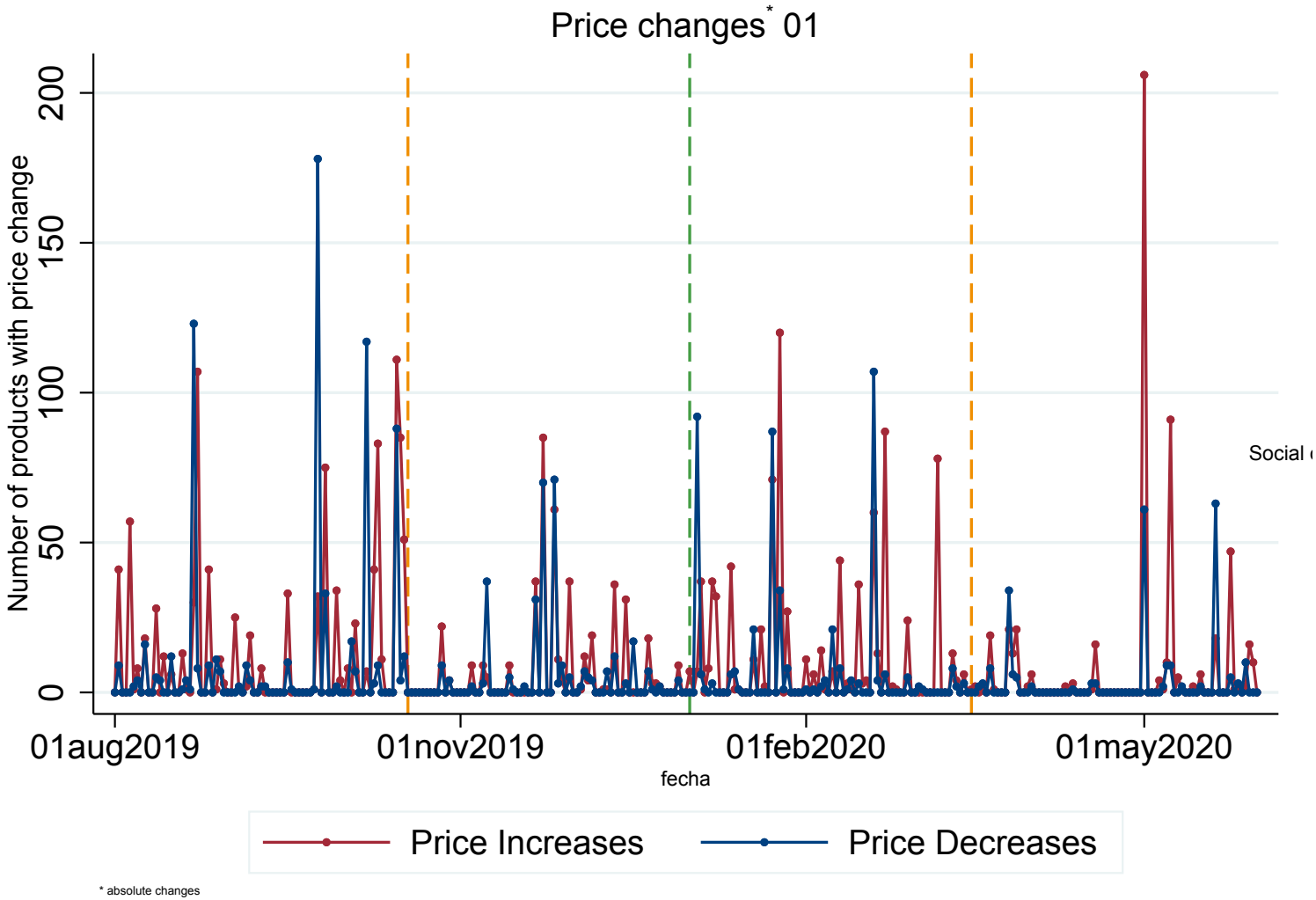
Price changes statistics

Extensive margin: fraction of firms/products changing prices.
Intensive margin: size of the adjustment.

