Decoding the Impact of Federal Reserve Emotions on Stock Market Activity with Deep Learning

Authors:
Reece D. Huff & Ali Kakhbod

Finance Group at Berkeley Haas
University of California, Berkeley

Overview

The primary objective of this project was to examine the emotions expressed by members of the Federal Reserve during press conferences and to explore the possible connection between these emotions and the intraday returns and trading volume of the S&P 500 index [1]. To accomplish this, the project made use of images taken from the press conferences and employed DeepFace [2] to predict emotions based on these images. The emotions were analyzed every two seconds and distilled over a three-minute time frames, and potential correlations with intraday returns and trading volume were investigated.

Method

Data Collection and Processing

The data utilized in this project comprised of frames extracted from the press conferences of the Federal Reserve, covering a total of 36 Federal Open Market Committee meetings between April 27th, 2011 and June 19th, 2019. These press conferences contained discussions about recent developments in the economy and the Federal Reserve's strategies and plans. The images were processed and analyzed using the DeepFace API for emotion prediction [2].

In addition to the images, intraday returns and trading volume data for the S&P 500 index were obtained and analyzed. Mean returns and trading volume at the same timestamps as the emotional measurements were computed.

Emotion Recognition Using DeepFace

DeepFace was employed to predict emotions from the images collected from the press conferences. Emotions were analyzed every two seconds, as previous research has shown that most facial expressions last between 0.5 to 4 seconds [3]. DeepFace predicts seven different emotions: anger, disgust, fear, happiness, sadness, surprise, and neutral.

Subsequently, a set of emotional metrics was created, including the mean negative emotion (Negative Emotion), the standard deviation of the negative emotion (Negative Emotion$_{std}$), absolute changes in negative emotions (Negative Emotion$_{dmd}$), and the first principal component of all predicted emotions (Negative Emotion$_{pca}$). Negative emotions were defined as anger, disgust, and fear. The Negative Emotion metric was calculated as follows:

$$\text{Negative Emotion}_{i,k} = \frac{\text{Anger}_{i,k} + \text{Disgust}_{i,k} + \text{Fear}_{i,k}}{\overline{\text{Anger}}_k + \overline{\text{Disgust}}_k + \overline{\text{Fear}}_k}$$

Here, Anger$_{i,k}$, for instance, denotes the average intensity of anger expressed during a specific 3-minute interval i for Chair k. Similarly, $\overline{\text{Anger}}_k$ represents the average intensity of anger expressed across the entire sample by Chair k [1].

Statistical Analysis

After obtaining the emotional measurements, these metrics were compared with the intraday returns and trading volume of the S&P 500 index at corresponding timestamps. Linear correlations were employed to investigate the relationship between emotions and intraday returns and trading volume.
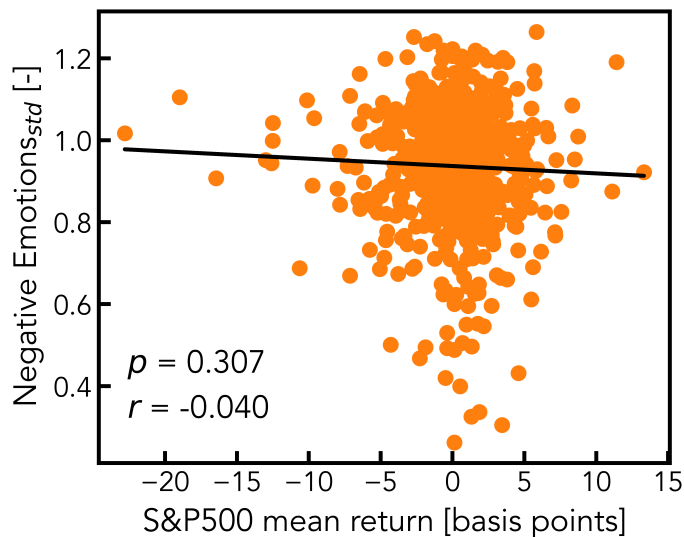
Results

The results showed that the mean returns did not exhibit any significant correlation with the emotional metrics, with all $p > 0.05$ (Figure 1).

