On the robustness of Obaid and Pukthuanthong's photo pessimism result[1]

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Abstract

Obaid and Pukthuanthong (2022) find that daily market return is negatively related to the previous day's (lag 1) value of their pessimistic sentiment measure derived from Wall Street Journal news photos for the period from August 2008 to September 2020. We replicate their results and show that the statistical significance of the lag 1 photo pessimism measure depends on the inclusion of year 2011 data – indeed, more specifically, on 20 observations (from 2011) out of 3,044 total observations. Oddly, with the removal of 2011 data, the lag 2 photo pessimism measure maintains its positive statistical significance.

Key words: Photo pessimism, Sentiment, Return predictability.

JEL codes: G14, G40.

[1] We thank Professor Khaled Obaid and Professor Kuntara Pukthuanthong for making their photo pessimism and text pessimism measures publicly available and answering relevant queries. We are also very grateful for guidance from Ivo Welch, an anonymous reviewer, and Ranjodh Singh, and for comments from seminar participants at Curtin University and the FIRN 2023 Conference.

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On the robustness of Obaid and Pukthuanthong's photo pessimism result

The relationship between news sentiment and the performance of the stock market is widely recognized. Tetlock's (2007) seminal study uses a psychosocial dictionary to quantify the textual pessimism of a daily Wall Street Journal (WSJ) news column and finds a negative relationship between news pessimism and the market return the next day. Obaid and Pukthuanthong (2022), hereafter O&P, introduce a novel method of measuring pessimistic news sentiment derived from photographic images in news articles. Their study finds that the market return predictiveness of photos is stronger than that of text in WSJ news articles, and that this photo effect is stronger on days with "salient" news photos when the photo pessimism measure is in the top or bottom decile of its range. This paper replicates the primary regression results of O&P and checks for the robustness of their results with respect to year-by-year data exclusions from the original full sample. We demonstrate that O&P's photo pessimism effect is not significantly evident when the subsample excludes year 2011 data but remains statistically significantly evident for subsamples inclusive of year 2011 data. With an analysis of influential observations, we attribute the statistical significance of O&P's result to as few as 20 observations from year 2011 (out of 3044 total observations). Our result suggests that the overall market return predictiveness of O&P's photo pessimism measure is sample specific rather than a generalizable result.

Stemming from an interest in investor sentiment, our scoping of O&P's very interesting results for potential research extensions gave rise to concerns about robustness. Our analysis is only possible due to O&P's commendable transparency in making their data publicly available. Ultimately this paper is a replication exercise that serves to caution researchers against undue confidence in sentiment quantifications derived by methods similar to that specified by O&P. Demonstration of the replicability (or lack thereof) of research evidence is foundational to subsequent scientific progress.[3]

[3] Hamermesh (2007) specifies three types of research replication: pure replication entails zero deviation from the original data and method; statistical replication entails variation of the data sample (but not the data population); and scientific replication entails a different data population and a different (but similar) method. Our approach is best categorized as statistical replication.

This paper proceeds as follows. The next section reviews relevant literature. Section 2 details this study's data and methodology. Results, analysis and robustness tests are in Sections 3 and 4, and Section 5 concludes.

1. Literature Review

Investor sentiment is an important factor in financial markets that affects the return performance of various securities. Researchers have notably built investor sentiment measures from macroeconomic and market information, or via news sentiment. Baker and Wurgler's (2006, 2007) seminal approach is to quantify investor sentiment in terms of closed-end fund discounts, NYSE share turnover,[4] IPO frequency and average first day return performance, the equity financing share of new capital raisings, and the market-to-book value premium of dividend paying stocks over nonpayers: they find evidence of a positive relationship between sentiment and stock overpricing (implied by subsequent return underperformance), and that the relationship is stronger for hard-to-arbitrage stocks such as small or young stocks. Baker, Wurgler and Yuan (2012) find similar evidence for six international stock markets and also find that the separate stock market prices of dual-listed firms are distinctly influenced by the separate stock market sentiment levels. Chung, Hung and Yeh (2012) find that the Baker and Wurgler sentiment measure is only reliably significantly predictive of stock returns during expansionary economic conditions when investor optimism is likely heightened. Also using Baker and Wurgler's sentiment measure, Yu and Yuan (2011) find that a positive relationship between market excess returns and market variance is only evident for low-sentiment periods, which indicates that investor sentiment can subvert fundamental risk-reward relationships.

Beyond the realm of macroeconomic and market conditions, weather conditions and sporting events may also impact investor mood and sentiment. Saunders (1993) finds a relationship between New York City weather and US stock returns. Hirshleifer and Shumway (2003) present international evidence that stock returns are lower on cloudy days than on sunny days. Edmans, Garcia and Norli (2007) document depressed stock

[4] NYSE share turnover is no longer included in Baker and Wurgler's sentiment measure updates in response to the prevalence of automated trading.

market performance for countries following a loss at international sporting events in soccer, cricket, rugby and basketball. Chang, Chen, Chou and Lin (2012) find that NFL games are associated with depressed next day returns for firms located near the losing team's homebase, and that this effect is magnified for unexpected losses and critical games, and for firms with small size, low profitability or high return volatility. Edmans, Fernandez-Perez, Garel and Indriawan (2022) suggest that personal music choices will be reflective of the mood and sentiment of individuals. Using Spotify music streaming data, Edmans et al. calculate the average positivity (as indicated by Spotify's valence metric) of the most popularly streamed Spotify music for use as a proxy for aggregate national sentiment; they find that weekly changes in their music positivity measure are "positively correlated with same-week equity market returns and negatively correlated with next-week returns, consistent with sentiment-induced temporary mispricing" (p234).

Tetlock (2007) explains that news sentiment can be predictive of stock returns either via a biasing influence on investor sentiment and consequential irrational noise trading, or as a source of valuable information with which investors rationally update fundamental valuations. The difference will be that the stock return impact of biased noise trading can be expected to be reversed by rational arbitrageurs. Tetlock quantifies the pessimism of the daily WSJ "Abreast of the Market" news column with respect to the Harvard psychosocial dictionary and finds that his news pessimism measure is predictive of lower next day stock market return and subsequent return reversal over the next few days, which is consistent with news sentiment being a driver of biased investor sentiment. Garcia (2013) derives news sentiment from New York Times articles and obtains stock return predictiveness evidence consistent with Tetlock. García additionally finds that the news sentiment effect is stronger in economic downturns, and that positive news sentiment is predictive of higher stock returns. The news sentiment effect has been further validated by researchers using the Thomson Reuters News Analytics (TRNA) dataset (Uhl, 2014; Smales, 2014, 2015a, 2015b; Hendershott, Livdan and Schurhoff, 2015; Khuu, Durand and Smales, 2016; Allen, McAleer and Singh, 2019; Durand, Khuu and Smales, 2023). TRNA employs machine learning techniques, specifically a neural network, to classify the sentiment conveyed in news stories based on analysis of sentences rather than individual words.

The internet and multi-media technologies have fostered a profusion of news formats. In particular, more than ever before, high-quality news images are easily disseminated. Such visual news may evoke sentiment in viewers more readily than catchy headlines or ledes or entire articles. Photos have the capacity to be attention-grabbing and emotionally impactful. Using eye-tracking evidence, Garcia and Stark (1991) find that visual content is the most common starting point for newspaper readers, and that initial visual impressions influence perceptions of accompanying text. In comparison to text, photos more readily engender emotional connection with viewers, making visual information more persuasive and easier to recall (Entman, 1993; Iyer and Oldmeadow, 2006). Powell, Boomgaarden, De Swert and De Vreese (2015) find that visual news promotes a state of behavior readiness in viewers, and thereby a tendency for impulsive behavior. Moreover, pictural news enables readers with language barriers or low text cognition ability to obtain easy-to-understand news information (Chiah, Hu and Zhong, 2022). Text can convey complexity and nuance, but messaging effectiveness will often depend on readers' pre-knowledge (Scheufele and Tewksbury, 2007). It is therefore conceivable that pictural news has more impact on investor sentiment than textual news.

