Reading Inflation Expectations from the Treasury Market: Insights from Institutional Investor Trading Activity*

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Abstract

We use granular data covering trades in Treasury Inflation-Protected Securities (TIPS) to characterize the role of investor flows in distorting market-implied inflation indicators used by policymakers to assess inflation expectations. We find that institutional investor trading can drive measures of inflation expectations based on TIPS, but the impact from observed trading is usually small. The recent rise in market-implied inflation may have been amplified, on the margin, by trend-chasing activity. Pockets of investors tend to trade systematically either with, or against, price movements, suggesting conditions facing these participants can lead to market movements that exaggerate or underestimate true changes in expectations, respectively. Our analysis supports the view that the TIPS market is highly informative of inflation expectations, but policymakers should consider distortions resulting from trading behavior when interpreting market signals, especially when volatility is elevated.

Keywords: Price-pressure, U.S. Treasury market, inflation expectations, monetary policy, momentum, asset-pricing, institutional investors

JEL Codes: E7, G1, G4, G12, G32

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1 Introduction

Since the onset of the COVID-19 pandemic, the U.S. economy has experienced inflation fluctuations that haven't been seen for decades.[1] Volatility in the price levels of goods and services may contribute to persistent changes in households and businesses' inflation expectations, a limiting factor for policymakers seeking to strengthen the economic recovery. Surveys and financial markets provide evidence of evolving expectations. However, both sources of information are imperfect, leaving policymakers with noisy signals to guide policy. Market-based indicators—such as those based on U.S. Treasury Inflation Protected Securities (TIPS)—have the advantages of being priced by investors with "skin in the game" and are updated in real-time. In this insight, we use granular transaction data in the TIPS market to characterize sources of noise policymakers can consider when assessing inflation expectations.

Since the current economic recovery began in mid-2020, the market has sent a strong signal of higher inflation expectations. The rise has been most pronounced in measures covering short time horizons, e.g. over the next 2 years, while longer-dated measures have remained comparatively well-anchored (see Figure 1). These dynamics are consistent with the view that monetary policy would respond sufficiently to prevent a sustained overshoot of inflation above the Federal Reserve's 2 percent objective, affirmed by the pivot in policymaker communications since late 2021.[2]

We find that institutional investor trading can drive measures of inflation expectations based on TIPS—potentially distorting their signal for expectations—but the impact from observed trading is usually small. Our estimates indicate that the price impact of TIPS trading flows is higher when overall market volatility is elevated. Conversely, flows have an imperceptible effect, on balance, when volatility is below average. The rise in market-implied inflation from mid-2020 through late 2021 may have been amplified by trend-chasing

[1] The rise in prices, as measured by the price index for personal consumption expenditures, reached 5.8 percent (4.9 excluding food and energy) on a year-over-year basis as of the end of 2021, after having averaged 1.6 percent over the decade leading up to the pandemic. (Source: FRED)

[2] See Institute Take "What do Fed rate hikes mean for U.S. households' financial health?" (March 2022).

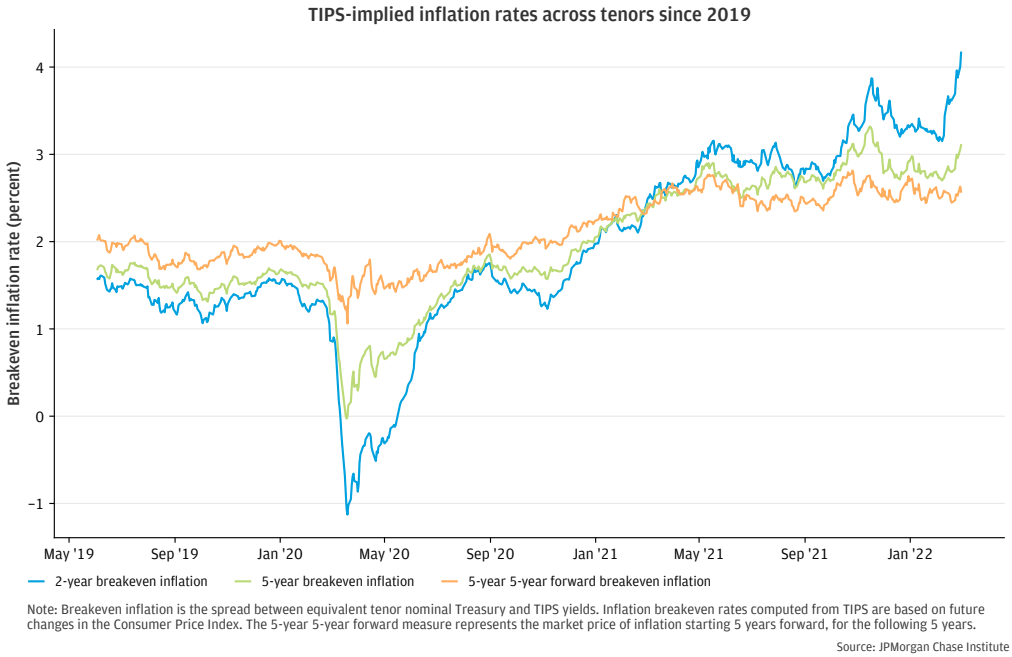


Figure 1: Market-based expected inflation measures have risen notably in the short-term, while longer-dated measures remain largely stable.

activity, although the price impact of trading in our data explains, at most, one-fifth of the increase. Pockets of investors tend to trade systematically either with, or against, price movements, suggesting conditions facing these participants can lead to market movements that exaggerate or underestimate true changes in expectations, respectively. Our analysis supports the view that the TIPS market is highly informative of inflation expectations, but policymakers should consider distortions resulting from trading behavior when interpreting market signals, especially when volatility is elevated.

After introducing our data and a primer on how inflation is priced in markets, we organize our analysis around four findings.

- Finding 1: **Institutional investor trading activity affects indicators of inflation expectations, but distortions are usually modest when volatility is contained.**

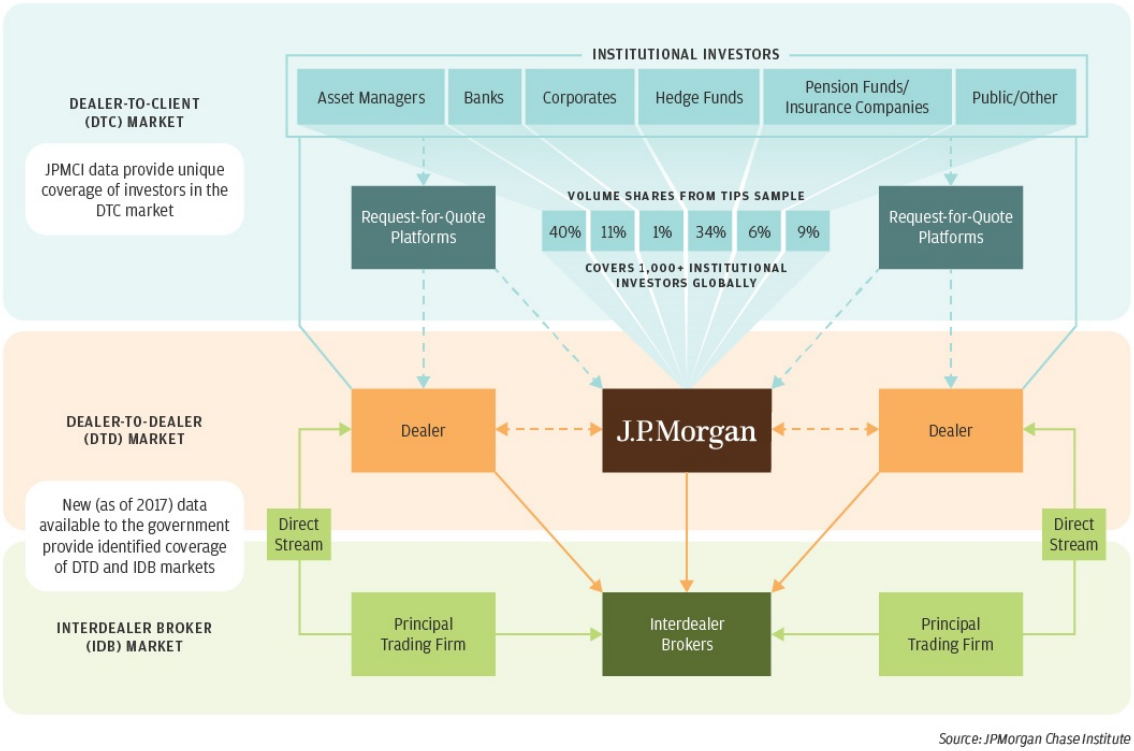
- Finding 2: **Trend-chasing flows contributed modestly to the rise in inflation pricing since mid-2020.**

- **Finding 3**: **Investor flows help explain the sharp divergence in relative TIPS pricing during March 2020, in which less-liquid securities deeply underperformed amid extreme market volatility.**

- **Finding 4**: **Market participants that usually trade against prevailing price action initially bought TIPS as their prices fell in March 2020, however, their purchases were small and began to reverse by the peak of the crisis.**

About the data

Our unique lens comes from de-identified data about institutional investor trading in financial markets. The data used in this analysis cover over 1000 global institutional investors' transactions in TIPS with the Markets Division of J.P. Morgan's Corporate and Investment Bank from 2013 through late 2021. Trades worth about $1 trillion in gross volume form the core sample.



