Journal of Public Economics 248 (2025) 105416

Contents lists available at ScienceDirect

Journal of Public Economics

journal homepage: www.elsevier.com/locate/pubec

# The full, persistent, and symmetric pass-through of a temporary VAT cut☆

Tiago Bernardino[a], Ricardo Duque Gabriel[b,*], João Quelhas[c], Márcia Silva-Pereira[d,e]

[a] IIES, Stockholm University, Stockholm, Sweden
[b] Federal Reserve Board, Washington, DC, USA
[c] Stockholm University, Stockholm, Sweden
[d] Banco de Portugal, Lisbon, Portugal
[e] Nova SBE, Carcavelos, Portugal

## HIGHLIGHTS

- The VAT cut was fully passed through to consumer prices on impact.
- Prices stayed low for the full policy duration, showing persistent pass-through.
- Prices rose symmetrically when the VAT was reinstated, indicating full reversal.
- High consumer salience and falling producer prices likely drove full pass-through.
- The policy cut headline inflation by 0.68 percentage points in the short run.

## ARTICLE INFO

*JEL classification:*
E31
H20
H22

*Keywords:*
Value-added tax
Pass-through
Microdata
Public policy
Inflation

## ABSTRACT

We investigate the pass-through of a temporary value-added tax (VAT) cut on selected food products to consumer prices in Portugal. Exploiting a novel data set of daily online prices, we find that the VAT cut was fully transmitted to consumer prices, persisted throughout the policy duration, and prices returned to the pre-implementation trend after reversal. We discuss two potential mechanisms driving this result: the policy's salience to consumers in a high-inflation environment and the decline in producer prices when implemented. We estimate that the policy reduced the inflation rate by 0.68 percentage points on impact.

☆ We thank the editor, Antoine Bozio, two anonymous referees, Youssef Benzarti, Daniel Dias, Mitch Downey, Rita de la Feria, Erwan Gautier, Andrew Goodman-Bacon, Jarkko Harju, Camille Landais, Kieran Larkin, Jens Oehlen, Elvira Prades, Stephan Schneider, David Schönholzer, David Seim, Jeffrey Wooldridge, and participants at the 17th PEJ Annual Meeting, the 12th LuBraMacro Meeting, the 8th Swedish Conference in Economics, the 3rd "Portuguese Around the World: Central Banking Edition" Conference, and seminars at Banco de Portugal, ECB, FED Board, GEE/GPEARI, IIES, ISEG, Nova SBE, U. Minho, U. Porto for valuable comments and discussions. We thank Banco de Portugal's Microdata Research Laboratory for their data support. T. Bernardino acknowledges financial support from the Jan Wallanders & Tom Hedelius Foundation (H21-0020). M. Silva-Pereira acknowledges financial support from Fundação para a Ciência e a Tecnologia (2021.04898.BD). João Quelhas was affiliated with Banco de Portugal during most of the project. The views expressed herein are those of the authors and should not be attributed to any of the affiliated institutions. A working paper version was previously circulated with the title "A Temporary VAT Cut in Three Acts: Announcement, Implementation, and Reversal".

* Corresponding author.
*Email addresses:* tiago.bernardino@iies.su.se (T. Bernardino), ricardo.f.duquegabriel@frb.gov (R.D. Gabriel), joao.quelhas@su.se (J. Quelhas), marcia.pereira@novasbe.pt (M. Silva-Pereira).

https://doi.org/10.1016/j.jpubeco.2025.105416
Received 11 November 2024; Received in revised form 13 May 2025; Accepted 19 May 2025
Available online 10 June 2025
0047-2727/Published by Elsevier B.V.

## 1. Introduction

Between 2020 and 2023, at least 21 countries enacted temporary value-added tax (VAT) reductions on food products to mitigate the adverse effects of rising living costs (Asquith, 2024). However, the effectiveness of these measures has sparked controversy among economists and policymakers.

The canonical tax incidence model states that the economic burden of consumption taxes depends on the relative elasticities of supply and demand (Harberger, 1962). This implies that the pass-through of a VAT change can range from 0 % to more than 100 % (Benzarti, 2024). In most theoretical pricing models (e.g., constant markups), consumers are expected to bear the full burden of the tax since it does not change optimal pricing by firms, implying that VAT changes should be fully passed through to consumer prices. However, recent empirical literature on consumption tax incidence has found that VAT cuts are often not fully transmitted to consumer prices (Kosonen, 2015; Fuest et al., 2024), their effects dissipate quickly (Crossley et al., 2014), and prices often rise to higher levels than before the reduction upon reversal (Benzarti et al., 2020). This seems to be regardless of whether the cut is temporary (Amores et al., 2023; Fuest et al., 2024; Forteza et al., 2024) or permanent (Benzarti et al., 2024), although pass-through estimates are higher in the first case.

In this paper, we estimate the pass-through of a temporary VAT cut to consumer prices, using a novel data set of daily online retail prices in Portugal. The policy affected 46 food products that had a tax cut from 6 % to 0 % between April 18, 2023, and January 4, 2024. We find a pass-through of 100 % on impact, which persists for most of the policy duration and is symmetric upon reversal, suggesting that a temporary VAT cut can achieve a full, persistent, and symmetric pass-through to consumer prices in the context of supermarkets. These results appear to be consistent with the standard tax incidence models about VAT pass-through. However, we argue that the policy context, in particular the salience of the policy implementation, has played a major role in achieving such results.

We exploit a novel data set of daily online prices covering all food products sold in four major Portuguese supermarkets. It encompasses 43,283 items, of which 10,180 were affected by the VAT cut. Our empirical analysis is motivated by descriptive statistics comparing the price dynamics of the food items affected by the VAT cut (treated group) with the other food items that kept their VAT rate (control group). From our descriptive analysis, we draw three key findings. First, the prices of both treated and control groups followed similar trends before the policy announcement. Second, we observe a striking break in the price series of the treated group on the day of implementation, resulting in a price gap that remains broadly constant until the official announcement of the reversal, after which the price gap closes completely. Third, we find that both treated and control groups exhibit similar patterns in the frequency and direction of price adjustments, except during the weeks surrounding the implementation and reversal of the policy.

To estimate the causal effects of the policy, we use a linear panel model with dynamic policy effects in an event-study setting. This approach is suitable for assessing the effects of such a policy change, given its clear announcement and implementation dates.

We document a sharp and substantial decrease in the relative price between treated and control items. On impact, prices were 5.66 % lower, implying a pass-through estimate of 100 %. This effect was persistent. When we extend the time window to assess the duration of the policy's impact, we find that the estimated pass-through remains close to 100 % for several months, up until the announcement of the policy's termination. This indicates that the VAT cut was fully transmitted to consumer prices and that this transmission was long-lasting. The estimated treatment effect only begins to decline slightly during the final weeks of the policy.

We also study the reversal of the zero VAT policy separately, considering its official announcement as the starting point. We find that the price gap between the treatment and control groups begins to decrease slightly after the end of the policy announcement. Furthermore, we uncover a symmetric pass-through to the implementation when the policy is reverted. When the policy ended, prices of the goods included in the VAT cut basket jumped by 5.98 %, demonstrating symmetry of the pass-through between the start and end of the policy.

Leveraging the richness of the data, we then test the heterogeneity of the pass-through estimates. We run separate event-study regressions on different subsamples by product categories, brand (trademark versus white label), origin (domestic versus imported), supermarket size (big versus small), and prices before the policy change (below and above the median). We find that, when the policy was implemented and when the policy was reverted, the large majority of the categories had a treatment effect contained within the 95 % confidence band of the average treatment effect. We interpret this as full pass-through of the VAT cut and its reversal across the different product dimensions.

Next, we assess whether the pass-through estimates are robust to other specifications using a comprehensive battery of tests. First, using aggregate data from the Harmonized Index of Consumer Prices (HICP) for Portugal and Spain, we confirm that the estimated policy effect is also observed in monthly data used by the respective statistical offices to compute official inflation statistics. This finding corroborates that our results are not specific to online platforms and also apply to physical outlets, further validating the identification strategy. Second, we employ the synthetic difference-in-differences (SDiD) approach proposed by Arkhangelsky et al. (2021), which estimates time and item weights to make pre-trends similar between treatment and control groups. Third, given the critical importance of selecting an accurate control group, we explore alternative combinations of products: all products sold in supermarkets, only food and drinks, only nonfood products, and only those products with a 6 % VAT rate. Finally, we test the robustness of the main results with other data treatments and outcome variables, such as prices without discounts or prices per unit. All estimates point toward the full and symmetric pass-through of the temporary VAT cut in Portugal for the 46 supermarket food products included in the VAT cut basket.

To better understand the potential mechanisms underlying our results, we discuss two potential explanatory factors: consumers' increased awareness of the policy amid high inflation and the decline in producer prices when the VAT cut occurred. The VAT cut was highly salient to consumers: It received extensive media coverage for a prolonged period, garnered significant public attention, and was tracked by the Portuguese Association for Consumer Protection and the main newspapers. The products with a VAT cut were identified through advertisements, banners, and stickers, and the high-inflation environment made consumers more attentive to price changes. Additionally, the policy's introduction coincided with a deflationary trend in producer-level food prices. This trend in supermarkets' input costs – not only for the treated goods but for control ones as well – may have facilitated the full pass-through observed at the retail level. Our results suggest that effective policy communication and the timing of the intervention relative to input price dynamics significantly influenced the policy's success.

