

ECONOMIC USES OF AI AND APPLICATIONS OF AI AND BIG DATA

News Media, Inflation, and Sentiment[†]

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News media are a key source of information for households (Flaxman, Goel, and Rao 2016; Chahrour, Nimark, and Pitschner 2021). They form a critical step in the pass-through from macroeconomic shocks to household expectations and sentiment, and it therefore affects outcomes and optimal policy decisions. Modern economic news not only contains raw statistics, it also interprets those statistics for its readers. As inflation news has commanded headline space in the United States over the last two years, media outlets and articles have interpreted that news in heterogeneous ways. In this paper, we study the relationship between these portrayals of inflation in news media and consumer sentiment.

Our empirical analysis links news articles about inflation in the United States to rich social media data from Twitter. We first use tools from natural language processing to extract two competing topics from inflation news articles, representing reporters' divergent views of the causes and consequences of inflation. The first topic relates inflation to financial variables, and the second relates inflation to real variables. As inflation rose in 2021, the real economy "Main Street" topic became substantially more prevalent than the financial "Wall Street" topic.

We then examine how exposure to these different portrayals of inflation affects the sentiment of Twitter users. We match each inflation news article to the Twitter users who "quote retweet" it and then measure the change in sentiment embodied in all tweets sent by that user in a narrow window after their engagement with the article. When realized inflation is low, there is no correlation between engaging with news articles focused on either Wall Street or Main Street topics and changes in sentiment. However, when realized inflation is above the Federal Reserve's 2 percent target, engaging with the Main Street topic is associated with significant declines in sentiment. Together, these two findings predict that from an aggregate decline in sentiment in the second half of 2021, 62 percent can be attributed to the change in how the media portrayed inflation news.

This is consistent with theories in which certain "viral" narratives of economic circumstances can have large effects on aggregate beliefs (Shiller 2017, 2020). Macaulay and Song (2022) show how the topics we estimate in news articles relate to formal descriptions of such narratives as causal graphs of variables (Eliaz and Spiegler 2020; Andre et al. 2022). Our results here can therefore be interpreted as showing that a viral narrative of inflation harming the real economy took off in late 2021, which substantially added to the declines in aggregate consumer sentiment seen at the time.

I. Data and Methods

Our sample of news media consists of articles from 28 major US news outlets between 2014 and 2021. For each outlet, we identify—from its official Twitter account—a list of base tweets that contain the keywords "PPI", "CPI", or "inflation," and we collect the corresponding 3,327 news articles from Factiva.

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FIGURE 1. INFLATION TOPICS

Notes: This figure reports results from estimating the LDA model on articles about inflation, with two topics and symmetric Dirichlet priors. The size of a term represents the likelihood for it to appear in a topic.

To capture competing inflation topics from news articles, we employ latent Dirichlet allocation (LDA), a natural language processing model widely used to uncover latent topics in texts. As reported in Figure 1, the first "Wall Street" topic relates inflation to monetary policy ("fed" and "central bank") and financial variables ("bond" and "interest rate"), whereas the second "Main Street" topic relates inflation to household income and the real economy ("wage," "cost," and "consumer"). The key difference between these two topics is that the Main Street topic emphasizes the connection between inflation and real variables that affect households.

A novel feature of our data is the link from newspaper coverage to social network data from Twitter, which allows us to trace the spread of inflation news. For each base tweet from news outlets, we identify Twitter users who have interacted with the base tweets through quote

retweeting. The resulting sample consists of 5,128 users. The median user is active, with 30 tweets in the 24-hour window around the exposure to inflation news.

Finally, we collect tweets from these users' timelines using Twitter's application programming interface. We study the high-frequency changes in their tweet sentiment in a 24-hour window around the exposure to a certain inflation topic. We employ a standard naïve Bayes classifier to measure the textual sentiment of a tweet, generating a sentiment score between -1 and 1 , with 1 being most positive.

II. Evolution of Inflation Topics

We first present the prevalence of inflation topics over time. We measure the prevalence of a topic k as

$$(1) \quad v_t(k) = \sum_{j \in \mathcal{J}} \sum_{d \in \mathcal{D}_j} \omega_{jt} \theta(d, k),$$

where $\omega_{jt} = \frac{N_{jt}}{\sum_{j \in \mathcal{J}} N_{jt}}$ measures the influence of a news outlet, $\theta(d, k)$ is the LDA loading of an article d on a topic k , and N_{jt} is the frequency a news outlet j is mentioned on Twitter in day t (excluding self mentions). The prevalence of a topic, therefore, is a weighted sum of the prominence of a topic in an article weighted by the potential reach of the article.

