Left-Digit Bias in Household Inflation Expectations

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Abstract: People often process numbers in simplified ways. One such simplification is left-digit bias, the tendency to give more weight to the leftmost digit of a number. We study whether this bias affects how households process inflation numbers when forming inflation expectations. Using cross-country data and a regression discontinuity design, we show that expectations jump when inflation crosses round-number thresholds, particularly multiples of five, but only when inflation is rising. A randomized controlled trial confirms these findings. Embedding the bias in a New Keynesian model reveals weaker initial but more persistent responses to a cost-push shock, requiring more persistent monetary policy.

Keywords: Inflation expectations, Left-digit bias, Monetary policy, Randomized controlled trial

JEL classification: C83, D83, D84, E31

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1. Introduction

People often process numbers in simplified ways. One such imperfection is left-digit bias, the tendency to give more weight to the leftmost digits of a number than to the remainder. This behavioral pattern is robust, widespread, and well established. A classic example is 0.99-cent pricing, where consumers view \$4.99 as meaningfully lower than \$5.00 (e.g., Strulov-Shlain, 2023; Thomas and Morwitz, 2005). Left-digit bias has also been shown in various other contexts, including stock markets, used-car prices, and ride-sharing (Agarwal *et al.*, 2022; Lacetera *et al.*, 2012; List *et al.*, 2023). Yet we do not know whether households read inflation numbers through the same left-digit lens.

Inflation expectations are central for household and firm decisions, shape the propagation of shocks in modern macroeconomic models, and are therefore highly relevant for monetary policy. If households are subject to left-digit bias when processing inflation numbers, small changes around salient thresholds may have outsized effects on their expectations. For example, an increase in the inflation rate from 4.9 to 5.0 percent may lead to a larger increase in inflation expectations than an increase from 4.8 to 4.9 percent. Given the widespread prevalence of left-digit bias in other contexts and the importance of inflation expectations, it is surprising that this link has not been studied before. In this paper, we fill this gap by theoretically and empirically studying left-digit bias in household inflation expectations.

We first present a theory of the phenomenon, demonstrating how left-digit bias generates discontinuities in the relationship between current inflation numbers and inflation expectations near inflation thresholds. Second, based on the theory, we develop a regression discontinuity design to test for left-digit bias in household inflation expectations using aggregate cross-country data. Third, we conduct a randomized controlled trial (RCT) to test for left-digit bias in inflation expectations at the individual level, in an environment where we fully control the information provision. Lastly, we embed left-digit-biased inflation expectations into a New Keynesian model to study the macroeconomic and monetary policy implications.

In our theory, households form inflation expectations based on current inflation numbers. When this general functional relationship is subject to a jump discontinuity at some threshold value that is surpassed from below, we refer to this as an *increasing-inflation threshold event*. Similarly, when the threshold is crossed from above, we refer to this as a *decreasing-inflation threshold event*. We separate these two types of events because it is well-established that negative events often have a stronger impact on individual perceptions and behavior than positive events (e.g., Binder *et al.*, 2025; Chahrour *et al.*, 2025; D'Acunto *et al.*, 2021b; Gambetti *et al.*, 2023; Kahneman and Tversky, 1979; Tutino, 2013). These thresholds may take any value, but when they occur at round numbers—such as integers or multiples of five—we refer to this as left-digit bias in inflation expectations.

Motivated by our theory, we develop a regression discontinuity design to test for left-digit bias. The identifying assumption is that threshold events occur randomly after accounting for continuous changes in inflation. The idea is to compare situations where a country's inflation rate crosses a round number, such as 10 or 20 percent, to situations that exhibit similar economic conditions but where no threshold is crossed.

To implement this design, we need many instances where inflation surpasses thresholds such as multiples of five. Those situations are rare in normal times. We therefore exploit the 2021–24 inflation episode, during which inflation moved strongly and repeatedly across round-number thresholds. More precisely, we combine monthly inflation and survey-based household expectations from 29 European economies between 2017 and 2024.

We find that households' inflation expectations increase sizably when a country's inflation crosses a round-number threshold from below. On average, mean and median expectations increase by 0.6 and 0.8 percentage points, respectively, in response to an arbitrarily small increase in inflation that merely pushes the rate above the threshold. In contrast, we do not find significant effects at decreasing-inflation thresholds. Hence, households update their inflation expectations discontinuously when inflation crosses round-number thresholds from below, but not from above.

The change in average inflation expectations can be decomposed into an extensive margin—for example, when households previously expecting zero inflation now expect strictly positive inflation rates—and an intensive margin—for example, when households previously expecting strictly positive inflation now expect even higher inflation. We show that the extensive margin predominantly drives the overall effect of an increasing-inflation threshold event on inflation expectations. More precisely, fewer individuals expect zero or negative inflation, while more individuals expect strictly positive and accelerating inflation.

We further extensively test for left-digit bias at all possible thresholds, including randomly drawn rational numbers, integers, and multiples of five. The results paint a clear picture: left-digit bias in inflation expectations is most pronounced at multiples of five, specifically at 5, 10, 15, 20, and 25 percent. This pattern aligns with well-documented numerical regularities, as human number perception relies on a sub-base-5 structure, which makes these values natural anchors in mental categorization. Outcomes, therefore, often cluster at multiples of five in settings ranging from age reporting and health self-assessments to survey-based inflation expectations (A'Hearn *et al.*, 2009; Houle *et al.*, 2013; Binder, 2017). In the context of inflation rates, which are often around 2 percent and rarely exceed 10 percent in most advanced economies, thinking in steps of five is more salient than rounding to single integers, which helps explain why these thresholds, rather than 1-percentage-point cutoffs, matter for expectation formation.

Our cross-country evidence might be driven by other factors than individual number-processing behavior, such as media coverage. We therefore conducted an RCT to investigate left-digit bias in inflation expectations at the individual level, in an environment where we fully controlled the provision of information. Participants were instructed to play an inflation forecasting game (Salle *et al.*, 2023), where they were repeatedly presented with subsequent annual inflation numbers and asked to forecast next year's inflation before being presented with the actual inflation rate. We ran the survey in Germany from August 11 to September 19, 2025, with a total of 1,000 participants. Participants saw past inflation numbers from 2017 to 2022. In September 2022, Germany's inflation rate reached 9.9 percent. Our treatment group saw an inflation rate of 10.1 percent for 2023, while the control group saw 9.9 percent. This minor variation in inflation numbers falls within the bounds of measurement error and variation between different measures, such as HICP or CPI. It allows us to identify left-digit bias in inflation expectations cleanly.

The results clearly support the findings from our cross-country analysis: Respondents presented with inflation numbers just above the threshold of 10 percent expected a 0.7 percentage point higher inflation rate for the next year than respondents presented with inflation numbers just below the threshold. Hence, a likely explanation for the discontinuous jumps in the aggregate data is that households are subject to a genuine left-digit bias when processing inflation numbers.

After establishing left-digit bias in inflation expectations both in cross-country data and in a controlled experiment, we study its macroeconomic and monetary policy implications. We embed left-digit-biased inflation expectations into an otherwise standard New Keynesian model, modifying only how individuals perceive inflation and how they form expectations. Households and firms assume that inflation and output follow simple AR(1) processes and update their beliefs using perceived current inflation rather than the actual inflation rate. When left-digit bias is present, households update their perceived inflation discretely at round-number thresholds and only gradually between them.

We then analyze how left-digit-biased inflation expectations change the propagation of a cost-push shock. Without left-digit bias, inflation and the nominal interest rate increase, while the output gap decreases on impact, before all converge back to the steady state. With left-digit bias, the dynamics differ markedly. Even though inflation expectations and inflation increase on impact because the shock is sufficiently large to push the economy above the 5-percent threshold, the immediate responses are less pronounced than without left-digit bias. The reason is that with left-digit bias, individuals' expectations always stay behind those of individuals in the unbiased economy, updating only once thresholds are crossed. This delayed updating reduces the initial amplification effect operating through higher inflation expectations, resulting in more muted initial responses in inflation, the nominal interest rate, and the output gap. Once inflation expectations are elevated because a threshold has been crossed, however, they stay elevated for longer than in the economy without left-digit bias because we plausibly assume that decreasing-inflation threshold events do not affect inflation expectations. Hence, with the asymmetric left-digit bias in inflation expectations, initial responses are more muted. However, once a shock is sufficiently large for a threshold to be crossed, expectations remain elevated for longer, implying also a more prolonged recession and requiring a more persistent monetary policy response.

Our model hence provides one explanation for still elevated average inflation expectations in the U.S. and euro area after the inflation surge in 2021 and 2022, argued to present a form of de-anchored inflation expectations (Coibion and Gorodnichenko, 2025). Although not a full theory of de-anchoring, the model shows how transitory shocks can have prolonged effects on inflation and inflation expectations when left-digit bias is present. The key is that shocks are sufficiently large to push the economy across salient inflation thresholds. These inherent non-linearities also imply that small shocks can have very different effects depending on the current state of the economy. We demonstrate that small cost-push shocks can have much larger effects on the economy when inflation expectations are already elevated, compared to the steady state, where inflation expectations are zero. Applied to the current situation with still elevated inflation expectations, our model with left-digit-biased inflation expectations suggests that a small shock, such as a trade shock, could be sufficient to push the economy over the brink, causing inflation to cross a salient threshold and leading to pronounced increases in inflation.

Related literature. Our work relates to the literature on inflation expectations and to the literature on left-digit bias. A large body of work studies household inflation expectations (see Weber *et al.*, 2022a, for a recent survey). One central question is how households form inflation expectations and what factors determine them. Previously studied determinants are, among others, observed prices of single goods (Andrade *et al.*, 2023; Cavallo *et al.*, 2017; Coibion and Gorodnichenko, 2015; D'Acunto *et al.*, 2021b; Weber *et al.*, 2022b), central bank announcements (Coibion *et al.*, 2022; Dräger *et al.*, 2016; Lamla and Vinogradov, 2019; Picault *et al.*, 2022), demographic characteristics (Carrillo and Shahe Emran, 2012; D'Acunto *et al.*, 2021c), or past experiences (Goldfayn-Frank and Wohlfart, 2020; Malmendier and Nagel, 2015). Our work is more closely connected to other determinants, as we will discuss now.

Past realized inflation has been shown to affect households' expectations of future inflation. Coibion *et al.* (2023) find that Dutch households who receive information about recent inflation adjust their expectations accordingly. This finding is consistent with numerous other studies that demonstrate the impact of current inflation on household inflation expectations (Bracha and Tang, 2023; Carrillo and Shahe Emran, 2012; Chen *et al.*, 2022; Coibion *et al.*, 2022; Dräger, 2015; Dräger *et al.*, 2016; Pfajfar and Santoro, 2013; Pfäuti, 2025; Weber *et al.*, 2023). Our paper contributes to this literature by examining how household inflation expectations respond differently to current inflation when it crosses a round-number threshold.

Another determinant of inflation expectations is cognitive ability. Studying the male Finnish population, D'Acunto *et al.* (2022) find that only high-IQ men behave mostly like rational-expectations agents, having small forecast errors, consistent inflation expectations, and behaving according to the Euler equation (see also Cavallo *et al.*, 2017; D'Acunto *et al.*, 2019). We show that left-digit bias, a cognitive factor, affects inflation expectations.

We also relate to work on rational inattention to inflation (e.g., Sims, 2003; Cavallo *et al.*, 2017; Weber *et al.*, 2023). Left-digit bias may arise from rational inattention (Gabaix, 2019, ch. 2.3.15), but it could also reflect other cognitive processes; we remain agnostic about its origin. Two recent studies estimate an attention threshold beyond which inflation updating becomes stronger (Korenok *et al.*, 2022; Pfäuti, 2023). Pfäuti (2023) estimates a threshold at 3.91 percent. In contrast, our novel theory of left-digit-biased inflation expectations generates thresholds at salient round numbers. Then, inflation expectations jump discontinuously at these salient thresholds while changing modestly and continuously between them. Empirically, we find discontinuities at multiples of five (5, 10, 15, 20, and 25 percent), while thresholds at integers or random non-integer values show no effect.

Binder (2017) documents that many households report inflation expectations at multiples of five and uses this rounding behavior to construct a measure of inflation uncertainty. Her approach exploits variation in bunching at multiples of five of reported expectations, while we study how actual inflation numbers crossing multiples of five affect expectation formation. The prevalence of rounding at fives in survey responses supports our finding that salient intervals of five play an important role in how households process inflation information.

We also relate to the work on left-digit bias. Left-digit bias is most well-known and studied in the context of 99-cent pricing (Thomas and Morwitz, 2005; Sokolova *et al.*, 2020; Strulov-Shlain, 2023). Some studies demonstrate that left-digit bias leads to stock and currency price clustering as traders use round numbers as reference points (Sonnemans, 2006; Bhattacharya *et al.*, 2012; Urquhart, 2017). Agarwal *et al.* (2022) find that threshold events in stock market indices—such as 1,000-point round numbers—affect households' mortgage demand. Other areas where left-digit bias and round-number effects can be observed are sales prices of used cars and their mileage (Lacetera *et al.*, 2012); race times and athletes' willingness to take risks (Foellmi *et al.*, 2016); asking prices of online marketplace listings and negotiations (Backus *et al.*, 2019); students' scores in entrance exams and college enrollment (Goodman *et al.*, 2020); apartment purchases (Repetto and Solís, 2019); and ride-sharing services (List *et al.*, 2023). In addition, Garz (2018) and Garz and Martin (2021) demonstrate that round-number events in the unemployment rate have discontinuous effects on household perceptions of state of the economy and voting for incumbent politicians, respectively. We contribute to this research by studying left-digit bias in inflation expectations for the first time, theoretically and empirically, and by analyzing the monetary policy implications in a New Keynesian model. Furthermore, our theory admits thresholds not only at integers, but also at multiples of any other integer base, such as fives or tens, and it also allows for asymmetric left-digit bias.

Layout. The rest of the paper proceeds as follows. We begin in section 2 by defining left-digit bias in inflation expectations and developing its theoretical foundations. In section 3, we provide empirical evidence using cross-country data and a regression discontinuity design that exploits inflation crossing salient thresholds. Section 4 presents complementary evidence from a randomized controlled trial. In section 5, we study the macroeconomic and monetary policy implications of left-digit-biased inflation expectations in a New Keynesian model. Section 6 concludes.

2. Theory: left-digit bias in inflation expectations

2.1. General formulation

We use a general framework of inflation expectations to define left-digit bias in inflation expectations. In month t, a household observes inflation from the previous two months, π_{t-1} and π_{t-2}, and forms subjective expectations about future inflation $\mathbb{E}_t^b(\pi_{t+1})$ according to

$$\mathbb{E}_t^b(\pi_{t+1}) = f(\pi_{t-1}, \pi_{t-2}, \mathbf{X}_t), \tag{1}$$

where the superscript b indicates *behavioral* expectations that may deviate from rational expectations. Households do not yet observe current inflation π_t, consistent with the fact that monthly inflation numbers are typically only available at the very end of a month or even later, as explained in section 3.1. To align theory and empirics, we therefore assume the same information lag in the model, although the main results remain unchanged if households also observed π_t when forming expectations. The matrix $\mathbf{X}_t$ collects all other factors that may influence expectations, as discussed in the literature review. If $\mathbf{X}_t$ contains the full information set available at t, then equation (1) can be rational expectations.

We now define inflation thresholds with the general inflation expectations function (1).

Definition 2.1 (Inflation threshold event)**.** The parameter τ is an *inflation threshold* if the inflation expectation function f has a jump discontinuity at $\pi_{t-1} = \tau$. An *increasing-inflation threshold event* is defined by $\pi_{t-2} < \tau$ and $\pi_{t-1} \geq \tau$ for some inflation threshold τ, and a *decreasing-inflation threshold event* is defined by $\pi_{t-2} \geq \tau$ and $\pi_{t-1} < \tau$ for some inflation threshold τ.

This definition separates situations where inflation surpasses an inflation threshold from below from situations where it falls under an inflation threshold from above. Intuitively, households may pay more attention to negative events—such as inflation rising above a salient threshold—than to positive ones, such as inflation falling below it. This asymmetry is consistent with extensive evidence that individuals attend more to negative than to positive information. In behavioral economics, prospect theory (Kahneman and Tversky, 1979) formalizes such loss aversion, and models of rational inattention show that risk-averse agents optimally allocate more attention to adverse developments (Tutino, 2013). Empirically, households react more strongly to bad than to good economic news: negative macroeconomic shocks or inflation surprises receive disproportionate attention and trigger larger expectation revisions than equivalent positive events (Binder *et al.*, 2025; Chahrour *et al.*, 2025; D'Acunto *et al.*, 2021b; Gambetti *et al.*, 2023; Soroka, 2006).

According to the above definition, an inflation threshold could take any value, like 1.234 percent. However, these thresholds are round numbers if households form inflation expectations subject to left-digit bias.