Finally, we estimate the impact of the policy on the monthly inflation rate as measured by the HICP. Using the estimated impact that the policy had on treated food items in combination with the weight of this set of products in the official consumption basket, we estimate that the headline inflation rate fell by 0.68 percentage points (pp). This quantifiable impact on inflation highlights the potential of targeted fiscal policies as a tool for managing inflationary pressures.

*Related literature and contribution.* Our paper contributes to the literature on the incidence of VAT changes. We find a full pass-through of the tax cut in Portugal, with our estimates exceeding the upper bound of previous studies. In the context of food products, the range of pass-through estimates varies from 50 % (Benzarti et al., 2024) to 100 % (Gaarder, 2019). Moreover, Buettner and Madzharova (2021) analyze VAT changes in the durable goods sector and found close to full but delayed pass-through into prices, suggesting that the nature of

the product – whether essential or durable – can significantly affect the timing and extent of VAT pass-through. Other studies have explored the same phenomenon in industries such as restaurants (Harju and Kosonen, 2014; Harju et al., 2018; Benzarti and Carloni, 2019), hairdressing (Kosonen, 2015), cinema (Arce and Antonio, 2020), gasoline (Gautier et al., 2023; Montag et al., 2023), and online retailing (Fedoseeva and Van Droogenbroeck, 2024), persistently finding pass-through rates below our estimates.

Our result is consistent with the canonical model of tax incidence, and resonates with older studies by Poterba (1996) and Besley and Rosen (1999), which found that sales tax hikes are fully passed on to customers, and, more recently, Gaarder (2019), who found that a permanent VAT cut on food items in Norway was fully shifted to consumer prices. Despite this, there is vast and growing evidence of departures from full pass-through and from symmetric incidence. Blundell (2009) notes that there are alternative theoretical models of product market competition that predict varying degrees of tax pass-through. Information asymmetry and the degree of competition, as demonstrated in Hindriks and Serse (2019) and Bellon et al. (2024), are some of the main explanations for the differing estimates. In our analysis, we argue that the salience of the VAT cut had for consumers in a high-inflation environment and producer price dynamics may be alternative explanations for the complete and persistent pass-through estimated. Alternatively, the asymmetric incidence observed in other studies may stem from firm or industry-specific factors that are not present in the specific context of supermarkets.

We also show that the pass-through of the temporary VAT cut in Portugal was symmetric. Contrary to the conventional theoretical predictions on symmetric incidence, Benzarti et al. (2020) demonstrate that prices respond more strongly to VAT increases than decreases using two exogenous changes in the tax rate for Finnish hairdressers and VAT changes in the European Union. Similarly, Politi and Mattos (2011) found a qualitatively similar result for tax changes in the Brazilian food market. Karadi and Reiff (2019) find that the frequency of price changes is asymmetric: a greater number of goods experience price adjustments following a VAT increase compared to a VAT decrease. Our study complements these results by presenting evidence on a particular setting where symmetric incidence holds, consistent with standard models.[1]

The closest study to our analysis is Gaarder (2019), who examines a permanent VAT reduction on food in Norway and also documents a full pass-through. Our study differs in three key aspects: first, we analyze a temporary VAT cut and its reversal, allowing us to study symmetry in price adjustments; second, we use high-frequency daily data, rather than monthly price indices, providing a more granular view of price dynamics; and finally, we identify mechanisms behind the full pass-through, particularly consumer salience and producer price trends, which help explain why firms adjusted prices so consistently despite the tax cut being temporary.

*Outline*. The rest of the paper is organized as follows. In Section 2, we describe the background of the policy and detail its timeline. In Section 3, we present the data set of daily supermarket prices. In Section 4, we explain the empirical strategy adopted. Section 5 shows that the pass-through of the temporary VAT change in Portugal was complete, persistent, and symmetric. In Section 6, we discuss the mechanisms driving our results. Section 7 concludes.

## 2. Institutional background

In November 2021, headline inflation in Portugal, as measured by the year-on-year percentage change of the HICP, exceeded the European Central Bank's reference target of 2 % and embarked on an upward trend, peaking at 10.6 % in October 2022. As in other European countries, food prices in Portugal increased more rapidly, in particular after the invasion of Ukraine (see Fig. A.1 in the Online Appendix).

With food prices rising, public pressure mounted for the government to take action. This pressure intensified further when the Spanish government introduced a reduction in the VAT on a basket of essential goods at the end of 2022. Nevertheless, members of the Portuguese government, including the Minister of Finance, categorically rejected a VAT reduction, arguing that such a policy would have little effect on prices and, as a consequence, on households' purchasing power because retailers would absorb a significant portion of the VAT reduction in profit margins. On March 14, 2023, the Minister of Finance reinforced that no VAT change would lead to lower food inflation, as shown by the clippings in Fig. A.2 in the Online Appendix.

On March 24, 2023, against the previously set expectations, the Portuguese government changed its stance, and the Minister of Finance announced a cut in the VAT to 0 % on a selected list of 46 essential food products. The purpose of this policy was to fight the effects of inflation on households' purchasing power. The choice of the food products subject to the VAT cut was based on recommendations by the Directorate-General for Health, following the principles of a healthy and balanced Mediterranean diet and the most commonly consumed foods by the Portuguese population. It included, for example, bread, potatoes, pasta, and rice, and it had full coverage, meaning that it applied to all regions and was not targeted to any specific product dimension, such as low-priced items or white-label brands. Despite the selection of goods following a set of criteria, some appeared somewhat arbitrary. For instance, red beans were included, while white beans and black beans – which are substitutes – were not. The policy was enacted on April 18, 2023, for those 46 essential food items. All of them were previously taxed at a 6 % rate, with the exception of vegetable oils, which were taxed at a 23 % rate. The complete list of products in the VAT cut basket can be found in Table B.1 in the Online Appendix.

The VAT is a consumption tax levied on the value added to goods and services during each stage of the production and distribution chain. In the European Union, the VAT is included in posted consumer prices, making it less salient to consumers during purchases. Firms collect the VAT from consumers and remit it to the tax authority, offsetting it with credits for the VAT paid on input costs. This mechanism ensures that only the value-added portion is subject to taxation. Consumers who purchase goods and services for final consumption bear the full tax burden on the entire value of the final goods they buy. In Portugal, this tax represented 21.3 % of total government revenues in 2022 (9.4 % of GDP), making it the most important source of tax revenue. There are three VAT regimes: (1) the standard rate of 23 % applied to the majority of goods, (2) an intermediate rate of 13 %, and (3) the reduced rate of 6 % for certain essential goods.

Importantly, the policy attracted significant attention from the media and the general public. Consumer associations, journalists, and even some government officials closely monitored its implementation to assess whether supermarkets were raising posted prices above the original pretax prices.[2] Additionally, the labels of products included in the VAT cut indicated that they were subject to a 0 % rate, making this information highly salient to consumers (Fig. A.3 in the Online Appendix).

The policy was originally announced as a temporary price relief measure that would last until the end of October 2023. However, in September, the government announced an extension until the end of the year, and the official ending date was only announced on October 27. On January 5, 2024, the policy was reverted, and the VAT rate applied to the targeted products returned to 6 %. In summary, the timeline of the temporary VAT cut policy was as follows:

[1] Related literature looks at the effects of tax changes on consumption and finds strong temporary effects but limited or no intertemporal substitution effects (e.g., Cashin and Unayama, 2016; Baker et al., 2021).

[2] The Portuguese Association for Consumer Protection, for example, built a price tracker of some products included in the VAT cut basket and regularly shared it in the media.

- March 24, 2023: Announcement of a temporary VAT cut for "essential products"
- March 27, 2023: Announcement of the list of products included in the VAT cut basket
- April 18, 2023: Implementation of the policy
- October 27, 2023: Announcement of the official ending date of the policy
- January 5, 2024: Reversal of the VAT cut on all the products

Given this timeline, we use the two announcements, one for the implementation and the other for the reversal, as exogenous variations to study the dynamics of the pass-through of a VAT cut. These variations allow us to examine the dynamics of consumer prices throughout the entire policy life cycle. In the next section, we describe the data used for this analysis.

## 3. Data

### 3.1. Data description

Our analysis uses a data set with supermarket daily prices (SDP) curated by Banco de Portugal Microdata Research Laboratory (BPLIM) (2024). This data set includes daily prices from the online stores of the main Portuguese retailers. Collectively, these account for more than half of the retail market share in the country. The information is collected using automated web-scraping algorithms on a daily basis.[3] For all items sold on each retailer's website, BPLIM stores information about their name, brand, units, capacity, bar code, and price. For the latter, both the posted price and the regular price (without discount) are collected, when available. Afterward, the posted price per unit is obtained using the number of units sold as a bundle.

The European Classification of Individual Consumption according to Purpose (ECOICOP) is used to classify each item into its category using the five-digit level of disaggregation. The data set also includes a list of the products covered by the VAT cut using similar methods and guidance provided directly by the supermarkets, meaning that we are not required to perform this identification.

We focus on the period from January 2023 until the end of February 2024. During this time window, the data set encompasses around 63,000 items, defined as a product × supermarket combination. Several data-cleaning procedures are performed on this data set. Products that raised doubts about whether they were covered by the measure are excluded. Vegetable oils that had a decrease in the VAT rate from 23 % to 0 % are analyzed separately in Online Appendix A.3. Additionally, we exclude drinks, as these food items are not part of the treatment nor the control in the baseline specification presented above. Our final sample consists of 43,283 items, among which 10,180 (24 %) were treated by having a reduction in the VAT rate from April 18, 2023, to January 4, 2024. Table B.2 in the Online Appendix details all of the steps.