Using machine learning, O&P are the first to quantify the pessimistic or optimistic sentiment of the photos that accompany WSJ news articles over the period 2008 to 2020. They find that their daily photo pessimism measure is negatively related to the next day's market return and positively related to the market return over the remaining trading week, which is consistent with sentiment induced next-day mispricing and subsequent reversal. O&P also find that their photo pessimism measure dominates a parallel text-based news pessimism measure in terms of market return predictiveness. Chiah et al. (2022) further show that O&P's photo pessimism measure is predictive of market returns for 37 international stock markets (based on a pooled regression).[5]

[5] Chiah et al.'s (2022) photo pessimism measure is based on Getty Images photos for 1995 to 2018 rather than WSJ photos for 2008 to 2020, and their regression methodology is very different to that of O&P; thereby Chiah et al.'s results are distinct from O&P's. We later detail that O&P's primary result is not evident with respect to Getty Images photos for 2008 to 2018 (being the time-frame portion of the Getty Images photo data that best matches the WSJ photo data time-frame). Chia et al. use O&P's publicly available time series of the Getty Images daily photo pessimism measure, about which O&P themselves, in

O&P's evidence is aligned with the social and behavioral priming evidence from the field of psychology purporting that human behavior may be unconsciously influenced by evocative stimuli or tasks. However, the late behavioral psychologist and Nobel laureate Daniel Kahneman specifically raised concerns about the robustness of priming results in an open letter in 2012 where he described the research field as the "poster child for doubts about the integrity of psychological research" (Yong, 2012). Chivers (2019) reviews the underwhelming results of replication efforts for previously published priming evidence.

2. Data and methodology

O&P's photo pessimism index (*PhotoPes*) and text pessimism index (*TextPes*) time series from 22 August 2008 to 30 September 2020 are obtained from Professor Pukthuanthong's website (https://www.kuntara.net/). O&P use the Google Inception V3 convolutional neural networks (CNN) image classification model to classify the sentiment of news photos. Following fine-tuning of the model with 1,269 sentiment-labeled images from You, Luo, Jin and Yang (2015) (https://qzyou.github.io/projects/sa-ds/), the model classifies photo sentiment based on image features such as objects, color composition, and facial expressions. O&P apply the model to photos from the WSJ Online Archive for articles published between August 2008 and September 2020 in the Business, Economy, Markets, Politics and Opinion sections, and any economics related articles in international news. The photos are classified as either negative sentiment or not, and the daily *PhotoPes* variable is calculated as the proportion of photos classified as negative sentiment each day. For the same set of articles (i.e. only articles with photos), O&P use the text sentiment tool in Stanford's CoreNLP software to score the sentiment of individual sentences as either 0 for positive, 0.5 for neutral or 1 for negative, and then score each article's pessimism as the average sentiment of its sentences (https://stanfordnlp.github.io/CoreNLP/). The daily *TextPes* variable is then calculated as the average of the pessimism scores of each day's articles. The *PhotoPes* and *TextPes*

their internet appendix, raise significant concerns (https://www.kuntara.net/): one notable concern is that only the date each Getty Images photo was taken is known, not the publication date – hence there can be no confident conclusion that the images directly cause a sentiment effect. A robustness analysis of Chiah et al.'s results might also be an interesting exercise.

time series available from Professor Pukthuanthong's website are already winsorized at the 1% level and standardized to zero mean and unit standard deviation (we make no adjustments), and each day's values represent the previous day's news (i.e. the *PhotoPes* and *TextPes* time series are already lagged by one day). Individual stock data, and value-weighted market portfolio and S&P500 index data are obtained directly from the CRSP database (i.e. we do not use the stock market return data provided alongside the *PhotoPes* and *TextPes* time series at Professor Pukthuanthong's website). Daily asset pricing factor returns and risk-free return are obtained from Kenneth French's data library.

Panel A of Table 1 shows the summary statistics of daily *PhotoPes*, *TextPes* and the CRSP value-weighted market portfolio return (VWRETD).[6] The average daily proportion of news photos classified as negative sentiment is 22.8%, and the average daily pessimism of news articles is 68.6%. *PhotoPes* has a higher standard deviation than *TextPes*. *PhotoPes* and *TextPes* are significantly correlated, but the estimate (0.052) has small magnitude. Both *PhotoPes* and *TextPes* indices exhibit statistically significant autocorrelation. Neither *PhotoPes* nor *TextPes* are significantly correlated with next-day VWRETD. In Panel B of Table 1 we present summary statistics of the month-by-month averages of daily *PhotoPes* and *TextPes* for comparison with the summary statistics of Baker and Wurgler's monthly sentiment index (B&W).[7] Monthly average *TextPes* and B&W have a significant correlation coefficient of –0.562, whereas monthly average *PhotoPes* and B&W are not significantly correlated. Different proxies for the same underlying phenomenon should be correlated (Chan, Durand, Khuu and Smales, 2017), thus the lack of significant correlation between the novel *PhotoPes* measure and the established B&W measure is a concern.

[6] Although our analysis uses the already winsorized and standardized *PhotoPes* and *TextPes* data that is publicly available from Professor Pukthuanthong's website, for sake of comparability with O&P's summary statistics, the commensurate summary statistics presented in our Table 1 have been "de-standardized" with the relevant standard deviation and mean values reported by O&P.

[7] Baker and Wurgler's monthly sentiment index time series is obtained from Professor Jeffrey Wurgler's website: https://pages.stern.nyu.edu/~jwurgler/.

[Insert Table 1 here]

To provide examples of the photo sentiment classifications generated by O&P's methodology, we apply their process (i.e. the Inception V3 image classification model fine-tuned with You et al.'s (2015) sentiment-labelled images) to the complete set of 29,146 images from the WSJ "Photos of the Day" archive spanning 16 September 2008 to 31 December 2018.[8] Table 2 presents examples of these photos with 0th, 25th, 75th, and 100th percentile sentiment scores. Photos with a sentiment score greater than 0.5, which corresponds to the 79th percentile, are deemed negative sentiment. The examples indicate that, at around the 75th percentile for sentiment score, photos classified as non-negative sentiment (with sentiment score moderately less than 0.5) may be more appropriately classified as negative sentiment.

[Insert Table 2 here]

We replicate the baseline result of O&P with regression equation 1 (which coincides with equation 4 in O&P's paper)

$$R_t = \mathbf{b}_1'\mathbf{L5}(PhotoPes_t) + \mathbf{b}_2'\mathbf{L5}(TextPes_t)$$
$$+b_3(PhotoPes * TextPes)_{t-1} + \mathbf{b}_4'\mathbf{L5}(R_t) + \mathbf{b}_5'\mathbf{L5}(R_t^2) + \mathbf{b}_6'\mathbf{X}_t + e_t \, , \qquad (1)$$

where R_t is the day t market return as represented by the CRSP value-weighted market portfolio (VWRETD) or the S&P500 Index, *PhotoPes* and *TextPes* are O&P's daily photo and text pessimism measures, $\mathbf{L5}(\cdot)$ denotes a vector of five lags ($t-1$ to $t-5$) of the variable it is applied to, and $\mathbf{X}_t$ denotes a vector of a constant term, day-of-week (except

[8] Barriers to bulk downloads from WSJ's online archives make it impractical to attempt to specifically replicate O&P's news photo data set. Instead, we use the WSJ Photos of the Day series which comprises eight to 20 photos per business day editorially deemed newsworthy and impactful.