Definition 2.2 (Left-digit bias in inflation expectations)**.** Household inflation expectations are subject to *left-digit bias* if inflation thresholds exist at round numbers, where round numbers are defined as multiples of a strictly positive integer.

For example, if the integer is 1, inflation thresholds occur at 1, 2, 3 percent, and so forth; if the integer is 5, at 5, 10, 15 percent, and so forth. Following these definitions, we will empirically test for left-digit bias as outlined in section 3.2. First, we examine the presence of left-digit bias at different potential inflation thresholds. Second, we test for asymmetry in left-digit bias between increasing- and decreasing-inflation threshold events.

2.2. Left-digit bias and perceived inflation

What might be the reason for left-digit bias in inflation expectations as just defined? We illustrate this with one possible specification of equation (1). However, we do not restrict the empirical analysis to this specification.

First, assume symmetry in left-digit bias, such that increasing- and decreasing-inflation threshold events lead to the same absolute changes in inflation expectations. A representative household[1] perceives inflation with a left-digit bias according to:

$$\underbrace{\pi_t^p}_{\text{Perception}} = \underbrace{\left\lfloor \frac{\pi_t}{\tau} \right\rfloor \tau}_{\text{Round numbers}} + \underbrace{(1-\theta)\left(\pi_t - \left\lfloor \frac{\pi_t}{\tau} \right\rfloor \tau\right)}_{\text{Attention to values between round numbers}} , \tag{2}$$

where $\theta \in [0,1]$ captures the degree of left-digit bias, or inattention to inflation[2], $\tau > 1$ is the inflation threshold, and $\lfloor \rfloor$ is the floor operator. Perceived inflation is a round number plus a fraction $1-\theta$ of the distance between the actual inflation rate and the round number, reflecting attention to these in-between values.

This formulation follows the literature on 99-cent pricing, see, for example, List *et al.* (2023) and Strulov-Shlain (2023), except that we apply it to inflation perceptions, and the 99-cent pricing literature considers $\tau = 1$.

If inflation surpasses the threshold τ from below, and if the change itself is infinitesimally small, perceived inflation jumps discontinuously by $\theta\tau$. The same applies to decreasing-inflation threshold events, where perceived inflation jumps downwards by $\theta\tau$ if inflation crosses the threshold from above. Hence, equation (2) cannot generate asymmetry in left-digit bias.

Second, we therefore consider a more general specification that allows for asymmetry. A representative household perceives inflation according to

$$\begin{aligned}\overbrace{\pi_t^p}^{\text{Perception}} &= \overbrace{\pi_{t-1}^p}^{\text{Perception } t-1} + \overbrace{d(\pi_t, \pi_{t-1})}^{\text{Discontinuous updating}} + \overbrace{(1-\theta)[\Delta\pi_t - d(\pi_t, \pi_{t-1})]}^{\text{Attention to inflation changes}} \\ &\quad + \underbrace{(1-\lambda)\left[\pi_{t-1} - \pi_{t-1}^p\right]}_{\text{Attention to inflation level}},\end{aligned} \tag{3}$$

with $d(\pi_t, \pi_{t-1})$ capturing discontinuous updating, $\lambda \in [0,1]$ inattention to the level of inflation, and $\Delta\pi_t \equiv \pi_t - \pi_{t-1}$ the change in the actual inflation rate. Households update their perceived inflation only discontinuously according to

$$d(\pi_t, \pi_{t-1}) = \Delta \left\lfloor \frac{\pi_t}{\tau} \right\rfloor \tau \times \begin{cases} 1 & \text{if } \Delta \left\lfloor \frac{\pi_t}{\tau} \right\rfloor \geq 0 \\ \chi & \text{else ,} \end{cases} \tag{4}$$

[1] One could also model two groups of households, one attentive and one inattentive, and aggregate their expectations, resulting in the same aggregate expectation formation process described here, except that the inattention parameter would reflect the group sizes. This approach would also be closer to the changes along the extensive margin at inflation threshold events in the empirical section. We keep the model simple and assume a representative household for illustrative purposes.

[2] We use the term *inattention* when referring to left-digit bias, but left-digit bias might also be the result of imperfect price recall, a tendency to choose round numbers to represent reference prices, or price categorization (Strulov-Shlain, 2023).

with $\Delta\lfloor\frac{\pi_t}{\tau}\rfloor \equiv \lfloor\frac{\pi_t}{\tau}\rfloor - \lfloor\frac{\pi_{t-1}}{\tau}\rfloor$ and $\chi \in [0,1]$. The difference $\Delta\lfloor\frac{\pi_t}{\tau}\rfloor$ is one if inflation crosses a threshold from below, negative one if inflation crosses a threshold from above, and zero if no threshold is crossed.

According to equation (3), it is cognitively costly to process and store an entire number in memory, and individuals might only pay attention to the leftmost digits. Therefore, households do not fully update their perceived inflation if inflation does not cross a threshold between two periods. However, if inflation crosses one threshold from below, then τ is added to the perceived inflation rate. For example, assume thresholds that are multiples of five, $\tau = 5$, and fully inattentive households, $\theta = \lambda = 1$. If inflation moves from $\pi_{t-1} = 4.8$ to $\pi_t = 4.9$, the floor function returns 0 for both, and the household does not update its perceived inflation, $d(\pi_t, \pi_{t-1}) = 0$. However, if inflation moves from $\pi_{t-1} = 4.9$ to $\pi_t = 5.0$, the floor function returns 0 for π_{t-1} and 1 for π_t. Since the household pays only attention to the leftmost digit, it will update its perceived inflation by $\tau = 5$ percentage points, $d(\pi_t, \pi_{t-1}) = 5$.

If $\chi = 1$, left-digit bias is symmetric and equation (3) reduces to equation (2). The more general, dynamic formulation in equation (3) allows for the asymmetry between exceeding thresholds and falling below thresholds, captured by $\chi \neq 1$. For example, if $\tau = 5$ and $\chi = \theta = 0$, perceived inflation jumps upwards by 5 percentage points when inflation crosses a threshold from below, but it does not jump downwards when inflation falls below a threshold. For perceived inflation also adjusting downwards over time, however, the household has to pay some attention to the level of actual inflation, that is, $\lambda < 1$. Otherwise, with $\chi < 1$ and $\lambda = 1$, perceived inflation would increase in discrete jumps forever, never converging back to actual inflation. We, therefore, include the last term in equation (3).

We have assumed that households exogenously pay attention only to the leftmost digit of inflation rates. This assumption could be endogenized by introducing cognitive costs of attention, following Gabaix (2019), so that households endogenously choose the level of attention $\theta \in (0,1)$ to pay to inflation rates. We follow the literature on 99-cent pricing (List *et al.*, 2023; Strulov-Shlain, 2023) in modeling left-digit bias and do not take a stance on its specific cause. Likewise, we do not provide a theory that endogenously generates asymmetry in left-digit bias, $\chi < 1$, which may arise from loss aversion (Kahneman and Tversky, 1979), rational inattention (Tutino, 2013), or other mechanisms.

Based on their perception of inflation, equations (3) and (4), households form inflation expectations. The representative household assumes that inflation π_t evolves according to an AR(1) process

$$\pi_{t+1} = \rho\pi_t + (1-\rho)\pi^* + \epsilon_{t+1}, \quad (5)$$

where $\rho \in (0,1)$ is the perceived inflation persistence, π^* is the perceived long-run inflation rate, and ϵ_{t+1} denotes a white-noise shock with mean zero. Inflation might evolve differently, but the household believes it follows this process. In a given month t, households then form inflation expectations based on perceived inflation from period $t-1$ and the AR(1) process:

$$\mathbb{E}_t^b(\pi_{t+1}) = \rho^2 \pi_{t-1}^p + (1-\rho^2)\pi^*. \tag{6}$$

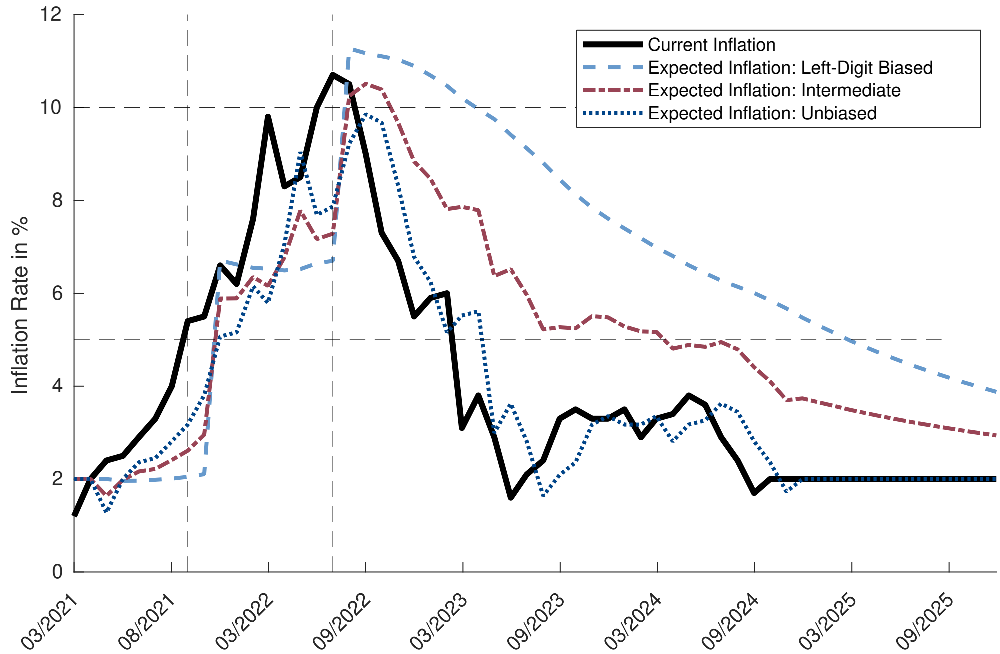
Jump discontinuities in perceived inflation, as described in equation (3), directly translate into jump discontinuities in inflation expectations. The timing is, as previously described, taking account of the empirically plausible information lag, but the main results of this sections would not change if households observed current inflation π_t when forming expectations.

Figure 1 illustrates the theoretical mechanism of left-digit-biased expectation formation with an example. For actual inflation, we use the HICP inflation in Spain from March 2021 until September 2024 and assume it stays constant at 2% afterward. Expected inflation is then calculated with equations (3), (4) and (6). We consider inflation thresholds at multiples of 5 and three cases of left-digit bias in inflation expectations: no left-digit bias, $\theta = 0$, intermediate left-digit bias, $\theta = 0.5$, and full left-digit bias $\theta = 1$. Initial values for perceived inflation are chosen such that perceived inflation converges to steady state inflation of 2% in the long run.[3] For perceived and expected inflation to revert to low values and eventually coincide with actual inflation, λ has to be set to a value below 1. We set $\lambda = 0.95$, capturing some attention to the level of inflation.

Under full attention to current inflation, $\theta = 0$, expected inflation follows current inflation closely with a lag. The other extreme of full inattention to current inflation beyond multiples of five, $\theta = 1$, shows that expected inflation updates discontinuously once an increasing inflation threshold event occurs. The first increasing-inflation threshold event occurred in October 2021, when inflation increased from 4.0 to 5.4 percent, and the second in June 2022, when inflation increased from 8.5 to 10.0 percent. After the first event, inflation expectations jump from around 2.1 to 6.7 percent, and after the second event, they jump from 6.7 to 11.2 percent. Due to asymmetry in left-digit bias, expected inflation does not jump down immediately during the subsequent decreasing-inflation threshold events. Instead, expected inflation gradually converges to actual inflation when households are inattentive. In the intermediate case, $\theta = 0.5$, expected inflation also adjusts between thresholds, but a considerable part of the adjustment takes place only when a threshold is crossed.

This example illustrates that if left-digit bias in inflation expectations is asymmetric, expectations become downward-rigid, adjusting only slowly to lower values once an increasing-inflation threshold has been surpassed. In the following sections, we empirically test for left-

[3] To be precise, $\pi_0^p = \tau \left\lfloor \frac{\pi_0}{\tau} \right\rfloor + (1-\theta)\left[\pi_0 - \tau \left\lfloor \frac{\pi_0}{\tau} \right\rfloor\right] + \theta\left(\pi^* - \tau \left\lfloor \frac{\pi^*}{\tau} \right\rfloor\right)$, where π^* is steady state inflation which we set equal to 2%.



Notes: Current inflation is the HICP for Spain from March 2021 to September 2024 from our main data described in section 3.1. Current inflation is assumed to remain at 2% afterward. Expected inflation is calculated with equations (3), (4) and (6), for $\theta = 0$ ('Unbiased'), $\theta = 0.5$ ('Intermediate'), and $\theta = 1$ ('Left-Digit Biased'). We set the perceived persistence to $\rho = 0.95$.

Figure 1: Example of inflation expectations with left-digit bias

digit bias, $\theta > 0$, and for its asymmetry, $\chi < 1$.

3. Cross-country evidence

3.1. Data

We compile a dataset on consumer prices and household inflation expectations in 29 European countries between January 2017 and December 2024. This period encompasses the 2021–24 inflation episode, characterized by large swings in inflation rates. Such fluctuations are essential for identifying inflation threshold events. We focus on 29 European economies because comparable monthly data are available for a large set of countries and over an extended period, allowing us to exploit both cross-country and temporal variation in inflation dynamics. The sample is restricted to observations for which data on inflation expectations and the consumer price index—as first published—are available.[4]

[4] We exclude Turkey because its persistently high inflation rate makes it an outlier in this group of countries.

Consumer prices and inflation threshold events

We obtain the monthly year-on-year change in the Harmonized Index of Consumer Prices (HICP) for all countries in our sample from Eurostat. The data underlying this index are collected by the national statistical offices and transmitted to Eurostat. The HICP is the key indicator used when inflation trends are communicated to the public. Eurostat and most national offices regularly report it in their monthly press releases and on their websites and social media channels.[5] We use the initially published index and inflation rate before any later statistical revisions to capture the information available to the public at the time of release. These data are available from January 2016 onward (Eurostat, 2018).

In our baseline estimations, we test whether inflation thresholds exist at multiples of 5: 5, 10, 15, 20, and 25 percent. We focus on this range because most observations in our sample fall between 0 and 25 percent. The value of 0 percent is not considered a threshold, as households are likely less interested in price developments during low-inflation periods, and crossing this value has theoretically ambiguous implications.[6] We run extensive tests on other potential inflation thresholds in section 3.4, showing that inflation threshold events are most pronounced at multiples of 5.

Previous research shows that threshold events may not be salient if they occur too frequently and lack the historical element of newsworthiness (Garz and Martin, 2021). To address this issue, we mandate that the same threshold value must not have been crossed in the past 12 months, neither from below nor above. This restriction helps to exclude crossings that likely do not draw much attention among households due to wear-out effects. Formally, for a given country i and month t, we measure an increasing-inflation threshold in the data as

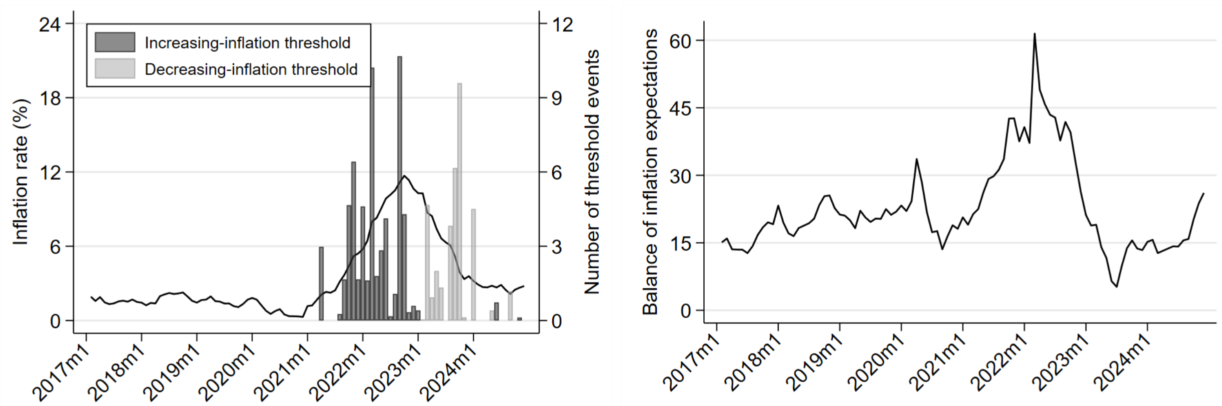
$$e_{i,t}^{increasing} = \begin{cases} 1 & \text{if } \Delta\left\lfloor \frac{\pi_t}{\tau} \right\rfloor > 0 \text{ and } e_{i,t-s}^{increasing} = e_{i,t-s}^{decreasing} = 0 \text{ for } s = 1, 2, ..., 12 \\ 0 & \text{otherwise,} \end{cases} \tag{7}$$

and a decreasing-inflation threshold event as

$$e_{i,t}^{decreasing} = \begin{cases} 1 & \text{if } \Delta\left\lfloor \frac{\pi_t}{\tau} \right\rfloor < 0 \text{ and } e_{i,t-s}^{increasing} = e_{i,t-s}^{decreasing} = 0 \text{ for } s = 1, 2, ..., 12 \\ 0 & \text{otherwise.} \end{cases} \tag{8}$$

[5] Most national statistical offices also publish a national consumer price index (CPI). However, data on the CPI are not consistently available in unrevised form (i.e., as first published), which is why we use the HICP in our main analysis and rely on the CPI only for robustness checks.