	1 Food and Beverages	**2** Alcoholic Beverages	**5** Furnishing	**6** Health	**7** Transport	**9** TVs	**12** Miscellanous
mean life (days)	341.4	318.7	351.8	281.2	238.5	271.1	267.2
pct. changes	1.1	1.0	2.2	0.4	2.2	2.5	1.0
pct. increases	67.6	58.7	57.2	81.0	82.7	60.7	58.5
avg price increase	18.5	19.2	15.0	20.2	2.2	13.7	51.0
pct. decreases	32.4	41.3	42.8	19.0	17.3	39.3	41.5
avg price decrease	-15.4	-16.4	-11.8	-28.1	-2.8	-8.8	-16.8
Observations	935,464	361,802	106,043	79,254	1,952	9,599	113,695

Price changes: [Div 01] Food and beverages

Before the March 18, food and non-alcoholic beverages group showed the highest frequency of price variation.



Frequency of price changes

Table: Summary Statistics

	1. Food and Beverages 12.2% (19.5%)					
	raw		**NS**		**KM**	
	Mean	Median	Mean	Median	Mean	Median
Daily frequency	1.8	1.6	1.3 ⇓	1.2	1.2 ⇓	1.1
Monthly frequency	40.6	37.6	30.8 ⇓	30.2	29.5 ⇓	28.6
Implied duration (days)	67.5	63.7	90.8 ⇑	83.5	95.6 ⇑	89.2
Implied duration (months)	2.3	2.1	3.0 ⇑	2.8	3.2 ⇑	3.0

Note: Price series are filtered with NS Nakamura and Steinsson (2008) procedure and KM Kehoe and Midrigan (2015) to take away temporary sales and other promotions. Coverage by each division and in parenthesis the official weight.

Source: Own calculations.

Frequency of price changes

	full sample	pre-shocks	outbreak	pandemia	uplift
	1. Food and Beverages 12.2% (19.5%)				
Daily frequency	1.3	1.3	1.2 ⇓	1.1 ⇓	1.4 ⇑
Monthly frequency	30.8	32.5	30.3 ⇓	28.3 ⇓	32.1 ⇑
Implied duration (days)	90.8	82.7	89.5 ⇑	102.8 ⇑	88.1 ⇓
Implied duration (months)	3.0	2.8	3.0 ⇑	3.4 ⇑	2.9 ⇓

Note: Calculations based on series filtered using Nakamura and Steinson (2008) methodology.

Source: Own calculations.

Frequency of price changes

	full sample	pre-shocks	outbreak	pandemia	uplift
	1. Food and Beverages 12.2% (19.5%)				
Daily frequency	1.3	1.3	1.2 ⇓	1.1 ⇓	1.4 ⇑
Monthly frequency	30.8	32.5	30.3 ⇓	28.3 ⇓	32.1 ⇑
Implied duration (days)	90.8	82.7	89.5 ⇑	102.8 ⇑	88.1 ⇓
Implied duration (months)	3.0	2.8	3.0 ⇑	3.4 ⇑	2.9 ⇓
	2. Alcoholic Beverages 2.8% (4.8%)				
Daily frequency	1.4	1.9	1.2 ⇓	1.1 ⇓	1.4 ⇑
Monthly frequency	32.8	41.4	28.6 ⇓	27.3 ⇓	33.8 ⇑
Implied duration (days)	183.0	75.8	99.0 ⇑	106.6 ⇑	450.4 ⇑
Implied duration (months)	6.1	2.5	3.3 ⇑	3.6 ⇑	15.0 ⇑
	5. Furnishing 0.8% (6.5%)				
Daily frequency	2.3	3.3	2.3	1.3	2.4
Monthly frequency	49.2	59.2	48.1	34.1	53.7
Implied duration (days)	60.4	38.6	49.7	100.5	58.5
Implied duration (months)	2.0	1.3	1.7	3.3	1.9

Note: Calculations based on series filtered using Nakamura and Steinson (2008) methodology.

Source: Own calculations.

