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Abstract

Households participating in financial markets pay attention to inflation news when making their investment decisions, even in an environment of mostly low and stable inflation. ETFs and open-ended mutual funds holding Treasury Inflation-Protected Securities (TIPS) receive inflows from retail investors, and nominal Treasury ETF experience outflows, when long-horizon market-based inflation expectations measures increase. Changes in household survey expectations or in measures of inflation uncertainty do not contribute much in explaining retail TIPS fund flows. Retail flows into TIPS funds are asymmetric, with strong reactions only to positive inflation news, and sticky, with flow responses to news gradually playing out over several months. Retail investors appear to pay some attention to regular Federal Reserve announcements, but major events such as the "taper tantrum" in May 2013, the presidential election in November 2016, and the COVID-19 crisis in March 2020 are associated with particularly large retail TIPS fund flows.

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Inflation Hedging on Main Street? Evidence from Retail TIPS Fund Flows *

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November 2022

Households participating in financial markets pay attention to inflation news when making their investment decisions, even in an environment of mostly low and stable inflation. ETFs and open-ended mutual funds holding Treasury Inflation-Protected Securities (TIPS) receive inflows from retail investors, and nominal Treasury ETF experience outflows, when long-horizon market-based inflation expectations measures increase. Changes in household survey expectations or in measures of inflation uncertainty do not contribute much in explaining retail TIPS fund flows. Retail flows into TIPS funds are asymmetric, with strong reactions only to positive inflation news, and sticky, with flow responses to news gradually playing out over several months. Retail investors appear to pay some attention to regular Federal Reserve announcements, but major events such as the "taper tantrum" in May 2013, the presidential election in November 2016, and the COVID-19 crisis in March 2020 are associated with particularly large retail TIPS fund flows.

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I. Introduction

Rising inflation rates in the wake of the COVID-19 pandemic have brought back to the forefront the question how rising inflation expectations affect consumers' spending and investment decisions and whether these decisions in turn could generate higher future inflation. Policymakers emphasize the importance of anchoring long-term inflation expectations, but their key concern is not about inflation expectations as such, but whether economic agents make decisions that reflect anchored expectations. A key question therefore is how strongly and how fast consumers adjust their choices in response to the changing inflation expectations. For example, in August 2021, the median inflation expectations in the Federal Reserve Bank of New York's Survey of Consumer Expectations (SCE) rose to 4% p.a. over a 3-year horizon after many years below 3%.[1] Does this suggest that consumers' decisions at that time consistently reflect the belief that future inflation will stay persistently above the Federal Reserve's inflation target?

Surveys capture consumers' perception of current inflation and their expectations of future inflation, but changes in beliefs expressed in surveys do not necessarily translate one-for-one into economic decisions. Coibion, Gorodnichenko, Kumar, and Pedemonte (2020) discuss evidence that inflation expectations affect consumers' decisions in survey experiments, such as in Armantier, Bruin, Topa, Klaauw, and Zafar (2015). But in these survey experiments respondents are prompted to pay attention and to think about inflation. In the absence of such a prompt, consumers generally seem to pay little attention to inflation news or to monetary policy announcements—at least in low-inflation regimes (Binder 2017; Coibion et al. 2020; Bracha and Tang 2022).[2]

Moreover, an evaluation of households' inflation concerns is complicated by the fact that inflation expectations measures come in several different types. For example, there exist expectations in surveys of households and professional forecasters, market-based expectations

1. `https://www.newyorkfed.org/newsevents/news/research/2021/20210913`.

2. A recent paper by Rudd (2021) argues that the absence of a clear link between expectations and decisions casts doubt on the policy-relevance of macroeconomic models in which inflation expectations play an important role.

extracted from asset prices of inflation-linked securities or derivatives, and expectations at short and long horizons. These series are not perfectly aligned. For example, Reis (2021) shows that unanchoring of inflation expectations in the 1970s was apparent in some empirical expectations series, but not in others. Which of these series policy makers should focus on is not clear without evidence on the links between these different expectations proxies and the choices of economic decision-makers.

In this paper, we examine households' investment decisions to shed light on this question. Specifically, we focus on households' aggregate flows into funds that hold inflation-protected Treasury securities (TIPS). As Campbell and Viceira (2001) and Campbell, Chan, and Viceira (2003) have shown, inflation-protected bonds should be generally attractive assets for risk averse investors. But as long as inflation is perceived as stable, retail investors may view the more familiar nominal bonds as sufficiently good substitutes for inflation-protected bonds. Retail investors interest in inflation-protected bonds may then be limited (Campbell 2000). Our working hypothesis is that a rise in realized inflation, inflation expectations, or inflation uncertainty could make inflation risks more salient to retail investors, leading to an increase in households' aggregate demand for inflation-protected bonds relative to other market participants and hence a positive net flow from retail investors into inflation-protected bond funds.

Our main tests are based on retail flows into exchange-traded funds (ETF), supplemented with additional tests using open-ended mutual fund (MF) flow data. So far, little is known about households' use of these inflation-protected investment products in their financial asset portfolios. To focus specifically on the investment flows directed by consumers rather than professional portfolio managers, we extract aggregate *retail* ETF order flow imbalances from microstructure (TAQ) data. Specifically, we identify marketable retail orders using the approach of Boehmer, Jones, Zhang, and Zhang (2020) that relies on the fact that marketable retail orders receive subpenny price improvements.

The first part of our analysis looks at the relationship between TIPS ETF retail flows and measures of changes in realized and expected inflation. We use inflation swap rates as market-

based inflation expectations. We obtain survey-based expectations from the Michigan Survey of Consumers (MSC). We focus on median inflation expectations of survey respondents in the highest income tercile, as those are the ones most likely to be investors in TIPS ETFs. It turns out that retail TIPS ETF flows respond positively and strongly to changes in five-year market-based inflation expectations. Market-based inflation expectations at one-year horizons do not add much incremental explanatory power. This is sensible, as long-term expectations should be more relevant for retail investors' asset allocation. Somewhat surprisingly though, survey-based expectations do not add much either. Overall, long-horizon market-based expectations measures seem to be most closely related to the underlying factors that induce retail investors to seek inflation-protected investments.

We then look at the role of time-variation in inflation uncertainty. We use the standard deviation of the risk-neutral distribution of inflation extracted from inflation caps and floors as market-based inflation uncertainty measure. We also obtain a survey-based measure of individuals' perceived inflation uncertainty from the New York Fed's Survey of Consumer Expectations. As it turns out, changes in inflation uncertainty measures, whether market-based or from surveys, do not play much of a role in explaining retail TIPS ETF flows. Retail investors' concerns about future inflation when making investment decisions seem to be captured better by changes in market-based expected inflation rather than changes in the uncertainty measures.

We also show that the strong effect of market-based inflation expectations on retail flows persists when we control for flow-performance relation by including contemporaneous and past returns of TIPS ETF in the regression. Furthermore, we obtain broadly similar results for flows into retail share classes of open-ended TIPS mutual funds.

If investors allocate more to TIPS ETF because they are concerned about future inflation, then a natural source of these funds is withdrawals from the product that would be an extremely close substitute in a world of stable inflation: nominal Treasury ETF. This is, in fact, what we find. While long-horizon market-based inflation expectations are positively associated with flows into TIPS ETF, they are negatively related to nominal Treasury ETF

flows.

Retail investors' flow responses to changes in market-based inflation expectations exhibit two properties that have appeared elsewhere in the literature on inflation and inflation expectations: asymmetry and stickiness. First, the response of flows is strongly asymmetric. TIPS ETF retail flows rise when long-horizon market-based inflation expectations increase, but they do not decrease much when market-based inflation expectations go down. For example, a positive one-standard-deviation change in 5-year market-based expectations is associated with a 0.605 standard deviation of retail inflow to TIPS ETFs during the same quarter, while a negative one-standard-deviation change in 5-year market-based expectations is associated with an outflow of only 0.071 standard deviations. This is reminiscent of the findings in Curtin (2009) and Baqaee (2020) that household inflation expectations are more responsive to inflationary news than to disinflationary news. However, in our case, the asymmetry shows up in investment decisions, and not just stated expectations. Our findings therefore provide support for the assumption in the macroeconomic model of Baqaee (2020) that households place greater weights on inflationary news than disinflationary news when they make decisions.

Second, retail TIPS ETF flows are sticky. They rise with market-based inflation expectations in the same month, but most of the flow is realized predictably with a delay in the subsequent four months. This apparent stickiness in retail investors' reaction relates to a pervasive theme in the macroeconomics literature on inflation concerning the economic sources of inertia. Some models feature sticky information (e.g., as in Carroll 2003; Mankiw and Reis 2002) with slow updating of beliefs, while others have sticky actions (e.g., as in Calvo 1983) where beliefs may be updated quickly, but economic agents are slow to act on these beliefs due to frictions (see, also, Gabaix 2019). For retail TIPS ETF flows, we find that actions—in the form of fund flows—are more delayed than beliefs, as measured by MSC inflation expectations. In particular, household inflation expectations in the MSC react with a one-month lag to market-based inflation expectations, i.e., much faster than retail TIPS ETF flows. One possibility is that frictions prevent retail investors from quickly acting on changing beliefs.

An alternative is that individuals who participate in surveys get prompted by the survey questions to think about inflation and, as a consequence, update their beliefs faster than they would otherwise have. In either case, measuring stickiness with survey expectations as in Carroll (2003) would understate the degree of stickiness in actions.

In addition to direct news about inflation, or news reflected in market-based measures of inflation expectations, retail investors could also react to prominent events that they perceive as having inflation implications. One natural question, given the tight connection between monetary policy and inflation, is whether retail investors pay attention to Federal Reserve monetary policy announcements. Using daily consumer confidence data from a household survey, Lewis, Makridis, and Mertens (2019) find the surprising result that consumer confidence responds instantaneously to federal funds rate target changes. For retail TIPS ETF flows, we also find a reaction to monetary policy announcements, but the picture is mixed. For announcement days on which monetary conditions tightened (as indicated by a rise in Treasury yields), we find that retail investors pulled money out of TIPS ETF on the day of the announcement and several subsequent days, consistent with the tightening allaying their concerns about future inflation. In contrast, for announcement days on which the Fed was easing policy (as indicated by a fall in Treasury yields), we find virtually no reaction of flows.

The situation is clearer for events that attract unusually high attention. When Fed Chair Ben Bernanke announced on May 22, 2013 that the Fed would start tapering its asset purchases at some future date, we see huge retail outflows from TIPS ETFs in the weeks following this announcement. These outflows coincide with the "Taper Tantrum" in bond markets that saw a sharp rise in Treasury bond yields and that was widely covered in the media. Similarly, there was strong net retail buying of TIPS ETFs following the election of Donald Trump as U.S. president in November 2016. Overall, it seems that retail investors do pay attention to major events that may have inflation implications, just not to the regular FOMC meetings.