[6] Other possible thresholds observed in the data, such as 30 and 35 percent, are also excluded because these are rare and collinear with the fixed effects in the regression models.



(a) Inflation rate **(b)** Inflation expectations

Figure 2: Inflation and inflation expectations in Europe from January 2017 to December 2024

The difference in floor functions, $\Delta\left\lfloor \frac{\pi_t}{\tau} \right\rfloor$, is one if inflation crosses a threshold from below, negative one if inflation crosses a threshold from above, and zero otherwise. Due to this 12-month protection window, our data starts from January 2017. We verify that our results hold when using other arbitrarily selected protection periods, such as 0, 6, and 18 months.

Based on this definition, we identify 114 inflation threshold events, with 72 increasing- and 42 decreasing-inflation threshold events. As shown in Figure 2a, most events occurred during the 2021–2024 inflation episode, underscoring that our identification exploits this exceptional period of high and volatile inflation. Inflation threshold events differ markedly across countries and over time, with 33 distinct month–year occurrences and at least one event in every country in our sample.

Inflation expectations

Data on households' inflation expectations come from the European Business and Consumer Surveys, administered by the European Commission. These surveys are conducted by national institutes in the EU member states and candidate countries and have been previously used in several studies (for example, Andrade *et al.*, 2023; Badarinza and Buchmann, 2009; Bracha and Tang, 2023; Chen *et al.*, 2022; D'Acunto *et al.*, 2022, 2019, 2021a; Dräger, 2015; Duca-Radu *et al.*, 2021; Stanisławska *et al.*, 2021). We primarily use two variables: a qualitative and a quantitative measure of households' inflation expectations for the next 12 months.

The qualitative measure is based on the question: "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?" Survey respondents can choose one of the following answers: "increase more rapidly" (PP), "increase at the same rate" (P), "increase at a slower rate" (E), "stay about the same" (M), "fall" (MM), or "don't know" (N).

In our main specification, we use the balance of inflation expectations as provided by the European Commission:

$$(PP + 0.5P) - (0.5M + MM),$$

which ranges from -100 to +100. We also consider each single category in extensions. The balance is a weighted difference between households that expect weakly higher future inflation and those that expect zero or negative inflation. Simply put, a larger balance indicates that more households expect increasing inflation. As shown in Figure 2b, the average balance of inflation expectations increased during the 2021–24 inflation episode. The aggregate balances within each country are representative of a country's population (European Commission, 2023).

The quantitative measure is based on the question, "By how many percent do you expect consumer prices will go up/down in the next 12 months?" and allows survey respondents to enter a number. We use this data to calculate mean and median expectations. Here we exclude country-months with less than 800 interviews and responses with estimates below -5 or above 30 percent, following the truncation approach of Huber *et al.* (2023).

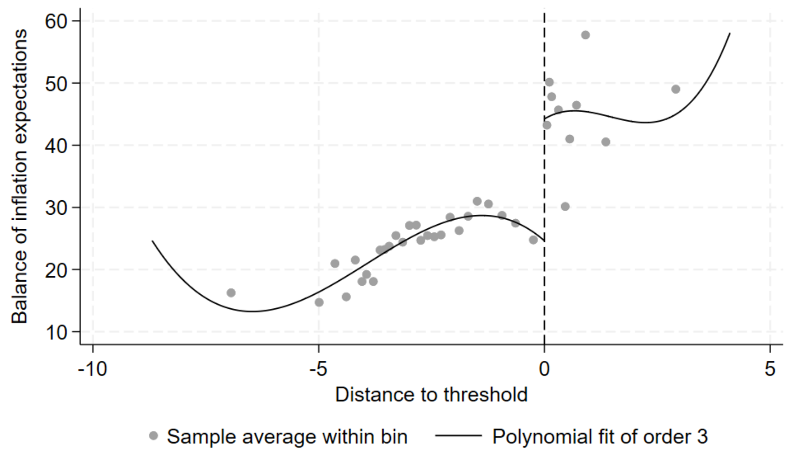
3.2. Estimation strategy

When inflation increases from, for example, 3.8 to 5.1 percent, two simultaneous effects on households' inflation expectations might occur. First, the substantial price increase leads to higher expected future inflation. Second, crossing the 5 percent threshold may impact expectations beyond the effect of the price increase itself due to left-digit bias. We employ a regression discontinuity-like design to disentangle these two effects on inflation expectations. This approach allows us to capture households' discontinuous responses to inflation changes when a threshold is crossed, as predicted by our theory in Section 2.

A conventional regression-discontinuity design (RDD) involves an assignment variable that determines which units receive treatment based on a specific cutoff value of the assignment variable. In our case, assignment into treatment and control observations depends on two variables: the level of and the monthly change in the inflation rate.[7]

While RDDs have been extended to accommodate multiple assignment variables (e.g., Cattaneo *et al.* 2020), we use a slightly different approach because our assignment variables do

[7] The following two studies have used an RDD to study left-digit bias. Repetto and Solís (2019) estimate discontinuous jumps in the final price as a function of the asking price for apartments, while Heraud and Page (2024) estimate discontinuities between the transaction price and the expected payoff of foreign exchange options. We study inflation and inflation expectations and consider a more dynamic setup as we consider both the level and the change in the inflation rate.



Notes: The x-axis measures a country's distance of inflation in period $t-1$ from its next upper threshold from period $t-2$: $\pi_{t-1} - 5\left\lceil \frac{\pi_{t-2}}{5} \right\rceil$. This way, we pool all increasing-inflation threshold events at multiples of five (5%, 10%, 15%, 20%, and 25%). By definition, values on the x-axis < 0 refer to situations without increasing-inflation threshold events, whereas values ≥ 0 depict increasing-inflation threshold events. The figure excludes threshold events where the same threshold was reached or exceeded in the past 12 months, as defined in equation (7).

Figure 3: Inflation expectations around increasing-inflation thresholds

not have fixed cutoffs, but treatment status depends on the interplay of these variables. For example, if a country's inflation in the current month is 9.6 percent, an increase of 0.4 percentage points or more would be necessary to reach the 10 percent round-number threshold in the next month. The larger the initial distance between the inflation rate and the next threshold value, the larger the monthly change in the inflation rate necessary to cross the threshold. Hence, the treatment assignment is a function of the distance between the inflation rate and the next round-number threshold, as well as the size of the change in the rate between the current and next month. In addition, a conventional RDD has the disadvantage that we could not simultaneously estimate the impact of increasing- versus decreasing-inflation threshold events, nor could we test for asymmetric effects of both types of events.

To visualize the underlying discontinuity, we plot the balance of inflation expectations against the distance of the inflation rate from its next upper threshold in Figure 3. Whenever the inflation rate in period $t-1$ is above the next upper threshold based on the inflation rate in period $t-2$, an increasing-inflation threshold event has occurred and the value on the x-axis is positive. It can already be seen that considerably more households expect increasing inflation when the inflation rate crosses a multiples-of-five threshold than when it does not, supporting the notion of left-digit bias.

To formally estimate the impact of round-number threshold events, we specify a two-way fixed effects model in which inflation expectations π^e in country i and month t are regressed on binary indicators $e_{i,t-1}^{increasing}$ and $e_{i,t-1}^{decreasing}$ of inflation threshold events, defined in equations (7) and (8), while controlling for actual inflation development $\mathbf{Z}_{i,t-1}$:

$$\pi^e_{i,t} = \alpha_1 e^{increasing}_{i,t-1} + \alpha_2 e^{decreasing}_{i,t-1} + \alpha_3 \mathbf{Z}_{i,t-1} + \theta_i + \rho_t + \epsilon_{i,t} \tag{9}$$

We consider the balance of qualitative inflation expectations as well as the mean and median of quantitative inflation expectations as outcome variables $\pi^e_{i,t}$, which denotes future inflation expectations reported in period t. The country fixed effects θ_i control for time-invariant differences in expectations between states, whereas the time fixed effects ρ_t account for overall trends in Europe. This specification is identical to the model proposed by Garz and Martin (2021), except that their assignment variables are the level and change of the unemployment rate. Apart from that, we specify the vector of controls $\mathbf{Z}_{i,t-1}$ in the same way: bin dummies for the level of the inflation rate as well as a polynomial of order 3 of the monthly change in a country's inflation rate.

The bin dummies account for real price effects and differences in the baseline probability of crossing a round-number threshold at different inflation rate levels. The closer the inflation rate is to the next round number, the more likely it is to cross this round number in the next month. While it would be possible to include the inflation rate level as a continuous variable, bin dummies have the advantage of accounting for possible nonlinear effects. Adjusting the bandwidth of the bin dummies is equivalent to selecting the bandwidth in standard regression discontinuity designs. Eurostat and its national counterparts measure the inflation rate with a precision of one decimal place. We include one bin dummy for each possible value, with a bandwidth of 0.1 percentage points. For example, we include separate bin dummies for inflation rates between 3.8 and 3.9 percent, and between 3.9 and 4.0 percent. This allows us to control for the rate level in the most fine-grained way possible. In Section 3.4, we verify that our results remain similar when we use other possible bandwidths, such as intervals of 0.2 and 0.5 percentage points.

The polynomial of the rate change controls for the mathematical fact that threshold events are more likely the greater the change in inflation from the previous to the next month. The results are generally not sensitive to the choice of the polynomial order, such as 2, 3, or 4, as we show in Section 3.4. The same applies when we substitute the rate change polynomial with rate change bin dummies and when we interact the rate change with the inflation level bin dummies.

Equation (9) examines how changes in inflation rates in month $t-1$, not in month t, affect expectations. This timing reflects the structure of the data. Consumer surveys eliciting inflation expectations are conducted during the first two to three weeks of each month (European Commission, 2023), whereas Eurostat and the national statistical offices release their initial consumer price index estimates between the end of the reference month and the middle of the following one (Eurostat, 2018). Consequently, when households are surveyed, they do not yet observe the inflation estimate for the current month. We, therefore, link their expectations to the inflation rate and possible threshold events from the previous month, also avoiding potential reverse causality stemming from households' expectations affecting current inflation rates.

Equation (9) yields causal estimates of α_1 and α_2 as long as threshold events occur randomly, conditional on continuous changes in inflation. The balance checks reported in Table A.1—which show that threshold events are uncorrelated with population size, GDP, government debt, interest rates, unemployment, and the balance of payments—support the assumption of random assignment.

The surveys underlying our outcome variables are representative of each country's population. However, estimates that ignore differences in population size across countries would be misleading. We therefore weight all regressions by each country's population share in the sample and compute standard errors robust to clustering by country and autocorrelation (Cameron and Miller, 2015).

3.3. Main results

The estimation results are summarized in Table 1. According to Column (1), increasing-inflation threshold events significantly increase the balance of inflation expectations. The point estimate suggests an increase of 5.7 percentage points, corresponding to approximately one-third of the standard deviation of the balance of expectations, as $5.627/17.185 = 0.327$. Hence, the effect of an increasing-inflation threshold event is sizable. The coefficient on the decreasing-inflation threshold dummy is small and not significant at conventional levels. Importantly, as discussed in section 2, we reject the null hypothesis that the effects of increasing- and decreasing-inflation threshold events are symmetric, $\alpha_1 + \alpha_2 = 0$ in equation (9), with a p-value of 0.005.

According to Column (2), an increasing-inflation threshold event raises the mean of inflation expectations by 61 basis points, corresponding to 0.17 standard deviations of this variable. As Column (3) shows, the median of expected future inflation increases by 81 basis points, or 0.19 standard deviations, when an increasing-inflation threshold event occurs. In contrast, the effect of decreasing-inflation threshold events on households' quantitative expectations is not statistically different from zero.

To illustrate the magnitude of the threshold effect, consider a case where median expected inflation is 4.00 percent and current inflation rises from 4.99 to 5.00 percent, crossing the 5 percent threshold. This one-basis-point change is negligible and well within typical measure-

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations
Increasing-infl. threshold	5.627***	0.613***	0.804*
	(1.797)	(0.184)	(0.421)
Decreasing-infl. threshold	0.986	-0.051	0.334
	(1.815)	(0.291)	(0.557)
H_0: symmetric effects (p-value)	0.005	0.076	0.111
Mean of dependent variable	22.538	6.696	4.709
SD of dependent variable	17.185	3.596	4.274
Observations	2699	2327	2327

Notes: Qualitative expectations refer to the weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.
* p<0.10, ** p<0.05, *** p<0.01

Table 1: Inflation threshold events and inflation expectations

ment error. Yet, households' median inflation expectations jump discontinuously from 4.00 to 4.80 percent—a sizable shift. Because inflation thresholds occur at multiples of five, this effect implies that when inflation increases by five percentage points over several months, almost one-fifth of the total adjustment in median expectations happens discontinuously at the threshold. Hence, the results in Table 1 show that inflation threshold events have pronounced effects on mean and median inflation expectations, consistent with evidence from qualitative expectations.

How are changes in the quantitative measure of inflation expectations related to changes in the qualitative measure? We study this by differentiating between changes in average expected inflation along the extensive margin—changes in the qualitative measure—and changes along the intensive margin—changes in the quantitative measure. With a slight abuse of notation, let $\bar{\pi}^e_{t+1}$ denote the mean over households' inflation expectations. This mean can be decomposed into a sum of within-group mean inflation expectations weighted by group sizes:

$$\bar{\pi}^e_t = \sum_{j=1}^{J} \omega_j \times \bar{\pi}^e_{t,j},$$

where ω_j is the representative share of respondents in group j, such that $\sum_{j=1}^{J} \omega_j = 1$, and $\bar{\pi}^e_{t,j}$ is the mean inflation expectation of group j for a total of J groups. We consider $J = 5$ different groups, which correspond to the five possible responses to the qualitative question on inflation expectations: "increase more rapidly," "increase at the same rate," "increase at a slower rate," "stay about the same," and "fall." [8] A change in average expected inflation can be decomposed into changes along the intensive and extensive margins as follows:

$$\underbrace{\Delta\bar{\pi}^e_t}_{\text{total change}} = \underbrace{\sum_{i=1}^{I} \Delta\omega_i \times \bar{\pi}^e_{t,j}}_{\text{extensive margin}} + \underbrace{\sum_{i=1}^{I} \omega_i \times \Delta\bar{\pi}^e_{t,j}}_{\text{intensive margin}} + \underbrace{\sum_{i=1}^{I} \Delta\omega_i \times \Delta\bar{\pi}^e_{t,j}}_{\text{interaction term}} \tag{10}$$

where $\Delta\bar{\pi}^e_{t,j}$ is the change in the mean inflation expectation of group j, and $\Delta\omega_j$ is the change in the share of respondents in group j in response to a threshold event. The first term on the right-hand side of equation (10) captures changes in inflation along the extensive margin, the second term captures the intensive margin, and the third term is the interaction term.

While we can accurately estimate how an inflation threshold event changes the share of households that belong to certain inflation expectations groups, $\Delta\omega_j$, we can only provide an imprecise estimate of how the within-group average inflation expectation responds to an inflation threshold event, $\Delta\bar{\pi}^e_{t,j}$. Our treatment, current inflation surpassing a round-number threshold, also affects individuals' group assignments. Ideally, we would like to observe respondents' qualitative inflation expectations in the period before the treatment, keeping the assignment of respondents into groups constant when the treatment occurs. This pre-treatment assignment is impossible since the European Business and Consumer Survey is a repeated cross-section. Therefore, we estimate the total change in average inflation expectations, the contribution from the extensive margin, and we calculate the sum of the intensive margin and the interaction term residually from equation (10).

The total change in average expected inflation in response to a threshold event is estimated in Table 1, Column (2), and equals 61 basis points. To obtain the extensive margin, we estimate equation (9) for each of the five groups separately, with the share of households in a given group as the dependent variable. The regression results are shown in Table A.2 in the Online Appendix. The share of households that expect inflation to increase more rapidly and the share of households expecting inflation to stay the same both increase by more than 2 percentage points. This increase in both groups is mainly due to respondents leaving the groups that expect zero or negative inflation.