Frequency of price changes

	full sample	outbreak	pandemia	uplift
	6. Health			
Daily frequency	0.3	0.5	0.2 ⇓	0.2 ⟺
Monthly frequency	11.5	18.7	6.9 ⇓	9.0 ⇑
Implied duration (days)	396.5	161.7	488.6 ⇑	587.4 ⇑
Implied duration (months)	13.2	5.4	16.3 ⇑	19.6 ⇑
	7. Transport			
Daily frequency	2.5	3.5	2.1	1.7
Monthly frequency	50.8	65.4	47.1	40.1
Implied duration (days)	44.7	28.3	47.2	58.6
Implied duration (months)	1.5	0.9	1.6	2.0
	9. Recreation and Culture			
Daily frequency	2.8	2.4	1.8	4.1
Monthly frequency	54.8	51.5	42.4	70.5
Implied duration (days)	40.1	41.4	54.3	24.6
Implied duration (months)	1.3	1.4	1.8	0.8
	12.Miscellaneous			
Daily frequency	1.5	1.5	1.2	1.7
Monthly frequency	34.8	34.9	30.3	39.3
Implied duration (days)	85.8	79.7	112.5	65.1
Implied duration (months)	2.9	2.7	3.8	2.2

Note: Calculations based on series filtered using Nakamura and Steinson (2008) methodology.

Source: Own calculations

Frequency of price changes and duration

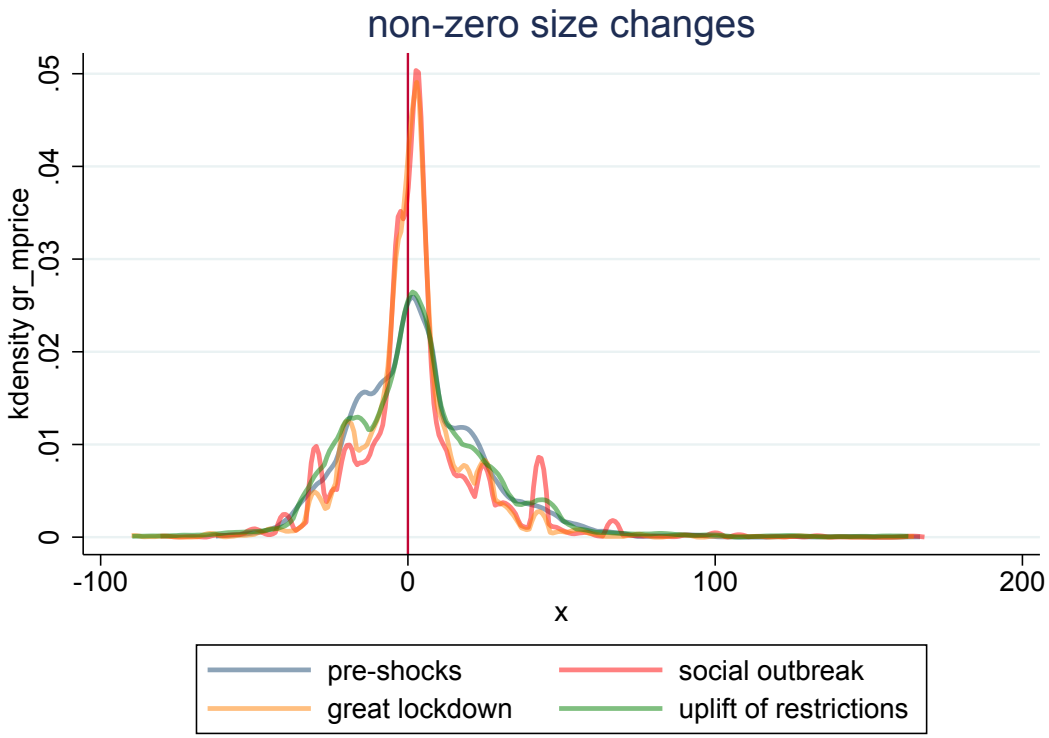
Our micro level estimations indicate that prices are relatively more flexible than in other countries → These results provide some evidence in favor of greater price flexibility in developing countries in relation to that observed in developed countries