In summary, retail investors in aggregate respond strongly and systematically to market-based inflation expectations, or to the news that drives the changes in market-based inflation

expectations, and they do so asymmetrically and sluggishly. Even though much of our sample period, except the very end, was a period of low and stable inflation, at least a substantial subset of retail investors are attentive to inflation news. When market-based long-horizon expectations rise, retail investor money flows into inflation-protected funds. Policy makers sometimes express skepticism whether market-based inflation expectations measures (see, e.g., Yellen (2015)) are a good proxy for the inflation expectations of households. But our evidence indicates that they are, in fact, more closely related to retail investor investment decisions than are inflation expectations measures from household surveys.

Our findings relate to work that has found households to be responsive to inflation and inflation expectations in their financial decisions. Malmendier and Nagel (2016) show that individuals life-time experiences of inflation shape their inflation expectations. They further show that individuals in cohorts with higher experience-based inflation expectations are more likely to choose fixed-rate mortgages rather than variable-rate mortgages. Botsch and Malmendier (2020) reinforce this finding with much better data on mortgage choice. Much of the variation exploited in these analyses is cross-sectional across individuals and cohorts, and observations are available only with multi-year gaps between survey waves. It therefore does not speak directly to the question whether one should expect households to adjust their decisions in response to recent inflation news. In contrast, in this paper, we focus on time-series variation with data available up to daily frequency.

Our analysis focuses on investment decisions because fund flows can be measured very well. However, the fact that fund flows of retail investors are sensitive to market-based inflation expectations is suggestive that people's decisions in other domains may also be affected. When investors are concerned about inflation in their investment portfolios, it seems likely that they may also be concerned about inflation in their choices as a consumer or a business manager. In this regard, the relatively strong links between inflation and financial decisions in our paper contrasts with the generally mixed evidence on links between inflation and consumption decisions. However, the key to reconciliation may be the heterogeneity in the strength of this link. Bachmann, Berg, and Sims (2015) generally find only a weak relation between inflation

expectations and readiness to spend in the Michigan Survey of Consumers, but they also find that the relation is stronger for individuals who are good inflation forecasters. D'Acunto, Hoang, Paloviita, and Weber (2021) find a stronger relation for high-IQ individuals and for durable consumption plans. Burke and Ozdagli (2021) combine a survey of expectations with data on actual spending and find a link between inflation expectations and durable consumption, but only for respondents with college education. Since ETF investors are likely to be more wealthier, more educated, and more sophisticated in economic matters, than the average survey participant, our findings tie in well with the evidence on heterogeneity in this literature.

Our work also connects to a literature on the relation between aggregate mutual fund flows and macroeconomic conditions. This literature has focused on equity mutual funds and bond funds in general, but does not speak to the relation between the inflationary environment and TIPS fund flows. Jank (2012) shows that aggregate equity mutual fund flows are related to macroeconomic news, with worsening of the macroeconomic situation leading to outflows. Greenwood and Shleifer (2014) find that individual investors' optimism about future stock market returns is associated with aggregate equity mutual fund inflows. Da, Engelberg, and Gao (2015) find that high google search volume for recession-related keywords such as unemployment or bankruptcy predicts mutual fund flows out of equity funds and into bond funds.

The rest of the paper is organized as follows. Section II describes the data. Section III analyzes the relationship between TIPS fund flows, inflation expectations, and inflation uncertainty. Section IV studies flows around events. Section V concludes.

II. Data

II.A. Retail TIPS and Treasury ETF Flow

Our main variable of interest is retail flow into TIPS ETFs that we extract from from microstructure data (TAQ) following a modification of the approach of Boehmer, Jones, Zhang,

and Zhang (2020). Their approach identifies marketable retail orders based on the fact that they typically receive subpenny price improvement. If the subpenny part of the transaction price is in the interval $(0, 0.4)$, it is identified as a retail sell transaction; if it is in the interval $(0.6, 1)$ it is identified as a retail buy transaction. Transactions at a round penny or near the half-penny, i.e. with subpenny part in the interval $[0.4, 0.6]$, are not treated as a retail-initiated transaction. The data starts in 2010 as Boehmer, Jones, Zhang, and Zhang (2020) note that subpenny price improvements for retail orders became pervasive only by 2010, so the method should not be applied to earlier data.

We modify the Boehmer et al. method in two aspects. First, we include only off-exchange trades and we exclude intermarket sweep orders. Intermarket sweep orders are institutional orders that can also show up at subpenny prices. Second, we implement the improvements in the trade-signing algorithm suggested by Schwarz, Barber, Huang, Jorion, and Odean (2022) using the WRDS files that match trades and NBBO quotes. If the prevailing bid-ask spread is one cent, or if the trade price is outside the bid-ask spread, we use the Boehmer et al. signing approach. If the prevailing bid-ask spread is larger than one cent and the trade price is inside the bid-ask spread, we label the trade a sell if the price is below the midpoint of the bid-ask spread, and label the trade a buy if the price is above the midpoint of the bid-ask spread.

We construct the daily net order imbalance for each TIPS ETF by subtracting the dollar value of retail sells from the dollar value of retail purchases. If there is a positive net retail order imbalance on a given day, this means that either other existing ETF investors sell to retail investors, or that authorized participants sell to them newly created ETF shares that the authorized participants in turn obtain in exchange against delivery of the fund's underlying assets to the fund. In both cases, there is flow of retail investor money into the fund. We aggregate the daily net order imbalance by summing across all TIPS ETFs and then across time in weekly or monthly time periods. Finally, we construct percentage flows by dividing the weekly (monthly) retail net flow and total net flow by the total market capitalization of all TIPS ETFs at the end of the previous week (month). For comparison,

we also obtain a series of total aggregate flows for these ETFs from Bloomberg.

We obtain the set of TIPS ETFs each quarter by looking up ETFs in the CRSP Mutual Funds database with Lipper objective code as "IUT". We then exclude three ETFs with this objective code that do not appear to be TIPS ETFs.[3] For comparison, we also construct a series of retail investor flow into nominal Treasury ETFs. We identify them in the CRSP Mutual Funds database based on Lipper objective codes "IUG", "GUT", or "GUS." This selection criterion excludes short-term Treasury ETFs.

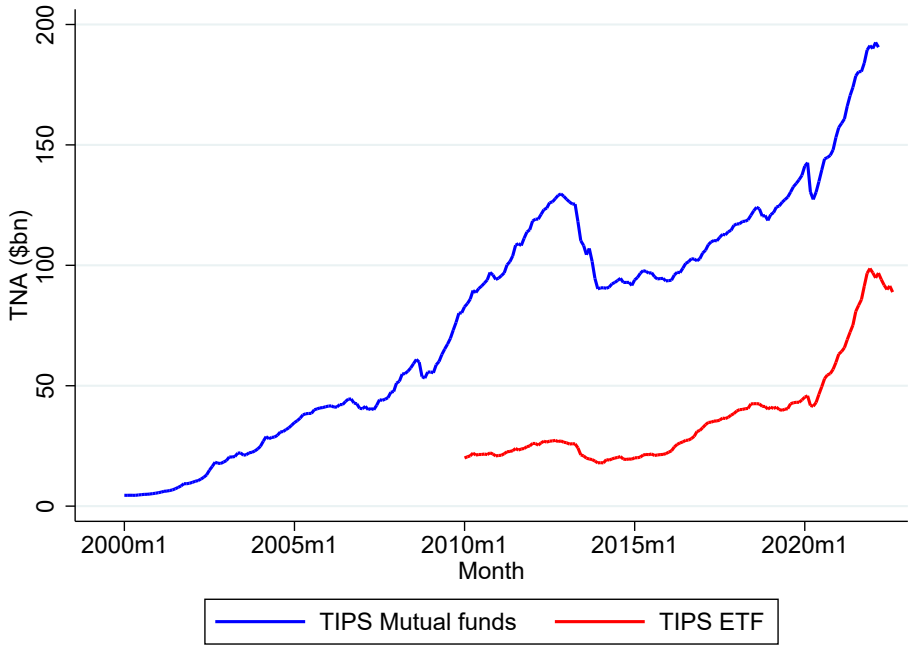
In some of our analyses, we also use open-ended mutual fund flows. We calculate aggregate fund flows based on retail share classes of open-ended mutual funds in the Lipper objective category "IUT". Flows from retail share classes only partly captures retail flows because many retail investors have access to institutional share classes in their retirement accounts. For this reason, our preferred measure is the ETF retail flow series, but the open-ended mutual fund retail flow series has the advantage of a longer time series.

Figure Ia plots the total net assets of open-ended TIPS mutual funds and ETFs. In the early years after the creation of the TIPS market in 1997, the total amount invested in TIPS mutual funds was very small. By the time our TIPS ETF retail flow measure starts in 2010, TIPS mutual funds had around $80bn assets, while TIPS ETFs had about $20bn. At the end of our sample period in August 2022, the combined net assets reached close to $280bn. For comparison, the outstanding stock of TIPS at the end of August 2022 was $1.8trn.[4]

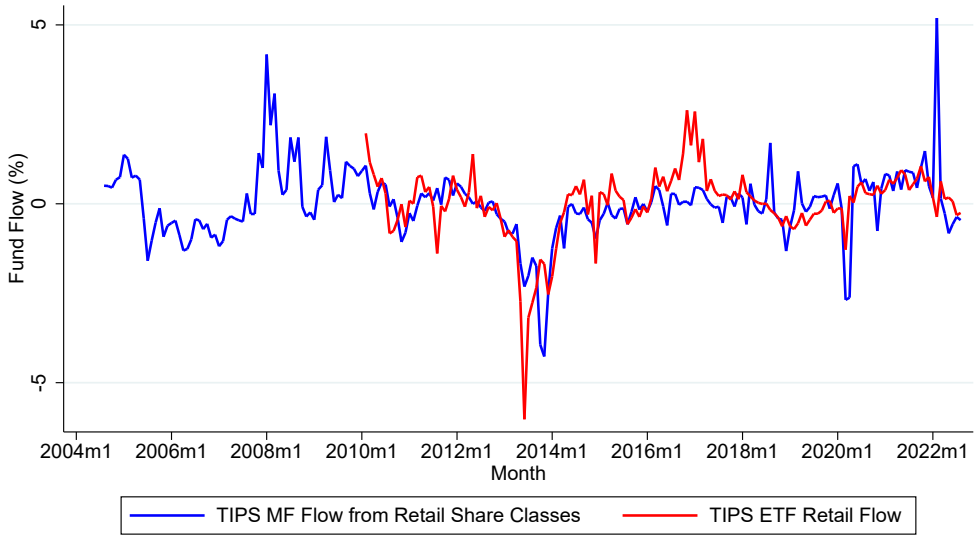
Figure Ib plots the time series of the two retail flow measures for open-ended mutual funds and ETFs. Both are demeaned and standardized to unit standard deviation for this plot. The two series have substantial positive correlation. The ETF flow measure shows spikes with positive or negative flows in 2013, 2016, and early 2020. We investigate these episodes in more detail later.

3. These are the funds with tickers IGHG (a corporate bond ETF that hedges interest rate risk with Treasury futures, not inflation protected instruments), QXRR (which invests in commodities among other things, in addition to TIPS), IVOL (this is mostly an interest rate volatility ETF).

4. See the monthly statement of the debt of the United States at `https://www.treasurydirect.gov/govt/reports/pd/mspd/mspd.htm`.