Monday) dummies and a recession dummy (hence $\mathbf{b}_1$, $\mathbf{b}_2$, $\mathbf{b}_4$, $\mathbf{b}_5$ and $\mathbf{b}_6$ are coefficient vectors).[9]

O&P identify a stronger photo pessimism effect when their *PhotoPes* measure is in the top or bottom decile of its range – for such circumstances O&P describe the underlying news photos as “salient”. To review this result, we apply regression equation 2 (which coincides with equation 5 in O&P’s paper)

$$\begin{aligned} R_t = {} & (E_t)[\mathbf{b}_1'\mathbf{L5}(PhotoPes_t) + \mathbf{b}_2'\mathbf{L5}(TextPes_t) + b_3(PhotoPes * TextPes)_{t-1} \\ & + \mathbf{b}_4'\mathbf{L5}(R_t) + \mathbf{b}_5'\mathbf{L5}(R_t^2)] + (1 - E_t)[\boldsymbol{\gamma}_1'\mathbf{L5}(PhotoPes_t) + \boldsymbol{\gamma}_2'\mathbf{L5}(TextPes_t) \\ & + \gamma_3(PhotoPes * TextPes)_{t-1} + \boldsymbol{\gamma}_4'\mathbf{L5}(R_t) + \boldsymbol{\gamma}_5'\mathbf{L5}(R_t^2)] + \mathbf{b}_6'\mathbf{X}_t + e_t , \end{aligned} \qquad (2)$$

where E_t is a dummy variable that equals 1 when $PhotoPes_{t-1}$ is in the top or bottom decile of its sample range (i.e. for salient news photo days).

Table 3 presents comparative summary statistics for salient and non-salient news photo days each year. For 3,048 sample days (entailing 3,044 regression observations incorporating lags) across about 12.1 years (22 August 2008 to 30 September 2020), top and bottom decile *PhotoPes* implies about 50 salient news photo days on average per full year. It is notable that 2011 has 97 salient news photo days, which is considerably more than for any other year. The 2011 *PhotoPes* values for salient news photo days also have notably more sentiment negativity than for most other years as indicated by their high mean and high proportion above average (in this regard, although the *PhotoPes* sentiment negativity is worse for 2015 and 2016, 2011 has far more salient news photo days). It is intriguing that 2011 is, however, not notable for especially extreme financial or economic events.[10] Accordingly, to check that O&P’s results are not dependent on a data artifact,

[9] Equation 1 (and equation 2) reproduce O&P’s formulas but with clarifying vector notation. A more expositive representation of Equation 1 is $R_t = \sum_{i=1}^{5} b_{1,i}PhotoPes_{t-i} + \sum_{i=1}^{5} b_{2,i}TextPes_{t-i} + b_3(PhotoPes * TextPes)_{t-1} + \sum_{i=1}^{5} b_{4,i}R_{t-i} + \sum_{i=1}^{5} b_{5,i}R_{t-i}^2 + \mathbf{b}_6'\mathbf{X}_t + e_t$.

[10] O&P highlight the termination of Osama Bin Laden and associated tensions, and the Tohoku earthquake and tsunami event that disabled the Fukushima nuclear power plant, as particularly noteworthy news stories of early 2011 that would have been accompanied by pessimistic photos. However, it seems debatable that Bin Laden’s termination would have been interpreted pessimistically on balance, or considered especially

our primary robustness challenge for O&P's results is to apply our equations 1 and 2 (their equations 4 and 5) to various subsamples of their data.

[Insert Table 3 here]

3. Results and analysis

From the application of equation 1, Table 4 reports the results that O&P present in their Table 3, together with our close replication of O&P's results showing that market return has a negative relationship with the previous day's *PhotoPes* and generally positive relationships with prior days' *PhotoPes* values. It is O&P's contention that high *PhotoPes* predicts a market fall driven by negative investor sentiment induced by pessimistic pictural news, which is then followed by a corrective market rebound. This is consistent with the individual lagged *PhotoPes* coefficients reported in Table 4's Panel A and the coefficient sums reported in Panel B: the sum of lags one to five *PhotoPes* coefficients is not significantly different from zero, but the sum of lags two to five *PhotoPes* coefficients is significantly positive.

It is worth commenting that Table 4 presents the interesting result that both five-day lagged *PhotoPes* and *TextPes* are significantly associated with market return together with (but in the opposite direction to) one-day lagged *PhotoPes* but not one-day lagged *TextPes*. From this it seems that O&P's most robust result is that week-old news pessimism (textual and pictural jointly) positively predicts market return, however this does not accord with a plausible theoretical narrative, so it is understandably ignored as an artifact. Nevertheless, this apparent statistical artifact cautions us to be wary of ascribing underlying sentiment causality to evidence that day-old news photos predict market return. O&P implicitly dismiss the significance of the *PhotoPes* and *TextPes* lag 5 coefficients via the insignificance of the cumulation of the lag 1 to lag 5 coefficients (see our Panel B of Table 4) with the interpretation that it entails the reversal of the more

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more significant than, say, the 2014 Ukrainian Presidential coup and subsequent Russian annexation of Crimea, or the 2021 US Capitol riot. Also, although the Tohoku earthquake and tsunami was especially impactful, it was only one of many major natural disasters from 2008 to 2020 including, for example, the 2010 Haiti earthquake and Hurricane Maria in 2017.

immediate pessimism effect. Unlike O&P, we also calculate cumulation of the lag 1 and lag 2 coefficients (again see Panel B of Table 4). We find that the cumulation of the lag 1 and lag 2 *PhotoPes* coefficients is not significantly different to zero, which indicates that reversal of the supposed photo pessimism effect predominantly occurs the following day. However, the cumulation of the lag 1 and lag 2 *TextPes* coefficients is significantly negative, which suggests a more prolonged text pessimism effect and reversal.

[Insert Table 4 here]

3.1 Influential year

Table 5 reports equation 1 regression coefficients for single year data subsamples. O&P's key evidence for the hypothesis that pessimistic visual news induces negative investor sentiment and consequential lower market return is a negative coefficient for the *PhotoPes* lag 1 variable. Such a result only obtains for the 2008 (partial year) and 2011 subsample regressions. O&P further consider a positive coefficient for *PhotoPes* lag 2 to be indicative of corrective market reversal. Although the 2011 subsample produces a significantly negative *PhotoPes* lag 1 coefficient, the corresponding *PhotoPes* lag 2 coefficient is not significantly positive. However, for the 2008 subsample, both the *PhotoPes* lag 1 and lag 2 coefficients are significant (negative and positive, respectively) and notably large in scale but are obtained with only 87 observations. That is, with single year data, O&P's overarching narrative of a photo pessimism effect followed by corrective reversal is only evident for the 2008 partial year data. Note that a single full year entails only about 250 data observation days, however regression equation 1 entails 26 independent variables; such a high proportion of regressors to observations undermines the statistical viability of the Table 5 regressions.

[Insert Table 5 here]

Table 6 presents the results from further application of equation 1 for year-by-year data exclusions from the full sample, which preserves more statistical power than the single year subsamples. O&P's key result, a significantly negative *PhotoPes* lag 1 coefficient, is evident so long as year 2011 data is not excluded.[11] That is, there is no significant relationship between *PhotoPes* and the next day's market return when 2011 data is excluded from the equation 1 regression sample, which militates against the robustness of O&P's photo pessimism effect. Instead, with 2011 data excluded, O&P's *PhotoPes* negative sentiment measure becomes a one-day-delayed positive sentiment measure because the *PhotoPes* lag 2 coefficient remains significantly positive. However, the significance of the *PhotoPes* lag 2 coefficient is dependent upon the 2008 partial year data. Exclusion of both 2008 and 2011 data from the equation 1 regression sample (see the right-most column of Table 6) relegates both the *PhotoPes* lag 1 and lag 2 coefficients to statistical insignificance (with notable further diminution of the *PhotoPes* lag 1 coefficient), which challenges the robustness of O&P's overarching narrative of a photo pessimism effect followed by corrective reversal.