Country	Period	Changing prices (%)*	Freq	Data	Reference
Chile	10/07-10/08	18.1	Daily	Online	Cavallo (2010)
	2007-2009	36.48	Weekly	Scanner	Chaumont (2010)
	1999-2005	44-49	Monthly	NSO	Medina et al (2007)
	2010-2018	29.92	Monthly	NSO	Canales and López (2020)
UK	1996-2006	19.0	Monthly	ONS	Bunn and Ellis (2011)
Brazil	10/07-12/08	43.7	Daily	Online	Cavallo (2010)
USA	1998-2005	21.1	Monthly	Nielsen	Nakamura (2008)
Mexico	1995-1997	32.5	Monthly	Banxico	Gagnon (2007)
	2000-2002	24.9			
	2003-2004	22.6			
Spain	1993-2001	15.0	Monthly	ONS	Álvarez and Hernando (2006)
Austria	1996-2003	13.0	Monthly	ONS	Baumgartner et al. (2005)
Belgium	1989-2001	17.0	Monthly	ONS	Aucremanne and Dhyne (2004)

*Note: We report the monthly frequency so as to make them comparable.

Size of price changes

Price change distributions show a high degree of concentration around values close to 0 $\rightarrow$ most price changes get smaller during the shocks.



Data source: ▸ Price Project Central Bank of Chile ▸ Filtered series

Main results and the way ahead

- Both shocks, social outbreak and pandemia, have changed the price setting behaviour of retailers (as expected). In both circumstances prices did not adjust as frequently as before.
- The supply of on-line products dramatically declined as the state of alarm was announced and selected quarantines imposed. Demand or supply conditions?
- Retailers seem to take a "wait and see" approach in terms of price changes (fear of "customer anger"?), and supply is recovering slowly.
- The average frequency of price changes is on average 32.6% within a month $\rightarrow$ more rigid than previous studies in Chile, the decline possibly driven by last events.
- There is heterogeneity in the frequency of price adjustment according to the different main CPI groups and more skewed towards smaller price adjustment.
- To the extent that mobility restrictions have been lifted, some products recovered their previous pricing pattern.
- Our micro level estimations indicate that prices are relatively more flexible that other countries $\rightarrow$ These results provide some evidence in favor of greater price flexibility in developing countries in relation to that observed in developed countries.

Main results and the way ahead

- What happens with price setting during a big shock? If prices are more sticky (they do not adjust), what are the implications in terms of welfare and efficiency? Policy implications?

Demand Are products missing due to a spike in demand by consumers?

Supply The products that are missing are those that need more social interaction to be produced? less automatized?

- **The way ahead** $\rightarrow$ (1) Increase the coverage: include the data we have from the other retailers/divisions and keep updating the dataset (2) compute additional statistics: price dispersion, synchronization,...

Thanks!

References

Aucremanne, L. y Dhyne, E. (2004) "How frequently do prices change? Evidence based on the micro data underlying the Belgian CPI," *Working Paper Series No. 331 / April 2004, European Central Bank.*

Álvarez,L, Burriel, P. and Hernando, I (2005) "Price setting behaviour in Spain: Evidence from micro PPI data " *Working paper series 522*

Cavallo, A., Gopinath, G., Neiman, B and J. Tang (2019) "Tariff Passthrough at the Border and at the Store: Evidence from US Trade Policy" *WP Harvard Business School* 20-041.

Cavallo, A., Cavallo, E and Rigobon, R (2013) "Prices and supply disruptions during natural disasters" *NBER Working paper series*

Chaumont,G. Fuentes, M., Labbé, F and Naudon, A . (2011) "Dinámica de precios en Chile: evidencia con datos de supemercado " *WP Central Bank of Chile 642 (2004)*

Bils, M. and Klenow, P. (2004) "Some Evidence on the Importance of Sticky Prices" *Journal of Political Economy, 112 (2004), 947–985*

Baumgartner, J., Glatzer, E., Rumler, F. y Stiglbauer, A. (2005). "How Frecuently do Consumer Prices Change in Austria? Evidence from Micro CPI Data" *WP Series No. 523 / September 2005, European Central Bank*

Bunn, P. and C. Ellis (2012) "Examining the behaviour of individual UK consumer prices" *The Economic Journal* 122(558).