We have an unbalanced panel, as some items are not always available or have missing price information.[4] Additionally, the items can be classified into different categories. Each item has an ECOICOP four-digit classification, which indicates the product category to which it belongs (e.g., bread and cereals, or fruit). We also classify items into trademark or white-label brands based on their brand. For the white-label classification, we identify items whose brand includes the name of the supermarket. Furthermore, we distinguish between imported and domestic items using the first three digits of the EAN bar code.[5] We classify larger supermarkets as those with a higher market share and smaller supermarkets as those with a smaller market share. Finally, we distinguish between high- and low-priced items using the median price of the treated items before the policy announcement. The number of treated and control items included in each of these categories is shown in Online Appendix B.2.

For our estimations, we use item weights which allow us to match our estimates following the structure of the HICP consumption basket and approximate the effect on inflation. The details on weighting are detailed in Online Appendix B.3.

### 3.2. Descriptive statistics

Fig. 1 presents the price dynamics of the food items included in the VAT cut basket vis-à-vis the remaining food items. These groups will be considered as treatment and control, respectively, hereafter. The two plotted lines show the average of the daily price index between January 1, 2023, and January 31, 2024, normalized to 100 on the day before the policy was unexpectedly announced on March 23, 2023. The vertical dashed lines point toward the relevant moments under analysis: the implementation on April 18, 2023; the reversal on January 5, 2024; and the respective announcements of each VAT change. The items included in the treatment basket were taxed at the rate of 6 % before the policy implementation and returned to this rate on the reversal day. The additional horizontal line shows the price level in case the VAT cut is fully transmitted. Four empirical patterns emerge in this figure.

First, the food products that were not subject to the VAT cut seem to be a plausible control group for the treated basket, as prices followed a similar trend before the announcement of the policy. This observation suggests that both groups of products were on parallel trends in the pre-reform period. Second, there was a striking break in the price series for the treated group when the policy was implemented. Third, the difference between the two groups of food products remained relatively

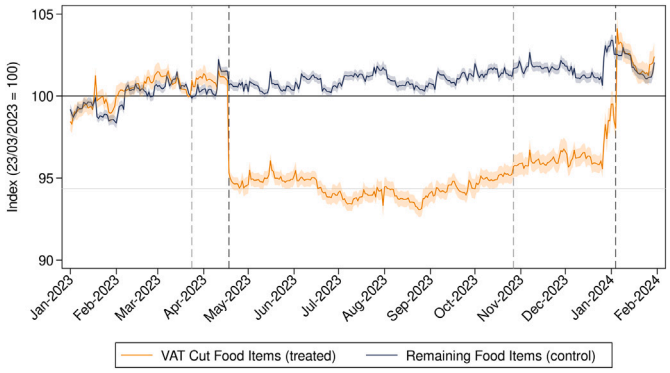


**Fig. 1.** Food prices during the temporary VAT cut in Portugal. *Notes:* This figure shows the price dynamics of the food items included in the VAT cut basket (treated, in orange) and the remaining food items, excluding drinks (control, in blue). The data represent an average of the daily price index for each item from January 1, 2023, to January 31, 2024, normalized to 100 on the day before the unexpected announcement of the policy. The figure includes a band defined by two times the standard deviation around the average. The average and the standard deviation are computed using item-level price data for each day. The first dashed line indicates the announcement of the measure (March 24, 2023), the second dashed line marks the implementation day (April 18, 2023), the third dashed line indicates the official announcement of the reversal (October 27, 2023), and the fourth dashed line marks the reversal date (January 5, 2024). The horizontal solid line represents the price level corresponding to the full pass-through of the VAT cut policy.
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

[3] In the last decade, the use of online prices has been increasing not only for measurement purposes but also for empirical research (Cavallo, 2013; Cavallo and Rigobon, 2016).

[4] In Online Appendix C.4, we validate that our results hold even if we impose a balanced panel for the estimation.

[5] The EAN bar code corresponds to the European Article Number, in which the first three digits identify the country where the bar code was issued. We use this information to identify items produced domestically (EAN code starting with the digits 560) and those imported.

constant until the announcement of the end of the policy at the end of October. After this announcement, the price gap between the two groups of products shrank. Fourth, on the reversal day, the average price index of the treated products returned to the same level as that of the control group, showing a symmetric response of prices to this VAT change.

These observations indicate a full, persistent, and symmetric transmission of the VAT cut policy into consumer prices and motivate the empirical analysis that follows, in which we formally validate these findings. However, these observations also show that this type of data is highly volatile and subject to frequent changes. Therefore, we conduct the analysis using periods of five days.[6]

As a case study, we look at the price index of treated beans compared to non-treated beans (Fig. A.4 in the Online Appendix). The price dynamics behave according to what one would expect. First, both groups have a similar path before the implementation of the policy, and then a gap opens up between the two series, which is maintained until the day of the reversal when it returns to the previous price level.

One concern with our analysis may be that the treatment and control groups have different price-updating frequencies. To assuage that concern, Fig. 2 illustrates the weekly frequency of price adjustments for the same baskets of items used above. An item is considered to have experienced a positive price change in a given week if its last price is higher than the last price of the previous week, and the opposite for a negative price change.[7] The left-hand-side panel displays the frequencies for goods included in the VAT cut basket, while the right-hand-side panel presents the frequencies for the other food items. Each graph differentiates between the direction of the price adjustments, with price increases depicted by orange bars and decreases by blue bars. This figure displays two main results.

First, both treated and control groups exhibit similar patterns in the frequency and direction of price adjustments, except for the weeks close to when the VAT was implemented and, subsequently, reverted. On average, approximately 20 % of the goods experienced price changes within the same week, with half of those having price increases and the remaining price decreases. This result reinforces the adequacy of our control group concerning the frequency of price adjustments. It also underscores the relevance of a thorough analysis centered around these two significant events, as the impact was concentrated around them.

To further validate the consistency of our data, we compute the monthly frequencies of price adjustments. In this case, we obtain an average monthly frequency of price changes of 30.5 %. We exclude April 2023 and January 2024, as these months have abnormal pricing behavior. If we benchmark this sample against stylized features of consumer price-setting behavior in Portugal (Costa Dias et al., 2008; Martins and Quelhas, 2024) or in other countries, such as the ones from the euro area (Gautier et al., 2024) or the U.S. (Nakamura and Steinsson, 2008), we find similar figures for food.

Second, the total frequency of price changes is symmetric when the VAT decreases and when it increases back to the initial level. In the week when the VAT cut was implemented, 92 % of the goods in the VAT cut basket experienced a price decrease. Conversely, during the week when the VAT was reinstated, about 83 % of these goods saw a price increase. This small difference contrasts evidence put forward by Karadi and Reiff (2019) and Benzarti et al. (2020), who find that the frequency of price changes is asymmetric, particularly that a greater number of goods experience price adjustments following a VAT increase compared to a VAT decrease. For example, in Karadi and Reiff (2019), after the VAT increases, more than half of the products analyzed have a price increase, but after the VAT decrease, only 27 % of the products have a price change. Similar differences show up in Benzarti et al. (2020).

Finally, we examine the distribution of price changes during the week following the VAT cut implementation, compared to the week before its announcement. Fig. 3 presents this distribution: the left-hand panel shows the results for items included in the VAT cut basket, while the right-hand panel displays the corresponding distribution for other food items. Most items in the VAT cut basket experienced price reductions of 5 % to 7 %, indicating full pass-through. In contrast, most other food items did not show significant price changes.

This pattern aligns with uniform pricing, where firms set prices as the product of marginal cost and a fixed markup (DellaVigna and Gentzkow, 2019; Miravete et al., 2020). One possible explanation is that maintaining a constant markup simplifies administration, allowing firms to

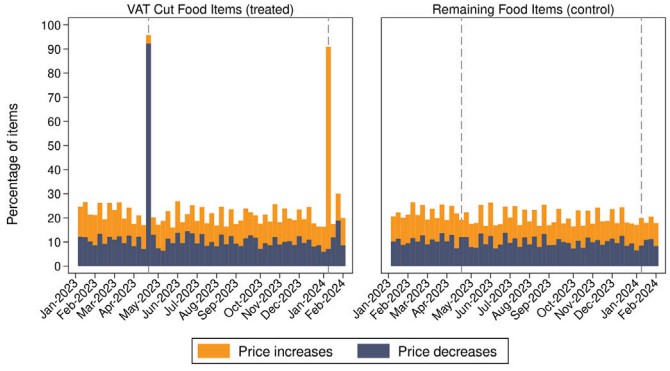


**Fig. 2.** Frequency of positive and negative price changes. *Note:* This figure shows the frequency of positive and negative price adjustments by week for the VAT cut food items (treated) and remaining food items (control). The stacked bars represent the percentage of items in a given week that experienced a change in the price level, with price increases shown in orange and price decreases in blue. An item is considered to have experienced a positive (negative) price change in a given week if its last price is higher (lower) than the last price of the previous week. The left-hand-side panel displays the frequencies for goods included in the VAT cut basket, while the right-hand-side panel presents the frequencies for the remaining food items. The first dashed line indicates the implementation day (week starting on April 18, 2023), and the second dashed line indicates the reversal date (week starting on January 5, 2024).
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

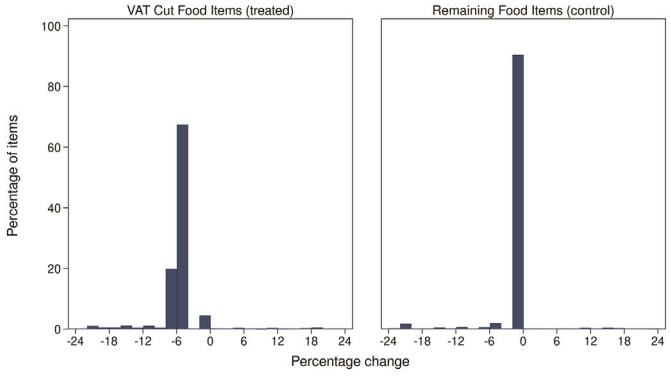


**Fig. 3.** Magnitude of price changes around the temporary VAT cut in Portugal. *Notes:* This figure shows the magnitude of price adjustments in the week following the implementation of the VAT cut compared with the week before its announcement for the VAT cut food items (treated) and the remaining food items (control). The bars represent the percentage of items in a given week that experienced a percentage change in the price level of the size of the respective bin, which corresponds to percentage changes. The left-hand-side panel displays the magnitudes for items included in the VAT cut basket, while the right-hand-side panel presents the magnitudes for the remaining food items.
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

[6] In Online Appendix A.3, we conduct our analysis without any data aggregation. Results are unchanged.