[Insert Table 6 here]

3.2 Influential observations

Having identified the importance of 2011 observations for the statistical significance of the market return predictiveness of O&P's photo pessimism measure, we next investigate how the significance of the coefficient of the *PhotoPes* lag 1 variable changes as the most influential 2011 data observations are incrementally removed from the sample. We rank the influence of 2011 observations by the absolute values of their DFBETAs for the *PhotoPes* lag 1 variable for the equation 1 regression model.[12] For comparison we do the same for every other year of the sample. Table 7 shows that the statistical significance of the *PhotoPes* lag 1 variable fails the 5% (10%) p-value hurdle once 10 (20) of the most influential 2011 observations are removed from the total sample of 3044 observations. Conversely, this significance persists at the 5% level or better when any other year's 20

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[11] The Table 6 results are obtained with market return represented by the CRSP value-weighted market portfolio (VWRETD). Qualitatively equivalent results are also obtained with market return represented by the S&P500 Index.

[12] The DFBETA of an observation for a particular independent variable is the difference in the coefficient of that variable with and without the observation.

most influential data observations are removed – in fact, for any single year other than 2011, 5% significance or better is maintained even with removal of the 100 most influential observations (or all 87 of the year 2008 observations). That is, as few as 10 to 20 observations from 2011 drive the statistical significance of O&P's results. The reliance of the statistical significance of O&P's results on such a small number of observations strongly implies the result is happenstance.

[Insert Table 7 here]

The Figure 1 scatter plot illustrates the noisy relationship between market return and *PhotoPes* lag 1. Figure 1 additionally shows that the 20 most influential 2011 observations are not especially notable as extreme outliers, which implicates the tenuous nature of statistical significance for noisy relationships.

[Insert Figure 1 here]

Table 8 presents the details of the 20 most influential 2011 observations along with, for additional context, the photos with the most and least negative sentiment for the lag 1 date from the WSJ Photos of the Day series as determined by O&P's photo sentiment classification methodology (i.e. the Inception V3 image classification model fine-tuned with You et al.'s (2015) sentiment-labelled images). For these 20 observations: 16 (80%) are salient observations (i.e. *PhotoPes* lag 1 is in the top or bottom decile of its sample range); 15 (75%) present a negative relationship between market return (VWRETD) and *PhotoPes* lag 1, and thereby promulgate O&P's key result; 13 (65%) entail photo pessimism (i.e. *PhotoPes* lag 1 > 0);[13] and, in particular, 19 (95%) correspond to a four-month time window from 25 August to 28 December.

Our review of news photos for the seemingly critical 25 August to 28 December 2011 time window finds a markedly non-financial theme of geopolitical unrest associated with the Arab Spring uprisings including the overthrow of Libyan ruler Muammar Gaddafi in August and his gruesome death in October. Despite the geopolitical unrest, the S&P500

[13] Note that the *PhotoPes* lag 1 values reported in Table 8 are the publicly available winsorized and standardized values.

rose by about 8% from 25 August to 28 December 2011. Just prior to this period of influential observations, the S&P500 suffered a very substantial fall of about 17% across July and August 2011 coinciding with heightened concerns about the Greek sovereign debt crisis and the US debt ceiling.

[Insert Table 8 here]

The extreme sentiment WSJ Photos of the Day photos presented in Table 8 provide example visual context for the photo pessimism effect for the 20 most influential 2011 observations. The extreme negative sentiment photos are often associated with geopolitical turmoil (three of the 20 are associated with Arab Spring events), whereas the extreme non-negative sentiment photos perhaps have splashes of color or brightness as a commonality. Nonetheless, it is evident that the algorithmic sentiment classification of the photos is often not sensible. We leave it to the reader to subjectively judge whether such imagery might stir trading spirits.

3.3 Simulations

Having identified that O&P's key result is dependent upon a single influential year or, more specifically, only 20 influential observations from a single year, we apply two simulation approaches to identify whether this sensitivity is a reasonably likely manifestation if the empirically estimated equation 1 model is a "true model", or whether this sensitivity is more likely to indicate that O&P's result is a Type I statistical significance error.

***PhotoPes* lag 1 significance sensitivity for "true model" simulations**

The model for equation 1 (O&P's equation 4) obtained from our replication of O&P's results is

$$
\begin{aligned}
R_t = {} & 0.009779 - 0.0525 PhotoPes_{t-1} + 0.05613 PhotoPes_{t-2} \\
& -0.02623 PhotoPes_{t-3} + 0.031937 PhotoPes_{t-4} + 0.052144 PhotoPes_{t-5} \\
& -0.0303 TextPes_{t-1} - 0.04443 TextPes_{t-2} - 0.02008 TextPes_{t-3} \\
& -0.01576 TextPes_{t-4} + 0.09205 TextPes_{t-5} + 0.035363 (PhotoPes * TextPes)_{t-1} \\
& -0.10975 R_{t-1} + 0.00384 R_{t-2} + 0.020533 R_{t-3} - 0.03948 R_{t-4} - 0.02704 R_{t-5}
\end{aligned}
$$

$$+0.015548R_{t-1}^2 - 0.01263R_{t-2}^2 + 0.000396R_{t-3}^2 - 0.00305R_{t-4}^2 - 0.00822R_{t-5}^2$$
$$+0.074497D_{Tue} + 0.04074D_{Wed} + 0.065321D_{Thu} + 0.081715D_{Fri}$$
$$+0.006628D_{recession} + 1.306321\varepsilon_t\ , \qquad (3)$$

where: R_t is the day *t* market return as represented by the CRSP value-weighted market portfolio (VWRETD); $PhotoPes_{t-i}$ and $TextPes_{t-i}$ are i-day lagged observations of O&P's daily photo and text pessimism measures; various D_X are day-of-week and recession indicator dummy variables equal to one if the relevant condition X is true and zero otherwise; and ε_t is the standardized (i.e. unit standard deviation) model residual.

Using O&P's *PhotoPes* and *TextPes* daily time series from 4 September 2008 to 30 September 2020 with day-of-week and recession indicator conditions, and five initial values of R_t from 4 September to 10 September 2008, we apply equation 3 using 2,000 simulations of 3,035-day time series of ε_t to generate 2,000 simulations of 3,035-day (11 September 2008 to 30 September 2020) time series of R_t under two conditions: (i) ε_t are independent and identically distributed (iid) drawings from the standard normal distribution; and (ii) ε_t are standardized iid drawings from the Student's T distribution with five degrees of freedom ("T5" distribution). The Student's T5 distribution introduces leptokurtosis (i.e. "fat tails") into the simulation of R_t to better match the empirical distribution. The empirical daily observations of R_t (3,048 daily observations from 22 August 2008 to 30 September 2020) have mean 0.045%, standard deviation 1.33, skewness –0.424, and excess kurtosis 12.5. In comparison, the simulated daily observations of R_t (2,000×3,035=6,070,000 daily observations for each of the two conditions for the model residuals) have: (i), under condition of standard normal residuals, mean 0.044%, standard deviation 1.33, skewness –0.008, and excess kurtosis 0.005; and (ii), under condition of standardized Student's T5 residuals, mean 0.042%, standard deviation 1.33, skewness –0.449, and excess kurtosis 11.5. These time series simulations of R_t, in combination with the empirical values of all other equation 1 variables, represent alternative scenarios under the assumption that O&P's photo pessimism model is a "true model".