(A) Total net assets



(B) Standardized time-series of retail fund flows

FIGURE I
Total Net Assets and Retail Fund Flows of TIPS ETF and Mutual Funds

II.B. Market- and survey-based inflation expectations

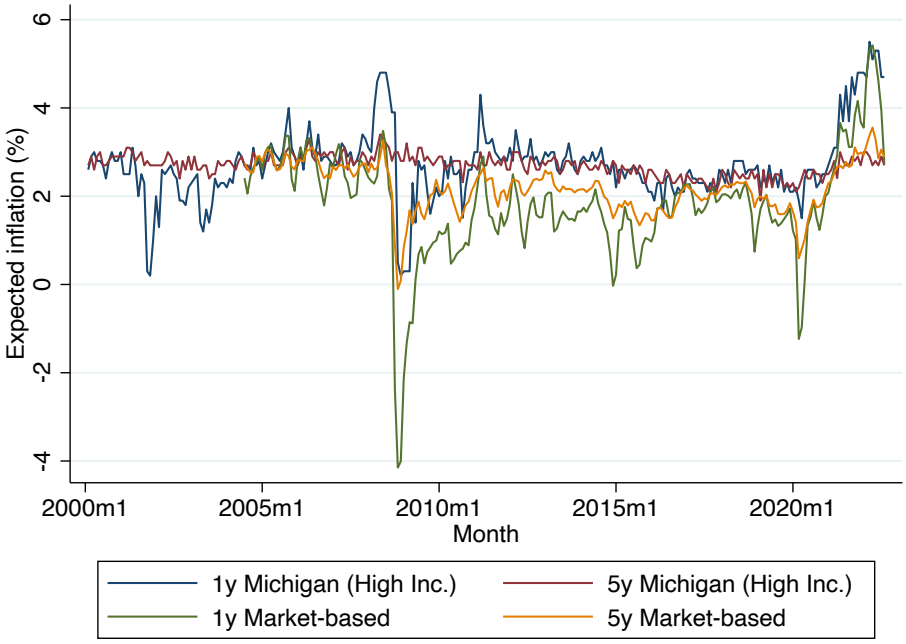
In our analysis, we want to understand how different measures of inflation expectations and inflation uncertainty relate to TIPS ETF retail flows. We measure risk-neutral market-based expectations of future inflation with daily rates of 1-year and 5-year inflation swaps from Bloomberg. We supplement these market-based measures with survey-based inflation expectations from the Michigan Surveys of Consumers. Since higher-income survey respondents are more likely to be financial market participants, we focus on median inflation expectations of the upper tercile by household income. Inflation expectations are available monthly at 1-year and 5-year horizons. Figure IIa plots the time series of these inflation expectations measures. Sensibly, the long-horizon measures are less volatile than the short-horizon measures. It is also apparent that market-based expectations measures are more volatile than the survey-based measures.

II.C. Market- and survey-based inflation uncertainty

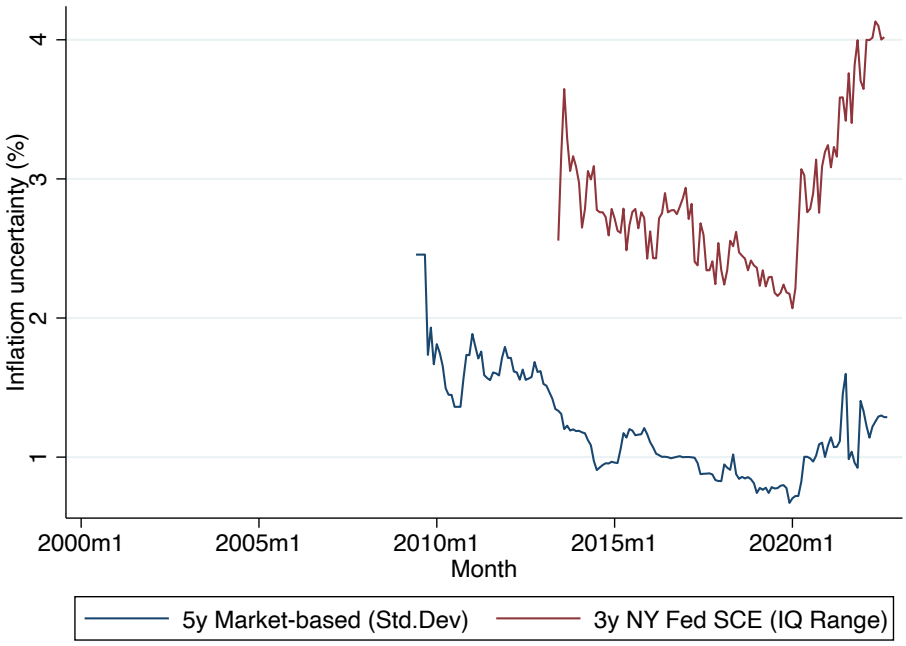
Our market-based measure of inflation uncertainty is the weekly standard deviations of the risk-neutral distribution at a 5-year horizon implied by prices of 5-year CPI caps and floors, obtained from the website of Federal Reserve Bank of Minneapolis. As survey-based uncertainty measure, we use median inflation uncertainty from the Survey of Consumer Expectations at the Federal Reserve Bank of New York. This measure reflects individual respondents' uncertainty that they express when they state percentiles of their perceived distribution of future inflation rates. The published uncertainty measure is the difference between the 25th and 75th percentile of a generalized beta distribution fitted to the raw percentile responses. Figure IIb plots the time series of these inflation uncertainty measures.

II.D. Real-time realized inflation

We obtain real-time available CPI data from the Federal Reserve Bank of Philadelphia. We calculate year-on-year realized inflation as the percentage change of of the CPI. The realized inflation rate in April 2020, for example, is then the percentage change of the March 2020



(A) Inflation expectations



(B) Inflation uncertainty

FIGURE II
Time-series of inflation expectations and inflation uncertainty measures

CPI (as announced in April 2020), from March 2019 (based on the update available by April 2020).

II.E. Summary statistics

Table I presents summary statistics at a monthly frequency for the key variables used in our empirical analysis. For interpreting the results we show below, it is useful to remember that monthly TIPS ETF flow has a mean of 0.07% and standard deviation of 0.34%. Aggregated to quarterly flow, the mean would be about 0.40% and the standard deviation around 0.92%.

III. TIPS ETF FLOWS, INFLATION EXPECTATIONS, AND INFLATION UNCERTAINTY

We begin by analyzing whether retail demand of TIPS ETF is sensitive to market-based and survey-based measures of inflation expectations and inflation uncertainty.

III.A. Inflation expectations

As Figure Ib shows, TIPS ETF flows have substantial persistence. Moreover, it seems unlikely that all retail investors would respond immediately to news about future inflation. For this reason, we first look at flows aggregated to quarterly frequency. After documenting some basic relationships in quarterly data, we then look in more detail at the lead-lag relationships at higher frequencies.

Table II shows the results from regressions of TIPS ETF retail flows on several measures of contemporaneous changes in realized inflation and inflation expectations. All variables represent three-month flows or changes over three-month periods and we run these regressions with overlapping monthly observations. The dependent variable and the explanatory variables are standardized to unit standard deviation (s.d.). Contemporaneous is defined as follows. For realized inflation we assign dates based on the CPI announcement date while for market-based expectations the relevant date is the trading date on which a price was realized. In both cases, we think of these dates as the earliest dates at which retail investors could have

TABLE I
Summary Statistics

This table shows summary statistics of monthly data. Flows are measured over three-month periods. TIPS ETF institutional flow is the difference between the total ETF flow minus the retail flow that we construct from TAQ data. TIPS ETF return is the value-weighted return of all TIPS ETFs available in a given period. Similarly, TIPS MF return is the value-weighted return of all TIPS mutual funds available in a given period. Realized inflation is real-time year-on-year percentage change of the CPI. The five-year inflation swap rate becomes available in August 2004; the three-year ahead inflation uncertainty in the New York Fed Survey of Consumer Expectations (SCE) becomes available in June 2013; the risk-neutral standard deviation implied by five-year CPI caps and floors becomes available in June 2009. For a given variable, Δ measures the difference between the value in the current month and value three months prior.

	2010/02 - 2022/08			2004/08 - 2022/08		
	N	Mean	S.D.	Mean	Mean	S.D.
TIPS ETF retail flow	151	0.07%	0.34%	-	-	-
TIPS ETF inst. flow	151	0.91%	2.28%	-	-	-
TIPS ETF return	151	0.25%	1.20%	-	-	-
TIPS MF flow from retail share classes	-	-	-	217	0.13%	1.99%
TIPS MF flow from inst. share classes	-	-	-	217	1.04%	2.56%
TIPS MF return	-	-	-	217	0.30%	1.45%
Realized 1-year inflation	151	2.27%	1.83%	217	2.38%	1.82%
5-year inflation swap rate	151	2.09%	0.46%	217	2.19%	0.55%
1-year inflation swap rate	151	1.80%	1.00%	217	1.83%	1.24%
1-year infl. exp. of Mich. survey (high income)	151	2.81%	0.76%	217	2.82%	0.84%
5-year infl. exp. of Mich. survey (high income)	151	2.58%	0.23%	217	2.68%	0.26%
3-year ahead inflation uncertainties of SCE	111	2.83%	0.51%	111	2.83%	0.51%
S.D. of 5-year CPI cap/floor-based infl. exp.	151	1.17%	0.31%	159	1.22%	0.37%
ΔRealized 1-year inflation	151	0.61%	1.90%	217	0.29%	2.19%
Δ5-year inflation swap rate	151	0.00%	0.17%	217	0.00%	0.22%
Δ1-year inflation swap rate	151	0.01%	0.43%	217	0.00%	0.54%
Δ1-year infl. exp. of Mich. survey (high income)	151	0.02%	0.36%	217	0.01%	0.46%
Δ5-year infl. exp. of Mich. survey (high income)	151	-0.00%	0.21%	217	0.00%	0.21%
Δ3-year ahead inflation uncertainties of SCE	110	0.01%	0.20%	110	0.01%	0.20%
ΔS.D. of 5-year CPI cap/floor-based infl. exp.	151	-0.00%	0.09%	158	-0.01%	0.11%

learned the news contained in the published inflation rates or market prices. For the Michigan and New York Fed SCE surveys, the date represents the date the survey was carried out. Since the survey is a measurement of what individual respondents already know, we use the survey date, not the date on which the survey was published.

Column (i) shows changes in 5-year market-based expectations are strongly related to TIPS ETF retail flows during the same quarter. Realized inflation also has a positive relationship to flows, but the coefficient estimates are not significantly different from zero at conventional significance levels. Motivated by earlier findings in Curtin (2009) and Baqaee (2020) that household inflation expectations are more responsive to inflationary news than to disinflationary news, we allow for different sensitivity to positive and negative news by separating the positive and negative realizations of the explanatory variables (after standardizing to unit s.d.). Positive changes in in 5-year market-based expectations have a strong relation to TIPS ETF retail flows. A one s.d. increase in 5-year market-based inflation expectations is associated with an increase of flow by 0.605 s.d. (s.e. = 0.272). In contrast, decreases in 5-year market-based expectations have much smaller effects that are not significantly different from zero. This shows that the asymmetry documented in Curtin (2009) and Baqaee (2020) applies not only to updating of expectations, but it also appears in retail investors' investment decisions as reflected in the TIPS ETF retail flows here.

