Retail Price Discounts and the Post-Pandemic Inflation Surge: Evidence from Online Micro Data*

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1 Proposal

The historic surge in inflation in the aftermath of the COVID-19 pandemic represented a major challenge for mainstream monetary policy models.[1] Because these models incorporate significant nominal and real price rigidities, they imply low and stable inflation and thereby unable to account for sudden, large, persistent and broad-based rise in inflation. Recent empirical studies relate post-pandemic inflation surge to the increased number and size of product-level price changes.[2] Such evidence is consistent with models in which firms can accelerate the pace of their price adjustments in response to rapidly changing economic conditions (Cavallo, Lippi, and Miyahara, 2023; Blanco et al., 2023). An alternative—ignored in standard models—is that firms can decrease the proportion of their low-price products and/or manage to sell a higher proportion of high-price products. The degree to which these mechanisms contribute to recent inflation dynamics remains an open question. We address it in this paper by studying the behaviour of retail "sales"—temporary price discounts and special promotions—before, during and after the pandemic.

Sales are large temporary price reductions used pervasively in goods markets. They contribute

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[1] Among the G7 countries, peak year-over-year CPI inflation in 2021–2023 reached 9.1% in the United States, 6.3% in France, 8.8% in Germany, 11.8% in Italy, 4.3% in Japan, 11.1% in the United Kingdom and 8.1% in Canada. Kryvtsov, MacGee, and Uzeda (2023) review the debate over the causes of the 2021–22 rise in inflation.

[2] Montag and Villar (2022); Karadi et al. (2023) present evidence for the United States, Karadi et al. (2023) for the euro area, Davies (2021) for the United Kingdom, Balleer et al. (2020) for Germany, Rudolf and Seiler (2022) for Switzerland, Beer et al. (2023) for Austria, Jiang et al. (2022) for China.

to inflation primarily via two effects. Since products on sale have much lower prices than regularly priced products, the degree to which retailers vary the number of price discounts influences measured inflation (*the price effect*). Because consumers actively look for lower prices—either across products in the same store or across stores—the resulting variation in expenditures between discounted and regularly priced products contributes to "effective" inflation, not generally measured by official statistics (*the weight effect*). We intent to demonstrate that retailers' adjustments of sales made a significant impact on inflation during this time, via both price and weight effects.

We use detailed micro data for product prices collected every day from the websites of 58 large retailers in 7 countries—the United States, France, Germany, Italy, Spain, Netherlands, and the United Kingdom—from January 1, 2019 to August 2, 2023. All retailers are large "multi-channel" firms selling both online and in brick-and-mortar stores. We focus on food and beverage products, the largest component of goods consumption, roughly one third. In total, the dataset contains 12.2 price observations for 1.4 million products, providing us with rich time and cross-section price variation for studying the role of price discounts in post-pandemic inflation surge.

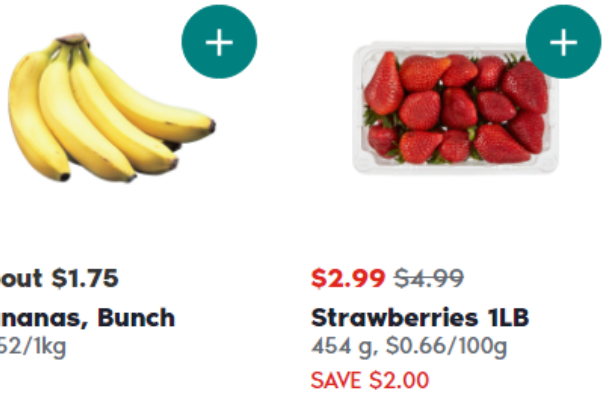


Figure 1: Example of a sale flag on a retailer's website.

Price discounts are identified by retailers' sale flags or by applying ad-hoc filters to price data. Sale flags are based on discount advertisements posted by retailers alongside product's price (Figure 1). Alternatively, we apply a V-shaped sales filter that identifies a price decrease of 10% followed by price increase within 90 days.[3] Table 1 summarizes the share and magnitude

[3]For the discussion of sale filters, see, for example, Nakamura and Steinsson (2008).

of price changes for sales in the dataset.