U.S. Treasury Market Structure

Our data provide a unique look into the dealer-to-client market for TIPS,[3] complementing a dataset of Treasury market transactions available to government officials since 2017, Trade Reporting and Compliance Engine (TRACE) for Treasuries. The infographic shows the perspective of our data in the context of the overall Treasury market structure.[4] An important feature of our data—a panel data perspective with investor attributes—is a crucial element differentiating our analysis from the U.S. government's dataset, which lacks detailed information of the end-investors trading in the dealer-to-client market. Our ability to follow individual investor's activity over time aids our categorization of trading activity, supporting price impact estimates (introduced in Finding 1) and aggregated systematic flow calculations (described in Finding 4).

Primer: How are views of inflation reflected in financial markets?

The main indicator of future U.S. inflation priced in bond markets is the difference between interest rates on standard (nominal) Treasury securities and those indexed to inflation: Treasury Inflation Protected Securities (TIPS).[5] The return on TIPS is a combination of a "real" yield, representing the gain in purchasing power over a period of time, plus a rate tied to increases in the Consumer Price Index (CPI). The gap between the market yield on nominal Treasuries and the real yield of TIPS of the same maturity date is the rate of CPI-based inflation above which an investor would be better off to own TIPS. For this reason, it is termed the "breakeven" rate of inflation, depicted in Figure 2.

Under simple financial theories with no transactions costs, the Treasury market would perfectly reflect the inflation rate expected by investors. In practice, however, distortions of market prices from expectations can come from numerous sources. For example, TIPS are

[3] Our data also contains transactions for other securities traded by J.P. Morgan with its clients, including the nominal Treasury market, foreign government bonds, and foreign exchange, as explored in previous reports by the JPMorgan Chase Institute, e.g. Tracking Spillovers During the Taper Tantrum.

[4] The infographic is a modified version of the Treasury Market Structure model appearing in Brain et al. (2018).

[5] Financial derivatives—e.g., inflation swaps and options on inflation rates—offer traders other routes to expressing views on future inflation. However, inflation swaps in the US make up a small fraction of the volume traded in TIPS (White 2021), so we focus on transactions in the Treasury market.

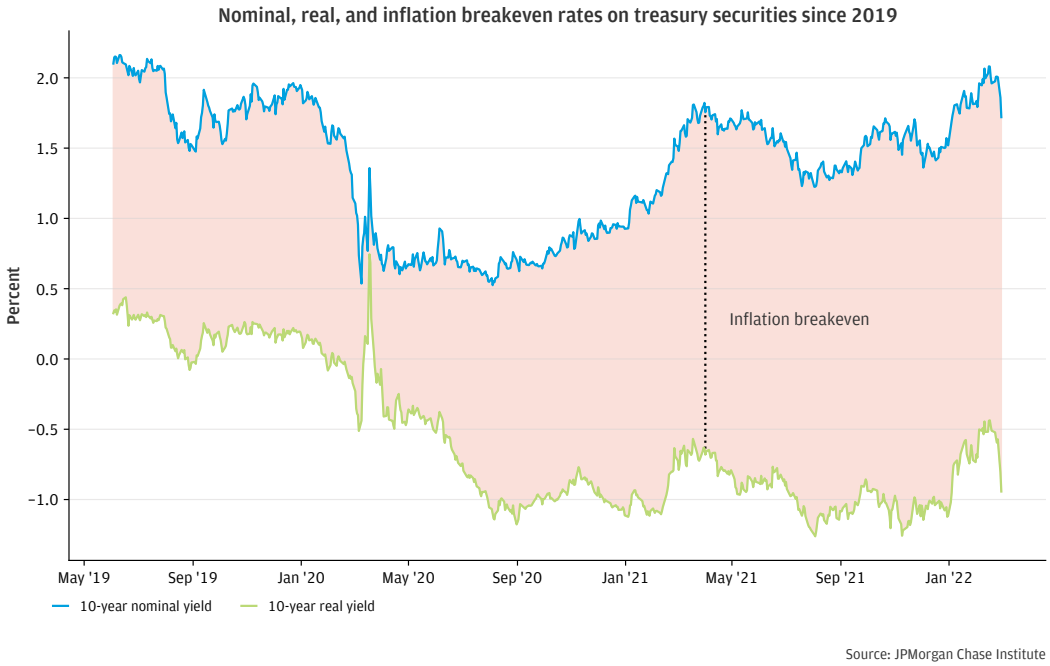


Figure 2: The difference between the yields on standard 'nominal' Treasury securities and TIPS represents the outlook for inflation.

less liquid than their nominal counterparts, suggesting the relevance of a liquidity discount which can vary over time. Meanwhile, the value of protection against high (or low) inflation outcomes can influence breakeven rates through risk premia that depend on the perceptions of traders.[6] Reliably parsing market prices to differentiate expectations from risk premia is challenging and leaves policymakers with imprecise knowledge of true inflation expectations. We bring new granular data to the topic.

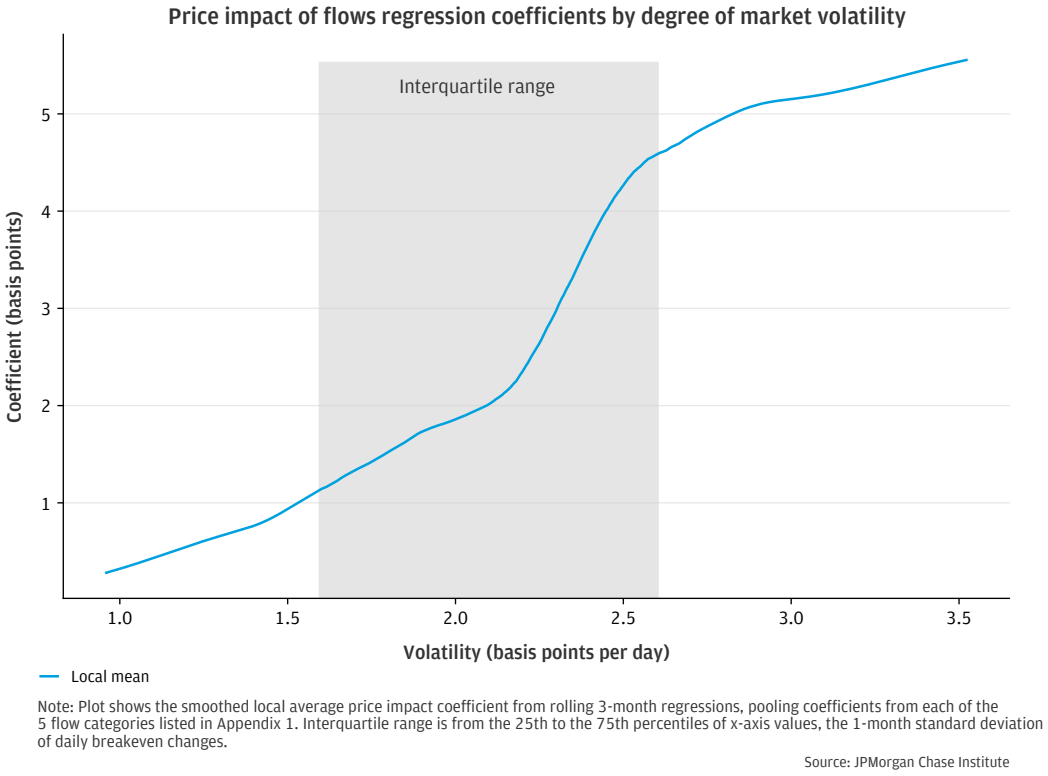
Finding 1

Institutional investor trading activity affects indicators of inflation expectations, but distortions are usually modest when volatility is contained.