News about long-term inflation seems more likely to be relevant for retail investors' asset allocation than news about the short-run outlook for inflation. For this reason, we started our analysis with 5-year market-based expectations in column (i). Column (ii) uses 1-year market-based expectations instead. The relationship of TIPS ETF retail flow to 1-year expectations is weaker than for 5-year market-based expectations. There is the same asymmetry between negative and positive changes in market-based expectations, but the statistical confidence is weaker. The R^2 drops from 13.6% in column (i) to 7.3% in column (ii). Thus, 5-year expectations clearly dominate the 1-year expectations.

One might think that inflation expectations in household surveys would provide the best measure of inflation concerns of retail investors, but the data suggests otherwise. Column

TABLE II

TIPS ETF Retail Flows and Contemporaneous Changes in Inflation Expectations

The dependent variable in the OLS regressions is three-month TIPS ETF retail flow standardized to unit standard deviation. All explanatory variables are also standardized to unit standard deviation (before splitting into positive and negative parts). All variables represent three-month flows or changes and we run these regressions with overlapping monthly observations. The sample period is from February 2010 to August 2022. The realized inflation is real-time year-on-year percentage change of the CPI. The market-based five(one)-year inflation expectation is measured as the five(one)-year inflation swap rates. The survey-based one-year inflation expectation is measured as the median one-year inflation expectation of Michigan survey respondents in the the top income tercile. For a given variable, Δ measures the difference between the realization in the current month and three months earlier. Further, when applicable, "$-$" denotes the negative realizations of the variable while "+" represents the positive part. In parentheses, we report Newey-West standard errors with three lags.

	(i)	(ii)	(iii)	(iv)	(v)
ΔRealized Infl. $(-)$	0.394	0.346	0.389	0.346	0.394
	(0.356)	(0.348)	(0.353)	(0.349)	(0.358)
ΔRealized Infl. $(+)$	0.310	0.324	0.338	0.315	0.310
	(0.179)	(0.179)	(0.205)	(0.169)	(0.179)
ΔMarket-based 5-year Infl. Exp. $(-)$	0.071		0.039	0.312	0.102
	(0.188)		(0.177)	(0.227)	(0.282)
ΔMarket-based 5-year Infl. Exp. $(+)$	0.605		0.611	0.807	0.629
	(0.272)		(0.310)	(0.306)	(0.304)
ΔMarket-based 1-year Infl. Exp. $(-)$		0.015			
		(0.174)			
ΔMarket-based 1-year Infl. Exp. $(+)$		0.250			
		(0.156)			
ΔSurvey-based 1-year Infl. Exp. $(-)$			0.324		
			(0.244)		
ΔSurvey-based 1-year Infl. Exp. $(+)$			-0.142		
			(0.180)		
ΔDiff. between Survey- and Market-based Infl. Exp. (1-year)				0.306	
				(0.130)	
ΔDiff. between Survey- and Market-based Infl. Exp. (5-year)					0.030
					(0.155)
Constant	-0.185	-0.106	-0.099	-0.191	-0.182
	(0.327)	(0.305)	(0.318)	(0.322)	(0.326)
Observations	149	149	149	149	149
Adjusted R^2	0.136	0.073	0.133	0.166	0.131

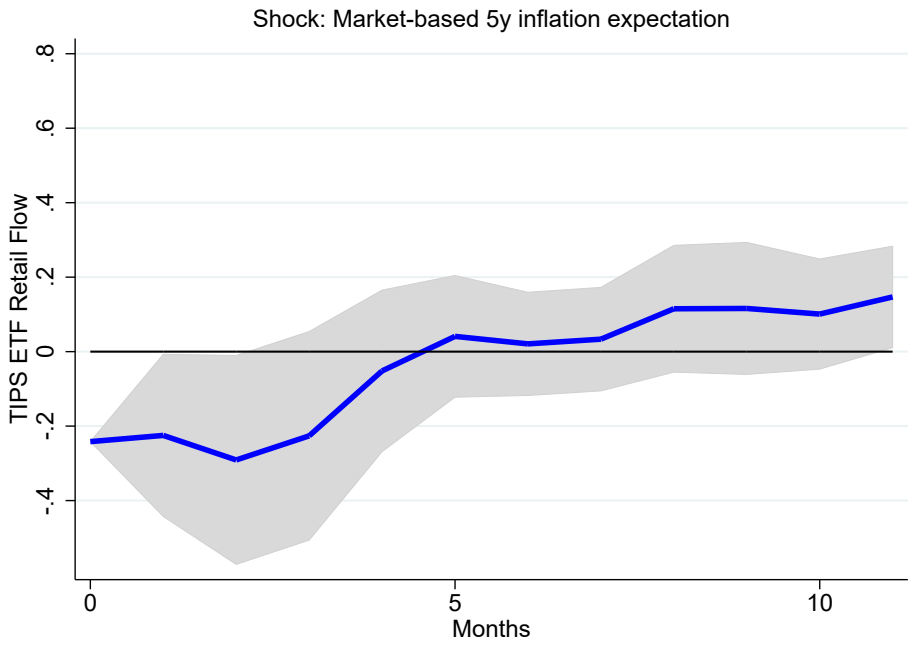
(iii) augments the specification from column (i) with changes in 1-year median inflation expectations of high-income respondents in the Michigan Survey of Consumers. We focus on high-income respondents because they are more likely to be financial market participants and hence potential investors of TIPS ETFs. As the results show, adding the changes Michigan survey expectations to the regression has little effect. The (adjusted) R^2 actually falls slightly from 13.3% from 13.6% in column (i) (if we use changes in 5-year Michigan survey expectations instead, the effect is even weaker). Evidently, changes in 5-year market-based expectations summarize much better the information that drives retail flows into TIPS ETFs. For explaining flows, there is little incremental information in Michigan Survey expectations.

Column (iv) and (v) explore whether the discrepancy between market-based and survey-based expectations explains retail flows. As Reis (2020) argues, when expectations of financial market participants and households diverge, this affects the real rate perceived by households. For example, if TIPS and nominal bond prices reflect low inflation expectations of market participants, but households' inflation expectations are higher, then households would perceive TIPS more attractive relative to nominal bonds as TIPS offers a higher real interest rate under households' expectations. Column (iv) therefore adds an expectations discrepancy term—the 1-year survey-based expectation minus 1-year market-based expectations—to the regression. The coefficient on the discrepancy term is of substantial magnitude and statistically significant, suggesting that a one s.d. increase in the discrepancy is associated with a positive TIPS ETF retail flows of 0.306 s.d. during the same quarter. The R^2 of 16.6% is substantially higher than in column (i). This suggests that disagreement about future inflation between households and financial market participants may be a contributing factor to TIPS ETF retail flows, but it is unlikely to be the whole story. Also, as column (v) shows, a similar discrepancy term constructed from 5-year expectations has much lower explanatory power and the coefficient estimate is not statistically significant at conventional levels. This is somewhat surprising, as disagreement at longer horizons should arguably be more important for retail investors asset allocation decisions than disagreement about the short-run inflation outlook.

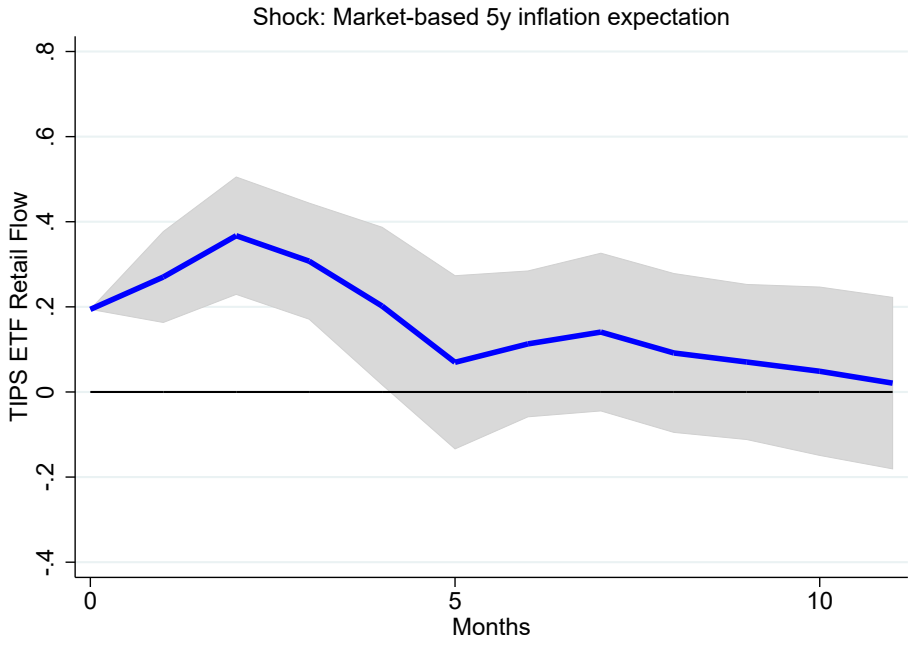
The regressions of quarterly flows on contemporaneous measures of changes in market-based inflation expectations in Table II are subject to the concern that causality could be in the direction of flows to market-based expectations rather than from market-based expectations to flows. Specifically, higher flows into TIPS ETFs could represent a rise in demand for TIPS that affects TIPS prices and, through no-arbitrage relationships between TIPS, nominal Treasury bonds and swaps, also the inflation swap rates that we use to measure market-based expectations.

Looking at the relative timing of retail flows and market-based expectations at a somewhat higher frequency helps us to at least partly sort this out. If flows mostly move with a lag relative to market-based expectations, the price impact reverse causality story is less plausible, at least for the bulk of the effect. A delayed response by flows is plausibly a consequence of retail investors gradually reacting to the inflation news associated with changes in market-based inflation expectations. Establishing whether retail investors' investment decisions are sensitive to such inflation news is the main purpose of our analysis.

To shed light on the relative timing of flows and market-based expectations, Figure III presents impulse responses from local projections (Jordà 2005) with monthly data. In these local projections, we first estimate a bivariate VAR(1) with flows and changes in market-based inflation expectations. To disentangle contemporaneous effects at horizon $k = 0$, we apply a Cholesky decomposition to the covariance matrix of innovations with the assumption that market-based expectations innovations cause flows, but not the reverse. This seems reasonable, as professional market participants presumably move faster to incorporate inflation news into prices than retail investors do, but it is an assumption that would still be of concern if one wanted to cleanly establish causality. The values in the plots for months $k > 0$ are from on a regression in which we predict future flows in month $t + k$ with the month t change in market-based expectations and month t flows. The plot shows the fitted value from this regression when we feed in a one s.d. shock to innovation in market-based expectations at t, including its contemporaneous effect on flows at t. We express the result in terms of standard deviations of VAR innovations of flows. The bands show 90% confidence intervals.