However, mean trading volume demonstrated a positive correlation with both the mean negative emotion and the absolute change in negative emotion, with $p = 0.041$ in Figure 2a and $p = 0.043$ in Figure 2c, respectively. This suggests that there is a connection between the negative emotions expressed by members of the Federal Reserve during press conferences and the trading volume of the S&P 500 index.
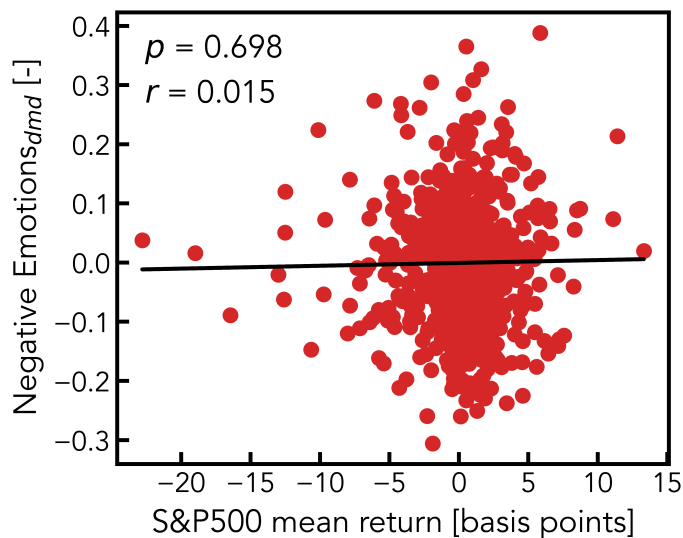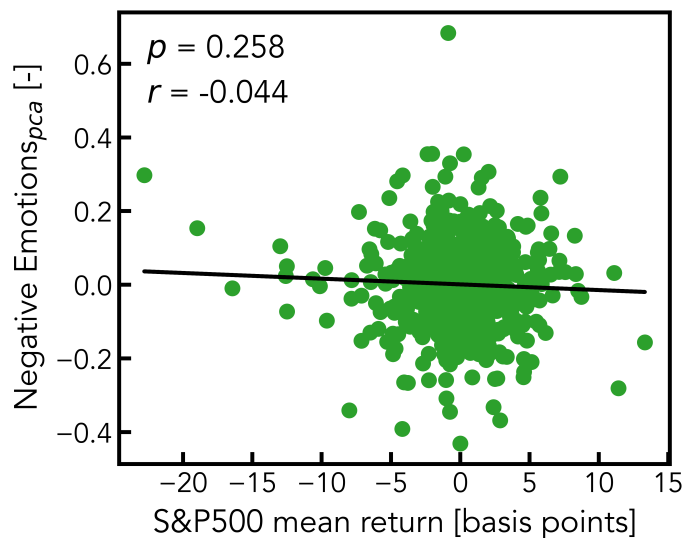
Returns
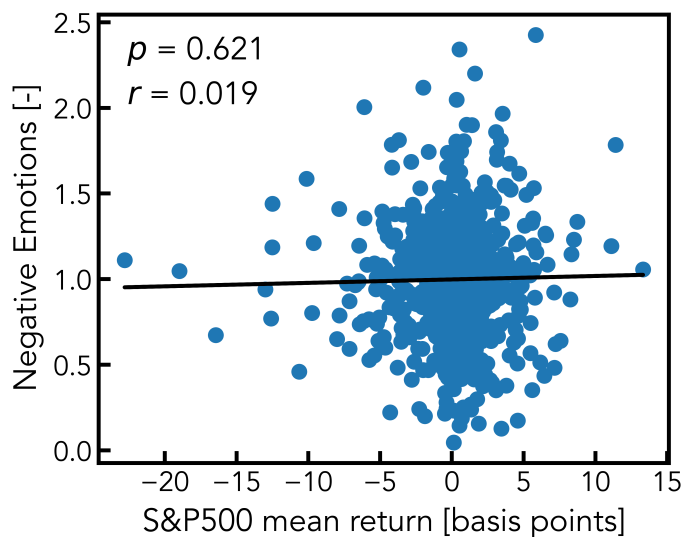
(a) Negative Emotions vs. mean return

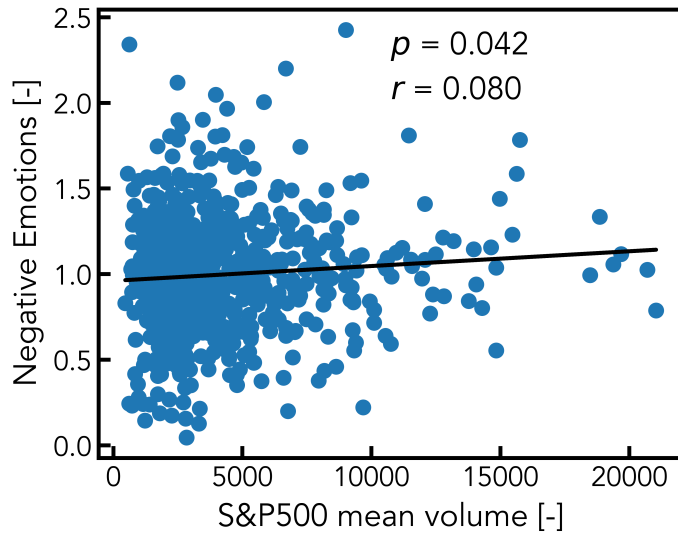(b) Negative Emotions$_{std}$ vs. mean return