We find a correlation between trading activity and changes in inflation breakeven rates that helps explain fluctuations after controlling for changes in other market prices. Investor

[6] See Kim, Walsh, and Wei (2019) for a concise, readable discussion of the decomposition of the yield curve across expectations and risk premia.

purchases in our data of $1 billion in TIPS—measured in 10-year equivalents—are associated with increases in inflation breakevens from just above 0 to 5.5 basis points, depending on the degree of market volatility (see Figure 3).[7] The below section: **Estimating price impact from flows data** details our methodology.



Note: Plot shows the smoothed local average price impact coefficient from rolling 3-month regressions, pooling coefficients from each of the 5 flow categories listed in Appendix 1. Interquartile range is from the 25th to the 75th percentiles of x-axis values, the 1-month standard deviation of daily breakeven changes.

Source: JPMorgan Chase Institute

Figure 3: The impact of flows on market-based inflation expectations is greatest in volatile markets.

Traditional views of time-varying liquidity are consistent with the positive relationship we find between market volatility and price impact of flows.[8] The magnitude of the coefficients, however, are more difficult to compare with prior research on Treasuries, given differences in the data, time periods, methodology, and underlying markets across studies. Estimates of

[7] Our estimates derive from a dataset of de-identified institutional investor transactions in Treasury Inflation Protected Securities (TIPS) vis-à-vis J.P. Morgan. Under the assumption that these flows represent market-wide dynamics, our price impact coefficients—reported in basis points per $1 billion—should be deflated by market share, which averaged about 5 percent over the sample period.

[8] Risks associated with making markets are higher when volatility and uncertainty are high, due to the risks of taking positions. Daley and Green (2016), for example, present a model in which asymmetric information leads to time-varying liquidity provision.

price impact in nominal Treasuries used to estimate the effects of Fed asset purchases—when scaled to the size of the TIPS market—suggests price impact of about half of one basis point per $1 billion in ten-year TIPS equivalents.[9] Since a given flow in our data may reflect a larger transfer of risk that could be spread across multiple market makers, our central estimate of 1 to 2 basis points per $1 billion (when volatility is close to its average level) is not directly comparable to this figure. Our price sensitivity estimates would be roughly in line with the literature on Large Scale Asset Purchases (LSAP) under the assumption that flows in our data represent, on balance, a subset of risk transfers that are spread across a few or several dealers.

Relative to typical volatility in the market, our identification method attributes a limited amount of price movement to flows. From 2013 to 2019, the average one-day change in the 10-year inflation breakeven rate was about 2 basis points. By comparison, a one standard deviation increase in TIPS purchases would shift the breakeven rate upward by less than a quarter of a basis point in the direction of the aggressor trading.[10] We view this evidence as largely consistent with the view that finds the TIPS market highly informative of changes in expectations, but we recognize the need to consider market distortions.[11]

Estimating price impact from flows data

Since every trade involves a buyer and a seller, analysis of the direction of the trading activity, or flow, requires identification of the initiator, or "aggressor," of the trade. On the other side of the transaction is the trader providing either the security or cash demanded, which

[9] Fed transcripts from 2013 (e.g., January 2013 FOMC) cite a rule of thumb indicating that a Fed LSAP announcement of $500 billion would move the risk premium component of Treasury yields down by 15 to 20 basis points. Considering an average maturity of 5-6 years and scaling down to the TIPS market size by multiplying by one-tenth, results in an estimate of half a basis point per $1 billion ten-year equivalents. Meanwhile, Ihrig et al. (2018) and D'Amico et al. (2012) determine the impact of LSAP I to be about 1 basis point per $10 billion, a price impact the latter authors note is relatively high compared to other estimates.

[10] For price impact of a one standard deviation flow, we multiply each aggressive flow measures' standard deviation by its coefficient, respectively, as shown in Appendix 1, Figure A.

[11] Kim, Walsh, and Wei (2019) provides a discussion of Fed researchers' attempts to separate market expectations from liquidity and risk premia.

we refer to as the "provider." Since longer-term TIPS carry more interest rate risk than TIPS with shorter time-to-maturity, we normalize trading volumes by the amount of risk transferred (e.g., net dollar value of a basis point, sometimes termed net DV01) and convert volumes to 10-year equivalents.

After parsing our data to identify aggressor trades—as described below—we run Ordinary Least Squares (OLS) regressions of the following form to estimate of β_f, an indicator of the price impact of flows. In our baseline specification, we control for changes in nominal yields (n) in basis points, crude oil prices (c) in percent, and the Cboe Volatility Index also known as the VIX (v) in index points.

$$\Delta BE_t = \beta_n \Delta n_t + \beta_c \Delta c_t + \beta_v \Delta v_t + \beta_f f_t + \epsilon_t$$

We measure time-varying price impact by conducting sub-sample analysis (depicted in Figure 1) and use interaction terms between flows and volatility, as reported in Appendix 1.

Aggressor flow identification

We use multiple approaches to infer the aggressor side of a trade. The task is challenging, because most TIPS transactions do not occur on exchange-like venues, where the trade price relative to the bid and ask prices helps identification. Our methods contend with this difficulty by using additional data about the context of the trade to identify which counterparty was most likely the aggressor.

- First, we observe the price change of a security being traded relative to the (real) yield curve. For example, if a security purchased by a client rises in price (falls in yield) relative to the curve, we categorize it as an aggressive client flow. These trades are termed "Aggressors." Importantly, the average relative yield change is zero, by construction, meaning that the identification method is not mechanically connected to overall yield curve moves.

- Second, we classify investors by their average market sidedness. Since market participants in our data may help J.P. Morgan offset inventory risk—making them de facto liquidity providers—we need a method of separating their flows from those that reflect true changes in TIPS demand. We assume that investors that typically buy duration-adjusted TIPS are more likely to be demanders of liquidity, because they resemble end-users or buy-and-hold investors. We categorize these investors as "Buyers." By contrast, traders that are more balanced between buys-and-sells are more likely candidates as de facto liquidity providers.[12][13]

Finding 2

Trend-chasing flows contributed modestly to the rise in inflation pricing since mid-2020.

We use the methodology developed in Finding 1 to estimate how much trading activity may have influenced the rise in breakevens from mid-2020 to late 2021. We find that aggressor flows from certain investors contributed notably to the rebound in breakevens, explaining about 30 basis points of the 160 basis point rise from June 2020 through October 2021, as illustrated in Figure 4. The category of trades we term "Aggressive Buyer" flows[14] (the section above, **Estimating price impact from flows data**, defines the groupings) drive the highest predicted flow impact. The estimate applies the 2013-19 price impact coefficient to flows observed since mid-2019.

Interpreting dynamics over this period, however, is challenging for at least two rea-

[12] Investors with a high proportion of sales may also be liquidity demanders, but their activity would also be consistent with buying securities at auctions and selling them later in the secondary market. This would put them on-par with balanced traders.

[13] In this analysis, we mainly weight volumes by their net duration exposure. Without trading activity, a bond portfolio loses duration over time as bonds come closer to maturity. Even passive ("buy-and-hold") investors with no changes to their assets under management would need to be net purchasers to offset natural decline in duration.

[14] Aggressive Buyer flows are the subset of flows of Buyers associated with "right way" movements in the relative prices of the securities traded. These can be both purchases and sales—of securities outperforming and underperforming, respectively, relative to the yield curve.