	Apr 2019–Jun 2021		Jul 2021–May 2023	
	Share	Size, %	Share	Size, %
FRANCE	0.12	27.8	0.10	26.9
GERMANY	0.32	33.8	0.28	32.4
ITALY	0.31	33.9	0.27	30.8
NETHERLANDS	0.22	31.3	0.15	30.1
SPAIN	0.16	23.9	0.13	22.9
UK	0.28	33.7	0.22	30.2
USA	0.26	32.7	0.23	42.9
All (pooled)	0.24	31.0	0.20	30.9

Table 1: Summary of discounted price changes.

Notes: The table summarizes the share and size of price changes due to sales in the dataset. Columns "Share" and "Size" provide the average share and average absolute size of initial price changes for products on sale. Sale is identified by a V-shaped filter where an initial price decrease is at least 10% and it is followed by a price increase within 90 days. Statistics are reported for two sub-periods: April 1, 2019 to June 30, 2021 and Jiuly 1, 2021 to May 2, 2023. "All (pooled)" row provides statistics for price changes pooled across all products in the dataset.

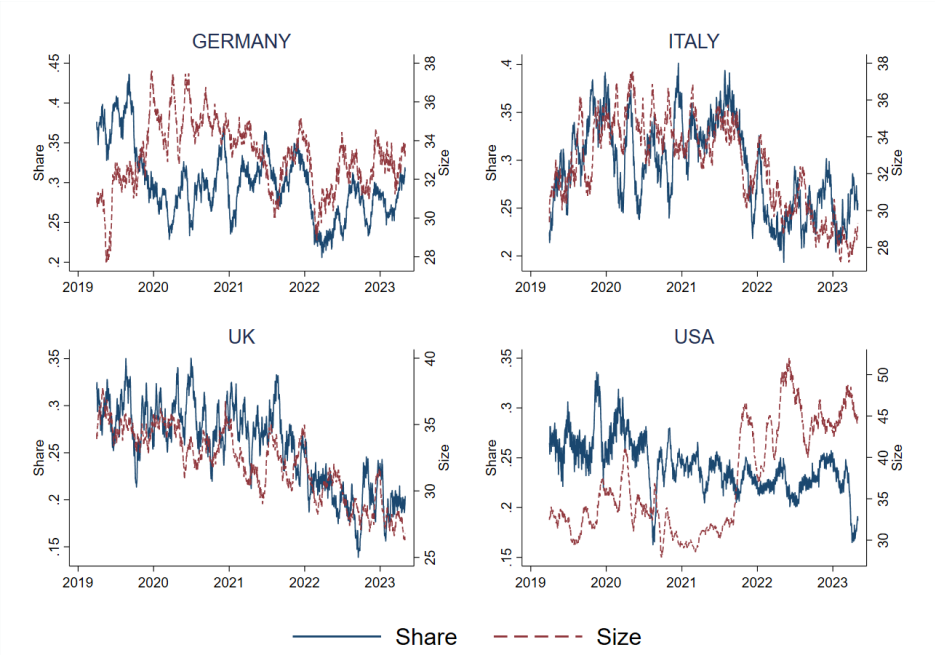


Figure 2: Share and size of price discounts.

Notes: This figure provides the time series for the share and size of price changes due to sales from April 1, 2019 to May 2, 2023. "Share" and "Size" are the average share and average absolute size (in %) of initial price changes for products on sale. Sale is identified by a V-shaped filter where an initial price decrease is at least 10% and it is followed by a price increase within 90 days.

We split the sample in two sub-periods: before/early in the pandemic (2019–mid-2021) and during/after the pandemic (mid-2021–2023) when inflation surge occurred. The share of price

changes due to sales decreased in all 7 countries. Across all observations, the average share decreased from 0.24 to 0.20 between two sub-periods. The magnitude of discounts also decreased in all countries, except the United States, where discounts increased from 32.7% to 42.9%.