[7] We obtain similar results using the item-level average price for each week.

pass all cost changes – including variations in consumption taxes – directly onto consumer prices. Consequently, under this pricing rule, the incidence of VAT falls entirely on consumers, meaning that they bear the full burden of any VAT rate changes.

## 4. Empirical strategy

We employ an event-study approach to formally estimate the effect of the VAT cut on the prices of affected food items, comparing these to the other food items that were not affected by the policy. Using the unique policy context described in Section 2, we analyze the consumer price dynamics before and after the announcement of the VAT reduction, as a starting point.

Our analysis uses the following linear panel model with dynamic policy effects:

$$P_{i,t} = \alpha_i + \gamma_t + \sum_{m=-G}^{M} \beta_m Z_{i,t-m} + \varepsilon_{i,t}, \quad (1)$$

where $P_{i,t}$ is the price index for each item $i$ (a unique product × supermarket combination), observed in time $t$. $\alpha_i$ and $\gamma_t$ denote item-specific and time-specific fixed effects, respectively. The variable $Z_{i,t-m}$ is the event indicator: It takes the value of 1 if the policy was announced at time $t - m$ and 0 otherwise. To facilitate the comparison relative to the policy's impact, the price index is normalized to 100 in the period immediately preceding the announcement, which enables a clear assessment of relative price movements post-announcement.[8]

A period $t$ in Eq. (1) corresponds to a five-day window, meaning that $P_{i,t}$ is the average price observed over those days. This methodological choice smooths out daily price volatility and aligns the data set to better capture the immediate and delayed effects of the policy. The five-day window is structured so that $m = 0$ coincides with the announcement and the subsequent windows capture policy effects, with $m = 5$ marking the onset of the implementation.[9]

The parameters $\{\beta_m\}_{m=-G}^{M}$ quantify the dynamic effects of the policy, interpreted as the cumulative average treatment effects on the treated (ATT) at different time horizons $m$. Here, $M$ and $G$ define the range of periods pre- and post-event considered in the analysis, respectively. A positive $\beta_m$ signals a price increase $m$ periods after the policy announcement, whereas a negative value indicates a price decrease. While the coefficients for $m < 0$ estimate the anticipatory reactions to the policy announcement, $m > 0$ captures responses after the announcement.

The main identification hypothesis of our exercise is the parallel trends assumption, which posits that, in the absence of the VAT reduction, the price trajectories of the treated and control products would have been identical. Although directly testing this assumption is not feasible, we can examine the presence of parallel trends before the policy announcement and adjust our estimates accordingly to reflect any preexisting trends.

Our identification strategy also hinges on satisfying two critical conditions to ascertain the causal effects of the VAT changes. First, the Stable Unit Treatment Value Assumption (SUTVA) stipulates that there must be no spillover effects between the treated and control groups. Concerns regarding the potential inclusion of certain food products in the VAT cut basket (and the reverse) led us to include only those items for which the classification was unambiguous since the policy started, thereby upholding the integrity of SUTVA.

Additionally, a reduction in the VAT rate is expected to increase demand for treated goods, potentially causing the tax-inclusive prices of treated goods to increase relative to untreated goods. Such a shift could bias the point estimates downward, understating the true pass-through. This downward bias is likely to be particularly pronounced for close substitutes subject to differential treatment, rendering our estimates a lower bound of the actual pass-through.

Second, the assumption of no anticipation asserts that the policy was unexpected, meaning that neither consumers nor supermarkets could have adjusted their behavior before the actual announcement of the policy changes. As discussed in Section 2, the Portuguese Finance Minister publicly rejected this policy several times, including only 10 days before its announcement. It is thus very unlikely that consumers and supermarkets reacted in advance.

Moreover, our model incorporates two sets of fixed effects to robustly estimate the policy impact. On the one hand, item fixed effects are used to control for unobservable attributes that do not vary over time, such as brand value or product expiry date of validity. Time fixed effects, on the other hand, help account for external shocks or time trends that might affect all products simultaneously; these include macroeconomic conditions, seasonal variations, or general inflationary pressures. These fixed effects are crucial for isolating the effect of the VAT cut from other confounding influences. Standard errors are clustered at the item level.[10] We also normalize $\beta_{-1}$ to zero, allowing us to interpret the plotted coefficients as estimated effects relative to the policy's impact. Finally, we carefully selected a control group consisting solely of other food items, excluding drinks, sold by retailers.

## 5. Full, persistent, and symmetric pass-through

### 5.1. Full pass-through

Fig. 4 reports our main estimates of Eq. (1). It displays the cumulative price dynamics, summarized by $\{\beta_m\}_{m=-G}^{M}$, after the announcement of the policy. The estimates reported in the figure correspond to the deviation from the extrapolated linear trend before the policy change, as

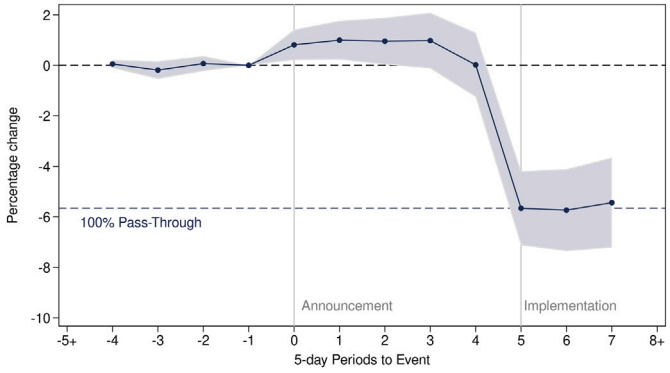


**Fig. 4.** Pass-through estimates of the 2023 temporary VAT cut in Portugal. *Notes:* This figure shows the event-study estimates from Eq. (1) after the policy announcement. The range of periods pre- and post-event considered in the analysis is $M = 4$ and $G = 7$. The estimated effect of the policy is the deviation from the extrapolated linear trend before the policy change, computed using four pre-event periods and a generalized method of moments estimator as in Dobkin et al. (2018). Item-level weights are used in the estimation. The shaded areas correspond to the 95 % confidence interval with standard errors clustered at the item level. Similar figures without linear trend extrapolation and with daily data are in Online Appendix A.3.
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

[8] This approach follows the standard normalization practice in event studies, in which changes are measured relative to a defined pre-event period, ensuring that the effects observed are directly attributable to the policy. See, for example, Freyaldenhoven et al. (2021). The estimation uses the implementation by Freyaldenhoven et al. (2025).

[9] In Online Appendix B.4, we detail the dates matching to these periods and identify the periods in which each event occurred. Additional event studies where a period $t$ corresponds to a single day are reported in Online Appendix A.3.

[10] We also experimented with clustering standard errors at the ECOICOP level, and all results remain statistically significant at the same confidence level.

in Dobkin et al. (2018). In the Online Appendix (Fig. A.5), we show the estimated coefficients without trend correction. The shaded region in the figure corresponds to the pointwise 95 % confidence interval, using standard errors clustered at the item level.

The coefficients fluctuate around zero in the days leading up to the announcement, which indicates no significant price changes in anticipation. Immediately after the announcement, the relative price between treated and control goods increased slightly by 0.81 %. This increase is, nevertheless, short-lived. In fact, before the policy started, the relative price of treated goods returned to the same level as in the period before the policy announcement.

The VAT cut started 25 days after the policy announcement. One can see that, immediately after the policy's implementation, there was a sharp and substantial decrease in prices. On impact, prices were 5.66 % lower, corresponding to a full pass-through.[11]

We formally test for the presence of pretrends and find no evidence of their existence. Nonetheless, we apply the pretrend correction method proposed by Dobkin et al. (2018), which involves estimating the ATT using Eq. (1) with a linear trend. This adjustment ensures that our coefficients of interest capture the precise quantitative effect of the policy change on consumer prices. However, this correction introduces a trade-off, as it increases the uncertainty of the point estimates. For comparison, Online Appendix A.3 presents the estimation results without the linear trend correction.

Overall, the event-study analysis provides compelling evidence that the temporary VAT cut policy had a tangible and immediate downward effect on consumer prices at the time of its introduction, as indicated by the narrow confidence intervals around the point estimates. These intervals are sufficiently precise to reject economically meaningful deviations from full pass-through, and even the lower bounds of our estimates remain consistent with the highest pass-through rates reported for food items in the literature.

While previous studies have examined the pass-through of tax changes, particularly tax cuts, almost none have found a full pass-through on impact (Benedek et al., 2020). One exception is the work by Gaarder (2019), who also finds complete pass-through of a permanent VAT cut on food in Norway. However, unlike the Norwegian setting, the VAT cut in Portugal was explicitly temporary. In Section 6, we discuss how the dynamics of producer prices and the salience of this policy for consumers may have affected the high pass-through observed.