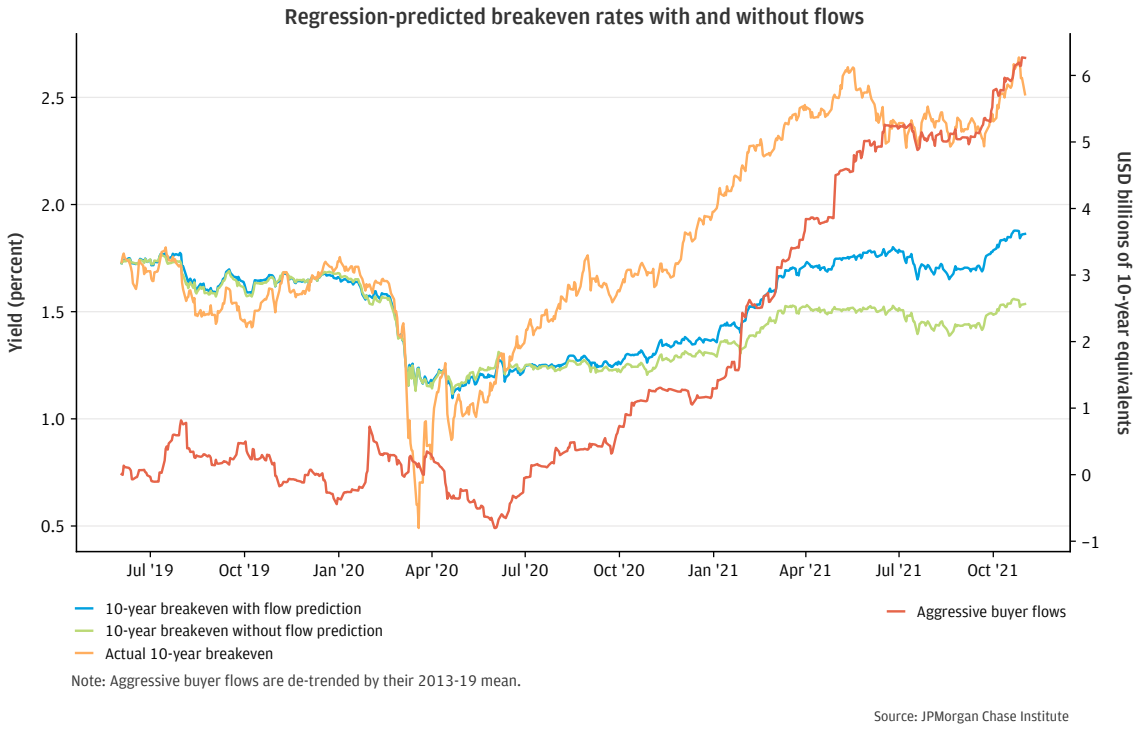


Figure 4: Over the COVID period, flows categorized as 'Aggressive buyer' add predictive power to a model of breakeven inflation.

sons. First, the Fed's large scale asset purchases likely altered the behavior of large dealers—particularly, primary dealers from which the Fed buys Treasuries—and their client counterparties. Indeed, in order to source securities to sell to the Fed, dealers need to make purchases in the market, which can tilt the net flows of clients towards selling. Second, higher volatility and uncertainty regarding inflation may have made dynamics observed over the in-sample period less applicable out-of-sample.

The trading behavior observed since the onset of COVID in early 2020 is consistent with prior episodes featuring large moves in Treasury yields. Investors in TIPS exhibit a trend-chasing pattern consistent with "herding." As depicted in Figure 5, the share of institutional investors buying TIPS—in counts, not dollar values—increased alongside rising inflation breakeven rates and vice versa. The correlation between the two variables was 0.51 over the 2013-21 period.

The net number of investors buying TIPS dipped during the peak of the COVID crisis as

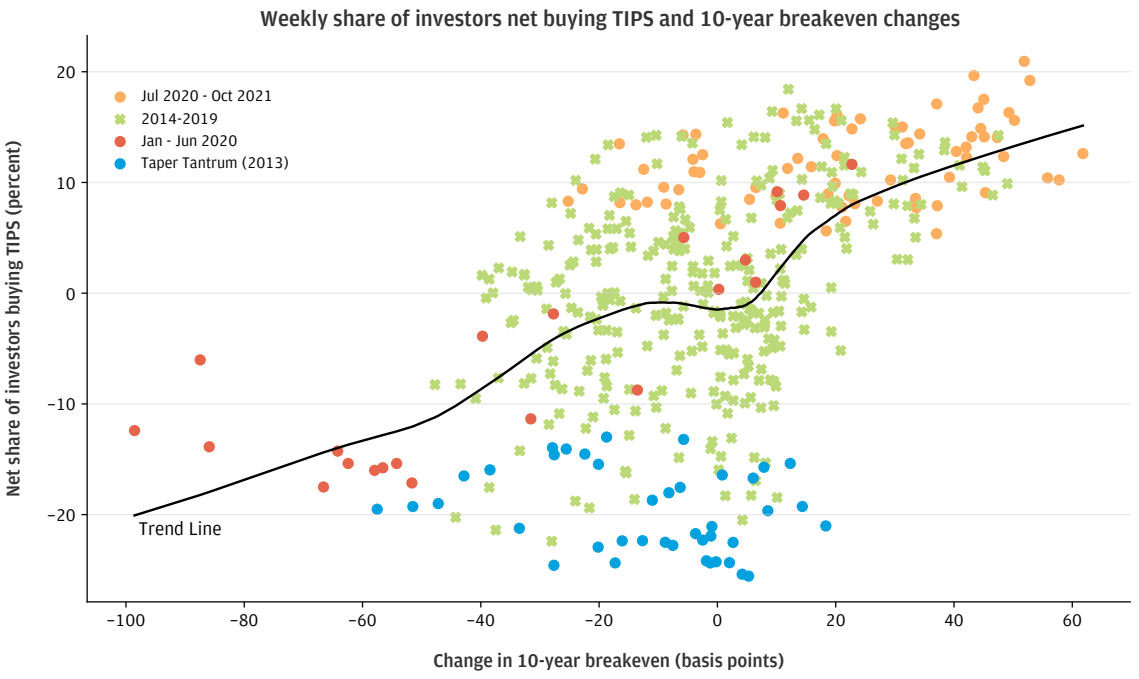
breakeven rates collapsed. From mid-2020 through late-2021, the turnaround aligned with a prevailing imbalance of buyers outnumbering sellers. A previous episode of sharp outflows from the TIPS market—the 2013 Taper Tantrum, in which the 10-year breakeven rates fell approximately 70 basis points in 3 months—featured a similar dynamic; however, selling observed during that period was even stronger and more sustained than usual. A potential explanation for that period is the sharp shift from open-ended Fed asset purchases, after years of monetary stimulus.

Finding 3

Investor flows help explain the sharp divergence in relative TIPS pricing during March 2020, in which less-liquid securities deeply underperformed amid extreme market volatility.

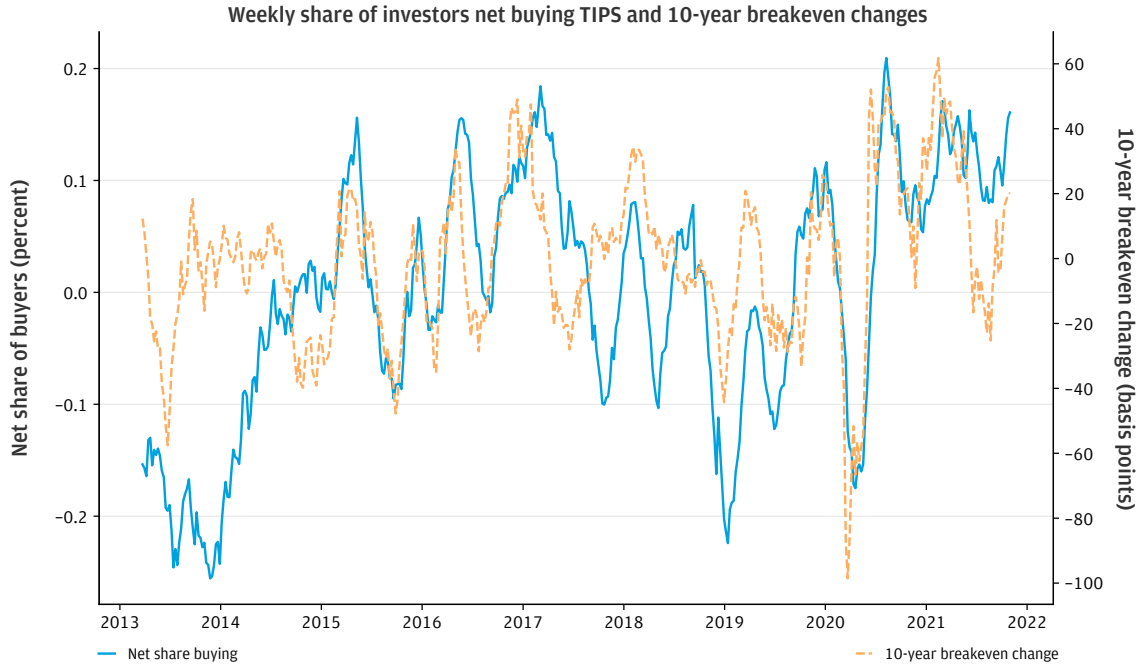
The rise in volatility across markets due to the COVID pandemic started in February 2020 and exploded in March. Treasury yields had been falling alongside declines in the stock market for two weeks until March 9, as the implications of spreading infections and the near-term economic fallout became clear. However, from March 9 to 18, most Treasury yields began rising and the deterioration in market liquidity accelerated, prompting aggressive Fed asset purchases to restore market function (see Figure 6). Given the focus of this analysis on inflation, we focus on TIPS. An interagency group of official sector policymakers and researchers provide an account of the episode centered on nominal Treasuries, enshrined in IAWG (2021).