Figure 2 visualizes the share and size of price changes that are associated with price discounts for four selected countries. While there are differences in the dynamics of discounts across countries, the tendency is the diminished use of discounts after mid-2021, around the time inflation started to surge. To give a sense of the direct impact on measured inflation, assume that retailers permanently decrease discounts from 0.24 to 0.20 (as the share of price changes), and that discounts are 30% on average. If after a year 90% of prices have changed, the resulting impact on inflation is 1.1 percentage points (i.e., (0.24–0.20)*30%*0.9). This back-of-the-envelope calculation suggests the price effect of discounts on inflation may have been significant.

In the subsequent analysis, we will implement decompositions of observed inflation rates into components stemming from regular and sale-related price changes. We will document the degree to which sales contribute to the dynamics of measured inflation for food and beverages. Variations across 7 countries and across 19 3-digit sub-sectors of the food and beverages sector will support the cross-sectional dimension of the analysis.

We are also expanding this dataset along two additional dimensions. First, we add micro price data for a large retailer that sells exclusively online. This enables us to analyze differences in sales behaviour between online and brick-and-mortar stores.[4] This comparison is particularly relevant for this period as many households switched their goods consumption from brick-and-mortar to online stores in the wake of the pandemic-induced lockdowns (Jaravel and O'Connell, 2020). Second, we are adding data on product availability and stockouts from Cavallo and Kryvtsov (2023). They show that the increased incidence of product shortages during the pandemic was associated with inflation, especially for imported products which were exposed to global supply disruptions. These data help us further elucidate the determinants of changes in retailers' prices and discounts.

In the second part of the paper, we assess the contribution of sales to effective inflation via the weight effect. Previous studies demonstrated that retail discounts influence effective prices and consumption by reallocating consumer spending over the business cycle. Coibion,

[4]Differences in behaviours of online and offline prices are discussed, in particular, in Cavallo (2017) and Gorodnichenko, Sheremirov, and Talavera (2018).

Gorodnichenko, and Hong (2015) show that in recessions households switch their spending from high- to low-price stores. Kryvtsov and Vincent (2020) argue that higher store discounts during recessions shift household expenditures to lower priced goods. We will use models from Coibion, Gorodnichenko, and Hong (2015) and Kryvtsov and Vincent (2020) to quantify the contribution of the wealth effect of sales on the effective inflation during 2020–2023. To the extent such consumption shifts were not captured by official statistics, measured inflation rates may have been *underestimated*!

Model analysis will inform the discussions of two open questions about the determinants of post-pandemic inflation. First, the pandemic has caused a sudden and dramatic change in how households' allocate their consumption spending (Cavallo, 2020; Diewert and Fox, 2020; Jaravel and O'Connell, 2020) and how they allocate their time between work and leisure due to working-from-home (Barrero, Bloom, and Davis, 2023). Because in both Coibion, Gorodnichenko, and Hong's and Kryvtsov and Vincent's models households can reduce their consumption prices by increasing their shopping time, the pandemic-induced shifts in consumption and time may have helped households attenuate the burden of rising prices. Second, the literature has been debating the roles of demand and supply disturbances in shaping the inflation surge (Balleer et al., 2020; Shapiro, 2022). In Kryvtsov and Vincent's model, both the expansionary demand shock and a contractionary supply shock raise inflation and lower price discounts. But the expansionary demand shock is associated with higher economic activity and the contractionary supply shock dampens economic activity. We therefore can use mutual covariation in consumption, hours worked and discounts in the calibrated model to gauge contributions of demand and supply shocks to fluctuations in the data.

Overall, this paper will contribute to the literature on inflation dynamics during and after the COVID-19 pandemic. The disruptions during the pandemic influenced where and how households search for bargains and incentivized retailers to look for ways to quickly raise their prices in the face of rising inflationary pressures. Therefore, sales behaviour is one of the key puzzle pieces to understanding the inflation surge and distilling appropriate policy responses.

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