To calculate how this change along the extensive margin affects average inflation expectations, following equation (10), we have to multiply the changes in the share of respondents

[8] We ignore the share of respondents answering the qualitative question with "do not know" since they cannot be used to calculate the mean expectation. On average, across countries and months, 6 percent of respondents answered "do not know," with a standard deviation of 0.24.

in each group with the average within-group inflation expectations. The sum of these values yields the extensive margin defined in equation (10) and equals 55 basis points. With a total change in average expected inflation of 61 basis points, we get the sum of the intensive margin and the interaction term of 6 basis points residually. Hence, we find that the main driver of the change in average expected inflation of 61 basis points is the extensive margin with 55 basis points, mainly because respondents who expected inflation to be zero or negative now expect inflation to increase more rapidly at a strictly positive rate. The intensive margin and the interaction term explain only 6 of the 61 basis points. This result is supported by what we find when we estimate how within-group inflation expectations change in response to a threshold event, as shown in Table A.3 where coefficients are small and insignificant.[9] Hence, increasing-inflation threshold events raise average inflation expectations considerably because fewer households expect zero or negative inflation and more households expect inflation to increase more rapidly, while within-group expectations change little.

3.4. Robustness and placebo tests

We now test for alternative inflation thresholds than multiples of 5. Table A.4 in the Online Appendix shows that we do not find a discontinuity when considering integers rather than multiples of five. To test for other thresholds more generally, we estimate 1,000 regressions with placebo thresholds based on randomly drawing five rational numbers between 0.1 and 29.9 percent. The results are summarized in Figure A.1. The distribution of coefficients from these placebo regressions is centered around zero, indicating null effects, while the estimate for multiples of five lies far in the right tail of the distribution.[10]

The prominence of thresholds at multiples of five is consistent with well-documented numerical and behavioral regularities. Human number perception is shaped by a sub-base-5 structure that originates from finger counting, making values such as 5, 10, 15, and 20 natural categorical anchors in mental representation and reporting (Domahs *et al.*, 2010; Moeller *et al.*, 2011). Across diverse contexts, from demographic age reporting and medical self-reports such as headache frequency to survey-based inflation expectations, outcomes often systematically cluster at multiples of five (A'Hearn *et al.*, 2009; Houle *et al.*, 2013; Binder, 2017). Our finding that inflation threshold effects occur at 5-percentage-point intervals therefore aligns with a broad regularity in human numerical cognition and behavior rather than being specific to the

[9] These results are related to Andrade *et al.* (2023), who find that most of the variation in inflation expectations between 2004 and 2018 in France is due to variations along the extensive margin. We show that the extensive margin changes to a large degree because of increasing-inflation threshold events.

[10] A fraction of 5.5 percent of regressions produce significant positive effects, which is to be expected due to Type I error when testing for statistical significance. With 1,000 replications, approximately 50 regressions should yield a significant effect just by chance, even if the true effect of placebo thresholds is zero.

inflation domain.

We run several other robustness checks. The detailed results can be found in the Online Appendix. Figure A.2 shows the results when we replace the multiples-of-five treatment dummy with separate dummies for individual thresholds. Accordingly, effect sizes and standard errors tend to increase as the threshold rises. We also include a 2 percent threshold dummy in the regression. While this value is not a multiple of five, it could be psychologically relevant due to the European Central Bank's inflation target. However, as the figure shows, crossing this threshold does not induce a discontinuous change in inflation expectations.

In the baseline specification, we do not consider it a threshold event if the inflation rate has already crossed the same threshold value in the past 12 months due to the lack of news value of repeated crossings. Table A.5 indicates that the results remain similar when using 6- and 18-month protection periods. However, the effect sizes tend to be somewhat larger when we exclude threshold events under the 18-month criterion. This is plausible as the news value of a crossing increases the more time has passed since the previous crossing of the relevant threshold.

According to Table A.6, our results are robust to specifying alternative bandwidths for the bin dummies that control for the level of the inflation rate. While the baseline model includes one bin for each possible step in the inflation rate, equal to 0.1 percentage points, the alternative specifications use bandwidths of 0.2 and 0.5 percentage points, respectively, which produces slightly smaller effect sizes but otherwise similar results. In Table A.7, we change the polynomial order of the change in the inflation rate from third to second and fourth order and find no noticeable differences. Another alternative for accounting for changes in the inflation rate is to include bin dummies rather than a polynomial. According to Table A.8, this modification does not affect the results either. We also estimate models with interaction terms between the absolute change in the inflation rate and the individual bin dummies of the rate level. This specification accounts for the possibility that households react differently to rate changes of equal magnitude if these changes occur at different inflation rate levels. As Table A.9 indicates, the results remain qualitatively similar, though.

As discussed in Section 3.1, we use the HICP to measure inflation and define threshold events because this index is available for all countries in the sample as initially published. While a country's consumer price index (CPI) might be slightly more important when national statistical offices and news sites report about inflation, the CPI data are mostly only available in revised form. Hence, we cannot accurately evaluate the impact of CPI-based threshold events on inflation news coverage and expectations. While the estimated effect of increasing-inflation threshold events on qualitative expectations in Table A.10 substantially decreases, the sign of the coefficient remains positive—likely because the data revisions of the CPI introduce measurement error in the occurrence of threshold events.

In Table A.11, we use the wild cluster bootstrap method (Cameron *et al.*, 2008). The resulting p-values confirm the statistical significance of the relevant coefficients when we account for the relatively small number of clusters (i.e., 29 countries).

Table A.12 presents the results for inflation perceptions. Although the effects of increasing-inflation threshold events are less precisely estimated, the coefficients display the expected signs and align with the theoretical predictions. This pattern suggests that households do adjust their perceived inflation when salient thresholds are crossed, but the adjustment is more gradual because perceptions are path-dependent and incorporate past price experiences more strongly than expectations. The smoother evolution of perceived inflation, illustrated in Figure A.3, therefore likely reflects inertia in updating rather than the absence of threshold effects.

While our estimation strategy exploits discontinuous responses of households to changes in inflation, we do not rely on a conventional RDD because we have two assignment variables—the monthly change and the level of inflation—that lack fixed cutoffs for treatment assignment. To assess robustness, we also estimate a standard RDD using a combined assignment variable, $\pi_{t-1} - 5\lfloor \pi_{t-2}/5 \rfloor$, which measures the distance of the inflation rate in $t-1$ from the next upper round-number threshold in $t-2$. This approach has the advantage of a data-driven bandwidth choice. Despite some limitations, such as handling repeated crossings or distinguishing between increasing- and decreasing-inflation events, the results, reported in Table A.13, yield even stronger effects than our baseline specification. Hence, the evidence for discontinuities at multiples of five is robust and, if anything, understated in our main estimates.

4. Experimental evidence

4.1. Design and participants

While the cross-country evidence reveals clear discontinuities in aggregate expectations, it cannot explain why these jumps occur, as we only observe national inflation rates and country-level averages of expectations. We do not see what information individual households receive, nor how they process it. Threshold events may trigger direct number-processing responses, but they may also induce changes in media coverage that shift expectations for different reasons. To study the isolated, direct left-digit mechanism at the individual level, we complement the cross-country analysis with a randomized controlled trial. The experiment was preregistered at the American Economic Association's registry for randomized controlled trials and approved by the Swedish Ethical Review Authority (Garz and Larin, 2025b).

The experimental design is based on guidelines for information provision experiments on economic expectations (Fuster and Zafar, 2023) and took the form of an inflation forecasting

Forecasting round		Control	Treatment
1	Sep 2017	1.8%	1.8%
	Sep 2018	2.2%	2.2%
	Sep 2019	0.9%	0.9%
	Sep 2020	-0.4%	-0.4%
2	Sep 2021	4.1%	4.1%
3	Sep 2022	9.9%	10.1%

Table 2: Experimental design

exercise (Salle *et al.*, 2023), consisting of several rounds of forecasting. Table 2 summarizes the survey design, while the full wording can be found in Online Appendix B.1.

We ran the survey experiment in Germany for three main reasons. First, it is the largest economy in Europe, making its households' inflation perceptions particularly relevant. Second, the inflation rate in Germany recently exceeded the 10-percent threshold, allowing us to design the experiment around a realistic and salient setting without using fabricated statistics. Third, our fluency in German ensured accurate and precise wording of the survey instructions and information treatments.

In each round, participants saw real information about the past inflation rate, based on which they were asked to forecast the future inflation rate. The information treatment was designed to test for left-digit bias of participants when processing numerical information about the inflation rate. We used an active control group design, where all participants received some but different information (Haaland *et al.*, 2023).

In the first round, all participants saw annual month-on-month inflation rates of 1.8, 2.2, 0.9, and –0.4 percent from September 2017 to September 2020.[11] They were then asked to forecast the inflation rate for September 2021. In the second round, participants were shown the realized inflation rate of 4.1 percent in September 2021 and asked to forecast the inflation rate for September 2022. In the third round, participants in the control group saw an inflation rate of 9.9 percent, while participants in the treatment group saw a counterfactual value just above this threshold, 10.1 percent.[12] Presenting slightly different inflation values reflects the real information environment, where households may encounter alternative statistical releases

[11]We also considered using monthly changes in year-on-year inflation rates, in line with the frequency of the cross-country data. However, we discarded this option after receiving feedback during the piloting phase that this setup might confuse participants.

[12]The preregistered analysis plan also included a second treatment arm in which participants, in addition to seeing an inflation rate of 10.1 percent, were told that this was the highest value in 30 years. The purpose was to examine whether framing inflation as a historical record amplifies or dampens left-digit reactions. We analyze this treatment in ongoing work that focuses on left-digit bias and media coverage (Garz and Larin, 2025a).

such as flash estimates, revised estimates, or different inflation measures like the CPI and the HICP. A difference of 0.2 percentage points around a level of 10 percent is also well within typical measurement uncertainty during high-inflation periods.

The experiment was conducted on Prolific between August 11 and September 19, 2025. Potential participants were informed about the purpose of the research, the voluntary nature of participation, and their right to withdraw at any time. Explicit consent was required to proceed; otherwise, the survey was terminated. Each participant received a payment of 0.61 EUR. Given an average completion time of 147.4 seconds, this corresponds to an hourly rate of 14.90 EUR (about 17.44 USD), consistent with Prolific's recommended compensation and above Germany's minimum wage of 12.82 EUR. Based on power calculations, the target sample included 1,000 gender-balanced participants. As specified in the pre-analysis plan, we excluded non-consenting respondents, incomplete surveys, the top and bottom 1 percent in completion time, and inflation forecasts below −5 percent or above 30 percent, resulting in a final sample of 953 observations.

4.2. Analysis and results

We estimate the effect of the information treatment on participant p's pre-post change in inflation expectations:

$$\pi^e_{p,3} - \pi^e_{p,2} = \alpha + \beta \mathbb{I}(\pi_{p,3} = 10.1) + \gamma + \delta + \varepsilon_p$$

where $\pi^e_{p,3}$ and $\pi^e_{p,2}$ are participant p's inflation forecasts made in rounds 3 and 2, respectively, $\mathbb{I}(\pi_{p,3} = 10.1)$ is the treatment indicator and γ and δ are date and hour-of-the-day fixed effects. The β coefficient measures the impact of the information treatment on the outcome variable relative to the control group.

Our pre-registered analysis relies on the full randomized sample. Upon inspecting the data, we found that a subset of participants provided internally inconsistent inflation forecasts, suggesting that they paid little or no attention to the information treatments. We classify such *inattentive participants* as those who revised their inflation forecast in a direction inconsistent with their forecast error at least once during the experiment. For instance, consider a participant who underestimated inflation in round 2 by predicting 1 percent when the realized rate was 4.1 percent. If this participant subsequently reduced his forecast for round 3 to 0.5 percent, we regard them as inattentive, as they ignored the information that inflation had been 4.1 percent in the previous round. We re-estimate the treatment effects after excluding 249 *inattentive participants* post-hoc.

The results are summarized in Table 3. Column (1) reports estimates from the full ran-

	(1) Full sample	(2) Without inattentive respondents	(3) Without inattentive respondents
Treatment: increasing-inflation threshold	0.188	0.596**	0.737***
	(0.279)	(0.283)	(0.285)
Demographic controls	No	No	Yes
Mean of dependent variable	3.330	4.361	4.357
SD of dependent variable	4.302	3.675	3.675
Observations	953	704	703

Notes: OLS estimates. The dependent variable is the pre-post change in participants' inflation forecasts (in percentage points), based on quantitative inflation expectations truncated at -5 and +30%. All models include date fixed effects and hour-of-the-day fixed effects. Inattentive respondents are defined as those who revise their inflation forecast contrary to their forecast error. The demographic controls are legal sex, age, education, German nationality, and born in Germany. Heteroskedasticity-robust standard errors are in parentheses.
* *p<0.10,* ** *p<0.05,* *** *p<0.01*

Table 3: Results from the randomized controlled trial

domized sample, as specified in the pre-analysis plan. However, since our experiment did not include an attention screener, this specification mixes attentive and inattentive respondents. Consequently, the estimated effect of the treatment, a 0.19 percentage-point higher forecast when participants are told inflation is 10.1 percent rather than 9.9 percent, merely mirrors the difference in the information provided and shows no evidence of left-digit bias.

Column (2) excludes inattentive respondents and shows that forecasts in the treatment group are 0.60 percentage points higher than in the control group, despite the information difference being only 0.2 points. This disproportionate adjustment provides clear evidence of left-digit bias: once inflation crosses the two-digit threshold, participants revise their expectations upward more strongly than warranted by the underlying data.

This result remains robust when demographic controls are included, as shown in column (3). Robustness checks reported in Online Appendix B further confirm the stability of our findings. That is, our findings are unaffected by not truncating forecasts at −5 and 30 percent, Table B.1, or using the round 3 forecast level, rather than the pre-post change as the dependent variable, Table B.2.

We find no left-digit effect on qualitative expectations (Table B.3). This contrasts with the cross-sectional evidence from the previous section, but the difference follows directly from how the response distributions differ. In the cross-country data, about 26 percent of households expect zero or negative inflation, and threshold events shift many of them toward expecting positive inflation (Table A.2). In the experiment, only around 3 percent of respondents hold zero or negative expectations in round 2. With so few respondents in these categories, threshold events cannot move many participants into higher qualitative groups. The lower share of zero or negative expectations in the experiment likely reflects the more concentrated information participants receive about recent positive inflation, in contrast to the diffuse and irregular information environment in which households form expectations in the cross-country data. This makes respondents in the experiment somewhat too attentive. Such heightened attention—common in RCTs—reduces the scope for qualitative threshold reactions relative to everyday conditions.

We conducted further additional analyses to validate the experimental results in Table B.4 in the Online Appendix. A series of placebo tests shows that the treatment does not affect pre-treatment variables such as prior perceptions or earlier-round forecasts. Finally, respondents in the treatment group complete the survey seven to ten seconds faster than those in the control group, consistent with a cognitive mechanism in which crossing a round-number threshold prompts quicker, more intuitive judgments rather than more deliberative ones.

Overall, our complementary randomized controlled trial provides causal evidence that individuals exhibit left-digit bias when processing inflation information and forming expectations. Unlike the cross-country evidence presented in Section 3.3, the experiment identifies this mechanism by controlling the information treatment at the individual level. Its main limitation is external validity: participants in a survey experiment do not face the same information environment as in the real world, where people encounter inflation news at different times and from diverse sources before reporting their expectations. For left-digit bias to emerge, individuals must pay some attention to the inflation information—too little implies pure inattention, while too much would eliminate the bias altogether. Our findings therefore suggest that future experiments on left-digit bias in inflation expectations should incorporate attention screeners and calibrate the realism of attention paid to the information provided.

5. A New Keynesian model with left-digit-biased inflation expectations

5.1. The model

To study how left-digit-biased inflation expectations affect the dynamics of inflation and the output gap in general equilibrium and what the implications for monetary policy are, we now embed left-digit-biased inflation expectations as defined in section 2 in a simple New Keynesian model (Galí, 2015).

The following three equations summarize the model

$$\pi_t = \beta \mathbb{E}_t^b \pi_{t+1} + \kappa \widetilde{y}_t + z_t \tag{11}$$

$$\tilde{y}_t = \mathbb{E}_t^b \tilde{y}_{t+1} - \frac{1}{\sigma}\left(\hat{i}_t - \mathbb{E}_t^b \pi_{t+1}\right) \tag{12}$$

$$\hat{i}_t = \phi_\pi \pi_t + \phi_y \tilde{y}_t, \tag{13}$$

together with left-digit-biased inflation expectations as given by equations (3), (4) and (6) from section 2 and output-gap expectations[13]

$$\mathbb{E}_t^b \tilde{y}_{t+1} = \rho_y^2 \tilde{y}_{t-1}.$$

See Online Appendix C.1 for the derivation.

Equation (11) is the New Keynesian Phillips curve (NKPC) with π_t denoting the inflation rate, β the household's subjective discount factor, $\mathbb{E}_t^b \pi_{t+1}$ are *behavioral* inflation expectations, κ the slope of the Phillips curve, $\tilde{y}_t$ the output gap, and z_t a cost-push shock following an AR(1) process with persistence ρ_z. It describes how firms set current prices and determine inflation based on their expectations of future inflation and the current output gap. Equation (12) is the aggregate Euler equation with $\frac{1}{\sigma}$ the intertemporal elasticity of substitution, and $\hat{i}_t$ the difference of the nominal interest rate and its steady-state value. It describes how households choose current relative to expected future consumption based on the next-period real interest rate. Finally, equation (13) is a simple Taylor rule with inflation coefficient ϕ_π and output gap coefficient ϕ_y. This monetary policy rule captures how the central bank sets the nominal interest rate based on inflation and the output gap.