The extreme volatility in the overall yield curve was accompanied by stark divergences between the prices of different TIPS instruments that typically trade in nearly lockstep, due to their closely related cash flows. Investors have the choice to hold more recently issued Treasury securities—referred to as "on-the run", or less recently issued securities, referred to as "off-the-run". Gaps between these two sets of securities widened sharply as market



Note: Data are weekly and smoothed by a 12 week moving average. The net share of investors represents the sum of investors net buying TIPS (in duration-weighted terms) minus the sum of investors net selling TIPS divided by the total number of investors active during the period.

Source: JPMorgan Chase Institute



Note: Data are weekly and smoothed by a 12 week moving average. The net share of investors represents the sum of investors net buying TIPS (in duration-weighted terms) minus the sum of investors net selling TIPS divided by the total number of investors active during the period.

Source: JPMorgan Chase Institute

Figure 5a and 5b: Trend-chasing activity—measured by the numbers of traders moving in the same direction—has been a pervasive dynamic in the TIPS market since COVID and in prior episodes.

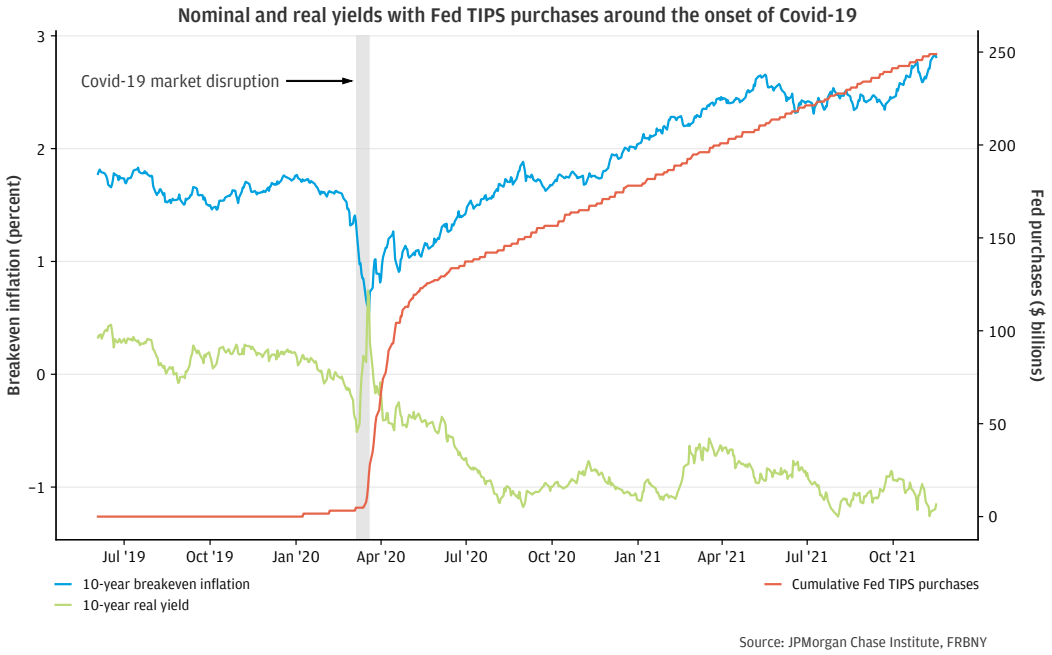


Figure 6: The sharp March 2020 volatility in the broader Treasury market prompted large asset purchases by the Federal Reserve that included TIPS.

volatility spiked, a sign of sharply deteriorating liquidity.

Our data help explain these trends. Investor sales of off-the-run TIPS coincided with purchases in more liquid on-the-run securities, depicted in Figure 7. During the two-week period of peak volatility, almost every trading day featured sales of off-the-runs and purchases of on-the-runs among institutional investors vis-à-vis J.P. Morgan. While some market participants took advantage of the opportunity to buy TIPS at depressed prices, they did so in the most liquid securities, leaving other investors to sell less liquid securities at relatively distressed values.

Finding 4

Market participants that usually trade against prevailing price action initially bought TIPS as their prices fell in March 2020, however, their purchases were small and began to reverse by the peak of the crisis.

A substantial portion of market participants in our sample trade in a systematic way,

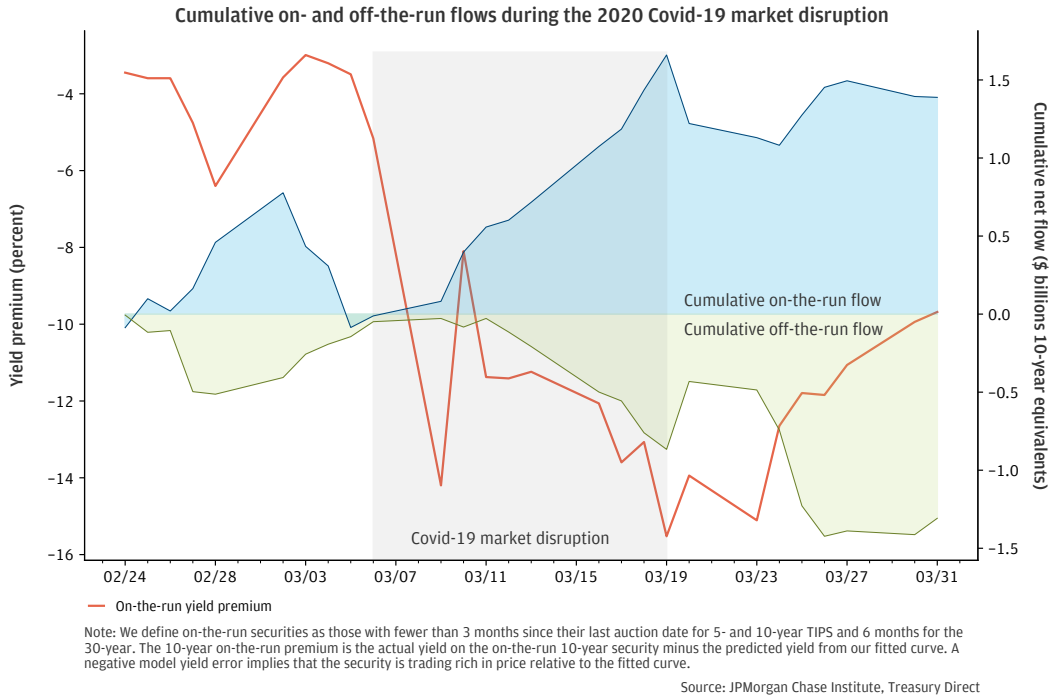


Figure 7: During the days of peak market volatility around the beginning of COVID, investors generally purchased more liquid on-the-run TIPS, while selling less liquid off-the-run TIPS.

either buying TIPS as breakeven inflation rises or vice versa consistently over time. Market participants that trade in a correlated way with prices—either a positive or negative correlation—represent over half of TIPS market participants that trade actively in our sample and 80 percent of active market participants' flows.[15] To categorize investors, we run client-level regressions of flows against TIPS performance, measured by breakeven rates (capturing TIPS performance relative to nominal Treasuries) and by real yields (capturing raw TIPS price changes). Appendix 2 details the categorization methodology.

Investors that trade in the prevailing market direction we term "trend-chasers." This category of investors augments the analysis in Finding 2, in which we document herding behavior in the direction of price movements, a pattern that emerges when averaging trading patterns across market participants. The categorization method discussed in this Finding makes the additional requirement of repeated behavior at the market participant level. We

[15] In this Finding we consider only investors with trading activity in at least 10 days in both the pre-COVID and COVID periods.

label investors who frequently trade in the opposite direction of prices "contrarians." These two sets of investors inherently exert counterbalancing forces on the market, with the former tending to exacerbate price movements and the latter dampening volatility.

As documented by an extensive IAWG report, a key contributor to Treasury market volatility in March 2020 was investor selling in a "dash for cash."[16] Flows from the contrarian category should typically counteract such a force. Figure 8 depicts contrarian investor behavior in TIPS during the episode. Indeed, contrarians initially traded against the sharp declines in inflation breakevens, buying TIPS as expected. However, days before large Fed purchases began, contrarians diverged from predicted behavior and started to sell when prices were at their lowest point.