Equation 1 regressions are then used to identify "true model" time series simulations of R_t for which the *PhotoPes* lag 1 coefficient is in the range [–0.056, –0.048] with 5%

statistical significance so as to be similar to the empirical coefficient value of –0.052 with 5% statistical significance. For the separate standard normal and standardized Student's T5 distribution specifications for ε_t, 202 and 205 similar "true model" time series simulations of R_t are identified, respectively.

Following the processes used for the Table 6 and Table 7 analyses, for each of the (202 and 205) similar "true model" time series simulations of R_t: the single year of data with the most influence on the value of the equation 1 *PhotoPes* lag 1 coefficient is identified and removed and the reduced time series' *PhotoPes* lag 1 coefficient and T-statistic are recorded; and for each single year of data the 20 observations ranked as having the most individual influence on the equation 1 *PhotoPes* lag 1 coefficient are identified, then the particular 20 most influential observations from a single year with the greatest combined impact on the *PhotoPes* lag 1 coefficient are identified and removed and the reduced time series' *PhotoPes* lag 1 coefficient and T-statistic are recorded. Panels A and B of Table 9 present summary statistics for the (202 and 205) *PhotoPes* lag 1 coefficients and T-statistics before and after removal of each time series simulation's most influential year of data and most impactful set of the 20 most influential data observations from a single year, along with a percentile ranking comparison of the empirical *PhotoPes* lag 1 coefficient against the simulation coefficients.

The Table 9 Panels A and B evidence indicates that the empirical *PhotoPes* lag 1 coefficient is much more sensitive to influential data than would be expected if the equation 3 estimated empirical model is a "true model". In particular, from reference to the percentile ranking comparison of the empirical *PhotoPes* lag 1 coefficient against the simulation coefficients, for the removal of the most impactful set of the 20 most influential data observations from a single year, the likelihood of seeing a less negative *PhotoPes* lag 1 coefficient than empirically observed is estimated to be 0.5% (1%) for the similar "true model" time series simulations with standard normal residuals (standardized Student's T5 residuals) – that is, equaling or surpassing the empirically observed weakening of the *PhotoPes* lag 1 coefficient from –0.052 to –0.034 is a very unlikely occurrence for the equation 3 model.

[Insert Table 9 here]

PhotoPes lag 1 significance sensitivity for Type I error simulations

We now compare the empirical equation 1 results to Type I error time series simulations. Simulated full sample data sets with no relationship between *PhotoPes* lag 1 and market return are created by combining randomly shuffled time orderings of the daily groupings of the $\mathbf{L5}(PhotoPes_t)$, $\mathbf{L5}(TextPes_t)$ and $(PhotoPes * TextPes)_{t-1}$ sentiment variable values with the empirical (true) daily time ordering of all other equation 1 variable values. By this data simulation process, for each daily observation the empirical relationship between the $\mathbf{L5}(PhotoPes_t)$, $\mathbf{L5}(TextPes_t)$ and $(PhotoPes * TextPes)_{t-1}$ values is maintained, but their relationship (as a group) with other variable values that were not shuffled is rendered meaningless. Thus, for these simulated time series, we have confidence in the truth of the null hypothesis of no meaningful relationship between market return and *PhotoPes* lag 1. Equation 1 regressions are then used to identify Type I error time series simulations for which the *PhotoPes* lag 1 coefficient is significantly negative at the 5% (two-tailed) level, entailing, by standard practice, erroneous rejection of the null hypothesis. From these Type I error time series simulations we then select those with *PhotoPes* lag 1 coefficients in the range [–0.056, –0.048] with 5% statistical significance so as to be similar to the empirical coefficient value of –0.052 with 5% statistical significance. This process is repeated 21,337 times to obtain 200 similar Type I error time series simulations.

The influential year and 20 most influential observations from a single year *PhotoPes* lag 1 sensitivity analysis previously applied to the similar "true model" time series simulations is again applied to the 200 similar Type I error simulation time series to obtain the $PhotoPes$ lag 1 coefficients and T-statistics before and after removal of each time series simulation's most influential year of data and most impactful set of the 20 most influential data observations from a single year. The associated summary statistics are presented in Panel C of Table 9 along with a percentile ranking comparison of the empirical *PhotoPes* lag 1 coefficient against the simulation coefficients.

The Table 9 Panel C evidence indicates that the sensitivity of the empirical *PhotoPes* lag 1 coefficient to the removal of influential data is similar to that which would be expected if the full time series statistical significance is a Type I error. In particular, from reference to the percentile ranking comparison of the empirical *PhotoPes* lag 1 coefficient against the simulation coefficients, for the removal of the most impactful set of the 20 most influential data observations from a single year, the likelihood of seeing a less negative *PhotoPes* lag 1 coefficient than empirically observed is estimated to be 29.3% for the similar Type I error time series simulations – that is, the empirically observed weakening of the *PhotoPes* lag 1 coefficient from –0.052 to –0.034 is not extreme or unusual if the full time series statistical significance of the *PhotoPes* lag 1 coefficient is a Type I error.

4. Robustness

4.1 Pre and Post 2011 data splits

Table 10 next presents the results from application of equation 1 for pre and post 2011 data samples, both with and without 2011 data included (i.e. 2008 to 2010, 2008 to 2011, 2011 to 2020, and 2012 to 2020 data). Like the Table 6 results we again see that the negative coefficient for the *PhotoPes* lag 1 variable is only statistically significant when the sample includes 2011 data. Table 3 shows that, in comparison to all other years except 2011, the years 2008 (full-year pro-rata), 2009 and 2010 each have very high frequency of salient news photo days (i.e. very high frequency of days with extreme *PhotoPes*); nevertheless, for the 2008 to 2010 data sample, the hypothesis that market return is negatively related to the previous day's *PhotoPes* is rejected. The hypothesis is similarly rejected for the 2012 to 2020 data for which the yearly occurrences of extreme *PhotoPes* days are comparatively much lower. That is, the statistical significance of the key element of O&P's *PhotoPes* effect is entirely dependent upon inclusion of 2011 data in the sample. Furthermore, the Table 10 results indicate that none of the *PhotoPes* and *TextPes* lag 1 and lag2 variables nor the *PhotoPes***TextPes* lag 1 variable are reliably predictive of market return.

[Insert Table 10 here]

4.2 Getty Images alternative *PhotoPes*

O&P generate an alternative photo pessimism index from Getty Images photos ($PhotoPes_{Getty}$) spanning 1926 to 2018,[14] which they use for a limited analysis available as an internet appendix.[15] O&P identify the 10 most popular photos from Getty Images Editorial News Section for each trading day of the series conditional on sample selection caveats that entail frequent missing daily data points. Using the same method applied to the WSJ photo series (i.e. the Inception V3 image classification model fine-tuned with You et al.'s (2015) sentiment-labelled images), the daily 10 photos are classified with an indicator variable as either negative or non-negative sentiment, and the daily photo pessimism index ($PhotoPes_{Getty}$) is then calculated as the average of the negative sentiment indicator variable weighted by the popularity ranking of the 10 photos. O&P find that $PhotoPes_{Getty}$ is significantly negatively related to market return.[16] Table 11 presents our results from application of equation 1 using only the 2008 to 2018 portion of the $PhotoPes_{Getty}$ time series (so that the data time-frame is comparable with the 2008 to 2020 WSJ *PhotoPes* time series). We find no relationship between market return and the previous day's $PhotoPes_{Getty}$ regardless of whether 2011 data is included.