Gagnon, E (2007) "Price Setting during Low and High Inflation: Evidence from Mexico" *International Finance Discussion Papers No. 896. Board of Governors of the Federal Reserve System.*

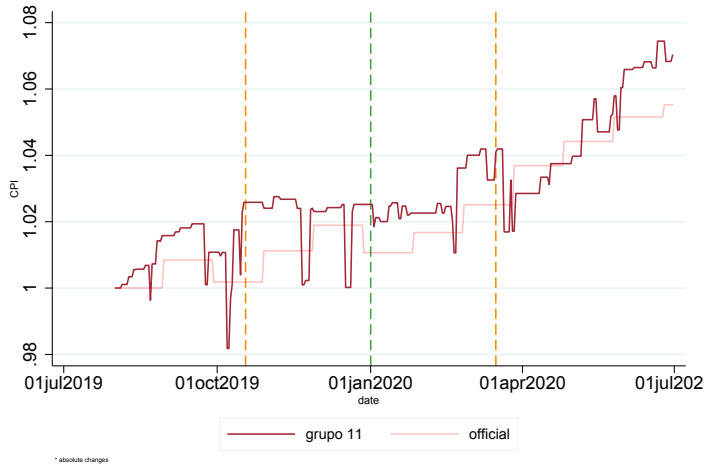
Medina, J.P., D. Rappoport and C. Soto (2007) "Dynamics of price adjustments: evidence from micro level data from Chile" *WP Central Bank of Chile* 432.

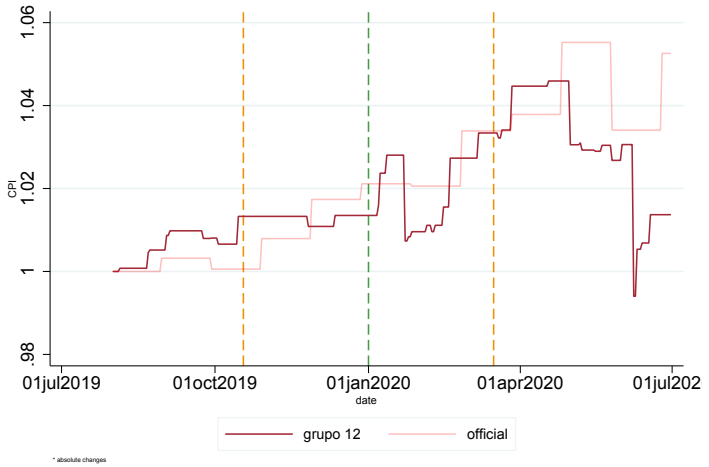
Nakamura, E. and Steinsson, J. (2008) "Five Facts about Prices: A Reevaluation of Menu Cost Models." *The Quarterly Journal of Economics, 123(4), pp. 1415-1464.*

coicop1	n.a	perishable	emergency	durable	service	energy	Total
01.- Food and beverages (n=76)	12.6	6.0	0.7	0.0	0.0	0.0	19.3
02.- Alcoholic beverages (n=8)	4.8	0.0	0.0	0.0	0.0	0.0	4.8
03.- Clothing and footwear (n=28)	3.4	0.0	0.0	0.0	0.1	0.0	3.5
04.- Housing (n=16)	7.7	0.0	0.0	0.0	7.1	0.0	14.8
05.- Furnishing and housing (n=36)	1.5	0.0	0.0	2.3	0.0	2.6	6.5
06.- Health (n=22)	7.8	0.0	0.0	0.0	0.0	0.0	7.8
07.- Transport (n=24)	10.3	0.0	0.0	2.9	0.0	0.0	13.1
08.- Communications (n=6)	5.5	0.0	0.0	0.0	0.0	0.0	5.5
09.- Recreation and culture (n=37)	6.6	0.0	0.0	0.0	0.0	0.0	6.6
10.- Education (n=11)	6.6	0.0	0.0	0.0	0.0	0.0	6.6
11.- Restaurants and hotels (n=7)	6.4	0.0	0.0	0.0	0.0	0.0	6.4
12.- Miscellaneous (n=32)	5.2	0.0	0.0	0.0	0.0	0.0	5.2
Total (n=303)	78.3	6.0	0.7	5.1	7.2	2.6	100.0