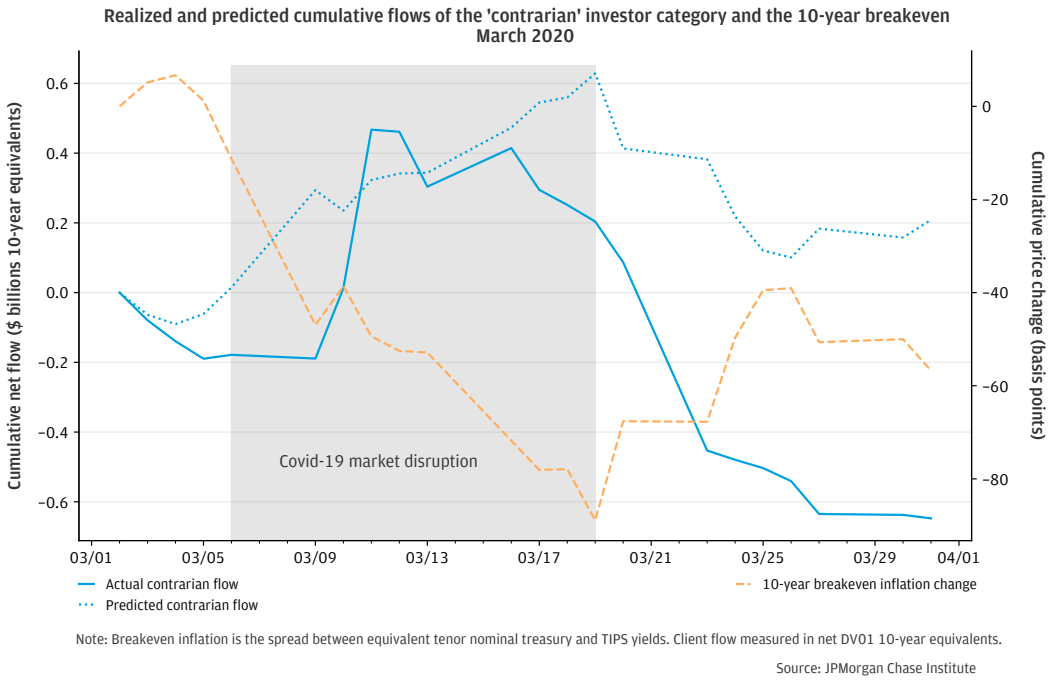


Figure 8: Contrarian TIPS investors, who typically trade against price changes, acted as expected until mid-March 2020 when they unwound earlier purchases in the face of extending market deterioration.

We interpret the pattern of flows during March 2020 as suggestive of limitations to contrarian trading as a market stabilizer. Even if contrarian investors are willing take on

[16] See the IAWG report documenting the events of March 2020, IAWG (2021).

risk by buying assets as prices decline, extended price movements could lead to losses on those positions. This could possibly trigger position unwinds, degrading the ability for contrarians to act as a volatility buffer in extreme circumstances.

Following Fed intervention, contrarian investors resumed their prior trading behavior, selling into the rebound in inflation breakeven rates between March and September 2020 (see Figure 9). The general pattern continued through most of 2021. In effect, contrarian selling provided the counterpoint to Fed purchases, and as documented in Finding 2, aggressive purchases by trend-chasing investors.

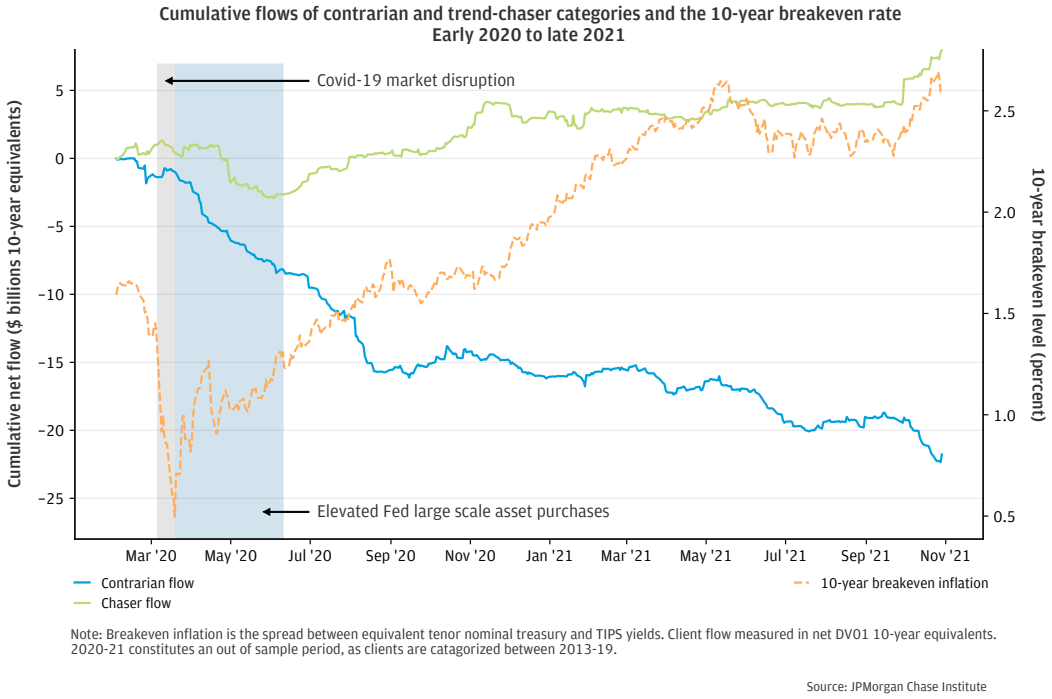


Figure 9: Trading by contrarian investors in TIPS provided supply in the wake of aggressive Fed asset purchases in 2020, but have since been fairly balanced against trend-chasers.

Looking forward, imbalances between systematic trading categories have the potential to cloud the market's signal for inflation expectations. To the extent trend-chasing dominates contrarian flows, price movements may overshoot true changes in expectations. On the other hand, contrarians tend to keep markets range-bound, potentially leading the market to understate, or lag, a true shift in expectations.

Conclusion and implications

Our research shows that institutional investors' trading activity can influence TIPS-implied inflation breakeven rates, a key indicator used by policymakers to track inflation expectations. The impact of investors trading TIPS flows on inflation breakeven rates is greatest when market volatility is high, but we can attribute only a small portion of price movements to flows in our data. Trend-chasing by investors in TIPS likely contributed modestly to the magnitude of the rebound in inflation from mid-2020 through late 2021, explaining at-most one fifth of the increase in breakeven rates. More generally, we document systematic trading patterns seen in the TIPS investor base that have the potential—if unbalanced—to exacerbate or suppress volatility in inflation breakeven rates, relative to the evolution in true expectations.

In the extraordinary Treasury market volatility of March 2020 institutional investor flows in our data show purchases of more liquid TIPS and sales of less liquid securities, paralleling dynamics in nominal Treasuries.[17] This helps explain sharp divergences in prices between the two classes of securities and deterioration in market functioning. Meanwhile, contrarian investors that frequently trade against prevailing market price moves were largely absent in the days prior to large Fed purchases. We interpret flows during this crisis as suggesting limitations of de facto liquidity provision by institutional investors in stabilizing the TIPS market.

The official sector (e.g. monetary and fiscal authorities) relies on financial markets to garner insights into inflation expectations relevant for the economic outlook. The impact of investor trading behavior on market dynamics points to an important role for market intelligence gathering efforts, like those undertaken by the Federal Reserve and Treasury Department.[18] Flows matter, especially when markets are volatile.

[17] See IAWG (2021) for a discussion centering on the nominal market.

[18] Examples of institutionalized engagement with market participants include market intelligence gathering by the Federal Reserve Bank of New York's Markets Group and the Treasury Borrowing Advisory Committee (TBAC). Studies published by the Bank for International Settlements—including Jeffery et al. (2016) and

Our unique lens into the dealer-to-client market for TIPS complements the data-driven analytical advances associated with the TRACE for Treasuries dataset initiated in recent years. These findings can support the digestion of anecdotal commentary into rigorous frameworks richened by the day-to-day workings of the market. In terms of the current signal for policy, our data suggest that the straight read from long-term breakeven rates should indeed be taken as a positive signal for the stability of inflation expectations and Fed credibility.

Serena et al. (2021)—provide a review of a variety of market intelligence efforts across central banks and increasing use of big data.