In Online Appendix C, we show that the full pass-through result is robust to different assumptions, modeling, and data choices. One notable exercise adds external validity to our baseline by comparing Portuguese with Spanish price dynamics (see Online Appendix C.1). For this exercise, we use monthly data at the ECOICOP five-digit level, which allows us to also test if the results can be generalized beyond supermarket online stores. We also find a full pass-through in this case.

### 5.2. Persistent pass-through

To explore the persistency of the pass-through, we estimate the event-study model in Eq. (1), allowing for a longer horizon, i.e., from the policy implementation until the end of the policy announcement. Fig. 5 plots the estimated coefficients and the respective 95 % confidence interval, using again standard errors clustered at the item level. In this analysis, contrary to the previous estimates, we do not correct for the pre-trends, as in Dobkin et al. (2018). Consequently, the estimated coefficient on impact, which corresponds to the first point in the figure, is slightly different from the one reported in Fig. 4.

The full pass-through estimated on impact remains high throughout the entire duration of the policy. Almost all the 95 % confidence intervals of the estimated coefficients include the 100 % pass-through line. This

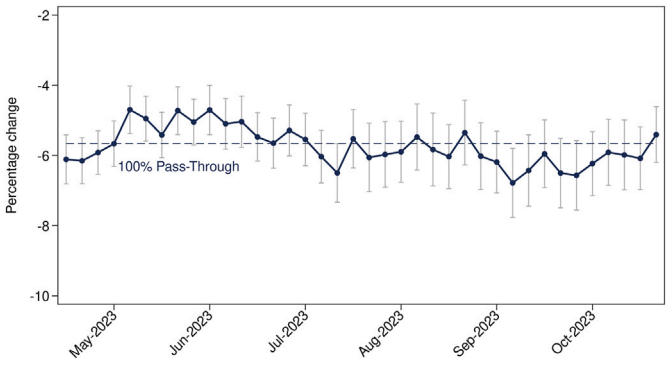


**Fig. 5.** Pass-through persistency of the 2023 temporary VAT cut in Portugal.
*Notes:* This figure shows the event-study estimates from Eq. (1) between the implementation and the reversal of the policy. The range of periods pre- and post-event considered in the analysis is $M = 4$ and $G = 41$ without any pre-trends adjustment. Item-level weights are used in the estimation. The gray bars correspond to 95 % confidence intervals with standard errors clustered at the item level.
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

persistence in the full pass-through is an unusual result in the literature examining the effects of a temporary VAT cut on consumer prices.

Fig. A.6 in the Online Appendix complements this analysis by showing how the magnitude of the price changes relative to the day before the announcement of the policy is distributed one, three, and six months after. It plots the distributions of the cumulative price changes of treated items, for each product $i$. These are fairly similar over time with a spike at the full pass-through level.

### 5.3. Symmetric pass-through

On October 27, 2023, the government announced the ending date of the policy to be on January 5, 2024. Even though there was an official announcement of the policy's end, it was known from the beginning that the policy was a temporary measure. Initially, it was supposed to last six months, but then the government extended it for three more months.

Fig. 6 plots the event-study coefficients estimated using Eq. (1) considering the announcement of the end of the policy as a reference date. The shaded region in the figure corresponds to the 95 % confidence interval around the point estimates, using standard errors clustered at the item level. The five-day window is structured so that $m = 0$ coincides with the reversal announcement, and the subsequent windows capture post-announcement effects, with $m = 14$ marking the onset at the policy's reversal.

Before the reversal announcement, there were no significant price differences between the items included in the VAT cut basket and the remaining ones, which is consistent with the persistence of the full pass-through discussed above. After this announcement, the coefficients entered a slight upward trajectory. When the policy ended on January 5, 2024, the prices of the goods included in the VAT cut basket jumped by 5.98 %, relative to the period before the reversal announcement.

This jump implies a full pass-through at the reversal, despite some announcement effect, closing the gap between the control and treated groups at the end of the policy. This indicates a symmetry of the pass-through between the start and end of the policy. We show the robustness of this result for a comprehensive battery of tests in Online Appendix C.

This symmetric effect is noteworthy. In a recent influential paper, Benzarti et al. (2020) show that consumption taxes have an asymmetric incidence, arguing that prices respond significantly more to increases than to decreases in VATs. Our findings provide evidence that the result of symmetry predicted by standard models can still hold. In Section 6, we discuss this result further, providing reasons for the observed symmetry.

[11] A decrease in the VAT rate from 6 % to 0 %, corresponds to a $-0.06/1.06 \times 100 = -5.66$ % change.

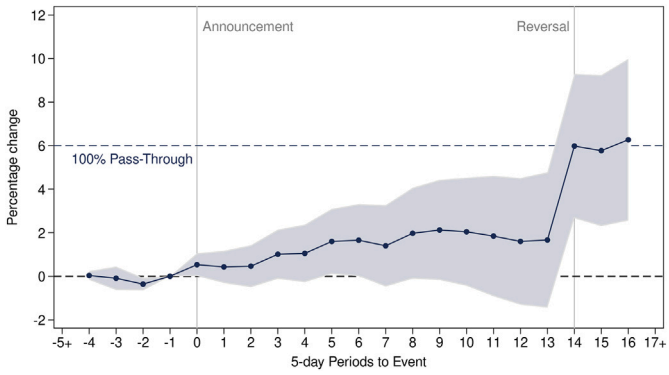


**Fig. 6.** Pass-through estimates of the 2023 temporary VAT cut reversal in Portugal. *Notes:* This figure shows the event-study estimates from Eq. (1) after the official announcement of the policy end. The range of periods pre- and post-event considered in the analysis is $M = 4$ and $G = 16$. The estimated effect of the policy is the deviation from the extrapolated linear trend before the policy change, computed using four pre-event periods and a generalized method of moments estimator (Dobkin et al., 2018). Item-level weights are used in the estimation. The shaded areas correspond to the 95 % confidence interval with standard errors clustered at the item level. Similar figures without linear trend extrapolation and with daily data are in Online Appendix A.3.
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

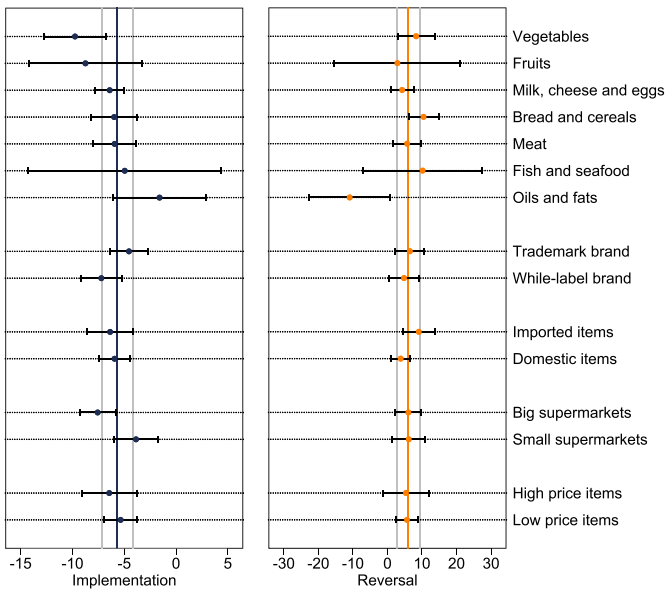


**Fig. 7.** Heterogeneous treatment effects analysis. *Notes:* This figure shows the heterogeneous treatment effects along different product dimensions in the implementation (left-hand-side panel) and the reversal (right-hand-side panel) of the policy. The treatment effect corresponds to the event-study estimate from Eq. (1) on the respective five-day period of the implementation (blue dots) and the reversal (orange dots), using subsamples created according to the different dimensions on the right: product categories (ECOICOP four-digit level), brand, origin, size of the supermarket, and price before the policy change. Product categories are ordered according to the size of the implementation coefficients. The vertical bars in each panel correspond to the aggregate coefficient for each of the two moments, reported in Figs. 4 and 6, along with the respective 95 % confidence interval lower and upper bounds in gray. The range of periods pre- and post-event considered in each analysis is the same as in the previous exercises. The estimated effect of the policy is the deviation from the extrapolated linear trend before the policy change, computed using four pre-event periods and a generalized method of moments estimator (Dobkin et al., 2018). The black solid lines correspond to the 95 % confidence interval with standard errors clustered at the item level.
*Source*: Authors' calculations based on the BPLIM-SDP dataset.

### 5.4. Heterogeneity analysis

Treatment effects may depend on product characteristics. We now extend our analysis to study differences in the pass-through across multiple dimensions. To do this, we create different subsamples according to various product characteristics. We examine whether any heterogeneity in treatment effects occurs across product types (using the four-digit ECOICOP classification), brands (trademark versus white label), origins (domestic versus imported items), supermarket size (big versus small), and prices before the policy change (below and above the median). Online Appendix B.2 reports the number of items in each category.

We estimate the coefficients in Eq. (1), restricting the treatment group to products with specific characteristics, using all food items not included in the VAT cut basket as control, as in the baseline exercise. Fig. 7 shows the estimated coefficients along the different dimensions. We look at the price dynamics at both the implementation, on the left side, and the reversal of the policy, on the right side.