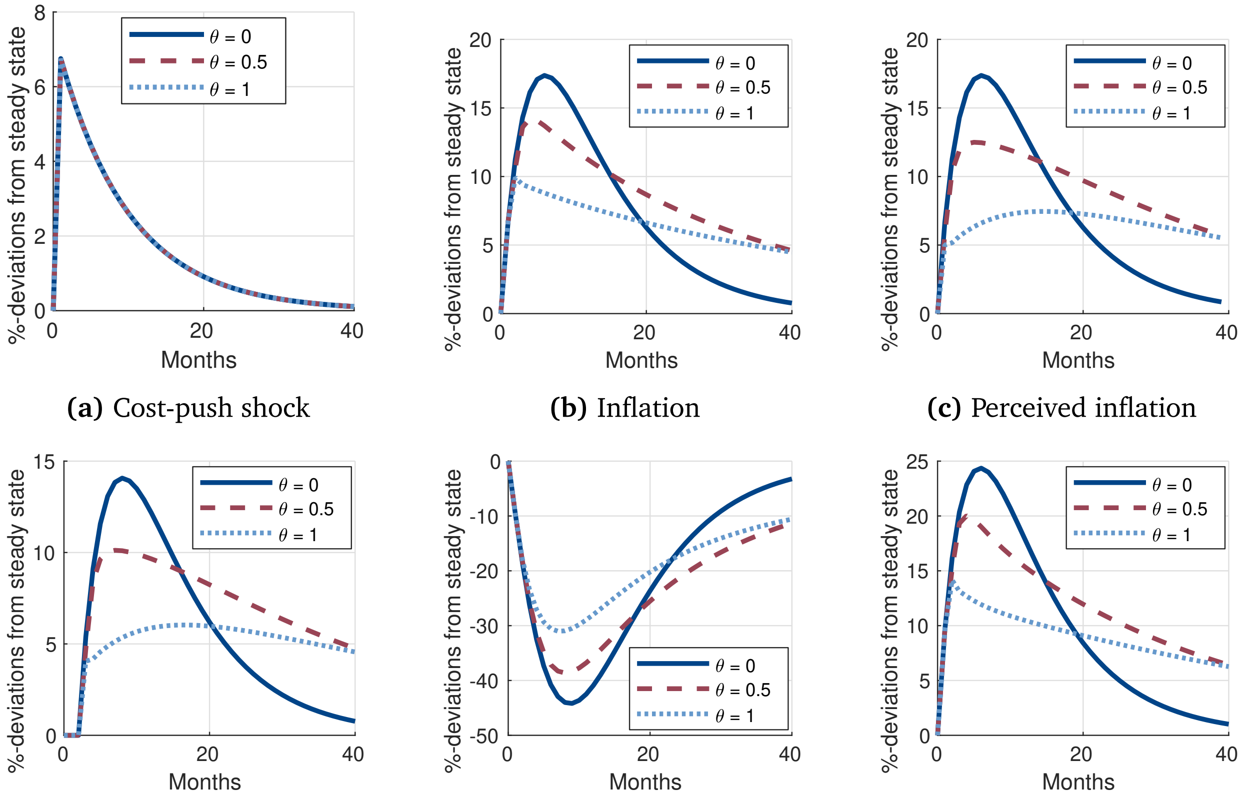
This model differs from the standard New Keynesian model in two ways. First, households believe that consumption and inflation follow AR(1) processes, and firms have forecasters that are identical to households regarding forming expectations about inflation and the output gap. Second, households do not perfectly observe inflation but instead have left-digit-biased inflation perceptions and expectations as defined in section 2. Perceived inflation can differ from actual inflation, affecting a household's forecast of future inflation.

5.2. How left-digit bias changes the propagation of a cost-push shock

We now examine how left-digit-biased inflation expectations shape the propagation of a cost-push shock. The system is solved by forward iteration, given initial values for the nominal interest rate, the lagged output gap, and past inflation, as well as an exogenous shock sequence z_t. At each step, this requires solving a nonlinear system of equations. The nonlinearity arises from the left-digit-biased formation of inflation expectations.

We calibrate the model at a monthly frequency, setting the following parameters to standard

[13] Consistent with the information lag in inflation perceptions and expectations, households form output-gap expectations based on last period's output gap.



(a) Cost-push shock **(b)** Inflation **(c)** Perceived inflation

(d) Expected inflation **(e)** Output gap **(f)** Nominal interest rate

Notes: The cost-push shock is of size 0.0675 on impact and follows an AR(1) process with persistence 0.9. The panels show impulse-response functions for different degrees of left-digit bias, $\theta \in \{0, 0.5, 1\}$, where $\theta = 0$ corresponds to no left-digit bias, $\theta = 1$ to full left-digit bias, and $\theta = 0.5$ to intermediate left-digit bias.

Figure 4: Impulse-response to a cost-push shock

values from the literature (Galí, 2015): β is set to 0.9967, resulting in a 4 percent real annual interest rate, κ is set to 0.01, σ is set to 1, ϕ_π is set to 1.5, and ϕ_y is set to $0.50/12 = 0.042$. We will study different values for the inattention to the right digits in inflation, θ. Following our findings from the empirical analysis, we study inflation thresholds that are multiples of five by setting $\tau = 5$. Similarly, since we do not find decreasing-inflation threshold events, we set $\chi = 0$. For inflation perceptions to converge to the steady-state inflation rate of 0 percent, households must still pay some attention to the current inflation level, $\lambda < 1$, as we discuss in section 2. We set $\lambda = 0.9$. The parameters for the subjective persistence of inflation and consumption are set to $\rho_\pi = 0.9$ and $\rho_y = 0.9$. Lastly, we consider a cost-push shock that causes inflation to exceed the 5 percent threshold on impact and then revert to zero with persistence $\rho_z = 0.9$. The implied impact shock size is 0.0675. Since this is a comparatively simple model, the results shown are not intended to be *quantitatively* accurate but to illustrate the *qualitative* effects of left-digit-biased inflation expectations on inflation dynamics and the output gap.

Figure 4 shows the impulse response functions to the same cost-push shock for different degrees of left-digit bias, $\theta \in \{0, 0.5, 1\}$. The dynamics can be understood step by step by tracing how the shock propagates through the system of equations.

The cost-push shock directly increases inflation in period 1 through the New Keynesian Phillips curve (11). Given the Taylor rule (13), higher inflation leads the central bank to raise the nominal interest rate. The higher nominal rate in turn reduces aggregate demand and thus the output gap through the Euler equation (12). The negative output gap then feeds back into the NKPC and dampens the inflationary pressure somewhat. In equilibrium, inflation jumps from 0 to 6.7 percent, surpassing the 5-percent threshold. The output gap declines by 9.6 percent, and the nominal interest rate rises by 9.6 percentage points. Because expectations are backward-looking, inflation expectations for the second period have not yet adjusted when the shock hits. Hence, in period 1, the responses are identical across all degrees of left-digit bias, θ.

In period 2, households receive information about actual inflation in period 1 and update their perceived inflation accordingly. Since inflation has crossed the 5-percent threshold, perceived inflation jumps to a value slightly above 5 percent for all θ. With weaker left-digit bias (that is, lower θ), households pay more attention to the exact inflation rate and therefore revise their perceived inflation more strongly upward. However, because the threshold crossing dominates perception, these differences are small in absolute terms. The higher perceived inflation in period 1 raises expected inflation for period 3. Since households have backward-looking expectations, this amplification occurs with a one-period delay: when households form expectations in period 2, they take into account the higher perceived inflation from period 1. As a result, inflation expectations for period 3 rise above zero for all θ. Higher inflation expectations in period 2 feed back into the NKPC (11), as firms anticipating higher future inflation set prices more aggressively. The same mechanism appears in the Euler equation (12), where households, expecting higher future inflation, postpone consumption, reducing the current output gap. Inflation thus increases again, and the output gap becomes more negative in period 2.

Up to this point, the responses are qualitatively similar across degrees of left-digit bias. The main differences emerge from period 3 onwards. In period 3, households observe inflation in period 2. If they are subject to left-digit bias, they disregard small changes as long as inflation does not surpass another threshold, meaning perceived inflation stays at about 5 percent. Without left-digit bias ($\theta = 0$), households pay full attention to the actual inflation rate, which has increased further to about 8.5 percent. Hence, perceived inflation now diverges strongly across degrees of bias. This difference carries forward to expectations. When forming expectations in period 3, unbiased households expect a higher future inflation rate for period 4, whereas biased households still expect roughly 5 percent inflation. These differences in expectations directly feed back into inflation dynamics. Without left-digit bias, higher expected inflation raises current inflation through the NKPC and leads to a stronger monetary tightening via the Taylor rule, which further depresses output through the Euler equation. With left-digit bias, however, the muted increase in expected inflation leads to a smaller rise in current inflation, a milder monetary policy response, and a less pronounced output contraction in period 3 and onward. Because of backward-looking expectations, this feedback loop produces a delayed amplification: even though the initial shock is already decaying, inflation and the interest rate continue to rise, while the output gap keeps declining. This mechanism generates the hump-shaped impulse response of inflation and the nominal interest rate in the unbiased case ($\theta = 0$).

As time passes, the cost-push shock itself fades out. In all cases, inflation, the output gap, and the nominal interest rate gradually converge back toward their steady-state values. However, with left-digit bias, the adjustment path differs markedly. Since households ignore small decreases in inflation as long as it remains above 5 percent, their perceived inflation and expectations decline only very slowly. When actual inflation eventually falls below the 5-percent threshold, there is no corresponding downward jump in perceived inflation, because the updating rule in equation (3)—governed by $\chi = 0$—prevents symmetric adjustments. Consequently, inflation perceptions and expectations remain elevated even as actual inflation declines. This slow downward adjustment implies that firms continue to expect moderate inflation and keep prices somewhat elevated, while households maintain subdued consumption, leading to a prolonged negative output gap. Monetary policy reacts to the still-high inflation expectations by keeping the nominal interest rate elevated for longer.

In sum, left-digit bias alters the transmission of cost-push shocks in two ways. It dampens the initial response of inflation because expectations do not fully adjust upward, but it also increases persistence once a threshold is crossed because inflation perceptions and expectations adjust downward only sluggishly when inflation declines. As a result, the economy with left-digit-biased expectations exhibits weaker short-run inflation responses but more persistent inflation, a more prolonged output contraction, and a longer period of tight monetary policy. The case of intermediate bias ($\theta = 0.5$) lies between these two extremes: initial reactions are slightly dampened, and the return to steady state is slower than without bias but faster than under full left-digit bias.

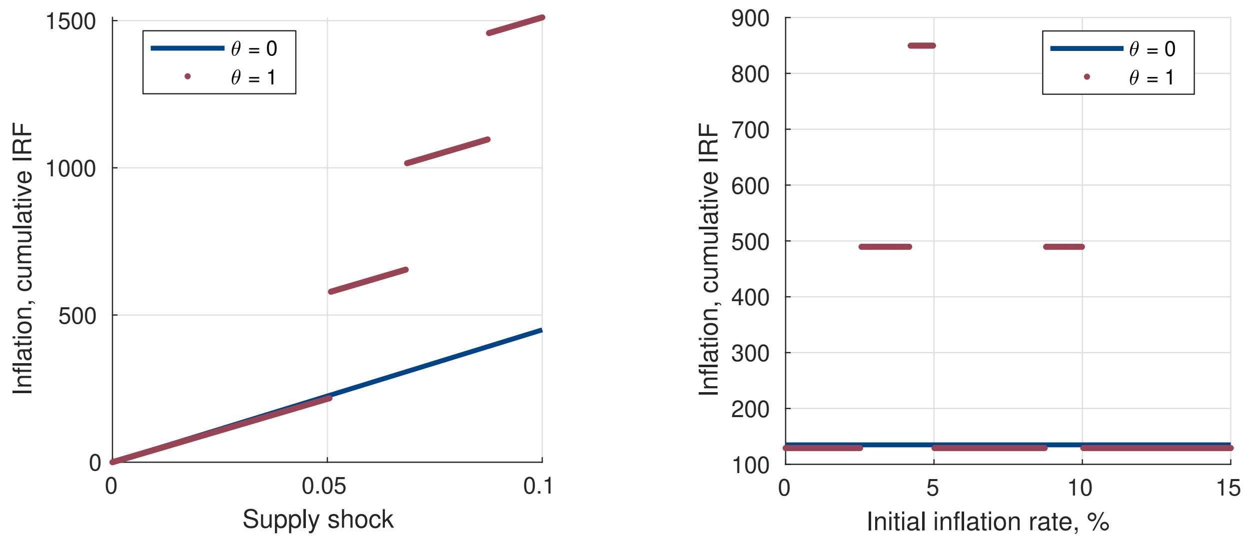
5.3. Discussion: de-anchoring and non-linearities

As the impulse responses in Figure 4 show, when a shock is large enough for inflation to exceed a salient threshold such as 5 percent, left-digit-biased expectations cause inflation expectations to remain persistently elevated even after the shock itself has faded. After three years and four months, the shock has largely vanished, yet inflation expectations with left-digit bias remain just below 5 percent, while they have returned close to zero without bias. This persistence arises because households update their inflation perceptions and expectations asymmetrically: they react when inflation crosses a threshold from below but not when it falls below a threshold from above. The strength of this persistence depends on the level-inattention parameter λ, and the exercise here serves to illustrate the mechanism rather than to quantify it.

These persistently higher inflation expectations after a large shock can be interpreted as a form of de-anchoring. In the model, inflation ultimately returns to its steady state of zero percent, but the adjustment takes considerably longer with left-digit-biased expectations, requiring monetary policy to keep interest rates higher for longer.[14] Empirically, several recent findings suggest that expectation did not become fully anchored during the recent disinflation, with some measures still showing de-anchoring and elevated expectations among US consumers (Coibion and Gorodnichenko, 2025), European firms (Baumann *et al.*, 2025), and European consumers (D'Acunto *et al.*, 2024). Our model provides a complementary explanation for why inflation expectations can stay elevated after initial shocks have dissipated. In short, the 'last mile' is long, and policy must remain restrictive to bring expectations back down.

Left-digit-biased inflation expectations introduce strong nonlinearities that depend on the size of a shock and the state of the economy into the New Keynesian model. Without left-digit bias, the model is linear by construction, because it was linearized around its steady-state when deriving equations (11) to (13), and the responses to shocks scale proportionally with the size of the shock. However, with left-digit-biased inflation expectations, the responses depend on whether inflation crosses a threshold or not. This results in implicit threshold values for the shock size. Typically, small increases in the shock size have only small effects on inflation, the output gap, and the nominal interest rate. However, if the shock crosses these implicit thresholds, the responses discontinuously jump to higher absolute levels. We show this nonlinearity in Figure 5a, where we plot cumulative inflation responses against different sizes of the cost-push shock. This non-linearity implies that the economy responds very differently to small shocks than to large shocks, and that monetary policy has to react much more aggressively and persistently once a shock pushes the economy over a threshold. Similarly, if several medium-sized shocks, for example, a demand shock due to expansionary fiscal policy and a cost-push shock due to rising energy prices, occur in close succession, their combined effect could push

[14]The literature on de-anchoring, however, goes further by allowing agents to hold beliefs about future inflation that diverge from the central bank's target under imperfect information (see Bocola *et al.*, 2025; Carvalho *et al.*, 2023; Dupraz and Marx, 2023 for recent examples).



(a) Shock-size dependence

(b) State-dependence

Notes: Both panels show results based on 300 simulations of 300-period impulse responses using the baseline parameterization. Both panels compare economies without left-digit bias ($\theta = 0$) and with full left-digit bias ($\theta = 1$). In the left panel, the horizontal axis shows the size of the supply shock, which is varied across the 300 simulations. For each simulation, we compute the cumulative inflation response of the inflation rate as the sum of deviations from the steady state over the entire transition. The right panel repeats this procedure for a fixed shock size ($z = 0.03$) but varies the initial inflation level. Specifically, inflation in the two pre-shock periods and perceived inflation are set to this initial level. The cumulative IRF then measures the total effect of the shock, computed as the difference between the transition with and without the shock, conditional on the same initial state away from steady state.

Figure 5: Non-linearities in the New-Keynesian model with left-digit-biased inflation expectations

inflation over a threshold, resulting in a much stronger response than each shock individually.