Figure 2, panel A reports the prevalence of each inflation topic over our sample period, normalized so that the maximum value corresponds to 100. The coverage on both topics is similar and minimal for most of the sample period, when inflation is low and stable. The coverage on both inflation topics spikes during 2021 when realized inflation rises.

The two topics do not, however, spread in equal amounts. The prevalence of the Main Street topic increases dramatically relative to that of the Wall Street topic in 2021. Under the interpretation of these topics as "narratives" about inflation, Figure 2, panel A shows signs of the Main Street narrative becoming "viral." As inflation rises to a historically high level, media outlets shift their attention to cover inflation news. In doing so, they also shift the narrative that they use to discuss inflation toward one that disproportionately emphasizes that

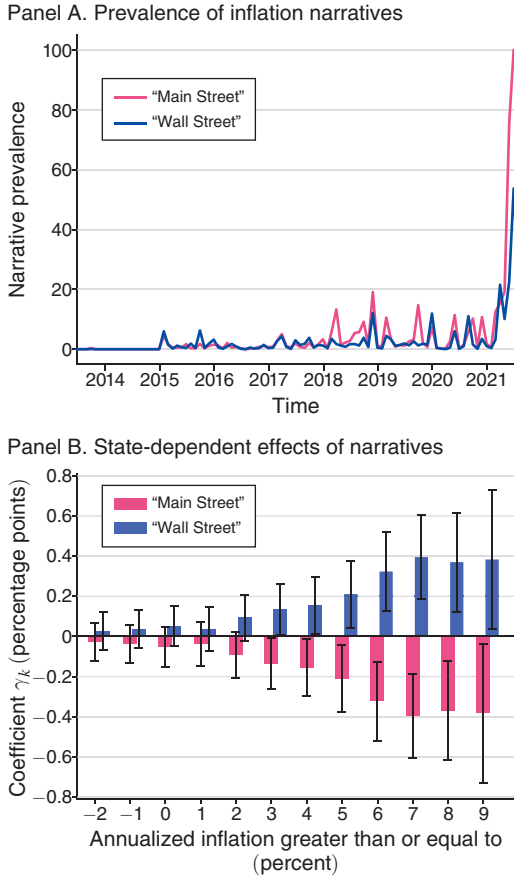


FIGURE 2. PREVALENCE AND IMPACT OF INFLATION NARRATIVES

Notes: Panel A reports the prevalence of inflation topics defined in (2). We have normalized the prevalence scores so that the maximum value corresponds to 100. Panel B reports the coefficients γ_{kc} from estimating the regression (2). Point estimates are reported in bars, and 90 percent confidence intervals are reported in whiskers.

inflation is an economic phenomenon with real consequences.

III. State-Dependent Effects of Inflation Narratives

Using these empirical measures of inflation narratives, we now estimate their effects on consumer sentiment. In this, we allow the estimated effects to vary with the realized rate of inflation in each period, to reflect the fact that a connection between inflation and other variables may

take different forms when inflation is high or low.¹

Our empirical model takes the form of a high-frequency event study. For user i who quote retweets article d containing narrative k at time t , we estimate the state-dependent effect of an inflation topic by estimating

$$(2) \Delta s_{itd} = \alpha_k + \beta_{kc} \cdot \mathbf{1}(\pi \geq c) + \underbrace{\gamma_{kc} \cdot \mathbf{1}(\pi \geq c)}_{\text{inflation}} \times \underbrace{\mathbf{1}(d, k)}_{\text{topic}} + \varepsilon_{itd},$$

where Δs_{itd} is the change in a Twitter user's textual sentiment 24 hours before and after quote retweeting the inflation base tweet; α_k is a constant; $\mathbf{1}(\pi \geq c)$ is an indicator variable that takes the value 1 if annualized consumer price index (CPI) inflation is greater than or equal to c percent; $\mathbf{1}(d, k)$ is a binary measure to capture a narrative's salience in an article relative to other media coverage, which takes the value 1 if the loading of an article on the narrative is above the cross-sectional mean; and ε_{itd} is a random error. The coefficient of interest is γ_{kc} , which measures the impact of inflation topic k on sentiment changes for a given level of inflation. We estimate (3) separately for each inflation topic and for each integer level of annualized CPI inflation $\pi \geq -2\%, \dots, 9\%$.