The first set of coefficients, at the top of the figure, shows the price change across different food categories. On the left, we see that, at the implementation stage of the policy, for the majority of food categories, the estimated coefficients are within the 95 % confidence band of the average treatment effect (represented by the gray vertical lines). This indicates that there was a full pass-through of the VAT cut across multiple product dimensions. The vegetables category is the exception, exhibiting a pass-through above 100 %. A possible reason for this is the decline in producer prices around the policy implementation for the products in this category (Fig. A.13 in the Online Appendix). In Section 6, we discuss in detail how falling producer prices can lead to price changes beyond the full pass-through result.

On the right, we observe a similar pattern following the policy reversal. For most product categories, the estimated treatment effect is within the 95 % confidence band of the average treatment effect (represented by the gray vertical lines). This indicates that the average full pass-through on reversal also happened across almost all food categories. A notorious exception is the oils and fats category. In Fig. A.9 in the Online Appendix, we plot the event study without the linear trend correction. The figure shows that before the announcement of the policy reversal, the price of this category was on an upward trajectory in comparison with the control group.[12] This upward trajectory is justified by a poor harvest year for olives, which contributed to the surge in the product prices of this category, particularly olive oil.

Regarding the other dimensions reported in the bottom part of both subfigures, we find that the estimated effect is contained within the 95 % confidence band of the average treatment effect. This suggests that the pass-through was not different across these other product characteristics. In Fig. A.10 in the Online Appendix, we complement this heterogeneity analysis by presenting the total net treatment effect between the policy announcement and its reversal for the same categories considered above. Despite some caveats in this analysis, as discussed in the Online Appendix, the broader picture reveals a symmetric pass-through across the different categories, with most dimensions exhibiting a net effect of approximately zero.

Overall, this likely reflects the relatively short duration and temporary nature of the policy and Portugal's specific economic context. Factors such as market competition, consumer behavior, and awareness about the VAT changes could play a crucial role in shaping these outcomes, as argued in Bellon et al. (2024). We discuss these aspects in more detail in Section 6.

[12] Since we apply the Dobkin et al. (2018) trend correction, the estimated coefficient for this category becomes smaller than the average treatment effect.

### 5.5. Robustness exercises

Next, we summarize the different robustness exercises we performed to validate these results. Further details of the data, methods, and results can be found in Online Appendix C.

*Identification strategy and external validity*. Our baseline identification strategy relies on a comparison between food items that retained their VAT rate and those that experienced a rate reduction, both sold on the online stores from which the data are web scraped. As an alternative identification strategy, we consider the price dynamics of food items across different countries. For this option, we collect aggregate HICP data for the treated products, using the ECOICOP five-digit classification, in Portugal and Spain. These data are sourced from Eurostat and collected by the national statistical offices.[13] This means that the data are standardized, allowing us to compare the evolution of each product category over time in the two countries. Moreover, the prices underlying these data are representative of both online and physical retail stores, providing external validity to our findings. In Online Appendix C.1, we estimate the pass-through of the VAT cut. Our results indicate that the change in the VAT was fully transmitted to consumer prices at the implementation stage and remained high throughout the policy duration.

*Synthetic difference-in-differences*. The difference-in-differences (DiD) identification strategy relies on the hypothesis that the treated and control groups exhibit parallel trends before the event. In our baseline results, we adjust for minor deviations in pre-trends to accurately interpret the coefficients. Alternatively, we employ the SDiD approach proposed by Arkhangelsky et al. (2021), which estimates time and item weights to ensure the parallel pre-trends between control and treatment groups. In Online Appendix C.2, we describe in detail this method and present the results obtained, showing that prices had a decrease between −6.97 % and −5.85 %, upon implementation and, subsequently, had an increase between 6.52 % and 7.86 %, upon reversal, using as reference the respective preannouncement days and a 95 % confidence interval. The estimates are consistent with the baseline results.

*Control group*. The selection of products included in the control group is critical for accurately estimating the ATT, as it must include goods that are comparable to those in the VAT cut basket. In our preferred specification, we focus exclusively on food products, excluding drinks. In Online Appendix C.3, we explore the pass-through dynamics of the VAT cut using four alternative control groups. First, we consider all products sold in the supermarket, both food and nonfood. Second, we restrict the control group to food and drink products. Third, we include only nonfood products to eliminate potential substitution effects among treated and control items. Fourth, we use products that have a reduced tax rate of 6 %, matching those in the treatment group. Although the estimated coefficients vary, the 95 % confidence interval includes the full pass-through point estimate at the implementation and at the reversal, corroborating the robustness of our finding of a full and symmetric pass-through.

*Data-cleaning methods*. The data set comprises 43,283 items over 14 months. The panel is unbalanced because not all products are available for sale every day of the year. These gaps may arise from product unavailability or data collection errors from the web-scraping algorithms. In our baseline specification, we use the unbalanced data set without any additional further cleaning or imputation. In Online Appendix C.4, we test the completeness and symmetry of the VAT cut pass-through using two methods to impute missing data. The first method carries forward the price from the last available day for a maximum of one week. The second method carries forward the price without any time limitation on the missing gap. We also examine a more stringent scenario, retaining only products with prices observed for all periods under analysis, resulting in a balanced panel of 8933 items. When prices are imputed without time restriction, the estimated coefficient at implementation falls below the full pass-through. In the other scenarios, the confidence interval consistently includes the 100 % pass-through.

*Outcome variable*. Another set of robustness exercises we conduct relates to the choice of the dependent variable. In our baseline specification, the dependent variable is the posted price as labeled, which includes the VAT and any applicable sales or discounts. In Online Appendix C.5, we estimate Eq. (1) using two alternative dependent variables – the regular price, i.e., the price before sales, and the posted price per unit – to account for potential shrinkflation. We show that the results consistently indicate a full and symmetric pass-through.

## 6. Discussion

Our results show that the temporary VAT cut on a subset of food items was fully passed through to consumer prices, with the effect remaining persistent and symmetric upon reversal. These findings align closely with predictions from standard models of tax incidence but stand in contrast to a growing body of recent empirical evidence documenting incomplete and asymmetric VAT pass-through. In what follows, we explore how the specific macroeconomic and institutional features of this policy episode may account for these outcomes and help bridge the gap between canonical theoretical predictions and recent empirical findings.

One potential explanation for obtaining a result aligned with standard models but at odds with these recent studies is that there may be firm or industry-specific factors present in those divergent cases that are absent in the context of supermarkets. For example, Harju et al. (2018), who examine VAT reductions in the case of restaurants, find that independent restaurants did not pass through any change to consumer prices, while chain restaurants fully passed the tax cut to consumers. This dichotomy between independent versus chain restaurants illustrates one scenario where firm-level factors can justify our result.

On the other hand, there might also be factors that are present in our context that could motivate the complete and symmetric pass-through, which do not hold for those anomalous cases. As previously mentioned, administrative costs associated with managing a large number of products provide a rationale for pricing at a constant markup, which would be consistent with a complete and symmetric pass-through and is specific to this industry. In industries where there are fewer products or services, this reasoning may not hold, thus justifying different pricing strategies that translate into incomplete and asymmetric pass-through.

Besides this, there are other features of this policy's setting that could be important drivers of the obtained results. In the rest of the section, we discuss more in-depth two other mechanisms, producer price dynamics and policy salience, for which we have suggestive evidence. We also discuss at the end of the section how the obtained results compare with the initially defined policy objectives.

### 6.1. Mechanisms

*Deflation in producer prices*. The time of the announcement and implementation of the policy coincided with producer prices embarking on a deflationary path. A fall in costs around the time of the policy means that retailers can fully pass through the VAT cut to consumer prices while keeping or even increasing their margins. It is important to note that deflation in producer prices is not exclusive to treated goods, being common to the vast majority of the goods for which we have producer price data. This fact means that retailers' margins on some of the control items could be increasing, providing further incentive to pass the VAT cut to consumer prices on treated goods.

To test this idea, we conduct an event study on weekly product-level price data in agricultural wholesale markets in the spirit of the analysis for consumer prices, following the methodology described in Section 4.[14] We include both treated and control items because declining producer prices for goods not affected by the VAT cut additionally

[13] In Online Appendix B.5, we describe the data sources in more detail.

[14] We describe the data set in more detail in Online Appendix B.5.

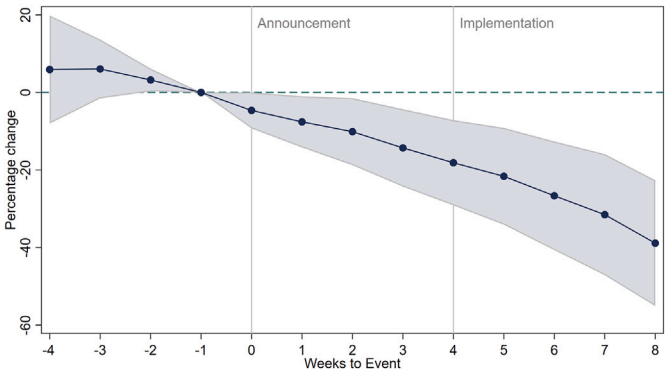


**Fig. 8.** Agricultural wholesale producer prices. *Notes:* This figure shows the event-study estimates from Eq. (1), with the exception that we do not consider a control group. We consider as a base period the week preceding the policy announcement, starting on March 20, 2023. The range of periods pre- and post-event considered in the analysis is $M = 3$ and $G = 7$. The shaded areas correspond to 95 % confidence intervals with standard errors clustered at the product × market combination.
*Source*: Authors' calculations based on the price data of the Agricultural Markets Information System of the Portuguese Planning, Policy and General Administration Office.

reduce retailers' average input costs. We also use a fixed-effects estimator on time and item, where the latter is a product-market combination. Our base period is the week preceding the announcement of the policy. Our window ranges from three weeks before the announcement until seven weeks after the announcement, with the policy being implemented three weeks after the announcement. Standard errors are clustered at the item level. The event study for agricultural wholesale prices departs from the empirical strategy for consumer prices in two ways: We do not use a control group due to insufficient available data on product categories, and we do not use trend correction.