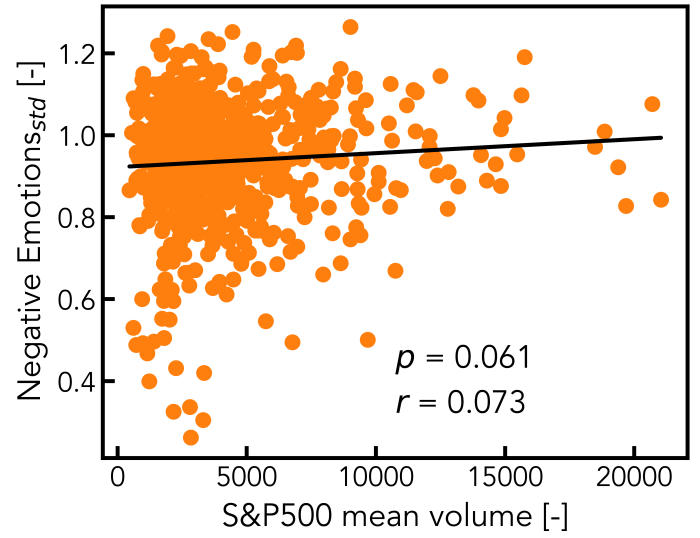(c) Negative Emotions$_{dmd}$ vs. mean return

(d) Negative Emotions$_{pca}$ vs. mean return

Figure 1: Linear correlation results on the mean **returns** during the FOMC press conferences
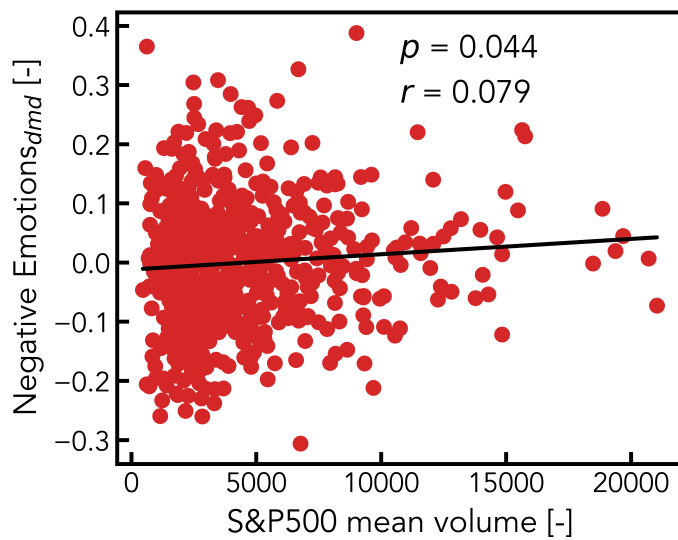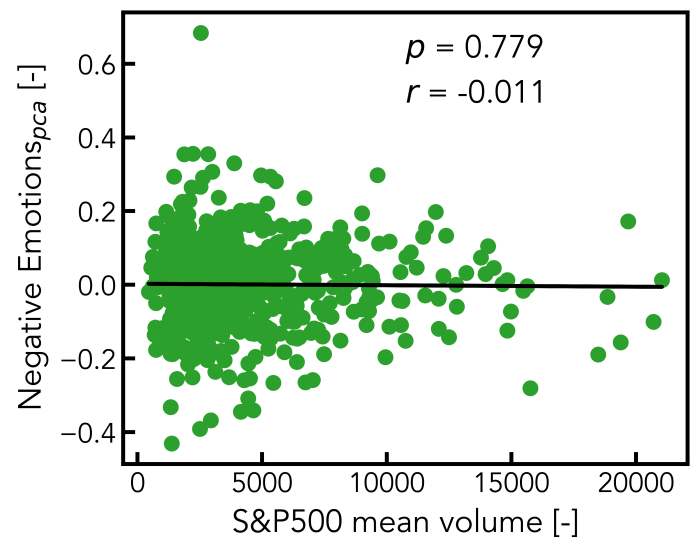
Volume

(a) Negative Emotions vs. mean volume

(b) Negative Emotions$_{std}$ vs. mean volume

(c) Negative Emotions$_{dmd}$ vs. mean volume

(d) Negative Emotions$_{pca}$ vs. mean volume

Figure 2: Linear correlation results on the mean **volumes** during the FOMC press conferences

References

[1] Filippo Curti and Sophia Kazinnik. "Let's Face It: Quantifying the Impact of Nonverbal Communication in FOMC Press Conferences". *Proceedings of the EUROFIDAI-ESSEC Paris December Finance Meeting*. 2022.

[2] Sefik Ilkin Serengil. DeepFace. *GitHub repository*, 2023. `github.com/serengil/deepface`.

[3] Paul Ekman and Wallace V Friesen. *Unmasking the face: A guide to recognizing emotions from facial clues*. Vol. 10, Ishk, 2003.