Relatedly, small shocks can have very different effects depending on the state of the economy. When inflation expectations are low, the effect of a small shock is limited—similar to the case without left-digit bias. However, when inflation and inflation expectations are already elevated but just below a threshold, a small shock can push the economy across that threshold and trigger a much stronger response. We illustrate this in Figure 5b, which plots cumulative inflation responses to equally sized shocks across different initial inflation levels. This state dependence underscores the risk associated with elevated inflation expectations. Our New Keynesian model with left-digit-biased expectations suggests that currently still elevated inflation expectations in both the euro area and the United States increase the likelihood that even small shocks—such as those from trade policy—could push inflation over a threshold again, generating a disproportionately strong inflationary response.[15] Our model thus provides a for-

[15] Different indicators of household inflation expectations exist across surveys, horizons, and summary statistics. Mean one-year-ahead inflation expectations in both the United States and the euro area remain above their pre-surge levels (Coibion and Gorodnichenko, 2025; European Central Bank, 2025).

mal framework for a concern raised in recent discussions (Coibion and Gorodnichenko, 2025).

6. Conclusion

This paper investigates left-digit bias in household inflation expectations. We theoretically define left-digit bias in inflation expectations and show how it leads to jump discontinuities between current and expected future inflation. Using data from 29 European countries between 2017 and 2024, we employ a regression-discontinuity design to estimate the impact of inflation threshold events on expectations.

Our main findings are as follows: First, inflation thresholds occur at multiples of 5 percent. Second, when inflation rises above these thresholds, mean and median inflation expectations jump by 0.6 and 0.8 percentage points, respectively. Third, we find an asymmetry in the effects of rising and falling inflation. When inflation falls below these thresholds, it does not significantly impact expectations. Fourth, the effect is primarily driven by households that previously expected zero or negative inflation. After inflation rises above these thresholds, these households now expect rising inflation.

These findings are based on cross-country data. To isolate the mechanism at the individual level, we run a randomized controlled trial. Participants are randomly exposed to inflation figures just below or just above a threshold. Those seeing the number above the threshold report markedly higher inflation expectations. This provides evidence that individuals process inflation figures with a left-digit bias.

To study the macroeconomic implications, we embed left-digit-biased inflation expectations in a New Keynesian model. We focus on a cost-push shock. With left-digit bias, initial responses in inflation, nominal interest rates, and the output gap are smaller than in an economy without left-digit bias because expectations adjust only once a threshold is crossed. However, when the shock is large enough to push inflation above 5 or even 10 percent, expectations increase sharply and remain elevated for longer. As a result, inflation stays high for longer, the recession is more prolonged, and monetary policy must keep interest rates high for an extended period compared to a model without left-digit bias.

Taken together, our evidence shows that round-number thresholds play a central role in how households process inflation information. These thresholds create non-linearities in expectation formation that matter both in the data and in the propagation of shocks. In ongoing work, we examine optimal monetary policy in this environment, where persistent expectation dynamics shape the welfare trade-offs faced by the central bank. We also study how the media reports inflation when a threshold is crossed—how often inflation is mentioned, how headlines change, and whether the tone shifts—and how such coverage amplifies or dampens threshold effects in household expectations.

References

AGARWAL, S., CORREIA, S., MORAIS, B. and SONG, C. (2022). Stock market milestones and mortgage demand: Evidence from US, Working Paper.

A'HEARN, B., BATEN, J. and CRAYEN, D. (2009). Quantifying quantitative literacy: Age heaping and the history of human capital. *The Journal of Economic History*, **69** (3), 783–808.

ANDRADE, P., GAUTIER, E. and MENGUS, E. (2023). What matters in households' inflation expectations? *Journal of Monetary Economics*, **138**, 50–68.

BACKUS, M., BLAKE, T. and TADELIS, S. (2019). On the empirical content of cheap-talk signaling: An application to bargaining. *Journal of Political Economy*, **127**, 1599–1628.

BADARINZA, C. and BUCHMANN, M. (2009). Inflation perceptions and expectations in the euro area: the role of news, Working Paper.

BAUMANN, U., FERRANDO, A., GEORGARAKOS, D., GORODNICHENKO, Y. and REINELT, T. (2025). Do inflation expectations become more anchored during a disinflation episode? evidence for euro area firms. *AEA Papers and Proceedings*, **115**, 266–270.

BHATTACHARYA, U., HOLDEN, C. W. and JACOBSEN, S. (2012). Penny wise, dollar foolish: Buy-sell imbalances on and around round numbers. *Management Science*, **58**, 413–431.

BINDER, C., FRANK, P. and RYNGAERT, J. M. (2025). *The Causal Effect of News on Inflation Expectations*. NBER Working Paper 34088, National Bureau of Economic Research, Cambridge, MA.

BINDER, C. C. (2017). Measuring uncertainty based on rounding: New method and application to inflation expectations. *Journal of Monetary Economics*, **90**, 1–12.

BOCOLA, L., DOVIS, A., JØRGENSEN, K. and KIRPALANI, R. (2025). *Monetary Policy without an Anchor*. NBER Working Paper 34436, National Bureau of Economic Research.

BRACHA, A. and TANG, J. (2023). Inflation levels and (in) attention. FRB of Boston Working Paper.

CAMERON, A. C., GELBACH, J. B. and MILLER, D. L. (2008). Bootstrap-based improvements for inference with clustered errors. *Review of Economics and Statistics*, **90**, 414–427.

— and MILLER, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, **50**, 317–372.

CARRILLO, P. E. and SHAHE EMRAN, M. (2012). Public information and inflation expectations: Microeconometric evidence from a natural experiment. *Review of Economics and Statistics*, **94** (4), 860–877.

CARVALHO, C., EUSEPI, S., MOENCH, E. and PRESTON, B. (2023). Anchored inflation expectations. *American Economic Journal: Macroeconomics*, **15** (1), 1–47.

CATTANEO, M. D., TITIUNIK, R. and VAZQUEZ-BARE, G. (2020). Analysis of regression-discontinuity designs with multiple cutoffs or multiple scores. *The Stata Journal*, **20**, 866–891.

CAVALLO, A., CRUCES, G. and PEREZ-TRUGLIA, R. (2017). Inflation expectations, learning, and supermarket prices: Evidence from survey experiments. *American Economic Journal: Macroeconomics*, **9** (3), 1–35.

CHAHROUR, R., SHAPIRO, A. and WILSON, D. (2025). News selection and household inflation expectations. *American Economic Review*, forthcoming.

CHEN, J., GORNICKA, L. and ZDAREK, V. (2022). Biases in survey inflation expectations: Evidence from the euro area, European Economy Discussion Papers.

COIBION, O., GEORGARAKOS, D., GORODNICHENKO, Y. and VAN ROOIJ, M. (2023). How does consumption respond to news about inflation? Field evidence from a randomized control trial. *American Economic Journal: Macroeconomics*, **15** (3), 109–152.

— and GORODNICHENKO, Y. (2015). Is the Phillips curve alive and well after all? Inflation expectations and the missing disinflation. *American Economic Journal: Macroeconomics*, **7** (1), 197–232.

— and — (2025). *Inflation, Expectations and Monetary Policy: What Have We Learned and to What End?* Working Paper 33858, National Bureau of Economic Research.

—, — and WEBER, M. (2022). Monetary policy communications and their effects on household inflation expectations. *Journal of Political Economy*, **130** (6), 1537–1584.

D'ACUNTO, F., CHARALAMBAKIS, E., GEORGARAKOS, D., KENNY, G., MEYER, J. and WEBER, M. (2024). *Household Inflation Expectations: An Overview of Recent Insights for Monetary Policy*. ECB Discussion Paper 24, European Central Bank.

—, HOANG, D., PALOVIITA, M. and WEBER, M. (2019). Cognitive abilities and inflation expectations. *AEA Papers and Proceedings*, **109**, 562–566.

—, —, — and — (2022). IQ, expectations, and choice. *The Review of Economic Studies*, **90** (5), 2292–2325.

—, — and WEBER, M. (2021a). Managing households' expectations with unconventional policies. *The Review of Financial Studies*, **35** (4), 1597–1642.

—, MALMENDIER, U., OSPINA, J. and WEBER, M. (2021b). Exposure to grocery prices and inflation expectations. *Journal of Political Economy*, **129** (5), 1615–1639.

—, — and WEBER, M. (2021c). Gender roles produce divergent economic expectations. *Proceedings of the National Academy of Sciences*, **118** (21).

DOMAHS, F., MOELLER, K., HUBER, S., WILLMES, K. and NUERK, H.-C. (2010). Embodied numerosity: Implicit hand-based representations influence symbolic number processing across cultures. *Cognition*, **116** (2), 251–266.

DRÄGER, L. (2015). Inflation perceptions and expectations in Sweden - Are media reports the missing link? *Oxford Bulletin of Economics and Statistics*, **77** (5), 681–700.

—, LAMLA, M. J. and PFAJFAR, D. (2016). Are survey expectations theory-consistent? The role of central bank communication and news. *European Economic Review*, **85**, 84–111.

DUCA-RADU, I., KENNY, G. and REUTER, A. (2021). Inflation expectations, consumption and the lower bound: Micro evidence from a large multi-country survey. *Journal of Monetary Economics*, **118**, 120–134.

DUPRAZ, S. and MARX, M. (2023). *Anchoring Boundedly Rational Expectations*. Working paper no 936, Banque de France.

EUROPEAN CENTRAL BANK (2025). Consumer expectations survey (ces). https://www.ecb.europa.eu/stats/ecb_surveys/consumer_exp_survey/, accessed on 2025-11-27.

EUROPEAN COMMISSION (2023). *The Joint Harmonised EU Programme of Business and Consumer Surveys – User Guide January 2023*. Tech. rep., European Commission, Directorate-General for Economic and Financial Affairs.

EUROSTAT (2018). *Harmonised Index of Consumer Prices (HICP) – Methodological Manual, November 2018*. Luxembourg.

FOELLMI, R., LEGGE, S. and SCHMID, L. (2016). Do professionals get it right? Limited attention and risk-taking behaviour. *Economic Journal*, **126**, 724–755.

FUSTER, A. and ZAFAR, B. (2023). Survey experiments on economic expectations. In R. Bachmann, G. Topa and W. van der Klaauw (eds.), *Handbook of Economic Expectations*, Academic Press, pp. 107–130.

GABAIX, X. (2019). Chapter 4 - behavioral inattention. In B. D. Bernheim, S. DellaVigna and D. Laibson (eds.), *Handbook of Behavioral Economics - Foundations and Applications 2*, *Handbook of Behavioral Economics: Applications and Foundations 1*, vol. 2, North-Holland, pp. 261–343.

GALÍ, J. (2015). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and Its Applications*. Princeton University Press, 2nd edn.

GAMBETTI, L., MAFFEI-FACCIOLI, N. and ZOI, S. (2023). Bad news, good news: Coverage and response asymmetries. *Finance and Economics Discussion Series, Board of Governors of the Federal Reserve System*, (2023-001).

GARZ, M. (2018). Effects of unemployment news on economic perceptions – Evidence from German federal states. *Regional Science and Urban Economics*, **68**, 172–190.

— and LARIN, B. (2025a). Crossing the line: Media coverage of inflation thresholds, mimeo.

— and — (2025b). Left-digit bias in household inflation expectations. AEA RCT Registry. August 04. https://doi.org/10.1257/rct.16243-1.1.

— and MARTIN, G. J. (2021). Media influence on vote choices: Unemployment news and incumbents' electoral prospects. *American Journal of Political Science*, **65** (2), 278–293.

GOLDFAYN-FRANK, O. and WOHLFART, J. (2020). Expectation formation in a new environment: Evidence from the german reunification. *Journal of Monetary Economics*, **115**, 301–320.

GOODMAN, J., GURANTZ, O. and SMITH, J. (2020). Take two! SAT retaking and college enrollment gaps. *American Economic Journal: Economic Policy*, **12**, 115–158.

HAALAND, I., ROTH, C. and WOHLFART, J. (2023). Designing information provision experiments. *Journal of Economic Literature*, **61**, 3–40.

HERAUD, F. and PAGE, L. (2024). Does the left-digit bias affect prices in financial markets? *Journal of Economic Behavior & Organization*, **218**, 20–29.

HOULE, T. T., BUTSCHEK, R. A., TURNER, D. P., SMITHERMAN, T. A., RAINS, J. C. and PENZIEN, D. B. (2013). Rounding behavior in the reporting of headache frequency: results from a population-based study in canada. *Headache: The Journal of Head and Face Pain*, **53** (6), 882–889.

HUBER, S. J., MININA, D. and SCHMIDT, T. (2023). The pass-through from inflation perceptions to inflation expectations, Deutsche Bundesbank Discussion Paper 12/2023.

KAHNEMAN, D. and TVERSKY, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, **47** (2), 263–291.

KORENOK, O., MUNRO, D. and CHEN, J. (2022). Inflation and attention thresholds, Working paper.

LACETERA, N., POPE, D. G. and SYDNOR, J. R. (2012). Heuristic thinking and limited attention in the car market. *American Economic Review*, **102**, 2206–2236.

LAMLA, M. J. and VINOGRADOV, D. V. (2019). Central bank announcements: Big news for little people? *Journal of Monetary Economics*, **108**, 21–38.

LIST, J. A., MUIR, I., POPE, D. and SUN, G. (2023). Left-digit bias at Lyft. *Review of Economic Studies*, **90** (6), 3186–3237.

MALMENDIER, U. and NAGEL, S. (2015). Learning from inflation experiences. *The Quarterly Journal of Economics*, **131** (1), 53–87.

MOELLER, K., MARTIGNON, L., WESSOLOWSKI, S., ENGEL, J. and NUERK, H.-C. (2011). Effects of finger counting on numerical development. *Frontiers in Psychology*, **2**, 328.

PFAJFAR, D. and SANTORO, E. (2013). News on inflation and the epidemiology of inflation expectations. *Journal of Money, Credit and Banking*, **45** (6), 1045–1067.

PFÄUTI, O. (2023). The inflation attention threshold and inflation surges, Working Paper.

— (2025). Inflation—who cares? Monetary policy in times of low attention. *Journal of Money, Credit and Banking*, **57** (5), 1211–1239.

Picault, M., Pinter, J. and Renault, T. (2022). Media sentiment on monetary policy: Determinants and relevance for inflation expectations. *Journal of International Money and Finance*, **124**, 102626.

Repetto, L. and Solís, A. (2019). The price of inattention: Evidence from the Swedish housing market. *Journal of the European Economic Association*, **18** (6), 3261–3304.

Salle, I., Gorodnichenko, Y. and Coibion, O. (2023). *Lifetime Memories of Inflation: Evidence from Surveys and the Lab*. NBER Working Paper 31996, National Bureau of Economic Research.

Sims, C. A. (2003). Implications of rational inattention. *Journal of Monetary Economics*, **50** (3), 665–690.

Sokolova, T., Seenivasan, S. and Thomas, M. (2020). The left-digit bias: When and why are consumers penny wise and pound foolish? *Journal of Marketing Research*, **57**, 771–788.

Sonnemans, J. (2006). Price clustering and natural resistance points in the Dutch stock market: A natural experiment. *European Economic Review*, **50**, 1937–1950.

Soroka, S. N. (2006). Good news and bad news: Asymmetric responses to economic information. *The Journal of Politics*, **68** (2), 372–385.

Stanisławska, E., Paloviita, M. and Łyziak, T. (2021). Consumer inflation views: Micro-level inconsistencies and macro-level measures. *Economics Letters*, **206**, 110004.

Strulov-Shlain, A. (2023). More than a penny's worth: Left-digit bias and firm pricing. *Review of Economic Studies*, **90** (5), 2612–2645.

Thomas, M. and Morwitz, V. (2005). Penny wise and pound foolish: The left-digit effect in price cognition. *Journal of Consumer Research*, **32**, 54–64.

Tutino, A. (2013). Rationally inattentive consumption choices. *Review of Economic Dynamics*, **16** (3), 421–439.

Urquhart, A. (2017). Price clustering in Bitcoin. *Economics Letters*, **159**, 145–148.

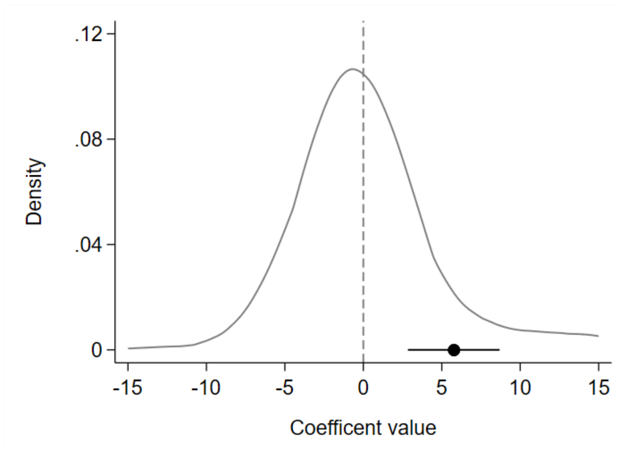
Weber, M., Candia, B., Ropele, T., Lluberas, R., Frache, S., Meyer, B. H., Kumar, S., Gorodnichenko, Y., Georgarakos, D., Coibion, O. *et al.* (2023). Tell me something i don't already know: Learning in low and high-inflation settings, NBER Working Paper.