Fig. 8 presents the results of the event study for agricultural wholesale prices described above. Prices were on a downward trend even before the announcement, with the decline relative to the period preceding the announcement being statistically significant for the entire period after the event. This finding provides further evidence of the falling producer prices potentially motivating the full pass-through but also allowing for it to persist over time. Fig. A.13 in the Online Appendix presents the producer price index for the total and four main categories of agricultural wholesale prices – meat, fruit, vegetables, and milk – which have the biggest weight in the consumer's basket. The total index showcases the same result, as we observe a decline in producer prices starting some weeks before the announcement of the policy until mid-May. In the case of meat, the fall begins later toward the end of April. The same pattern for the total is also observed for milk and, more starkly, for vegetables.

Comparing these results with the heterogeneous effects in Section 5.4, we can see that, at implementation, goods such as vegetables had a higher than full pass-through, coinciding with producer prices falling at the same time the policy was announced and implemented. As such, declining producer prices could be a mechanism for the unusually high pass-through we observe, allowing supermarkets to keep their margins or even increase them.

We complement this analysis by looking at the publicly available monthly industrial production price index for manufacturing food industries by category, published by Statistics Portugal. This decrease in producer prices is also present when we look at this series, as presented in Fig. A.14 of the Online Appendix. We can see that the total slightly declines from March 2023 to April 2023 and more afterward. Similar to wholesale agricultural prices, the fall is more pronounced for fruits and vegetables.

The deflation in producer prices may account for the full pass-through observed at the time of policy implementation. However, it falls short in explaining the symmetry in pass-through upon reversal, suggesting that additional mechanisms are at play. We argue that the institutional features of the policy, particularly the high degree of public awareness and salience, played a central role in shaping the response of economic agents. In what follows, we discuss how these features can account for both the completeness and the symmetry of the observed pass-through.

*Salience*. The VAT cut policy was extremely salient to consumers in several ways. First, as mentioned in Section 2, the discussion around the policy gathered significant media coverage and public attention. The rapid escalation of food prices, anecdotal claims of price gouging by supermarkets, pressure from several stakeholders for a VAT cut, and denial from members of the government that such a policy would be enacted are some of the factors that contributed to the elevated public attention.

The degree of media attention and public scrutiny is another potential mechanism that incentivized food retailers to pass through the VAT cut to consumers. Throughout the policy duration, the Portuguese Association for Consumer Protection built a price tracker of some products included in the VAT zero basket, which was regularly shared in the media. Although this association does not have any legal power to, for example, impose fines, it contributed to increasing consumers' awareness about the policy. The search intensity for the terms "IVA" and "Imposto sobre o valor acrescentado" (VAT and value-added tax, respectively, in Portuguese) on Google's search engine from January 2023 until February 2024 was very high, comparable with the search intensity for "Taylor Swift" in the same period, when the artist announced two concerts in Lisbon (see Fig. A.11 in the Online Appendix). This provides suggestive evidence of the high level of public attention to the policy.

Second, upon implementation, supermarkets heavily publicized the VAT cut policy. Banners were saying "IVA 0" next to the shelves with products in the VAT cut basket, and several of the items in the basket had stickers also indicating the VAT exemption (see Fig. A.3 in the Online Appendix). This publicity was a common practice across retailers, both in physical locations and online, making it much more salient to consumers which goods were included in the policy and which were excluded. The power of salience as a mechanism to explain the full and persistent pass-through of this temporary VAT cut is supported by Chetty et al. (2009), who provide evidence that consumers underreact to taxes that are not salient and that "the demand curve becomes more inelastic when individuals are inattentive". In our case, attention could then imply a higher tax elasticity of demand, thus providing further incentive for retailers to pass through the tax cut. Ramey (2021) also argues that changes in VAT and sales taxes are salient and understandable to the average consumer.

Third, this policy was implemented in an inflationary environment. Existing literature shows that, during high-inflation periods, attention to prices increases (Binder and Kamdar, 2022; Pfäuti, 2023; Weber et al., 2023) as price changes become more salient. This can justify heightened attention to prices, thus motivating the increased pass-through.

Moreover, we find evidence that consumers incorporated the VAT cut into their expectations. Following the policy announcement, the gap between the euro area's and Portugal's inflation expectations narrowed by nearly 2 pp. When the policy's official end was announced in late October 2023, this gap widened again (Fig. A.12 in the Online Appendix). This development demonstrates that the policy's salience was strong enough to alter expectations. Our findings corroborate Bachmann et al. (2021), who show how a temporary VAT cut can be used to influence consumer expectations.

*Other mechanisms*. Other mechanisms could play an important role in our results. Bajo-Buenestado and Borrella-Mas (2022) document that the pass-through of a tax on prices is about 38 % higher in vertically integrated markets compared to white-label branded products. In Fig. 7, we qualitatively validate this result, showing that white-label products

have a higher pass-through, even though the difference is not statistically significant. A large share of the items in our data is white-brand labeled (19.5 %), which could have contributed to the high pass-through we estimate. Fuest et al. (2024) also provide evidence of heterogeneity along market integration between trademark brand and white-label brand items.

A final set of reasons is related to the institutional setting of this particular policy. Before the announcement of the policy, the government met with stakeholders across the food supply chain and established several formal agreements with collective groups such as farmers, distributors, and industrial associations to ensure that these groups were committed to reducing and stabilizing prices. This type of agreement could create further incentives for agents across the supply chain to fully pass the VAT cut on to consumers. Furthermore, the government had instructed food safety inspectors from the Economic and Food Safety Authority to monitor prices, with particular emphasis on price speculation. During the nine months of the policy, the authority inspected approximately 2000 economic operators and identified 174 cases of noncompliance with the VAT cut policy.

### 6.2. Policy objectives

As mentioned in Section 2, the VAT cut policy had the explicit goal of mitigating the effects of inflation on household income and directly lowering inflation. Our results show that the pass-through of the policy to consumer prices was complete and persistent. Given the extent of this policy, we conclude that it was effective in lowering consumer prices. However, one could argue that there were better policy alternatives to fulfill this goal (e.g., direct transfers to poorer households).[15]

According to the Portuguese Directorate-General for Budget, the policy implied a total loss of tax revenue of 521 million Euros, which corresponds to 2.27 % of total value-added tax revenue and 0.89 % of total tax revenue in 2023. Other policies were implemented during 2023 to counter the welfare costs of inflation, such as direct transfers. The total expenditure on direct transfers to households – targeted at vulnerable households, families with children, and retirees – amounted to 578 million euros, which is 11 % more than the tax revenue lost due to the VAT cut policy.[16] This prompts us to consider the opportunity cost of the VAT cut and raises the question of the potential welfare implications of reallocating the lost tax revenue to alternative measures, such as direct transfers to households.

To evaluate the effectiveness of the policy in reducing inflation, we can approximate the policy's direct impact on aggregate inflation by combining the estimated price changes with each category's weight in the representative consumer's consumption basket. The weight of the goods included in the VAT cut basket was 12 % in 2023.[17] This implies that the effect of the temporary VAT cut on the aggregate inflation rate is 0.68 pp. Note that this estimate represents the direct effect on inflation. It does not consider changes in the consumption patterns that can affect the weight in the HICP of VAT cut products nor other general equilibrium effects.

[15] The lack of access to granular data on consumption does not allow us to look into the heterogeneous effects that this policy could have had on households. Benzarti et al. (2024) analyze the distributional effects of a VAT cut and conclude that such a policy is more beneficial to poorer than richer households by a factor of 3. Similarly, Gaarder (2019) finds that a permanent VAT reduction on food in Norway led to full pass-through and had progressive distributional effects, benefiting lower-income households more than proportionally.

[16] The figures presented in this paragraph related to the government's fiscal revenue and spending are available in the summary of the government's budget execution, published every year-end by the Portuguese Directorate-General for Budget (*Direção-Geral do Orçamento*), titled *Síntese da Execução Orçamental de dezembro de 2023*.

[17] This number is computed based on the weight that each food category has on the HICP and the percentage of products within each category with a VAT cut. Both are provided by Statistics Portugal.

## 7. Conclusion

In this paper, we investigate the pass-through of a temporary cut in the VAT to consumer prices, using a novel data set of daily online retail prices in Portugal that covers the full universe of food products sold in supermarkets. The decrease in the VAT affected a subset of food items starting on April 18, 2023, and lasted for approximately nine months. We analyze the consumer price dynamics across the complete policy lifetime.

We find that the pass-through of the VAT cut to consumer prices was complete, persistent, and symmetric. When the policy started, prices fell by 5.66 %, which corresponds to a full pass-through. Despite recent burgeoning evidence on the incomplete pass-through and asymmetric incidence of consumption tax changes, our results are consistent with baseline knowledge on VAT incidence. We also find that this high pass-through is sustained until the government announces the end of the policy. Furthermore, we provide evidence that when the policy was reversed, the prices of the goods included in the VAT cut basket returned to the trend of the other food items (the control group), exhibiting symmetry between the implementation and the reversal. These results are homogeneous across multiple dimensions and robust to several data and modeling choices.