Figure 2, panel B reports the results from estimating this model. The blue bars give the estimated effects for the Wall Street narrative and the red bars those for the Main Street narrative. Whiskers represent 90 percent confidence intervals. When annualized inflation is below the Fed's targeted 2 percent, neither narrative has a significant effect on consumer sentiment. This is consistent with evidence of the cyclicity of macroeconomic attention and, in particular, low levels of attention when inflation is low and stable (Cavallo, Cruces, and Perez-Truglia 2017; Song and Stern 2022). However, when inflation rises above 2 percent, the 2 narratives have significant and diverging effects on consumer sentiment. The Wall Street narrative, which does not connect nominal inflation to consumers'

¹ See Macaulay (2022) for evidence that households perceive substantially different consequences of inflation for real variables when realized inflation is high.

income, raises the sentiment of Twitter users who are exposed to it.

In contrast, after being exposed to the Main Street narrative indicating that inflation affects their income, Twitter users become more pessimistic. The negative effects of the Main Street narrative increase with the realized levels of inflation. When the annualized inflation is greater than or equal to 7 percent, exposure to a Main Street narrative lowers consumer sentiment by 40 basis points.

IV. Unpacking the Aggregate Effects of Inflation Narratives

Results from previous sections suggest that as inflation rises, the media increases coverage of inflation news and adopts the Main Street narrative that inflation harms the real economy. Individual consumers become more pessimistic after exposure to the Main Street narrative. Such changes in consumer sentiment may then affect the consequences of the inflation on aggregate demand (e.g., Lagerborg, Pappa, and Ravn forthcoming).

To understand the importance of these shifts in media narratives, we decompose the total effects on aggregate sentiment implied by our estimates into effects from individual narratives and effects from shifting narratives.

First, we define the cumulative effect of narratives on aggregate sentiment over a given time period as

$$(3) \quad u = \sum_t \sum_k \tilde{v}_{tk} \beta_{kc},$$

where $\tilde{v}_{tk} = v_{tk} / \sum_k v_{tk}$ is the relative prevalence of narrative k based on the daily prevalence measures v_{tk} in (1) and β_{kc} is the estimated state-dependent effects of narrative k from (3), with c denoting the integer floor of CPI inflation in month t . Over the time period considered, this calculation therefore sums weighted averages of the sentiment effects of each narrative, with the weights determined by the relative prevalence of each narrative in each period.

We compute this total effect for the second half of 2021, when inflation in the United States was rising rapidly. During that period, inflation narratives result in a total decline in sentiment of 13 percentage points, consistent with the aggregate decline observed, for example, in the Michigan Consumer Sentiment Index.

This cumulative effect of inflation narratives can then be decomposed into two components. First is the change in sentiment for a given distribution of inflation narratives, which arises because changes in inflation imply changes in the effects of those narratives. Second is the effect from changes in the prevalence of narratives over time. We calculate the effects of given narratives as

$$(4) \quad u_i = \sum_t \sum_k \tilde{v}_{t-12,k} \beta_{kc},$$

that is, by replacing the actual relative prevalence of each narrative in the second half of 2021 with the proportions from the same periods in 2020. The remaining effects,

$$(5) \quad u_s = u - u_i,$$

are attributed to the shift toward Main Street narratives observed in Figure 2, panel A.

This decomposition suggests that 62 percent of the decline in sentiment can be attributed to the shift toward the Main Street narratives in the media. Therefore, the majority of the decline in sentiment arises because the Main Street narrative goes viral.

V. Conclusion

We examine the relationship between news reporting about inflation and consumer sentiment. We find that different news articles interpret the same inflation numbers in different ways, offering competing narratives about the effects of inflation on other variables. Consistent with this interpretation, when a Twitter user engages with a news article that emphasizes the connections between inflation and the real economy in a period when inflation is high, that user becomes significantly more pessimistic. This Main Street narrative became viral as US inflation rose in late 2021. The accompanying shift in media portrayals of inflation can account for part of the fall in sentiment observed at that time across various measures.

These results suggest that tracking narratives in news media may provide policymakers with early warnings of changes in consumer sentiment. Moreover, if central bank communication can influence narratives in the media (Lamla and Vinogradov 2019; Coibion, Gorodnichenko, and Weber 2022), this may be a powerful tool

for macroeconomic stabilization. The potential of these policy implications is a useful avenue for future research, as is further work into the links between news media narratives and sentiment in other settings.

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