—, D'Acunto, F., Gorodnichenko, Y. and Coibion, O. (2022a). The subjective inflation expectations of households and firms: Measurement, determinants, and implications. *Journal of Economic Perspectives*, **36** (3), 157–184.

—, Gorodnichenko, Y. and Coibion, O. (2022b). The expected, perceived, and realized inflation of US households before and during the COVID19 pandemic. *IMF Economic Review*, **71** (1), 326–368.

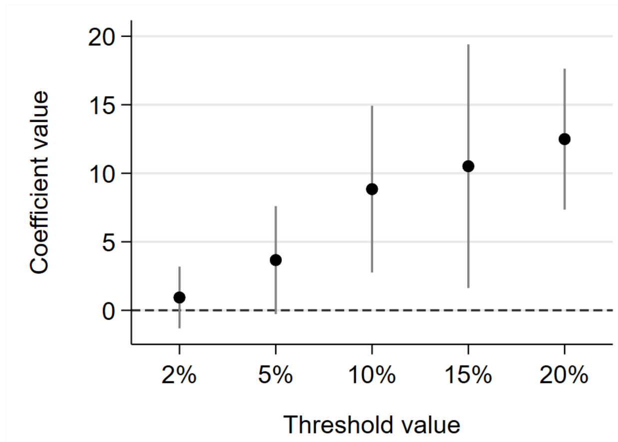
Online Appendix for "Left-Digit Bias in Household Inflation Expectations"

A. Additional figures and tables



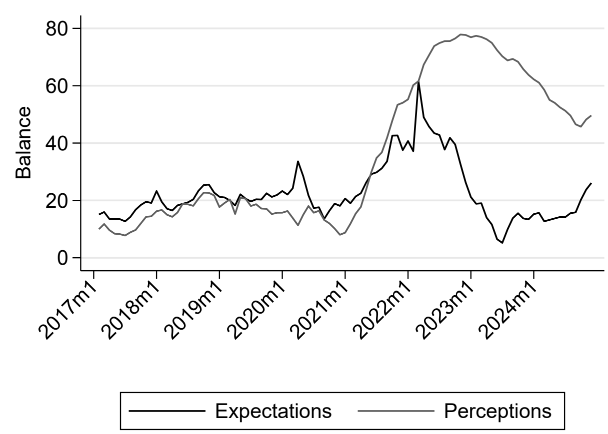
*Notes: The figure shows kernel density plots of the distribution of coefficients from re-estimating the baseline specification 1,000 times with increasing-inflation placebo thresholds. The dependent variable are qualitative inflation expectations. Each set of placebo thresholds consists of five non-integer values randomly drawn from all possible values (with one decimal place) in the interval from 0.1 to 29.1%. We create a new threshold event dummy that replaces the multiples-of-five treatment dummy when re-estimating the baseline specification. Cases in which the inflation rate crosses an integer value are set to 0 to avoid contamination of the placebo regressions with actual threshold effects. The black circle denotes the coefficient of the multiples-of-five increasing-inflation threshold dummy from equation (**??**), along with the 95% confidence interval (based on standard errors clustered by country*

Figure A.1: Regression results with placebo thresholds



Notes: The graph shows regression coefficients from estimating equation (9) with separate dummy variables for the increasing-inflation threshold values shown on the x-axis. The y-axis measures the reduced-form effect of the threshold events on qualitative inflation expectations (i.e., the ratio of households expecting increasing vs. decreasing inflation). The vertical bars denote the 90% confidence interval based on standard errors clustered by country.

Figure A.2: Individual inflation thresholds and inflation expectations



Notes: Based on data from the European Business and Consumer Surveys. Inflation expectations are based on the question, "By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?" while inflation perceptions are based on the question, "How do you think that consumer prices have developed over the last 12 months?".

Figure A.3: Balance of inflation expectations vs. balance of inflation perceptions

	(1) Population size	(2) GDP	(3) Government debt	(4) Interest rate	(5) Unemployment rate	(6) Balance of payments
Increasing-infl. threshold	-2.59	-2.65	-9.72	0.07	-0.20	-43.87
	(2.82)	(1.64)	(20.21)	(0.09)	(0.15)	(669.26)
Decreasing-infl. threshold	2.31	0.12	-14.21	0.03	0.26	-294.77
	(2.21)	(1.24)	(23.43)	(0.14)	(0.16)	(1524.93)
Country fixed effects	no	yes	yes	yes	yes	yes
Observations	2699	2693	2449	2484	2524	2148

Notes: Population size is based on yearly observations and refers to the number of inhabitants (in million) of a country on 1 January. GDP is based on quarterly observations and refers to chain linked volumes. Government debt is based on quarterly observations and is measured in billion euros. Interest rate is based on monthly observations and refers to long-term government bonds yield. Unemployment rate is based on monthly observations. Balance of payments (current account) is based on monthly observations and measured in million euro. All specifications include time fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. The regressions in Columns (2) to (6) are weighted by countries' population share in the sample. Standard errors (in parentheses) are clustered by country.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.1: Balance checks

	Share of households expecting prices to...				
	(1)	(2)	(3)	(4)	(5)
	...increase more rapidly	...increase at same rate	...increase at slower rate	...stay about same	...fall
Increasing-infl. threshold	2.378	2.237**	0.005	-3.881***	-0.740***
	(1.625)	(0.865)	(1.160)	(0.720)	(0.242)
Decreasing-infl. threshold	1.312	-1.284	-1.712	1.519	0.170
	(1.095)	(0.901)	(1.018)	(1.095)	(0.279)
Mean of dependent variable	18.599	37.398	17.823	23.886	2.293
SD of dependent variable	10.136	11.464	9.341	14.114	2.306
Observations	2327	2327	2327	2327	2327

All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.2: Inflation threshold events and qualitative inflation expectations (decomposed by answer options)

	Mean inflation expectations of households expecting prices to...			
	(1)	(2)	(3)	(4)
	...increase more rapidly	...increase at the same rate	...increase at a slower rate	...fall
Increasing-infl. threshold	0.336	-0.190	-0.325**	0.143
	(0.279)	(0.164)	(0.139)	(0.221)
Decreasing-infl. threshold	-0.463	-0.082	0.398	-0.552**
	(0.496)	(0.286)	(0.255)	(0.205)
Mean of dependent variable	12.678	10.177	7.211	-3.268
SD of dependent variable	4.974	4.172	2.860	1.009
Observations	2326	2326	2326	2145

All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.
* *p<0.10, ** p<0.05, *** p<0.01*

Table A.3: Inflation threshold events and quantitative inflation expectations (decomposed by answer options)

	(1)	(2)	(3)
	Qualitative expectations	Mean expectations	Median expectations
Increasing-infl. threshold	0.673	-0.022	0.082
	(1.014)	(0.085)	(0.237)
Decreasing-infl. threshold	-0.990	-0.059	0.469
	(1.436)	(0.162)	(0.329)
H_0: symmetric effects (p-value)	0.860	0.694	0.183
Mean of dependent variable	22.538	6.696	5.282
SD of dependent variable	17.185	3.596	5.266
Observations	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses any integer between 1 and 29 for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.
* *p<0.10, ** p<0.05, *** p<0.01*

Table A.4: Inflation threshold events and inflation expectations (integers as thresholds)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations	(4) Qualitative expectations	(5) Mean expectations	(6) Median expectations
6-month protection period						
- Increasing-infl. threshold	5.663***	0.619***	0.876			
	(1.799)	(0.183)	(0.547)			
- Decreasing-infl. threshold	0.077	-0.161	0.298			
	(1.665)	(0.267)	(0.599)			
18-month protection period						
- Increasing-infl. threshold				6.222***	0.681***	1.019*
				(1.655)	(0.175)	(0.533)
- Decreasing-infl. threshold				0.464	-0.403	-0.653
				(2.645)	(0.390)	(0.590)
H_0: symmetric effects (p-value)	0.008	0.134	0.156	0.049	0.522	0.668
Mean of dependent variable	22.538	6.696	5.282	22.535	6.698	5.284
SD of dependent variable	17.185	3.596	5.266	17.188	3.598	5.267
Observations	2699	2327	2327	2681	2309	2309

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 6 or 18 months. Standard errors (in parentheses) are clustered by country.
** p<0.10, ** p<0.05, *** p<0.01*

Table A.5: Inflation threshold events and inflation expectations (alternative threshold protection periods)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations	(4) Qualitative expectations	(5) Mean expectations	(6) Median expectations
Increasing-infl. threshold	4.340**	0.420**	0.729	3.773*	0.471**	0.419
	(1.794)	(0.195)	(0.562)	(1.973)	(0.179)	(0.392)
Decreasing-infl. threshold	0.115	-0.205	0.409	1.198	-0.115	0.468
	(2.271)	(0.348)	(0.709)	(2.235)	(0.310)	(0.633)
H_0: symmetric effects (p-value)	0.070	0.537	0.222	0.058	0.264	0.207
Bandwidth of inflation rate bin dummies	0.2	0.2	0.2	0.5	0.5	0.5
Mean of dependent variable	22.545	6.703	5.294	22.597	6.738	5.354
SD of dependent variable	17.183	3.606	5.284	17.190	3.647	5.369
Observations	2699	2327	2327	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects and a 3rd order polynomial of the change in inflation rate. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.6: Inflation threshold events and inflation expectations (alternative bandwidths for inflation rate bin dummies)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations	(4) Qualitative expectations	(5) Mean expectations	(6) Median expectations
Increasing-infl. threshold	5.289***	0.565***	0.757	5.607***	0.615***	0.867
	(1.704)	(0.188)	(0.539)	(1.783)	(0.183)	(0.538)
Decreasing-infl. threshold	1.087	-0.037	0.636	1.310	-0.067	0.591
	(1.837)	(0.298)	(0.618)	(1.919)	(0.301)	(0.635)
H_0: symmetric effects (p-value)	0.005	0.107	0.099	0.006	0.099	0.098
Change of inflation rate, order of polynomial	2	2	2	4	4	4
Mean of dependent variable	22.538	6.696	5.282	22.538	6.696	5.282
SD of dependent variable	17.185	3.596	5.266	17.185	3.596	5.266
Observations	2699	2327	2327	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.7: Inflation threshold events and inflation expectations (alternative polynomial orders for inflation rate change)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations
Increasing-infl. threshold	5.302***	0.628***	0.883**
	(1.585)	(0.186)	(0.397)
Decreasing-infl. threshold	-0.648	-0.190	0.639
	(2.141)	(0.217)	(0.510)
H_0: symmetric effects (p-value)	0.024	0.105	0.056
Mean of dependent variable	22.551	6.678	4.694
SD of dependent variable	17.160	3.592	4.266
Observations	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects and bin dummies of bandwidth 0.1 for the inflation rate and inflation rate change. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.8: Inflation threshold events and inflation expectations (bin dummies for inflation rate change)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations
Increasing-infl. threshold	5.750**	0.830**	1.210**
	(2.128)	(0.299)	(0.536)
Decreasing-infl. threshold	0.323	-0.157	0.343
	(2.073)	(0.258)	(0.706)
H_0: symmetric effects (p-value)	0.042	0.045	0.067
Inflation rate bin dummies (bandwidth = 0.1) × absolute change in the inflation rate	yes	yes	yes
Mean of dependent variable	22.538	6.696	4.709
SD of dependent variable	17.185	3.596	4.274
Observations	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.9: Inflation threshold events and inflation expectations (interactive specification)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations
Increasing-infl. threshold	1.187	0.767***	0.534
	(2.137)	(0.238)	(0.328)
Decreasing-infl. threshold	2.216	0.096	0.412
	(2.542)	(0.236)	(0.449)
H_0: symmetric effects (p-value)	0.323	0.014	0.114
Mean of dependent variable	22.478	6.666	4.670
SD of dependent variable	17.128	3.556	4.211
Observations	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.10: Inflation threshold events and inflation expectations (CPI-based regressions)

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations
Increasing-infl. threshold	5.627	0.613	0.804
	[0.007]	[0.000]	[0.060]
Decreasing-infl. threshold	0.986	-0.051	0.334
	[0.567]	[0.957]	[0.443]
H_0: symmetric effects (p-value)	[0.003]	[0.093]	[0.079]
Mean of dependent variable	22.538	6.696	4.709
SD of dependent variable	17.185	3.596	4.274
Observations	2699	2327	2327

Notes: Qualitative expectations refer to weighted difference between households that expect higher future inflation and those that expect zero or negative inflation. The mean and median expectations are based on households' point estimates of the future inflation rate. All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. P-values are in brackets.

Table A.11: Inflation threshold events and inflation expectations (p-values based on wild cluster bootstrap)

		Share of households thinking prices have...				
	(1)	(2)	(3)	(4)	(5)	(6)
	Balance of perceptions	...risen a lot	...risen moderately	...risen slightly	...stayed about same	...fallen
Increasing-infl. threshold	1.347	-0.468	1.223	1.140	-1.768**	-0.128
	(1.304)	(1.807)	(1.250)	(0.758)	(0.768)	(0.134)
Decreasing-infl. threshold	-4.582	-3.877	0.510	0.070	3.007**	0.294*
	(3.377)	(2.296)	(1.802)	(1.447)	(1.328)	(0.166)
Mean of dependent variable	35.946	30.860	28.124	25.167	14.848	1.000
SD of dependent variable	28.191	22.763	8.358	13.568	12.415	1.107
Observations	2699	2327	2327	2327	2327	2327

All specifications include time and country fixed effects, a 3rd order polynomial of the change in inflation rate, and inflation rate bin dummies with a bandwidth of 0.1. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.
** p<0.10, ** p<0.05, *** p<0.01*

Table A.12: Inflation threshold events and inflation perceptions

	(1) Qualitative expectations	(2) Mean expectations	(3) Median expectations	(4) Qualitative expectations	(5) Mean expectations	(6) Median expectations
Increasing-infl. threshold	11.591***	0.891***	3.655***	4.557***	1.630***	1.288***
	(1.070)	(0.092)	(0.135)	(0.922)	(0.106)	(0.105)
Value of assignment variable for threshold events occurring within 12 months after crossing the same threshold:	original	original	original	set to missing	set to missing	set to missing
Original number of obs. left of the cutoff	2571	2220	2220	2571	2220	2220
Original number of obs. right of the cutoff	128	107	107	72	65	65
Local number of obs. left of the cutoff	87	30	49	87	49	69
Local number of obs. right of the cutoff	57	39	39	33	23	28
Regression function: order of polynomial	1	1	1	1	1	1
Regression function: bandwidth	0.409	0.247	0.296	0.474	0.329	0.411
Bias function: order of polynomial	2	2	2	2	2	2
Bias function: bandwidth	0.762	0.584	0.581	0.877	0.635	0.703

Notes: The table shows robust bias-corrected regression discontinuity estimates based on mean squared error-optimal bandwidth selection, using the estimation implementation provided by Calonico et al. (2017). The assignment variable is defined as: $(rate_{t-1} - rate_{t-2}) - (threshold_{t-2} - rate_{t-2})$*. All specifications include time fixed effects, country fixed effects, and a binary decreasing-inflation threshold event indicator. The regressions are weighted by countries' population share in the sample. A threshold event refers to a situation where a country's inflation rate crosses a value of 5, 10, 15, 20, or 25% for the first time in the past 12 months. Standard errors (in parentheses) are clustered by country.*

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table A.13: Inflation threshold events and inflation expectations (regression discontinuity estimates)

B. Survey experiment

B.1. Detailed survey instructions

This appendix section shows that wording of the survey translated from German.

Introduction

Welcome! This scientific survey examines the influence of information about the inflation rate on inflation expectations. It takes approximately 3 minutes to fill out. During the survey, you will receive data on consumer prices in Germany. On this basis, you will be asked to make forecasts on future price developments.

The study comprises three forecasting rounds. In each round, you will receive data on consumer prices in previous years. On this basis, we ask you to forecast the future development of consumer prices.

However, we would like to start by asking you about your education. Please select the option that most closely matches your highest level of education.

- Without a degree or still in training
- Main or secondary school diploma
- (Fach-)Abitur
- University degree (e.g. diploma, bachelor, master)
- Doctorate or Habilitation

Inflation perceptions

We would also like to ask you for an assessment of the development of current consumer prices in Germany. How do you think that consumer prices have developed over the last 12 months? They have. . .

- risen a lot
- risen moderately
- risen slightly
- stayed about the same
- fallen

Start of Block: Initiation increase
By how many per cent do you think that consumer prices have gone up over the past 12 months? _._%

Start of Block: Initiation decrease
By how many per cent do you think that consumer prices have gone down over the past 12 months? _._%

Round 1

Thank you for your assessment of the current situation. We are now looking back on the years 2017 to 2020, where the percentage change in consumer prices in Germany—in September each year—was between -0.4 and 2.2%.
2017: 1.8%
2018: 2.2%
2019: 0.9%
2020: -0.4%
On the next page, you will be asked to provide a forecast for 2021 based on this information.