A Appendices

A.1 Price impact regression results

Figure A shows our point estimates of price impact, with 95 percent confidence intervals, from regressions of ten-year breakeven rate daily changes on several measures of TIPS net flows. One takeaway from these plots is the wide error bands. While many of the coefficients are statistically and economically significant, we are not able to pin down a precise average price impact. Part of the imprecision likely stems from noise inherent in financial market transactions data, and flows in our data represent a limited view of the overall market.

Under the identification assumptions described in Finding 1, we group candidate aggressor flows into the following five categories:

1. **Buyers** – All net flows from market participants in this category
2. **Buyer Aggressive** – Subset of (1) associated with a relative value movement of the security in the direction of the flow (e.g., purchases in a security that appreciates relative to the yield curve)
3. **Own Aggressive** – Aggressive flows of J.P.Morgan in the dealer-to-client market
4. **All Client Aggressive** – Aggressive flows of all clients in the dealer-to-client market
5. **Total Aggressive** – Flows in category 3 plus category 4.

Figure B shows the estimates of aggressor flow price impact when interacting flows with the standard deviation of ten-year inflation breakeven rate changes (taken over a centered 20-day trading window and z-scored). As described in Finding 1, price impact is higher when volatility is higher. When volatility is one standard deviation below its average level, price impact is effectively zero. High volatility is associated with notably higher price impact coefficients for some aggressor flow definitions, but error bands are also wide.

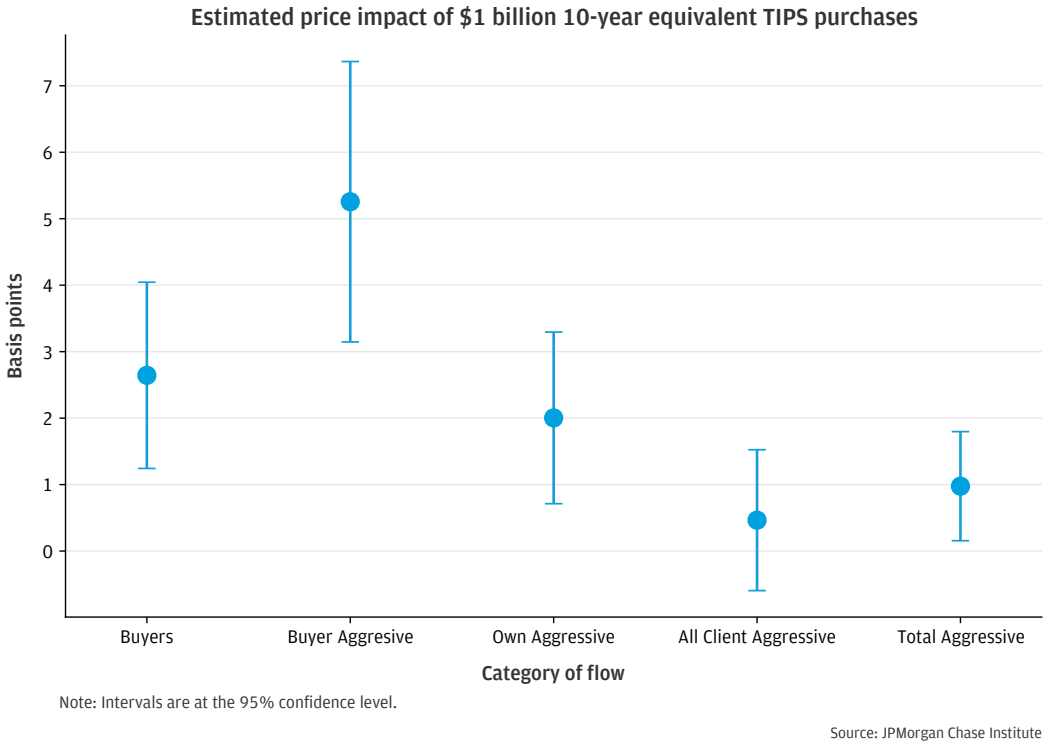


Figure A: Price impact estimates fall in wide range and vary by the source of aggressor flows.

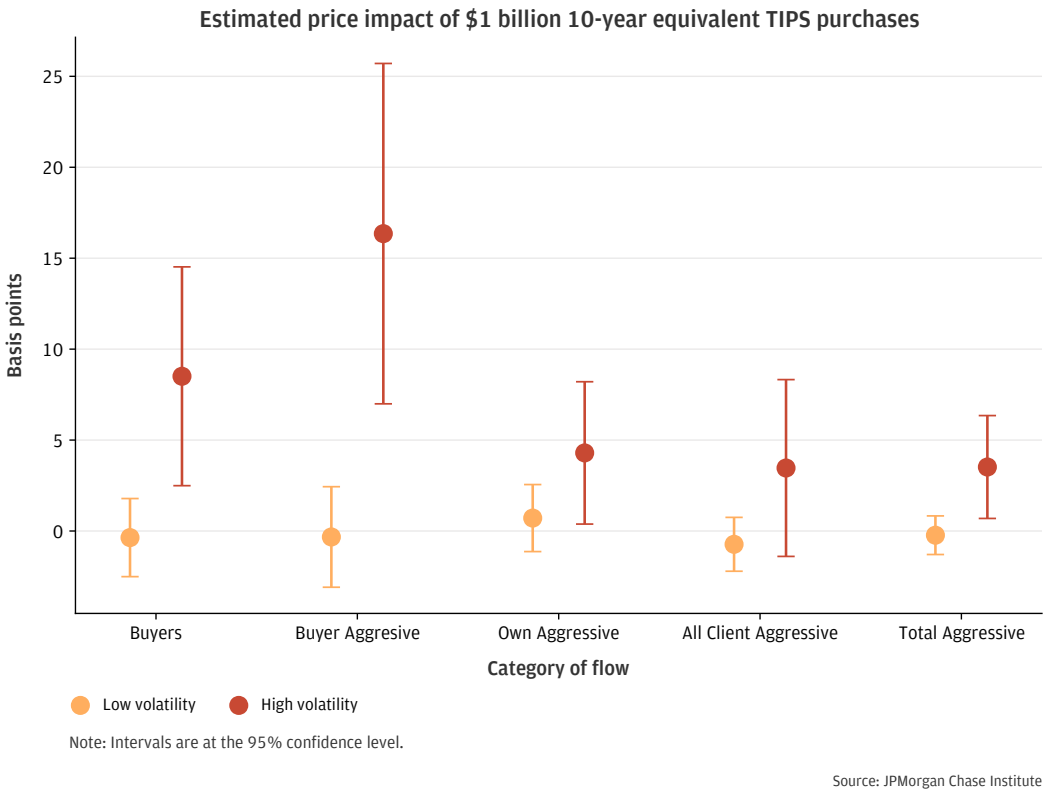


Figure B: Volatility interactions show higher price impact estimates, although with wide confidence bands.

A.2 Systematic Investor Categorization Methodology

To categorize investors as chasers or contrarians in Finding 4, we run client level regressions of risk-adjusted[19] flows against price action in both breakeven and real yields, as in the following regression specification. The left-hand-side variable, f, represents the risk-adjusted net flows of client, c; the 10-yr breakeven rate is BE; and the 10-year real yield is, RL.

Since market participants may respond to price changes over different tenors, we evaluate dynamics at three frequencies—daily, weekly, and monthly—across our actively trading TIPS client base from 2013 to 2019.[20] To be considered active, a client would have had to conduct at least 10 TIPS trades during the sample period.

$$f_{c,t} = \alpha_c + \beta_{c,BE}\Delta BE_t + \beta_{c,RL}\Delta RL_t + \epsilon_{c,t} \tag{1}$$

Trend-chaser or contrarian labels are determined by the sign of significant t-statistics.[21] For example, a chaser would be associated with a positive t-statistic with respect to their flows' relationship with breakeven price action, and a negative t-statistic with respect to their relationship with real yields. We then apply our categorization to an out-of-sample period, TIPS transactions from 2020 to 2021.

[19] As discussed in the section **Estimating price impact** from flows data, we normalize transactions by converting the amount of interest rate risk transferred into 10-year equivalents. I.e., we consider duration-adjusted flows.

[20] Only clients' active trading days are included. Days with zero flow are not included.

[21] Our cutoff is 5 percent significance level. For this exercise, we use heteroskedasticity consistent (HC2) standard errors, as suggested in Imbens and Kolesár (2016), given low regression observation counts for some market participants. In the case both coefficients are significant, we take the one with greatest statistical power.

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References

Brain, Doug, Michiel De Pooter, Dobrislav Dobrev, Michael J. Fleming, Peter Johansson, Collin Jones, Frank M. Keane, Michael Puglia, Liza Reiderman, Anthony P. Rodrigues, and Or Shachar. 2018. "Unlocking the Treasury Market through TRACE." Federal Reserve Bank of New York *Liberty Street Economics* (blog).