[Insert Table 11 here]

[14] https://www.gettyimages.com.au/editorial-images.

[15] O&P's Getty Images photo pessimism index time series and the internet appendix is available at Professor Pukthuanthong's website: https://www.kuntara.net/. Unlike the index time series derived from WSJ photos, the provided $PhotoPes_{Getty}$ time series is not winsorized or standardized to zero mean and unit standard deviation.

[16] Note that this result, as presented by O&P, is for market return and same-day (not lag 1) $PhotoPes_{Getty}$ and is thus neither comparable to nor supportive of the key result O&P obtain with the WSJ photo series. In their internet appendix, O&P raise several concerns about the Getty Images photo series. One concern is that only the date each photo was taken is known, not the publication date – hence it cannot be claimed with any confidence that a photo sentiment effect has been demonstrated using the $PhotoPes_{Getty}$ series. O&P also do not satisfactorily explain how photo popularity is determined: they claim photo popularity rank considers purchase history and number of views, but then state that Getty Images neither provides popularity scores nor gives access to the actual numbers of purchases or views for their photos.

4.3 Regressor interdependence

The significance of the relationship between market return and *PhotoPes* lag 1 and lag 2 is not only sensitive to sample selection (as shown in Tables 5, 6 and 10) but also to the chosen combination of additional regressors. For market return versus *PhotoPes* lag 1 and lag 2 full sample regressions, Table 12 shows how the *PhotoPes* lag 1 and lag 2 coefficients evolve separately and together with various additions of *TextPes* and *PhotoPes***TextPes* lag 1 and lag 2 regressors and different sets of control variables. The Table 12 results indicate that *PhotoPes* lag 2 is positively related to market return at the 5% statistical significance level for multiple with and without combinations of explanatory and control variables; however, the statistical significance of *PhotoPes* lag 1 is critically dependent upon multiple additional explanatory variables, which challenges the robustness of O&P's key photo pessimism result.

[Insert Table 12 here]

4.4 Controlling for *PhotoPes* salience

O&P find that their identified relationship between market return and *PhotoPes* is even stronger when news photos are salient – that is, when daily *PhotoPes* is in the top or bottom decile of its sample range. From application of equation 2 (which is equivalent to O&P's equation 5), Table 13 reports the results of our reworking of the analysis that O&P present in their Table 5; the presented coefficients are for the dummy variable condition $E_t = 1$, which indicates the condition that daily news photos are salient. The first two columns of Table 13 are O&P's results and our replication results showing that, under the condition of news photo salience, market return has a negative relationship with *PhotoPes* lag 1 and a positive relationship with *PhotoPes* lag 2, as per the Table 4 results but with stronger coefficients in terms of scale and significance (most notably for *PhotoPes* lag 2). The other columns of Table 13 present results for year-by-year data exclusions from the full sample; these results show that, even with the condition of news photo salience, the statistical significance of the *PhotoPes* lag 1 coefficient is dependent upon inclusion of 2011 data in the sample.

Due to the high prevalence of salient news photo days in 2011 (see Table 3), the top and bottom decile thresholds for classifying a *PhotoPes* observation as salient are heavily influenced by 2011 observations. The final column of Table 13 again presents results obtained with 2011 data excluded, but with re-specification of salient news photo days as those for which *PhotoPes* is in the top or bottom decile of the sample range with 2011 excluded: we still find that market return is unrelated to *PhotoPes* lag 1 when 2011 data is excluded.

[Insert Table 13 here]

4.5 Controlling for stock characteristics

Prior research has suggested that stocks that are difficult to arbitrage may be particularly sensitive to market sentiment (Wurgler and Zhuravskaya, 2002; Baker and Wurgler, 2006). Consistent with this contention, O&P find that their *PhotoPes* sentiment effect is stronger for stocks characterized by high idiosyncratic volatility (IVOL) or low market capitalization (MCAP).

Controlling for IVOL

IVOL poses arbitrage risk (Stambaugh, Yu and Yuan, 2015), which makes high-IVOL stocks hard to arbitrage and thereby more prone to mispricing. We investigate whether O&P's *PhotoPes* effect remains evident for high-IVOL stocks when 2011 data is excluded from the analysis. For each month of our sample period we classify the cross-section of CRSP stocks into IVOL quintiles, where IVOL is calculated as the standard deviation of either the prior one month or prior three months of daily return residuals with respect to the Fama-French-Carhart four factor asset pricing model. We then redo our equation 1 and equation 2 analyses with the market return dependent variable replaced with either the return or abnormal return (with respect to the Fama-French-Carhart four factor asset pricing model) for three different portfolios characterized by IVOL: a value-weighted portfolio of high-IVOL (i.e. top IVOL quintile) stocks; a value-weighted portfolio of low-IVOL (i.e. bottom IVOL quintile) stocks; and a long-short portfolio represented by the high-IVOL portfolio return minus the low-IVOL portfolio return.

For the three portfolios based on IVOL, Table 14 presents the *PhotoPes* lag 1 and *PhotoPes* lag 2 coefficients for equation 1, and for equation 2 with the salient *PhotoPes* condition $E_t = 1$, for the full sample period and with year 2011 data excluded from the sample. For the full sample, for both one-month IVOL (Panel A) and three-month IVOL (Panel B), the results show that both high-IVOL and low-IVOL portfolio returns are significantly negatively related to *PhotoPes* lag 1 and positively related to *PhotoPes* lag 2 (this *PhotoPes* effect is consistent with the narrative that negative pictural news is associated with negative investor sentiment which drives stock returns down the next day, which is then followed by a corrective stock return rebound); and this relationship is stronger when *PhotoPes* is salient. It is also evident that the *PhotoPes* effect for the full sample is significantly stronger for high-IVOL stocks than for low-IVOL stocks, as evidenced by the significance of the *PhotoPes* effect for the high-IVOL minus low-IVOL long-short portfolio (which is consistent with investor sentiment being more influential for hard-to-arbitrage stocks). However, consistent with our prior evidence that the *PhotoPes* effect is dependent on 2011 data, when 2011 data is excluded from the analysis, Table 14 shows that *PhotoPes* lag 1 is not significantly related to low-IVOL portfolio return, and only significantly negatively related to high-IVOL portfolio return for the three-month IVOL specification (Panel B) when *PhotoPes* is salient. That is, with the influential 2011 data excluded, O&P's *PhotoPes* effect is not robustly evident for hard-to-arbitrage high-IVOL stocks. Furthermore, the *PhotoPes* effect is completely absent when abnormal portfolio returns are considered.

[Insert Table 14 here]

Controlling for market capitalization

Small-market capitalization (MCAP) stocks are generally subject to high information asymmetry, low trading liquidity, and short-selling constraints, which makes small-MCAP stocks hard to arbitrage and thereby more prone to mispricing. We investigate whether O&P's *PhotoPes* effect remains evident for small-MCAP stocks when 2011 data is excluded from the analysis. For a sample of all NYSE, AMEX and NASDAQ stocks, small-MCAP (large-MCAP) stocks are identified as those with MCAP lower (higher) than the bottom (top) MCAP quintile breakpoint determined either annually from sorting of the cross-section of NYSE stocks only,[17] or monthly from sorting of the cross-section of all NYSE, AMEX and NASDAQ stocks. We then redo our equation 1 and equation 2 analyses with the market return dependent variable replaced with either the return or abnormal return (with respect to the Fama-French-Carhart four factor asset pricing model) for three different portfolios characterized by MCAP: a value-weighted portfolio of large-MCAP stocks; a value-weighted portfolio of small-MCAP stocks; and a long-short portfolio represented by the small-MCAP portfolio return minus the large-MCAP portfolio return.