(A) Response to negative changes in market-based inflation expectations



(B) Response to positive changes in market-based inflation expectations

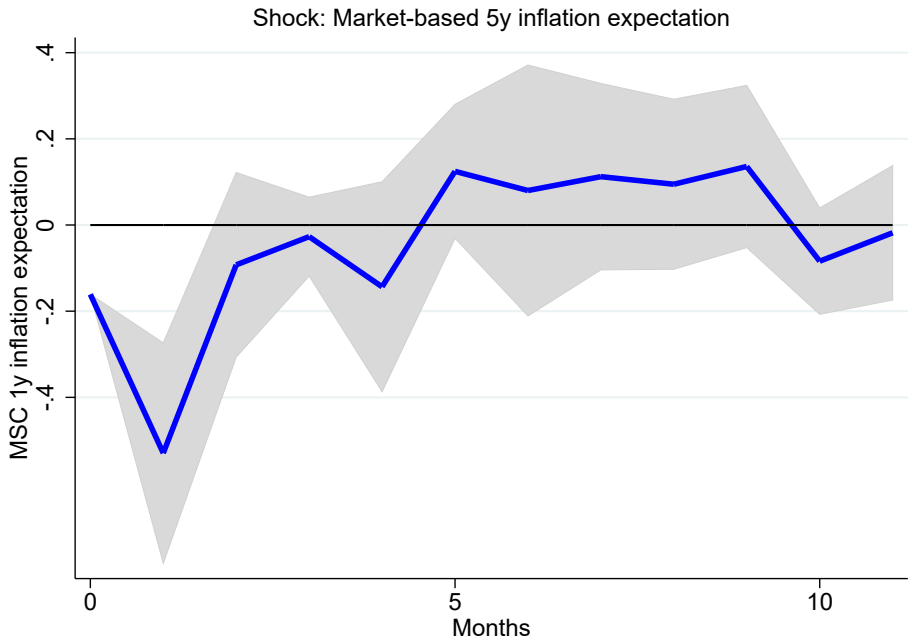
FIGURE III
Impulse response of TIPS ETF retail flows to a shock in market-based inflation expectations

More precisely, to account for the asymmetry that we found in the quarterly contemporaneous regressions, we run these local projections separately with the time series of the negative part of market-based expectations changes (with positive changes set to zero), shown in Figure IIIa, and with the positive part (with negative changes set to zero), shown in Figure IIIb. In the former case, we look at the impulse response to negative innovation in market-based expectations while in the latter case, we look at the impulse response of a positive innovation.

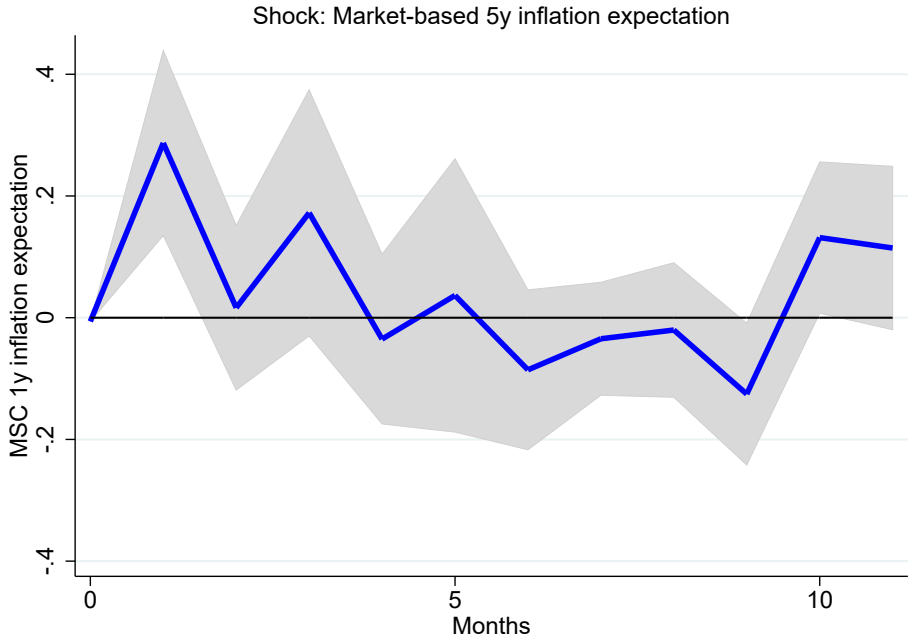
As the two plots show, in terms of the contemporaneous effect, there is actually little asymmetry between positive and negative innovations. In both cases, a one s.d. increase in changes in market-based expectations is associated with an increase of roughly 0.20 s.d. of the TIPS ETF retail flow innovation. The asymmetry comes in at longer horizons, but it is weaker than in our earlier regressions with quarterly data. Positive changes in market-based expectations have a clear positive flow response over the next four months, and perhaps for longer, although statistical uncertainty does not allow precise statements at longer horizons. In contrast, the flow response following negative changes in market-based expectations has a smaller hump at short lags and statistical uncertainty is bigger. Overall, the cumulative flow response (which can be obtained from the area under the impulse response shown in the figures) is bigger for positive changes.

Further, in terms of cumulative flow responses over longer periods, these plots also make it clear that the bulk of flow reactions to the changes in market-based expectations occurs at a lag. Therefore, while changes in market-based expectations are strongly linked to retail investor investment decisions, there is considerable stickiness in retail investors' reaction. This brings up the question whether the reason for this slow reaction is sticky information (e.g., as in Carroll 2003; Mankiw and Reis 2002) with slow updating of beliefs, or sticky action (e.g., as in Calvo 1983) where beliefs may be updated quickly, but economic agents are slow to act on these beliefs due to frictions (see, also, Gabaix 2019).

To shed light on this, Figure IV repeats the same local projection analysis, but now with



(A) Response to negative changes in market-based inflation expectations



(B) Response to positive changes in market-based inflation expectations

FIGURE IV
Impulse response of changes in Michigan survey inflation expectations to a shock in market-based inflation expectations

flows replaced by changes in 1-year Michigan survey expectations.[5] If sticky information was the main culprit for the stickiness in retail investor flows, we would expect that inflation expectations elicited in household surveys show delayed reaction to a similar degree as the flows. However, as Figure IV shows, this is not the case. The reaction of survey expectations is concentrated in the first month after the shock to market-based expectations. Quite different from Figure III, there is little delayed reaction beyond the one-month lag.

The stickiness in flows therefore seems to be largely due to the stickiness in actions rather than to informational stickiness. One caveat is that the survey data may overstate the speed of informational reaction. Individuals who participate in surveys get prompted by the survey questions to pay their attentions to inflation and, as a consequence, may update their beliefs faster than they would otherwise have.

Summing up, changes in market-based expectations of inflation are strongly associated with retail investor flows. Evidently, retail investors pay attention either to the market-based expectations themselves, or to the news that moves the market prices of inflation-hedging products. Retail investors' reaction is asymmetric, with stronger reaction to increases in market-based expectations than to decreases. While the reaction is strong in cumulative terms, much of it occurs with delay. Assuming that changes in survey expectations translate immediately into actions would overstate the speed of reaction.

III.B. Inflation uncertainty

We next examine whether contemporaneous changes in inflation uncertainty help explain time-variation in TIPS ETF retail flows. Table III shows regressions of quarterly TIPS ETF retail flows on contemporaneous measures of changes in market- and survey-based inflation uncertainty. As in our analysis of inflation expectations, we allow positive and negative changes to have different effects. We also scale all dependent variables to have unit s.d. (before splitting into positive and negative parts).

Column (i) uses market-based measures of inflation uncertainty extracted from prices of

5. We show the results for 1-year Michigan survey expectations because they are more strongly related to retail flows than the 5-year expectations in this survey, but the results for 5-year expectations are similar.

TABLE III

TIPS ETF Retail Flows and Contemporaneous Changes in Inflation Uncertainty

The dependent variable in the OLS regressions is three-month TIPS ETF retail flow standardized to unit standard deviation. All explanatory variables are also standardized to unit standard deviation (before splitting into positive and negative parts). All variables represent three-month flows or changes and we run these regressions with overlapping monthly observations. The sample period is from February 2010 to August 2022. The market-based five-year inflation expectation is measured as the five-year inflation swap rates. The market-based five-year inflation uncertainty is measured as the standard deviations of the risk-neutral distribution implied by five-year CPI caps and floors. The survey-based three-year inflation uncertainty is measured as the median of three-year ahead inflation uncertainty in the New York Fed Survey of Consumer Expectations (SCE). The realized inflation is real-time year-on-year percentage change of the CPI. For a given variable, Δ measures the difference between the realization in the current month and three months earlier. Further, when applicable, "-" represents the negative part of the variable while "+" represents the positive part. In parentheses, we report Newey-West standard errors with three lags.

	(i)	(ii)	(iii)	(iv)
ΔMarket-based 5-year Infl. Uncertainty $(-)$	-0.091	0.207		
	(0.243)	(0.280)		
ΔMarket-based 5-year Infl. Uncertainty $(+)$	0.208	-0.069		
	(0.157)	(0.165)		
ΔSurvey-based 3-year Infl. Uncertainty $(-)$			0.464	0.384
			(0.332)	(0.277)
ΔSurvey-based 3-year Infl. Uncertainty $(+)$			-0.177	-0.242
			(0.170)	(0.192)
ΔRealized Infl. $(-)$		0.397		0.779
		(0.355)		(0.405)
ΔRealized Infl. $(+)$		0.367		0.160
		(0.230)		(0.144)
ΔMarket-based 5-year Infl. Exp. $(-)$		0.098		0.005
		(0.190)		(0.205)
ΔMarket-based 5-year Infl. Exp. $(+)$		0.604		0.651
		(0.265)		(0.238)
Constant	-0.092	-0.123	0.348	0.274
	(0.197)	(0.312)	(0.163)	(0.179)
Observations	149	149	108	108
Adjusted R^2	0.000	0.132	0.042	0.251

inflation derivatives (caps and floors). As the results in the table show, the association of uncertainty with flows is weak and statistically insignificant. When we add realized inflation and changes in market-based inflation expectations in column (ii), these variables have coefficients that are close to those earlier in Table II. However, there is still no clear relation between inflation uncertainty and flows.