Daley, Brendan, and Brett Green. 2016. "An Information-Based Theory of Time-Varying Liquidity." *The Journal of Finance*.

D'Amico, S., W. English, D. López-Salido, and E. Nelson. 2012. "The Federal Reserve's Large-scale Asset Purchase Programmes: Rationale and Effects." *Economic Journal*.

Diercks, Anthony M., and Uri Carl. 2019. "A Simple Macro-Finance Measure of Risk Premia in Fed Funds Futures," *FEDS Notes*. Washington: Board of Governors of the Federal Reserve System.

Gabaix, Xavier, and Ralph S. J Koijen. 2022. "In Search of the Origins of Financial Fluctuations: The Inelastic Markets Hypothesis." *SSRN Electronic Journal*.

IAWG: Interagency Working Group Report. 2021. "Recent Disruptions and Potential Reforms in the U.S. Treasury Market: A Staff Progress Report."

Kim, Don, Cait Walsh, and Min Wei. 2019. "Tips from TIPS: Update and Discussions," *FEDS Notes*. Washington: Board of Governors of the Federal Reserve System.

Ihrig, J., E. Klee, C. Li, M. Wei, and J. Kachovec. 2018. "Expectations about the Federal Reserve's Balance Sheet and the Term Structure of Interest Rates." *International Journal of Central Banking*.

Imbens, Guido W, and Michal Kolesár. 2016. "Robust Standard Errors in Small Samples: Some Practical Advice." *The Review of Economics and Statistics*.

Jeffrey, Rosey, Holger Neuhaus, Matthew Raskin, Andreas Schrimpf, Alvin Teo, and Christian Vallence. 2016. "Market Intelligence Gathering at Central Banks." Bank for International Settlements, Markets Committee publication.

Serena, Jose Maria, Bruno Tissot, Sebastian Doerr, Leonardo Gambacorta. 2021. "Use of big data sources and applications at central banks." Bank for International Settlements, Irving Fisher Committee on Central Bank Statistics (IFC).

Steel, Mark F. J. 2020. "Model Averaging and Its Use in Economics." *Journal of Economic Literature*.

Vayanos, Dimitri, and Jean-Luc Vila. "A Preferred-Habitat Model of the Term Structure of Interest Rates." *Econometrica*.

Data Explanation

Figure 1

The figure illustrates a time series of breakeven inflation compensation from May 2019 to February 2022. The 2-year and 5-year breakeven series experience collapses between February and March 2020 before sharp increases from April 2020 through 2021 year-end, with both series passing the three percent mark in 2021. In contrast, the 5-year 5-year-forward breakeven series remains relatively stable and below three percent.

Infographic (in section **About the data**)

This infographic describes the Treasury market structure in the U.S. and where the perspective of our data fits within that structure. Our data is based on trades involving J.P. Morgan in the dealer-to-client market, which is composed of institutional investors, segment into six sectors: asset managers, banks, corporates, hedge funds, pension funds/insurance companies, and public/other. Asset managers and hedge funds account for nearly three fourths of the TIPS trades in the sample. Market participants trade with dealers, sometimes via request-for-quote platforms, in the dealer-to-client. Next, the dealer-to-dealer market is where dealers, including J.P. Morgan, trade with each other. Lastly, the interdealer broker market is another venue in which dealers can trade with each other, but through interdealer broker platforms, which also allow principal trading firms to connect with the dealers.

Figure 2

This exhibit illustrates a time series of the 10-year nominal yield and 10-year real yield from May 2019 to February 2022. The nominal yield is consistently greater than (above) the real yield time series. The chart highlights the area between the two curves as the 10-year inflation breakeven, as breakeven inflation compensation is computed as the difference between the nominal yield on a nominal treasury note and real yield on a Treasury inflation protected security of equivalent tenors.

Figure 3

Figure three illustrates the relationship between volatility (on the x-axis), measured as change in basis points per day, and price impact, measured as a coefficient whose unit is in basis point terms. This curve increases with a parabolic or quadratic shape before plateauing and flattening out around 2.5-3 basis points per day volatility, illustrating increasing price impact of flows during periods of higher volatility.

Figure 4

Figure four displays the predicted change in breakeven using the regression specification specified earlier in the box for estimating price impact. The chart compares two lines predicting the cumulative change in 10-year breakeven inflation. One line includes aggressor flows and the other does not. When comparing with the actual cumulative change in 10-year breakeven inflation, it is visibly clear that the inclusion of aggressor flows improves the prediction of our regression specification. These lines illustrating the actual and predicted cumulative change in breakeven inflation also share the plot with a line illustrating cumulative aggressive buyer flows. Such flows remain negative until June 2020, upon which there is an increase of over $6 billion USD of 10-yr equivalents between June 2020 and Oct 2021,

closely tracking the increase in 10-year breakeven inflation.

Figure 5a and 5b

Figure five A displays a scatter plot using an x-axis of weekly changes in 10-year breakeven inflation and a y-axis indicating the net share of investors purchasing TIPS as a percentage of total institutional investors. Each dot, representing a week, is color coded for four periods. Those periods being the Taper Tantrum (2013), 2014-2019, January to June of 2020, and July 2020 to October 2021. The July 2020 to October 2021 is concentrated in the top right quadrant of the exhibit, while the taper tantrum and Jan to June 2020 weeks remain in the bottom and bottom left quadrants respectively. The weeks of 2014-2019 remain for the most part in the center of the exhibit. The trend line fitted to the exhibit indicates positive comovement between changes in breakeven inflation and the share of investors purchasing TIPS.

Figure five B is a time series of the net share of institutional investors that are buyers of TIPS and the 10-year cumulative change in breakeven inflation from 2013 – Oct 2021. Starting in late 2014 there is a high degree of comovement between the series. When breakeven inflation narrows (i.e. falls) the net share of buyers falls, when breakeven inflation widens (i.e. increases) the net share of buyers increases.

Figure 6

Figure six shows 10-year breakeven and real rates plotted against cumulative fed TIPS purchases from May 2019 to November 2021. Immediately following the COVID-19 market disruption in March of 2020 fed purchases sharply increased and then continued to grow at a steady pace. Breakevens fell and real yields rose using the market disruption but then moved in the opposite direction after the disruption was over.

Figure 7

Figure seven compares the on-the-run TIPS yield premium with flows for on- and off-the-run TIPS. During the COVID-19 market disruption in March 2020, the yield premium decreases from -6 percent to -15 percent. At the same time, net flow into on-the-run tips increased from close to zero up to around 1.5 billion in 10-year equivalents. Additionally, net flows for off the run tips decreased from roughly -0.1 billion to -0.8 billion. After the market disruption, yields began to return to their previous levels. On the run flows essentially stayed at the same level while off the run flows continued to decrease.

Figure 8

Figure eight plots actual and predicted contrarian flows into TIPS against the 10-year breakeven inflation change. Actual investor flows followed their predicted values and increased during the COVID-19 market disruption as the 10-year breakeven fell. This changed near the end of the market disruption when actual flows started to decrease faster than predicted. By the end of March 2020, predicted contrarian flows were 0.2 billion while actual flows were -0.6.

Figure 9

Figure nine plots the relationship of contrarian and chaser flows and 10-year breakeven inflation. As breakevens rose between March 2020 and May 2021, contrarian flows initially decreased by about 20 billion and then slowed their decline after September 2020. At the

same time, chaser flows were relatively flat, increasing by about 5 billion from March 2020 to November 2021.

Figure A (Appendix)

This figure shows the estimated price impact of one billion dollars of 10-year equivalent TIPS purchases, in five different categories. The categories are buyers, buyers aggressive, own aggressive, all client aggressive, and total aggressive. The price impact is highest in the buyer aggressive group at around five, buyers and own aggressive groups are between two and three, and all client aggressive and total aggressive groups are between zero and one. The 95 percent confidence interval bands are wide, but only contain zero for the all client aggressive group.

Figure B (Appendix)

Appendix figure B shows the estimated price impact of one billion dollars of 10-year equivalent TIPS purchases, in five different categories and two different situations. The categories are buyers, buyers aggressive, own aggressive, all client aggressive, and total aggressive and the situations are when there is high volatility and when there is low volatility. In all four categories the price impact is higher when there is high volatility. When there is low volatility zero is within the margin of error in all categories. The highest price impact is in the buyer aggressive category and high volatility situation.

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