Collectively, these findings not only shed light on the direct impacts of VAT adjustments on prices but also highlight the critical importance of timing, communication, market expectations, and institutional settings in maximizing the efficacy of public policies aimed at managing inflation. Investigating further the role of market competition, consumer awareness, and retailer strategies during the different phases of tax adjustments could provide deeper insights into the optimal design and timing of such tax policies. Additionally, comparative studies across different economies and tax regimes could shed light on contextual factors that influence the efficacy and efficiency of VAT adjustments as a tool for managing inflation and supporting economic stability.

## Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Tiago Bernardino reports financial support was provided by Jan Wallander and Tom Hedelius Foundation. Marcia Silva-Pereira reports financial support was provided by Foundation for Science and Technology. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at doi:10.1016/j.jpubeco.2025.105416.

## Data availability

The replication package can be found at https://dataverse.harvard.edu/dataverse/VATcut. Part of the analysis uses publicly available data. The micro-level data and corresponding replication package will be available at the Banco de Portugal Microdata Research Laboratory (BPLIM), which any researcher can request access to.

## References

Amores, A., Barrios, S., Speitmann, R., and Stoehlker, D., 2023. Price Effects of Temporary VAT Rate Cuts: Evidence from Spanish Supermarkets. European Commission.

Arce, I. and Antonio, M., 2020. Una Evaluación Sobre Los Efectos de una Reducción del Tipo de Gravamen del IVA para los Bienes y Servicios Culturales. Instituto de Estudios Fiscales.

Arkhangelsky, D., Athey, S., Hirshberg, D., Imbens, G., and Wager, S., 2021. Synthetic difference-in-differences. Am. Econ. Rev. 111 (12), 4088–4118.

Asquith, R., 2024. Past value-added Tax and goods and services tax changes. VAT Calc. https://www.vatcalc.com/global/global-2022-vat-gst-changes/. (Accessed 16 July 2024).

Bachmann, R., Born, B., Goldfayn-Frank, O., Kocharkov, G., Luetticke, R., and Weber, M., 2021. A Temporary VAT Cut as Unconventional Fiscal Policy.
Bajo-Buenestado, R. and Borrella-Mas, M., 2022. The heterogeneous tax pass-through under different vertical relationships. Econ. J. 132 (645), 1684–1708.
Baker, S.R., Johnson, S., and Kueng, L., 2021. Shopping for lower sales tax rates. Am. Econ. J.: Macroecon. 13 (3), 209–250.
Banco de Portugal Microdata Research Laboratory (BPLIM), 2024. Supermarket Daily Prices Database. Extraction: March 2025. Version: V1. Banco de Portugal. Dataset.
Bellon, M., Copestake, A., and Zhang, W., 2024. Supply and demand determinants of heterogeneous VAT pass-through. SSRN 4800611.
Benedek, D., De Mooij, R., Keen, M., and Wingender, P., 2020. Varieties of VAT pass-through. Int. Tax. Public. Financ. 27, 890–930.
Benzarti, Y., 2024. Tax Incidence Anomalies. NBER, Wp 32819.
Benzarti, Y. and Carloni, D., 2019. Who really benefits from consumption tax cuts? Evidence from a large VAT Reform in France. Am. Econ. J.: Econ. Policy 11 (1), 38–63.
Benzarti, Y., Carloni, D., Harju, J., and Kosonen, T., 2020. What goes up may not come down: asymmetric incidence of value-added taxes. J. Polit. Econ. 128 (12), 4438–4474.
Benzarti, Y., Garriga, S., and Tortarolo, D., 2024. Can VAT cuts and anti-profiteering measures dampen the effects of food price inflation? NBER, Wp 32241.
Besley, T. and Rosen, H., 1999. Sales taxes and prices: an empirical analysis. Natl. Tax. J. 52 (2), 157–178.
Binder, C. and Kamdar, R., 2022. Expected and realized inflation in historical perspective. J. Econ. Perspect. 36 (3), 131–155.
Blundell, R., 2009. Assessing the temporary VAT cut policy in the UK. Fisc. Stud. 30 (1), 31–38.
Buettner, T. and Madzharova, B., 2021. Unit sales and price effects of preannounced consumption tax reforms: micro-level evidence from European VAT. Am. Econ. J.: Econ. Policy 13 (3), 103–134.
Cashin, D. and Unayama, T., 2016. Measuring intertemporal substitution in consumption: evidence from a VAT increase in Japan. Rev. Econ. Stat. 98 (2), 285–297.
Cavallo, A., 2013. Online and official price indexes: measuring Argentina's inflation. J. Monet. Econ. 60 (2), 152–165.
Cavallo, A. and Rigobon, R., 2016. The billion prices project: using online prices for measurement and research. J. Econ. perspectives 30 (2), 151–178.
Chetty, R., Looney, A., and Kroft, K., 2009. Salience and taxation: theory and evidence. Am. Econ. Rev. 99 (4), 1145–1177.
Costa Dias, M., Dias, D., and Duarte Neves, P., 2008. Stylised features of consumer price setting behaviour in Portugal: 1992–2001. Port. Econ. J. 7, 75–99.
Crossley, T.F., Low, H.W., and Sleeman, C., 2014. Using a Temporary Indirect Tax Cut as a Fiscal Stimulus: Evidence from the UK. IFS, Wp W14/16.
DellaVigna, S. and Gentzkow, M., 2019. Uniform pricing in U.S. retail chains. Q. J. Econ. 134 (4), 2011–2084.
Dobkin, C., Finkelstein, A., Kluender, R., and Notowidigdo, M., 2018. The economic consequences of hospital admissions. Am. Econ. Rev. 108 (2), 308–352.
Fedoseeva, S. and Van Droogenbroeck, E., 2024. Temporary VAT rate cuts and food prices in E-commerce. J. Retail. Consum. Serv. 77, 103693.
Forteza, N., Prades, E., and Roca, M., 2024. Analysing the VAT Cut Pass-Through in Spain using Web-Scraped Supermarket Data and Machine Learning. Banco de España, WP 17.
Freyaldenhoven, S., Hansen, C., Pérez, J., Shapiro, J., 2021. Visualization, Identification, and Estimation in the Linear Panel Event-Study Design. NBER, Wp 29170.
Freyaldenhoven, S., Hansen, C., Pérez, J., Shapiro, J., Carreto, C., 2025. xtevent: estimation and visualization in the linear panel event-study design. Stata J. 25 (1), 97–135.
Fuest, C., Neumeier, F., and Stöhlker, D., 2024. The pass-through of temporary VAT rate cuts: evidence from German supermarket retail. Int. Tax. Public. Financ. 1–47.
Gaarder, I., 2019. Incidence and distributional effects of value-added taxes. Econ. J. 129 (618), 853–876.
Gautier, E., Conflitti, C., Faber, R., Fabo, B., Fadejeva, L., Jouvanceau, V., Menz, J., Messner, T., Petroulas, P., Roldan-Blanco, P., Rumler, F., Santoro, S., Wieland, E., and Zimmer, H., 2024. New facts on consumer price rigidity in the euro area. Am. Econ. J.: Macroecon. 16 (4), 386–431.
Gautier, E., Marx, M., and Vertier, P., 2023. How do gasoline prices respond to a cost shock? J. Polit. Econ.: Macroecon. 1 (4), 707–741.
Harberger, A.C., 1962. The incidence of the corporation income Tax. J. Polit. Econ. 70 (3), 215–240.
Harju, J. and Kosonen, T., 2014. The Inefficiency of Reduced VAT Rates: Evidence from Restaurant Industry. International Institute of Public Finance.
Harju, J., Kosonen, T., and Skans, O.N., 2018. Firm types, price-setting strategies, and consumption-tax incidence. J. Public Econ. 165, 48–72.
Hindriks, J. and Serse, V., 2019. Heterogeneity in the tax pass-through to spirit retail prices: evidence from Belgium. J. Public Econ. 176, 142–160.
Karadi, P. and Reiff, A., 2019. Menu costs, aggregate fluctuations, and large shocks. Am. Econ. J.: Macroecon. 11 (3), 111–146.
Kosonen, T., 2015. More and cheaper haircuts after VAT cut? On the efficiency and incidence of service sector consumption taxes. J. Public Econ. 131, 87–100.
Martins, F. and Quelhas, J., 2024. Consumer Price-Setting Behaviour: Evidence from Food CPI Microdata.
Miravete, E.J., Seim, K., and Thurk, J., 2020. One markup to rule them all: taxation by liquor pricing regulation. Am. Econ. J.: Microecon. 12 (1), 1–41.
Montag, F., Mamrak, R., Sagimuldina, A., and Schnitzer, M., 2023. Imperfect Price Information, Market Power, and tax Pass-Through. George J. Stigler Center For The Study Of The Economy & The State, WP 337.
Nakamura, E. and Steinsson, J., 2008. Five facts about prices: a reevaluation of menu cost models. Q. J. Econ. 123 (4), 1415–1464.
Pfäuti, O., 2023. The Inflation Attention Threshold and Inflation Surges. Working Paper.
Politi, R. and Mattos, E., 2011. Ad-valorem tax incidence and after-tax price adjustments: evidence from Brazilian basic basket food. Can. J. Econ. 44 (4), 1438–1470.
Poterba, J., 1996. Retail price reactions to changes in state and local sales taxes. Natl. Tax. J. 49 (2), 165–176.
Ramey, V., 2021. Anticipations in Macro: The Importance of Salience, Comprehensibility, and Actionability. Keynote Lecture at RIDGE Forum on International Macro.
Weber, M., Candia, B., Ropele, T., Lluberas, R., Frache, S., Meyer, B., Kumar, S., Gorodnichenko, Y., Georgarakos, D., Coibion, O., et al, 2023. Tell me Something I Don't Already Know: Learning in Low and High-Inflation Settings. NBER, Wp 31485.