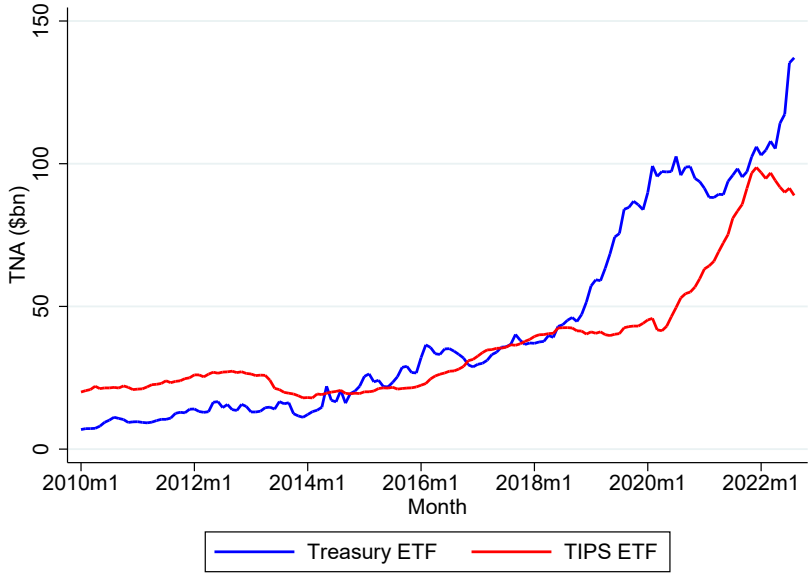
Columns (iii) and (iv) use survey-based measures of inflation uncertainty from the New York Fed Survey of Consumer Expectations instead of the market-based ones. In this case, similar to the case above, we still cannot reject at conventional significance levels that the coefficients on the uncertainty changes are zero. Overall, changes in inflation uncertainty measures have little explanatory power for TIPS ETF retail flows.

III.C. TIPS ETF vs. Nominal Treasury ETF Retail Flows

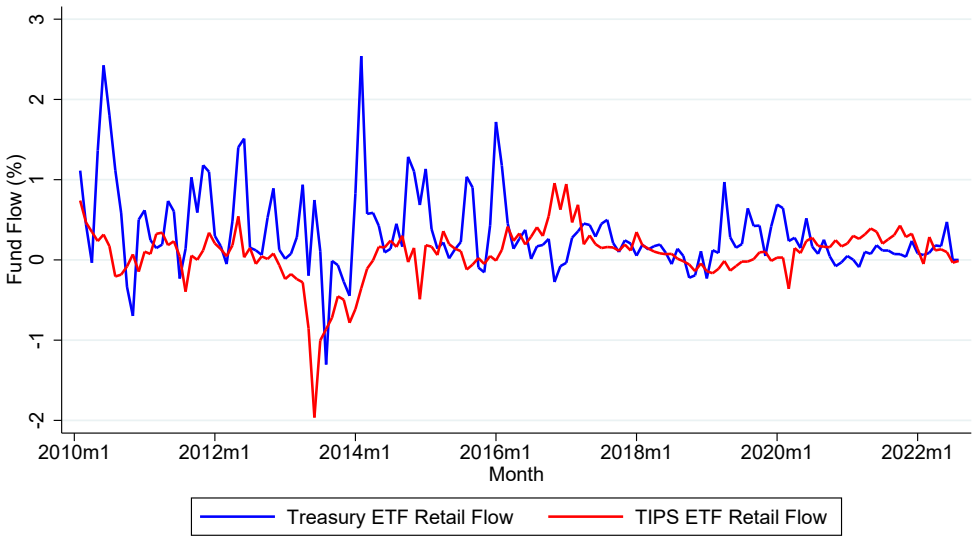
If a rise in market-based expectations is a proxy for factors that make inflation risks salient to retail investors, then the natural source of funds directed into TIPS ETF is outflows from nominal Treasury ETF. In times when retail investors do not pay much attention, and are not concerned much about inflation, nominal Treasury ETFs may be viewed as good substitutes, but when inflation risks become salient, this may change. If inflation concerns make TIPS ETF more attractive in the view of retail investors, these concerns should make nominal Treasury ETF less attractive. As a consequence, retail investors may reallocate from nominal Treasury ETF to TIPS ETF. To investigate this, we now compare the flows of nominal Treasury ETF with TIPS ETF.

Figure Va compares the aggregate total net assets of TIPS and nominal Treasury ETF. Both categories have roughly the same size during our sample period. For this reason, we conduct the analysis of flows of the two categories in terms of non-standardized percentage of total net assets. This allows us to compare the magnitude of the flows.

Figure Vb shows the two retail flow series. Hints of a negative correlation are already apparent in a visual inspection. For example, when the TIPS ETF flows are strongly positive, such as around the end of 2016 and in 2021, nominal Treasury ETF flows are low or negative.



(A) Total net assets



(B) Non-standardized retail fund flows

FIGURE V
Total Net Assets and Retail Fund Flows of TIPS and Treasury ETF

TABLE IV
TIPS ETF vs. Nominal Treasury ETF Retail Flows (Non-Standardized)

The dependent variable in the OLS regressions is three-month TIPS ETF retail flow or nominal Treasury ETF retail flow. The dependent variables are not standardized in this table. All explanatory are standardized to unit standard deviation (before splitting into positive and negative parts). All variables represent three-month flows or changes and we run these regressions with overlapping monthly observations. The sample period is from February 2010 to August 2022. The realized inflation is real-time year-on-year percentage change of the CPI. The market-based five(one)-year inflation expectation is measured as the five(one)-year inflation swap rates. The survey-based one-year inflation expectation is measured as the median one-year inflation expectation of Michigan survey respondents in the the top income tercile. For a given variable, Δ measures the difference between the realization in the current month and three months earlier. Further, when applicable, "$-$" denotes the negative realizations of the variable while "$+$" represents the positive part. In parentheses, we report Newey-West standard errors with three lags.

	(i) TIPS	(ii) Treasury	(iii) TIPS	(iv) Treasury
ΔRealized Infl. $(-)$	0.361	-0.092	0.317	-0.016
	(0.327)	(0.329)	(0.320)	(0.325)
ΔRealized Infl.$(+)$	0.285	0.047	0.289	0.040
	(0.164)	(0.197)	(0.155)	(0.185)
ΔMkt.-based 5-year Infl. Exp.$(-)$	0.065	-0.698	0.287	-1.078
	(0.173)	(0.410)	(0.208)	(0.431)
ΔMkt.-based 5-year Infl. Exp.$(+)$	0.556	-0.388	0.741	-0.707
	(0.250)	(0.246)	(0.281)	(0.253)
ΔDiff. between Survey- and Mkt.-based Infl. Exp. (1-year)			0.281	-0.482
			(0.120)	(0.181)
Constant	0.041	0.883	0.035	0.893
	(0.300)	(0.257)	(0.295)	(0.250)
Observations	149	149	149	149
Adjusted R^2	0.136	0.115	0.166	0.179

When TIPS ETF have strong outflows, such as around the end of 2014 or in early 2020, nominal Treasury ETF have inflows.

Table IV reports regressions similar to those in Table II, but now also for nominal Treasury ETF retail flows. Broadly speaking, the nominal Treasury ETF flows move in the opposite direction of TIPS ETF flows. When long-horizon market-based expectations move up, TIPS ETF receive retail inflows and nominal Treasury ETF experience outflows, consistent with the salience story where rise in market-based expectations is associated with factors that trigger inflation concerns of retail investors. The magnitudes are roughly in line. A one s.d. increase

in long-horizon market-based expectations is associated with an inflow of 0.556% of total net assets for TIPS ETF and an outflow of 0.388% of total net assets of nominal Treasury ETF. Since the levels of total net assets are roughly the same, with Treasury ETF total net assets slightly higher, these numbers also imply the dollar flows are roughly offsetting.

However, unlike TIPS ETF flows, the nominal Treasury ETF flows also move strongly with decreases in market-based inflation expectations. When market-based inflation expectations fall, nominal Treasury ETF receive inflows. One potential explanation is that falling market-based inflation expectations are also periods when retail investors substitute away from other riskier assets such as stocks towards nominal Treasury ETF. For example, the two post-2010 periods in which market-based inflation expectations fell substantially, the second half of 2015 and early 2020, were also periods in which the stock market performed poorly.

III.D. Controlling for the flow-performance relation

One potential concern with our finding that changes in market-based inflation expectations are strongly related to flows into TIPS ETF is that the returns of TIPS ETF are also correlated with contemporaneous changes in market-based inflation expectations. Could it be that what we picked up in Table II is actually a relation between TIPS ETF performance and flows?

To check this, Table V repeats key regressions from Table II controlling for value-weighted returns of all TIPS ETFs in the same quarter and earlier quarters. Consistent with a large literature on the flow-performance relationship of ETF and open-ended mutual funds, we also find a strong relationship between flows and performance for TIPS ETF. As columns (ii), (iii), and (iv) show, adding returns, especially contemporaneous returns, as explanatory variables along with the market-based inflation expectations variables strongly increases the R^2 in these regressions. The effect is flow-performance relation is asymmetric for TIPS ETF. Negative returns lead to outflows, while positive returns do not have a statistically significant effect.

Importantly though, controlling for past TIPS ETF performance has little effect on the

TABLE V

TIPS ETF Retail Flows and Contemporaneous Changes in Inflation Expectations: Controlling for Flow-Performance Relations

The dependent variable in the OLS regressions is three-month TIPS ETF retail flow standardized to unit standard deviation. All explanatory variables are also standardized to unit standard deviation (before splitting into positive and negative parts). All variables represent three-month flows or changes and we run these regressions with overlapping monthly observations. The sample period is from February 2010 to August 2022. The realized inflation is real-time year-on-year percentage change of CPI. The market-based five-year inflation expectation is measured as the five-year inflation swap rates. TIPS ETF return is the value-weighted return of all TIPS ETFs. For a given variable, Δ measures the difference between the realization in the current month and three months earlier. Further, when applicable, "-" represents the negative part of the variable while "+" represents the positive part. In parentheses, we report Newey-West standard errors with three lags.

	(i)	(ii)	(iii)	(iv)
ΔRealized Infl. (−)	0.394	0.287	0.328	0.331
	(0.356)	(0.355)	(0.347)	(0.364)
ΔRealized Infl. (+)	0.310	0.366	0.294	0.340
	(0.179)	(0.154)	(0.165)	(0.159)
ΔMarket-based 5-year Infl. Exp. (−)	0.071	-0.071	0.068	0.044
	(0.188)	(0.233)	(0.170)	(0.247)
ΔMarket-based 5-year Infl. Exp. (+)	0.605	0.576	0.487	0.413
	(0.272)	(0.239)	(0.223)	(0.217)
Contemporaneous TIPS ETF Return (−)		0.689		0.675
		(0.300)		(0.309)
Contemporaneous TIPS ETF Return (+)		-0.322		-0.278
		(0.197)		(0.203)
One-quarter lagged TIPS ETF Return (−)		0.522	0.522	0.553
		(0.225)	(0.204)	(0.222)
One-quarter lagged TIPS ETF Return (+)		-0.230	-0.146	-0.246
		(0.150)	(0.149)	(0.144)
Two-quarters lagged TIPS ETF Return (−)				0.493
				(0.145)
Two-quarters lagged TIPS ETF Return (+)				-0.133
				(0.104)
Constant	-0.185	0.387	0.070	0.712
	(0.327)	(0.251)	(0.284)	(0.237)
Observations	149	146	146	143
Adjusted R^2	0.136	0.366	0.209	0.432

coefficients of changes in realized inflation and changes in market-based inflation expectations. The relationship between flows and market-based inflation expectations changes does not appear to be an artifact of the flow-performance relationship.