For the three portfolios based on MCAP, Table 15 presents the *PhotoPes* lag 1 and *PhotoPes* lag 2 coefficients for equation 1, and for equation 2 with the salient *PhotoPes* condition $E_t = 1$, for the full sample period and with year 2011 data excluded from the sample. For the full sample and our first specification of small and large-MCAP stocks (Panel A), the results show that the *PhotoPes* effect (i.e. a significant negative coefficient for *PhotoPes* lag 1 and a significant positive coefficient for *PhotoPes* lag 2) is evident for both large-MCAP and small-MCAP portfolio returns, is stronger when *PhotoPes* is salient, and is significantly stronger for small-MCAP stocks than for large-MCAP stocks, as evidenced by the significance of the *PhotoPes* effect for the small-MCAP minus large-MCAP long-short portfolio (which is consistent with investor sentiment being more influential for hard-to-arbitrage stocks). Furthermore, when the influential 2011 data is excluded from the analysis, Panel A of Table 15 shows that the *PhotoPes* effect remains significantly evident for the small-MCAP portfolio return. However, for our second specification of small and large-MCAP stocks (Panel B), the small-MCAP portfolio return only weakly exhibits the *PhotoPes* effect specifically for the full sample with the salient *PhotoPes* condition, and not otherwise. That is, with the influential 2011 data excluded, O&P's *PhotoPes* effect is not robustly evident for hard-to-arbitrage small-MCAP stocks. When considering abnormal returns, *PhotoPes* lag 1 is significantly negatively related to the small-MCAP portfolio abnormal return for our first specification of small and large-MCAP stocks (Panel A), but not for our second specification (Panel

[17] This is equivalent to the approach used to calculate the size quintile portfolio returns reported at Kenneth French's data library (i.e. annual sorting of NYSE, AMEX and NASDAQ stocks with respect to the quintile breakpoints of NYSE stocks only).

B), which further implies that the *PhotoPes* effect is not robustly evident for hard-to-arbitrage small-MCAP stocks.

[Insert Table 15 here]

5. Conclusion

O&P have introduced a novel method of measuring pessimistic news sentiment derived from photographic images in news articles. News photos have the capacity to be attention-grabbing and emotionally impactful and may evoke sentiment in viewers more readily than catchy headlines or ledes or entire articles. O&P's study finds that the market return predictiveness of photos is stronger than that of text in WSJ news articles, and that this photo effect is stronger for days with extreme photo sentiment levels when their photo pessimism measure is in the top or bottom decile of its range. This suggests that investors rely more heavily on visual content than textual content in news articles when processing information.

We have replicated the primary regression results of O&P and checked for the robustness of their results with respect to year-by-year data exclusions from the original full sample. Our results demonstrate that O&P's photo pessimism effect is not significantly evident when the subsample excludes year 2011 data but remains statistically significantly evident for subsamples inclusive of 2011 data. Even for days with extreme (high or low) photo sentiment levels, higher photo pessimism is not significantly associated with lower market return when the subsample excludes 2011 data. Furthermore, an influential observations analysis identifies as few as 20 observations from 2011 that, when excluded from the analysis, result in the market return predictiveness of the photo pessimism measure failing the 10% statistical significance hurdle. This suggests that the overall market return predictiveness of O&P's photo pessimism measure is sample specific and not a generalizable result.

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Figure 1 – Daily market return versus photo pessimism

Description: This graph plots 3,048 observations of the daily log return of the CRSP value-weighted market portfolio, ln(1+VWRETD), versus the *PhotoPes* lag 1 variable, with separate identification of the 20 most influential 2011 observations identified by the absolute values of the DFBETAs for the *PhotoPes* lag 1 variable for the equation 1 regression model. Also shown are the regression lines for the 20 most influential 2011 observations (the red line with slope -0.0039), and for all other observations (the dashed blue line with slope -0.0002).

Note 1: the *PhotoPes* variable is the proportion of sample WSJ news photos algorithmically classified as negative sentiment each day; because the number of sample photos each day tends to remain within a narrow whole number range, the *PhotoPes* value frequently repeats precisely, which causes the distinct vertical alignments of the data-points in the scatter plot.

Note 2: the plotted *PhotoPes* values are the publicly available winsorized and standardized values.

Interpretation: The relationship between market return and *PhotoPes* lag 1 is noisy, and very weak when the 20 most influential 2011 observations are excluded.

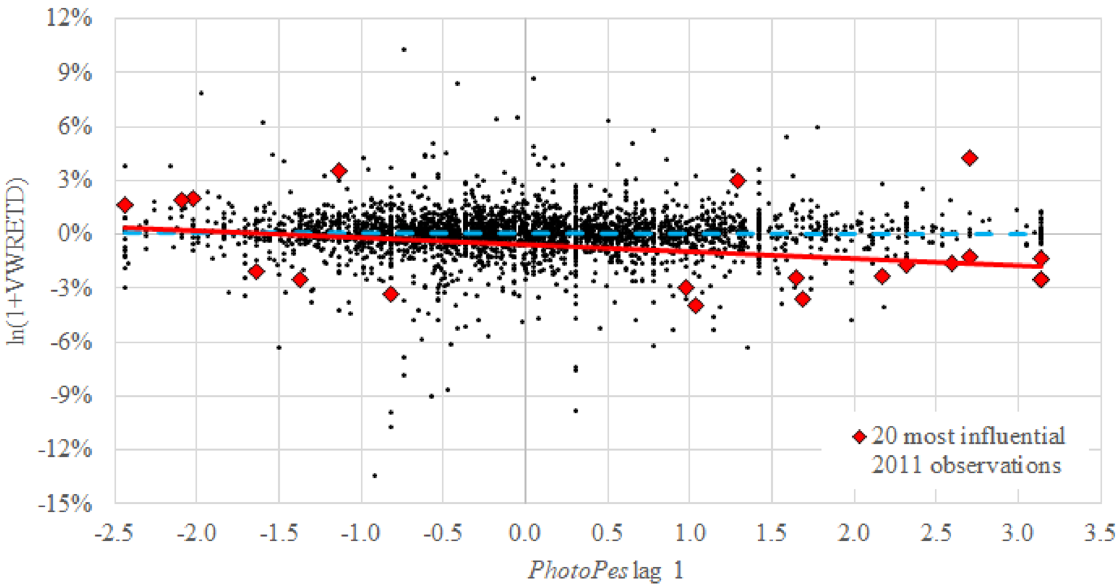


Table 1 – Summary statistics

Description: This table reports summary statistics for O&P's *PhotoPes* and *TextPes* time series (*PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day), the daily CRSP value-weighted market portfolio return (VWRETD), and Baker and Wurgler's (2006) monthly investor sentiment measure (B&W). Monthly *PhotoPes* and *TextPes* values are the month-by-month averages of daily *PhotoPes* and *TextPes*. Panel A (B) presents the number of observations, mean, median, 25th and 75th percentiles, and standard deviation of the daily (monthly) *PhotoPes*, *TextPes* and VWRETD (B&W) values, and their correlations, for the period from 22 August 2008 to 30 September 2020 (September 2008 to September 2020). The Panel A correlations for *PhotoPes* and *TextPes* are calculated with daily time series that are lagged by one day (lag 1) and by two days (lag 2) relative to the VWRETD daily time series. 10%, 5% and 1% correlation significance levels are indicated by *, ** and *** respectively.

Interpretation: Both *PhotoPes* and *TextPes* exhibit statistically significant autocorrelation. *PhotoPes* is not significantly correlated with the established B&W sentiment measure.