Assuming it is 2020, how do you think consumer prices will develop in 2021 compared to the previous year? They will...

- increase more rapidly

- increase at the same rate
- increase at a slower rate
- stay about the same
- fall

Start of Block: Round 1 increase
By how many per cent do you expect consumer prices to go up in 2021? _._%

Start of Block: Round 2 decrease
By how many per cent do you expect consumer prices to go down in 2021? _._%

The actual development shows a 4.1% increase in consumer prices in 2021. You forecasted an increase / decrease of _._%. On the next page, you will be asked to provide a forecast for 2022 based on the new information.

Round 2

Assuming it is 2021, how do you think consumer prices will develop in 2022 compared to the previous year? They will...

- increase more rapidly
- increase at the same rate
- increase at a slower rate
- stay about the same
- fall

Start of Block: Round 2 increase
By how many per cent do you expect consumer prices to go up in 2022? _._%

Start of Block: Round 2 decrease
By how many per cent do you expect consumer prices to go down in 2022? _._%

Control

The actual development shows a 9.9% increase in consumer prices in 2022. You forecasted an increase / decrease of _._%. On the next page, you will be asked to provide a forecast for 2023 based on the new information.

Treatment 1

The actual development shows a 10.1% increase in consumer prices in 2022. You forecasted an increase / decrease of _._%. On the next page, you will be asked to provide a forecast for 2023 based on the new information.

Treatment 2

The actual development shows a 10.1% increase in consumer prices in 2021—at that time the highest price increase in over 30 years! You forecasted an increase / decrease of _._%. On the next page, you will be asked to provide a forecast for 2023 based on the new information.

Assuming it is 2022, how do you think consumer prices will develop in 2023 compared to the previous year? They will...

- increase more rapidly
- increase at the same rate
- increase at a slower rate
- stay about the same
- fall

Start of Block: Round 3 increase
By how many per cent do you expect consumer prices to go up in 2023? _._%

Start of Block: Round 3 decrease
By how many per cent do you expect consumer prices to go down in 2023? _._%

End

The actual development shows a 4.3% increase in consumer prices in 2023. You forecasted an increase / decrease decline of _._%.

The study is finished. Thank you very much! The current inflation rate is 2.0% (July 2025). Further information is available on the website of the Federal Statistical Office. Unlike in this survey, it can be helpful to use other information besides the current inflation rate to predict the future inflation rate. Forecasts of the inflation rate are also always subject to uncertainty.

B.2. Additional tables

	(1) Full sample	(2) Without inattentive respondents	(3) Without inattentive respondents
Treatment: increasing-infl. threshold	0.267	0.471	0.585*
	(0.394)	(0.322)	(0.327)
Demographic controls	No	No	Yes
Mean of dependent variable	3.063	4.261	4.256
SD of dependent variable	5.925	4.272	4.274
Observations	966	706	705

Notes: OLS estimates. The dependent variable is the pre-post change in participants' inflation forecasts (in percentage points), based on non-truncated quantitative inflation expectations. All models include date fixed effects and hour-of-the-day fixed effects. Inattentive respondents are defined as those who revise their inflation forecast contrary to their forecast error. The demographic controls are legal sex, age, education, German nationality, and born in Germany. Heteroskedasticity-robust standard errors are in parentheses.
** $p<0.10$, ** $p<0.05$, *** $p<0.01$*

Table B.1: Results from the survey experiment (non-truncated forecasts)

	(1) Full sample	(2) Without inattentive respondents	(3) Without inattentive respondents
Treatment: increasing-infl. threshold	0.366	0.617**	0.756**
	(0.299)	(0.306)	(0.312)
Demographic controls	No	No	Yes
Mean of dependent variable	7.504	8.573	8.571
SD of dependent variable	4.604	3.989	3.992
Observations	956	705	704

Notes: OLS estimates. The dependent variable is the post-treatment quantitative inflation forecast truncated at -5 and +30%. All models include date fixed effects and hour-of-the-day fixed effects. Inattentive respondents are defined as those who revise their inflation forecast contrary to their forecast error. The demographic controls are legal sex, age, education, German nationality, and born in Germany. Heteroskedasticity-robust standard errors are in parentheses.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table B.2: Results from the survey experiment (post-treatment inflation forecasts)

	(1) Full sample	(2) Without inattentive respondents	(3) Without inattentive respondents
Treatment: increasing-infl. threshold	-0.111	-0.090	-0.075
	(0.073)	(0.071)	(0.073)
Demographic controls	No	No	Yes
Mean of dependent variable	-0.080	0.054	0.051
SD of dependent variable	1.135	0.935	0.932
Observations	953	704	703

Notes: OLS estimates. The dependent variable is the pre-post treatment change in participants' qualitative inflation forecast after transforming categorical values (fallen, stayed about the same, risen slightly, risen moderately, and risen a lot) into numerical values 1 to 5. All models include date fixed effects and hour-of-the-day fixed effects. Inattentive respondents are defined as those who revise their inflation forecast contrary to their forecast error. The demographic controls are legal sex, age, education, German nationality, and born in Germany. Heteroskedasticity-robust standard errors are in parentheses.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table B.3: Results from the survey experiment (based on qualitative expectations)

	(1) Inflation perception (percent)	(2) Round 1 forecast (percent)	(3) Round 2 forecast (percent)	(4) Survey duration (seconds)	(5) Inflation perception (percent)	(6) Round 1 forecast (percent)	(7) Round 2 forecast (percent)	(8) Survey duration (seconds)
Treatment: increasing-infl. threshold	0.454	0.399	0.191	-7.879*	0.716	0.291	0.023	-10.369**
	(0.493)	(0.243)	(0.194)	(4.270)	(0.604)	(0.305)	(0.202)	(4.865)
Sample without inattentive respondents	No	No	No	No	Yes	Yes	Yes	Yes
Mean of dependent variable	7.732	2.763	4.165	145.610	8.257	2.654	4.213	144.237
SD of dependent variable	7.353	3.731	2.991	65.468	7.472	3.975	2.578	63.056
Observations	896	941	953	953	657	701	704	704

Notes: OLS estimates. All models include date fixed effects and hour-of-the-day fixed effects. Inattentive respondents are defined as those who revise their inflation forecast contrary to their forecast error. Heteroskedasticity-robust standard errors are in parentheses.
* *p<0.10,* ** *p<0.05,* *** *p<0.01*

Table B.4: Results from the survey experiment (other outcomes)

C. Model derivation

C.1. New Keynesian model with left-digit-biased inflation expectations

We use a standard New Keynesian model (see, e.g., Galí, 2015). Instead of assuming full rational expectations, we assume households have left-digit-biased inflation expectations to align with our results. We further abstract from long-run growth and consider only one exogenous shock, a cost-push shock, to illustrate the implications of left-digit-biased inflation expectations. The model environment is described next, with derivations identical to those in Galí (2015, ch. 3) omitted for brevity.

C.1.1. Households

A representative infinitely-lived household seeks to maximize intertemporal utility

$$\mathbb{E}_t^b \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\sigma}}{1-\sigma} - \frac{N_t^{1+\varphi}}{1+\varphi} \right), \tag{C.1}$$

where C is a consumption index, N denotes hours worked, $\beta \in (0,1)$ is the discount factor, and $\sigma \geq 0$ and $\varphi \geq 0$ determine the intertemporal elasticity of substitution and the Frisch elasticity of labor supply, respectively. The expectation operator $\mathbb{E}_t^b$ denotes *behavioral* expectations, which do not need to coincide with rational expectations. The consumption index is given by

$$C_t = \left(\int_0^1 C_t(i)^{1-\frac{1}{\epsilon_t}} di \right)^{\frac{\epsilon_t}{\epsilon_t - 1}},$$

where $\epsilon_t > 1$ is the elasticity of substitution between goods and $C_t(i)$ denotes the consumption of variety i. The elasticity of substitution can exogenously vary over time to generate fluctuations in mark-ups and hence cost-push shocks. The period budget constraint reads

$$\int_0^1 P_t(i) C_t(i) di + Q_t B_t \leq W_t N_t + B_{t-1} + D_t, \tag{C.2}$$

where $P_t(i)$ is the price of good i, Q_t is the nominal price of a risk-free bond, B_t is the stock of nominal bonds, W_t is the nominal wage, and D_t is dividends.

Household inflation expectations are explained in detail in section 2: A household perceives inflation, π_t^p, with a left-digit bias as specified in equations (3) and (4), believes that inflation follows an AR(1) process, equation (5), with steady-state inflation $\pi^* = 0$ and hence forms inflation expectations based on past-periods perceived inflation, equation (6).

The household chooses consumption/savings and labor supply to maximize intertemporal utility (C.1) subject to the budget constraint (C.2) and an optimal allocation of consumption expenditures among different goods. The resulting first-order conditions are

$$
\begin{aligned}
C_t(i) &= \left(\frac{P_t(i)}{P_t}\right)^{-\epsilon_t} C_t \\
P_t &\equiv \left(\int_0^1 P_t(i)^{1-\epsilon_t} di\right)^{\frac{1}{1-\epsilon_t}} \\
P_t C_t + Q_t B_t &\leq W_t N_t + B_{t-1} + D_t \\
C_t^{\sigma} N_t^{\varphi} &= \frac{W_t}{P_t} \\
Q_t &= \beta \mathbb{E}_t^b \left(\frac{C_t^{\sigma}}{C_{t+1}^{\sigma}} \frac{P_t}{P_{t+1}}\right)
\end{aligned}
\tag{C.3}
$$

The first equation is the demand for good i, the second defines the ideal price index, the third denotes total consumption expenditures, the fourth is the re-written budget constraint, the fifth is the labor supply equation, and the last is the Euler equation.

C.1.2. Firms

Risk-neutral firms indexed by $i \in [0,1]$ produce a differentiated good $Y_t(i)$ according to

$$Y_t(i) = N_t(i),$$

where $N_t(i)$ is labor demand. Marginal costs are then equal to the real wage $mc_t = W_t/P_t$. Each firm has two managers, one setting prices and one making forecasts (see, e.g., Pfäuti, 2023). We assume that the forecasters form expectations as households do. When setting prices, firms face quadratic price-adjustment cost (Rotemberg, 1982) such that per-period real profits are given by

$$\frac{P_t(i)}{P_t} Y_t(i) - mc_t N_t(i) - \frac{\delta}{2}\left(\frac{P_t(i)}{P_{t-1}(i)} - 1\right)^2 C_t - T_t,$$

where $\delta > 0$ and T_t is a lump-sum tax. Using the production function and the demand for good i with $Y_t(i) = C_t(i)$ in equilibrium, the price-setter chooses the price $P_t(i)$ to maximize

$$\Pi_t(i) = \mathbb{E}_t^b \sum_{j=0}^{\infty} \beta^j \Bigg[\frac{P_{t+j}(i)}{P_{t+j}} \left(\frac{P_{t+j}(i)}{P_{t+j}} \right)^{-\epsilon_{t+j}} C_{t+j} - mc_{t+j} \left(\frac{P_{t+j}(i)}{P_{t+j}} \right)^{-\epsilon_{t+j}} C_{t+j} \\ - \frac{\delta}{2} \left(\frac{P_{t+j}(i)}{P_{t+j-1}(i)} - 1 \right)^2 C_{t+j} + T_{t+j} \Bigg].$$

The FOC reads

$$(\epsilon_t - 1) \left(\frac{P_t(i)}{P_t} \right)^{-\epsilon_t} \frac{C_t}{P_t} = \epsilon_t mc_t \left(\frac{P_t(i)}{P_t} \right)^{-\epsilon_t - 1} \frac{C_t}{P_t} - \delta \left(\frac{P_t(i)}{P_{t-1}(i)} - 1 \right) \frac{C_t}{P_{t-1}(i)} \\ + \beta \delta \mathbb{E}_t^b \left[\left(\frac{P_{t+1}(i)}{P_t(i)} - 1 \right) \frac{P_{t+1}(i)}{P_t(i)} \frac{C_{t+1}}{P_t(i)} \right].$$

Since all firms face the same profit-maximization problem, a symmetric equilibrium exists, implying $Y_t(i) = C_i(t) = C_t = Y_t$ and $P_t(i) = P_t$. The FOC then simplifies to

$$\frac{1}{\mathcal{M}_t - 1} Y_t = \frac{\mathcal{M}_t}{\mathcal{M}_t - 1} mc_t Y_t - \delta \pi_t (1 + \pi_t) Y_t + \beta \delta \mathbb{E}_t^b [\pi_{t+1} (1 + \pi_{t+1}) Y_{t+1}] \tag{C.4}$$

where $\pi_t \equiv \frac{P_t}{P_{t-1}} - 1$ is the inflation rate and $\mathcal{M}_t \equiv \frac{\epsilon_t}{\epsilon_t - 1}$ the desired mark-up.

C.1.3. Government and monetary policy

The government follows a balanced budget rule such that

$$T_t = \frac{D_t}{P_t} = \left[\frac{P_t(i)^*}{P_t} - mc_t \right] Y_t(i)^* - \frac{\delta}{2} \left(\frac{P_t(i)^*}{P_{t-1}(i)^*} - 1 \right)^2 C_t,$$

where a star denotes the optimal price and quantity. Under the balanced budget rule, the government sets taxes (T_t) so that after-tax firm profits are zero, meaning that the government redistributes all profits to households. In equilibrium, bonds are in zero supply, $B_t = 0$, and hence do not appear in the government budget.

Monetary policy is conducted by a central bank that sets the nominal interest rate according to a Taylor rule

$$i_t = \rho + \phi_\pi \pi_t + \phi_y \hat{y}_t, \tag{C.5}$$

where $\hat{y}_t \equiv y_t - y$ is the deviation of log-output from its steady state.

C.1.4. Three-equation New Keynesian model

A log-linear approximation of the Euler equation C.3 around the zero-inflation, zero-growth steady state yields

$$c_t = \mathbb{E}_t^b c_{t+1} - \frac{1}{\sigma}\left[i_t - \mathbb{E}_t^b \pi_{t+1} - \rho\right] \tag{C.6}$$

where lower-case variables are the logarithm of the uppercase variables and $i_t \equiv -\log Q_t$ and $\rho \equiv -\log \beta$ denote the nominal interest and discount rate, respectively.

Log-linearizing the firm's FOC (C.4) around the steady state yields

$$\pi_t = \beta \mathbb{E}_t^b \pi_{t+1} + \frac{\sigma + \varphi}{\delta(\mathcal{M} - 1)}\hat{y}_t + \frac{1}{\delta(\mathcal{M} - 1)}\hat{\mathcal{M}}_t, \tag{C.7}$$

where a hatted variable denotes the log deviation of the respective variable from its steady state value.

Next, we express the NKPC in terms of the output gap $\tilde{y}_t \equiv y_t - y^n$, where y^n is the natural output level in steady state. We calculate output under flexible prices with $\delta = 0$ to obtain it. The optimal price is then a mark-up over marginal cost, $\frac{P_t(i)}{P_t} = \mathcal{M}_t mc_t$, and natural output in logs is given by $y_t^n = \frac{1}{\sigma+\varphi}\log\left(\frac{1}{\mathcal{M}_t}\right)$. Since we define the output gap relative to natural output in steady state, we can replace $\hat{y}_t = \tilde{y}_t$ in equation (C.7), resulting in the NKPC, equation (11) in the main text:

$$\pi_t = \beta \mathbb{E}_t^b \pi_{t+1} + \kappa \tilde{y}_t + z_t,$$

where $\kappa \equiv \frac{\sigma+\varphi}{\delta(\mathcal{M}-1)}$ and the cost-push shock is defined as $z_t \equiv \frac{1}{\delta(\mathcal{M}-1)}\hat{\mathcal{M}}_t$.

Given $\hat{y}_t = \tilde{y}_t$ and defining $\hat{i}_t = i_t - \rho$, the Euler equation (C.6) and the Taylor rule (C.5) and can be rewritten to

$$\tilde{y}_t = \mathbb{E}_t^b \tilde{y}_{t+1} - \frac{1}{\sigma}\left[\hat{i}_t - \mathbb{E}_t^b \pi_{t+1}\right]$$
$$\hat{i}_t = \phi_\pi \pi_t + \phi_y \tilde{y}_t,$$

which are equations (12) and (13) in the main text.

References

CALONICO, S., CATTANEO, M. D., FARRELL, M. H. and TITIUNIK, R. (2017). Rdrobust: Software for regression-discontinuity designs. *The Stata Journal*, **17**, 372–404.

GALÍ, J. (2015). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and Its Applications*. Princeton University Press, 2nd edn.

PFÄUTI, O. (2023). The inflation attention threshold and inflation surges, Working Paper.

ROTEMBERG, J. J. (1982). Monopolistic price adjustment and aggregate output. *The Review of Economic Studies*, **49** (4), 517–531.