III.E. Open-ended TIPS mutual fund flows

In our analysis so far, we focused on TIPS ETFs because for TIPS ETFs we can measure total retail investor flows relatively cleanly using microstructure data. But it would be useful to check whether retail flows into open-ended TIPS mutual funds broadly exhibit similar dynamics. Additionally, open-ended mutual fund flow data are available earlier, since 2004, so that we can examine a longer time series. For this reason, we examine flows into retail share classes of open-ended mutual funds. Focusing on retail share classes does not cleanly identify total retail flows because many retail investors may have access to institutional share classes in their retirement accounts. However, the flow into retail share classes should at least not be contaminated by institutional flows.

Table VI repeats the key regressions from the earlier tables, but now with flows into retail share classes of open-ended mutual funds as the dependent variable. As before, dependent and explanatory variables are standardized to unit s.d. (before splitting into positive and negative parts). As can be seen, the results are broadly in line with those for TIPS ETF retail flows. Changes in market-based expectations, and in this case also changes in realized inflation, are strongly related to retail flows. Changes in market-based and survey-based uncertainty measures do not have a clear relationship with retail flows and the coefficient estimates are mostly insignificant at conventional levels. Unlike for TIPS ETF retail flows, though, the changes in the disagreement variable that we add in column (v) does not have a statistically significant relation with retail flows.

Furthermore, the magnitudes of the coefficients on changes in market-based expectations tend to be smaller in Table VI than in Table II. For example, in column (i) we estimate that a one s.d. positive change in market-based 5-year inflation expectations is associated with a 0.341 s.d. of inflow to retail share classes of open-ended TIPS mutual funds. For comparison,

TABLE VI

Flows into Retail Share Classes of Open-Ended TIPS Mutual Funds and Contemporaneous Changes in Inflation Expectations

The dependent variable in the OLS regressions is three-month flow into retail share classes of open-ended TIPS mutual funds standardized to unit standard deviation. All explanatory variables are also standardized to unit standard deviation (before splitting into positive and negative parts). All variables represent three-month flows or changes and we run these regressions with overlapping monthly observations. The sample period is from August 2004 to August 2022. The realized inflation is real-time year-on-year percentage change of the CPI. The market-based five-year inflation expectation is measured as the five-year inflation swap rates. TIPS mutual fund return is the value-weighted return of all TIPS mutual funds. The market-based five-year inflation uncertainty is measured as the standard deviations of the risk-neutral distribution implied by five-year CPI caps and floors. The survey-based three-year inflation uncertainty is measured as the median of three-year ahead inflation uncertainties of the New York Fed Survey of Consumer Expectations (SCE). The difference between survey- and market-based inflation expectation is taken between the inflation swap rate and the corresponding Michigan survey expectation. For a given variable, Δ measures the difference between the realization in the current month and three months earlier. Further, when applicable, "-" represents the negative part of the variable while "+" represents the positive part. In parentheses, we report Newey-West standard errors with three lags.

	(i)	(ii)	(iii)	(iv)	(v)
ΔRealized Infl. (−)	-0.133	-0.105	-0.172	0.418	-0.158
	(0.129)	(0.107)	(0.138)	(0.325)	(0.121)
ΔRealized Infl. (+)	0.819	0.755	0.773	0.521	0.818
	(0.136)	(0.111)	(0.132)	(0.115)	(0.136)
ΔMarket-based 5-year Infl. Exp. (−)	-0.029	-0.080	0.192	0.206	0.045
	(0.122)	(0.114)	(0.196)	(0.211)	(0.143)
ΔMarket-based 5-year Infl. Exp. (+)	0.341	0.358	0.569	0.671	0.419
	(0.164)	(0.140)	(0.220)	(0.233)	(0.180)
One-quarter lagged TIPS MF Return (−)		0.301			
		(0.162)			
One-quarter lagged TIPS MF Return (+)		0.463			
		(0.226)			
ΔMarket-based 5-year Infl. Uncertainty (−)			-0.027		
			(0.090)		
ΔMarket-based 5-year Infl. Uncertainty (+)			-0.200		
			(0.121)		
ΔSurvey-based 3-year Infl. Uncertainty (−)				0.453	
				(0.315)	
ΔSurvey-based 3-year Infl. Uncertainty (+)				-0.344	
				(0.117)	
ΔDiff. between Survey- and Market-based Infl. Exp. (1-year)					0.114
					(0.104)
Constant	-0.480	-0.536	-0.509	-0.064	-0.490
	(0.190)	(0.160)	(0.248)	(0.138)	(0.188)
Observations	215	214	156	108	215
Adjusted R^2	0.228	0.360	0.322	0.398	0.231

in Table II, the coefficient was 0.605, i.e., almost twice as big. This is a plausible result. Many ETF investors probably opt for ETFs rather than open-ended mutual funds because they seek a product that they can easily trade if they want to change their portfolio allocations. For this reason, one would expect that ETF flows exhibit more pronounced responses.

To summarize, the main finding of the ETF flow analysis that market-based inflation expectations are strong predictors of flows and that uncertainty measures do not have much explanatory power is confirmed using the open-ended mutual fund flow data.

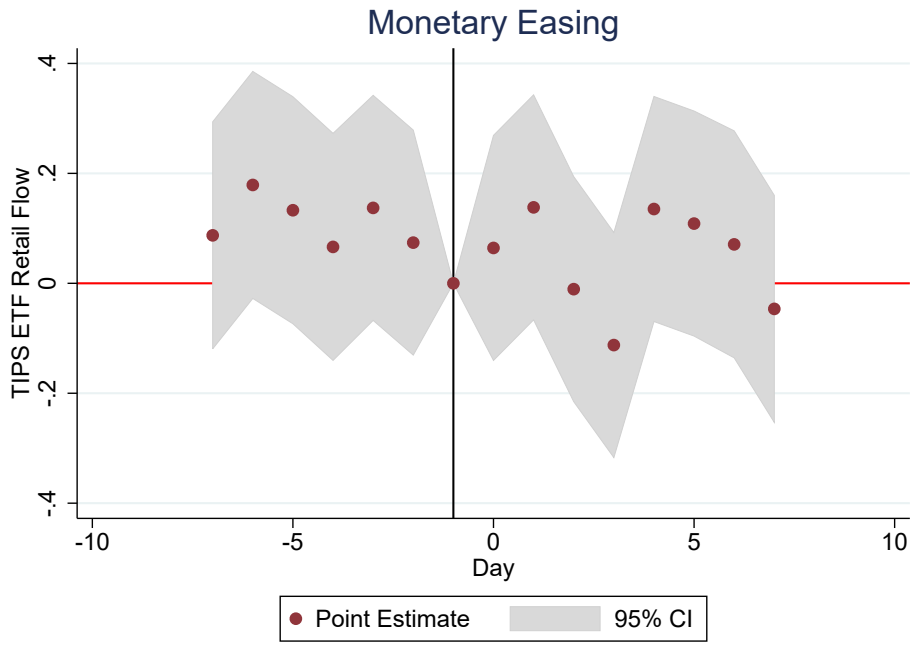
IV. TIPS ETF flows around Events

The measures of inflation expectations and inflation uncertainty that we examined so far may not necessarily fully span the information that induces retail flows into TIPS ETFs. One such information would be certain public events that retail investors could perceive as having implications for the inflation outlook. For this reason, we now investigate whether retail flows into TIPS ETF react to these events.

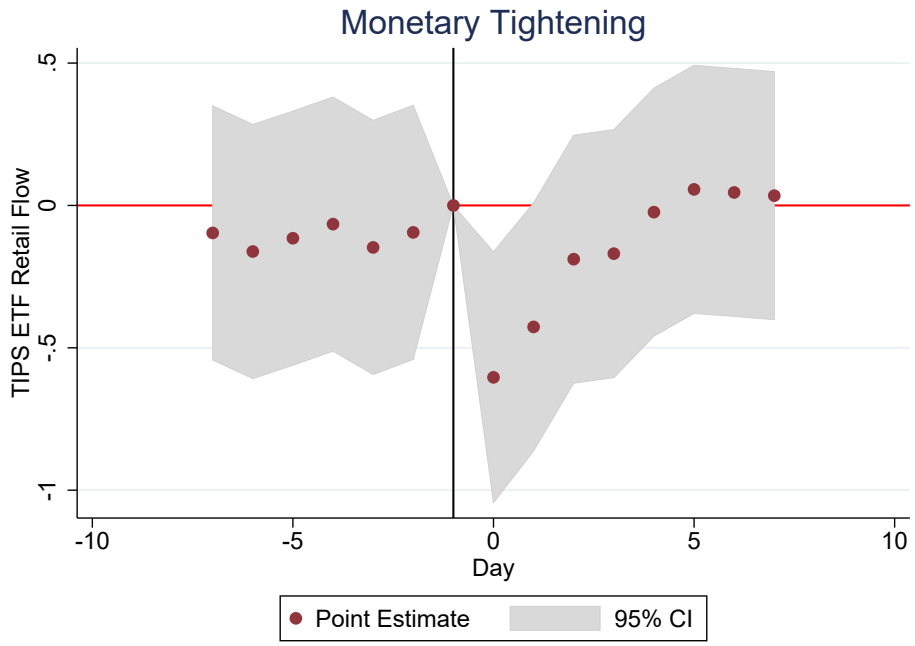
IV.A. FOMC meetings

A natural place to look, given the tight connection between monetary policy and inflation, is the periodic monetary policy announcements of the Federal Reserve. On one hand, as discussed in Binder (2017) and Coibion, Gorodnichenko, Kumar, and Pedemonte (2020), there is not much evidence that consumers pay attention to Federal Reserve announcements. On the other hand, somewhat surprisingly, Lewis, Makridis, and Mertens (2019) find that daily consumer confidence responds instantaneously to federal funds rate target changes. In light of this latter finding, it is perhaps not unthinkable that Federal Reserve announcements could induce retail investors to change their allocations to TIPS ETFs.

To study TIPS ETF retail flows around announcements following FOMC meetings, we now use the ETF net order imbalance data at daily frequency. Figure VI shows the average daily flows around FOMC meetings. Two-day meetings (with announcement on the second day) are collapsed into day 0. To separate FOMC meetings in which the announced policy



(A) FOMC meetings with negative change in 10-year treasury yields from day before to day after meeting



(B) FOMC meetings with positive change in 10-year treasury yields from day before to day after meeting

FIGURE VI
TIPS ETF Retail Flows around FOMC Meetings

represents a tightening of monetary policy from those with policy loosening, we look at the change in the 10-year Treasury yield from the day before to the day after the meeting. We then split the sample into meetings with a fall in the yield (shown in the top panel) and those with a rise in yields (shown in the bottom panel).[6]

As the figure shows, the results are directionally in line with our earlier regression results, but the asymmetry is different. When the Fed is tightening policy, which results in a rise in Treasury yields, and which should reduce concerns about future inflation, retail investors pull money of TIPS ETF on the FOMC meeting day and in subsequent days. But when the Fed is easing policy, there is no detectable reaction. So for policy easing, our findings are in line with the evidence from the other studies we discussed above that consumers do not seem to pay much attention to Federal Reserve announcements on a day-to-day basis. But policy tightening does seem to attract some of their attention.