CPI

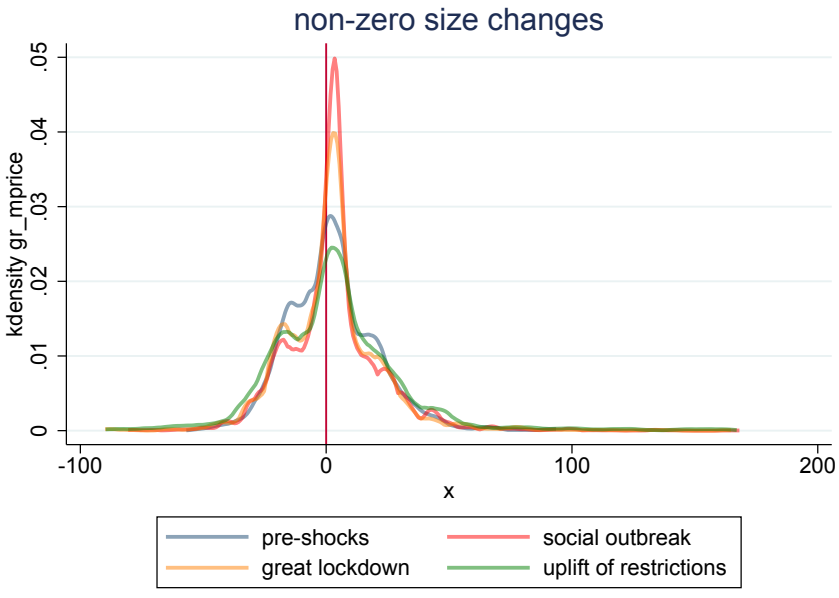
Good fit for some division-groups...



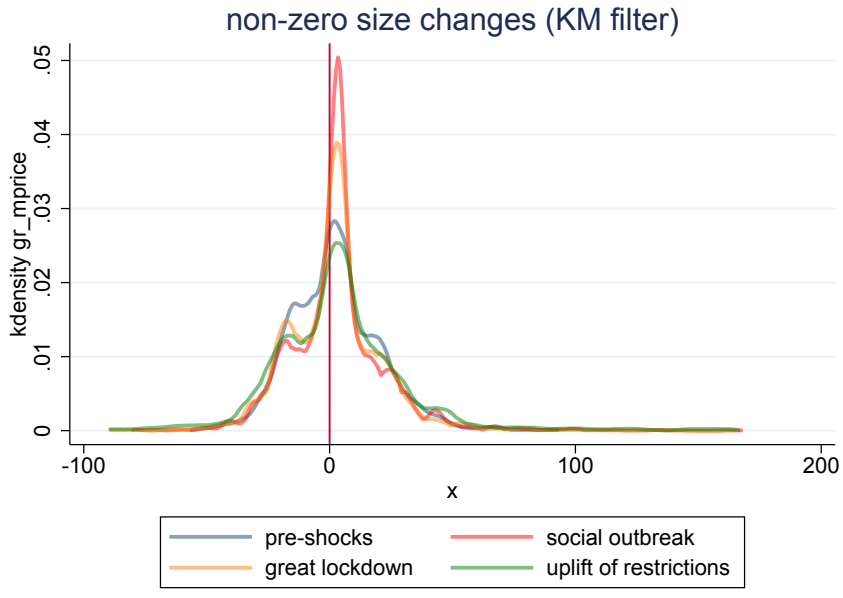


BACK

Size of price changes



Price series filtered with Nakamura Steinsson 2008 methodology to account for sales.



Price series filtered with Kehoe and Midrigan methodology to account for sales and other promotions.

BACK