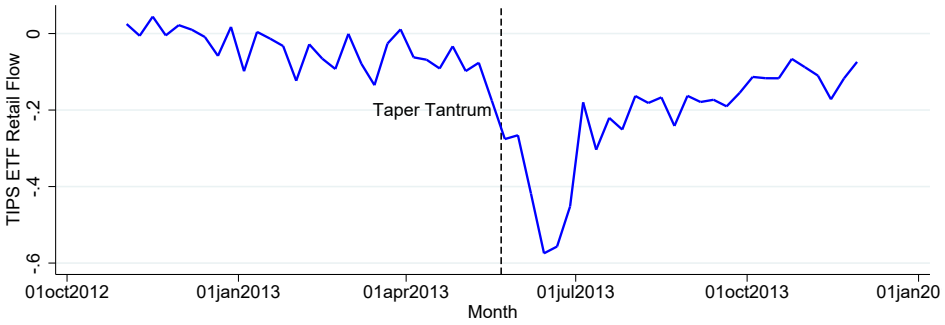
IV.B. Taper Tantrum in 2013

During our sample period there are two instances where communication from the Federal Reserve may have been particularly salient for retail investors: the announcement that lead to the "taper tantrum" in May 2013 and the announcement of massive asset purchases in response to the COVID-19 crisis in March 2020.

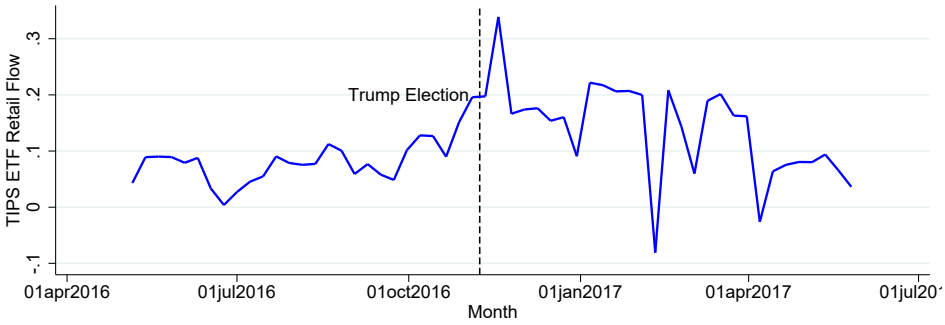
We look at the taper tantrum first. On May 22, 2013, Federal Reserve Chair Ben Bernanke announced that the Fed would start tapering its asset purchases at some future date—and apparently earlier than many investors had expected. This lead to what came to be known as the taper tantrum in bond markets, with Treasury yields rising sharply. The taper tantrum was covered widely in the media, which may have attracted retail investor attention.

Figure VII plots the weekly time series of TIPS ETF retail flows around the announcement, with the announcement date shown by the dashed line. In the weeks following the announcement, retail investors withdraw their capital at a rate of up to 0.6% of the total net assets of TIPS ETFs per week. This is about 7 standard deviations of the weekly TIPS

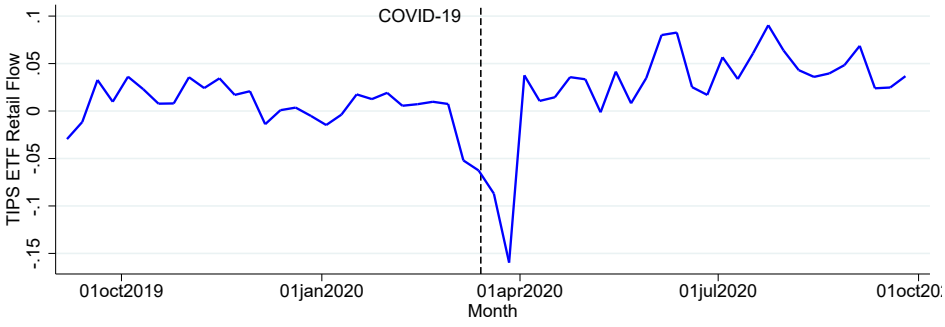
6. We also repeated this analysis by using changes in the 5-year inflation swap rates to define policy tightening and loosening. The results are similar.



(A) Taper Tantrum in May 2013



(B) Trump Election in November 2016



(C) COVID-19 in March 2020

FIGURE VII
TIPS ETF Retail Flows around Major Events: Weekly Data

ETF retail flow. In other words, these are massive outflows. As in our earlier analysis of flow responses to changes in market-based inflation expectations, there is a delayed reaction; outflows peaked several weeks after the announcement.

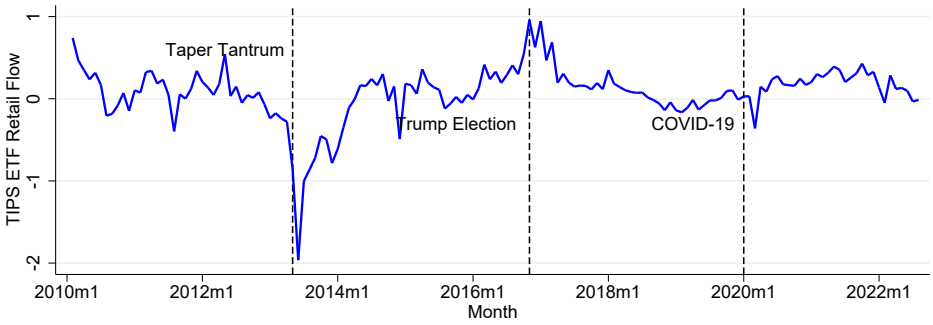
Figure VIII compares monthly data on TIPS ETF retail flows, shown in the top panel, with inflation expectations data, shown in the middle panel, and inflation uncertainty measures, shown in the bottom panel. Around the time of the announcement, market-based 5-year inflation expectations fell by about 0.5 percentage points. Survey-based expectations fell as well but due to the greater noise in this series it is more difficult to say whether this was truly associated with the announcement. In the meantime, there is no drop in inflation uncertainty. Thus, like in our earlier time series analysis of retail flows, there seems to be a link between market-based expectations and retail flows. Also, as in the earlier analysis, we see that flows moved more slowly than market-based expectations in response to the policy shock.

IV.C. COVID-19 crisis

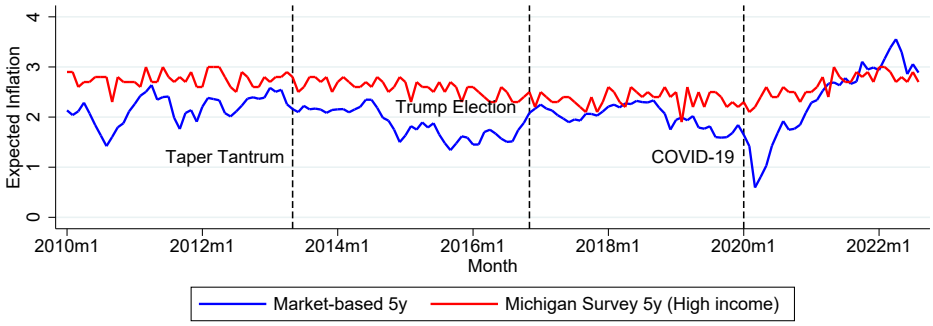
In response to the economic turmoil in wake of the COVID-19 pandemic and the Treasury bond market turmoil in March 2020 (see, e.g., He, Nagel, and Song 2021), the Federal Reserve lowered the federal funds target rate and announced massive asset purchase plan. Figure VIIc shows that this was followed first by large retail outflows from TIPS ETFs at a rate of more than 0.15% of total net assets of these ETFs per week. Figure VIII shows that these outflows are matched by a similar sharp decline in market-based inflation expectations. Survey-based inflation uncertainty also moved sharply higher at that time.

IV.D. Presidential election in 2016

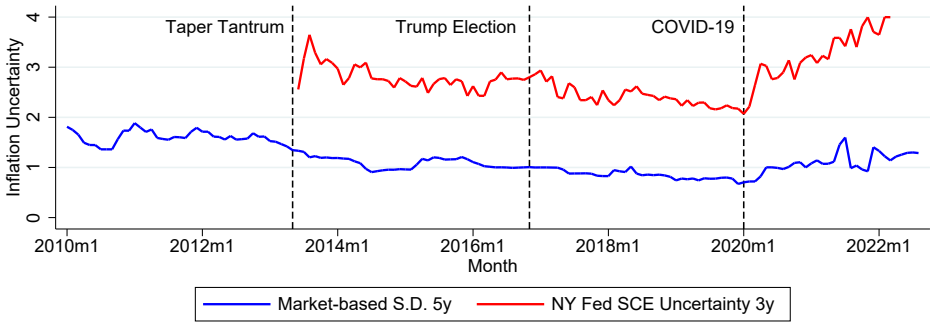
In addition to monetary policy announcements of the Federal Reserve, we also look at the time around the November 2016 presidential election. As shown in Figure VIIb, Weekly inflows start rising already before the election and they peak after the election of Donald Trump as president of the United States. Apparently, retail investors' desire for inflation protection rose



(A) TIPS ETF Retail Flow



(B) Inflation Expectation



(C) Inflation Uncertainty

FIGURE VIII
TIPS ETF Retail Flows around Major Events

sharply. The magnitudes of inflows are about half as big as the outflows in the wake of the taper tantrum. As Figure VIII shows, market-based 5-year inflation expectations are again moving in the same direction as flows. They rise by about 0.7 percentage points around the election. There is little movement in either survey-based expectations or inflation uncertainty measures.

V. Conclusion

During most of our sample period, inflation was low and stable. Yet, retail investors apparently pay attention to news about inflation even when inflation expectations are, according to many measures, well-anchored. When market-based long-horizon inflation expectations rise, aggregate retail flows into inflation-protected ETF increase, while nominal Treasury ETF experience outflows. Prominent potentially inflation-relevant events such as the taper tantrum in 2013 and the 2016 presidential election are also associated with substantial retail TIPS fund flows. For households' investment decisions, inflation appears to be a material factor that they do not ignore, even in a benign inflationary environment.

Somewhat surprisingly, changes in market-based measures of inflation expectations extracted from inflation swap rates seem to be the best proxy for the inflation news factors that induce households to change their allocation to inflation-protected investments. Household survey-based measures have little incremental explanatory power for retail TIPS fund flows over and above market-based measures. Changes in market-based inflation expectations also dominate changes in inflation uncertainty in explaining retail TIPS fund flows. Evidently, movements in the first moment of inflation, rather than changes in the second moment, are the main factor that induces retail investors to seek more inflation protection.

For policy makers interested in understanding inflation concerns of households, the results in this paper suggest that market-based expectations measures should not be dismissed. They are in fact closely linked to households investment decisions. This does not necessarily mean that retail investors are paying close attention to prices of inflation derivatives. More likely, the news that moves prices of these derivatives also reaches households and influences their

views of the inflation outlook. But movements in market-based expectations seem to provide a good summary of the inflation news that reaches households through these other channels.

Policy makers may also find it useful to monitor retail flows into inflation-protected investment products directly in addition to expectations data. Households' investing behavior may provide additional early cues whether the central bank is losing credibility and inflation expectations are becoming unanchored.

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