Panel A – Daily measures

	Daily obs.	Mean	Median	25th percentile	75th percentile	Standard deviation		Correlation				
								PhotoPes lag 1	*PhotoPes* lag 2	*TextPes* lag 1	*TextPes* lag 2	VWRETD
PhotoPes	3048	0.228	0.222	0.180	0.270	0.077	*PhotoPes* lag 1	1				
							PhotoPes lag 2	0.111***	1			
TextPes	3048	0.686	0.681	0.646	0.722	0.056	*TextPes* lag 1	0.052***	0.01	1		
							TextPes lag 2	0.001	0.052***	0.542***	1	
VWRETD	3048	0.045%	0.081%	–0.391%	0.586%	1.33	VWRETD	–0.023	0.041**	–0.022	–0.024	1

Panel B – Monthly measures

	Monthly obs.	Mean	Median	25th percentile	75th percentile	Standard deviation		Correlation		
								PhotoPes	*TextPes*	B&W
PhotoPes	145	0.229	0.224	0.209	0.247	0.028	*PhotoPes*	1		
TextPes	145	0.686	0.670	0.657	0.723	0.041	*TextPes*	–0.022	1	
B&W	145	–0.288	–0.265	–0.366	–0.158	0.212	B&W	–0.104	–0.562***	1

Table 2 – Photo sentiment classification examples

Description: This table displays two examples each of photos from the WSJ Photos of the Day series (comprising 29,146 photos from 16 September 2008 to 31 December 2018) with 0th, 25th, 50th, 75th, and 100th percentile sentiment scores as determined by O&P's photo sentiment classification methodology (i.e. the Inception V3 image classification model fine-tuned with You et al.'s (2015) sentiment-labelled images). Photos with sentiment score greater than 0.5 (corresponding to the 79th percentile sentiment score) are deemed negative sentiment.

Interpretation: At around the 75th percentile for sentiment score, photos classified as non-negative sentiment (i.e. with a sentiment score less than 0.5) may be more appropriately classified as negative sentiment.

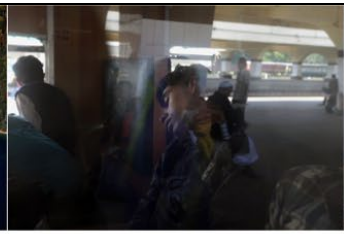
Sentiment score percentile	0th (sentiment score 0.00)	25th (sentiment score 0.02)	50th (sentiment score 0.12)	75th (sentiment score 0.40)	100th (sentiment score 1.00)
Photo example 1					
Photo date	23-April-2018	26-December-2010	17-October-2013	26-November-2013	19-September-2014
Photo caption	German Chancellor Angela Merkel and Enrique Peña Nieto, president of Mexico, with his wife Rivera de Peno, greet a robot at the IGB Automation stand at the Hannover Fair 2018.	STROLLING SANTAS: Volunteers of America Sidewalk Santas kicked off the Christmas season with a walk through midtown Manhattan during the Santa Parade in New York Friday.	BEAUTIFUL COLORS: Foliage turned colors near Eibsee Lake in a valley of Germany's highest moutain, the Zugspitze, near Garmisch-Partenkirchen, Germany.	NAP NOW: A man slept on a train during a transportation strike in Dhaka, Bangladesh, Tuesday. Bagladesh's opposition blocked roads, railways and waterways to protest government plans to hold a general election on Jan. 5.	An image shows a photo montage of a logistics depot in northeastern Iraq before and after a mission by French Rafale fighter jets from the Al-Dhafra air base.
Photo example 2					
Photo date	04-December-2013	18-October-2012	07-January-2016	28-October-2008	07-April-2011
Photo caption	Catch! Britain's Prince William threw a ball during his visit to the Westway Sports Centre in London on Wednesday.	DAY AT THE PARK: Palestinian students rode swings at the Al-Bashir amusement park on the outskirts of Gaza City.	A man watches as high surf crashes into a wall in Montecito, Calif., after storms pummeled the region with heavy rainfall.	FLOODED OUT: A Palestinian man covered in a blanket walked on a flooded street Tuesday after heavy rain in the Khan Younis refugee camp in the southern Gaza Strip.	SWIMMING IN RUBBISH: A resident swam through debris and rubbish looking for recyclable materials Thursday after a fire in Malabon City, Phillipines, that affected about 1,000 residents. No casualties were reported.

Table 3 – Summary statistics by year for salient and non-salient news photo days

Description: This table presents summary statistics for O&P's *PhotoPes* time series and the daily CRSP value-weighted market portfolio return (VWRETD) by year for salient and non-salient news photo days from 2008 to 2020. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day. As per O&P's specification, salient news photo days are identified as those for which the *PhotoPes* measure is in the top or bottom decile of its range.

Note 1: only about a third of 2008 and three-quarters of 2020 are represented in the sample.

Note 2: the *PhotoPes* summary statistics are calculated with respect to the publicly available winsorized and standardized *PhotoPes* values.

Interpretation: 2011 has a comparatively high prevalence of salient news photo days.

Year	Salient news photo days (*PhotoPes* in top or bottom decile)						Non-salient news photo days					
	Daily obs. (Pro-rata full year values in parentheses)	*PhotoPes*			VWRETD (%)		Daily obs. (Pro-rata full year values in parentheses)	*PhotoPes*			VWRETD (%)	
		Mean	Proportion above average	Standard deviation	Mean	Standard deviation		Mean	Proportion above average	Standard deviation	Mean	Standard deviation
2008	25 (69)	–0.76	0.32	2.01	0.30	3.00	66 (181)	0.05	0.50	0.63	–0.57	4.15
2009	75	–0.19	0.40	1.83	0.55	1.47	177	–0.12	0.38	0.64	–0.06	1.85
2010	72	0.28	0.53	1.97	0.15	0.96	180	–0.15	0.39	0.58	0.04	1.24
2011	97	1.00	0.67	1.95	0.04	1.29	155	0.07	0.52	0.70	–0.02	1.63
2012	50	0.65	0.64	1.77	0.20	0.77	200	–0.07	0.44	0.61	0.03	0.83
2013	46	–0.34	0.39	1.56	0.09	0.67	206	–0.09	0.42	0.57	0.11	0.71
2008-2013	365 (409)	0.28	0.52	1.94	0.21	1.35	984 (1099)	–0.07	0.43	0.62	–0.01	1.65
2014	37	0.24	0.54	1.65	0.05	0.60	215	0.01	0.51	0.64	0.04	0.74
2015	44	1.08	0.82	1.42	–0.03	1.14	208	0.28	0.69	0.60	0.00	0.89
2016	34	1.06	0.76	1.46	–0.12	0.74	218	0.15	0.62	0.57	0.08	0.87
2017	37	0.16	0.54	1.65	0.02	0.50	214	0.07	0.54	0.56	0.09	0.42
2018	32	–1.27	0.06	0.74	–0.10	0.87	219	–0.21	0.34	0.56	–0.01	1.04
2019	32	–1.35	0.03	0.58	0.17	0.56	220	–0.27	0.31	0.54	0.10	0.79
2020	30 (40)	–0.43	0.33	1.42	–0.34	2.73	159 (210)	–0.12	0.42	0.58	0.13	2.32
2014-2020	246 (256)	0.01	0.47	1.62	–0.04	1.19	1453 (1504)	–0.01	0.49	0.60	0.06	1.08

Table 4 – Replication of O&P's photo pessimism evidence

Description: Panel A of this table reports the coefficients of the $\mathbf{L5}(PhotoPes_t)$, $\mathbf{L5}(TextPes_t)$ and $(PhotoPes * TextPes)_{t-1}$ regressors for the equation 1 regression with market return represented by the CRSP value-weighted market portfolio (VWRETD) or the S&P500 Index for two circumstances: (i) as determined by O&P and reported in their Table 3; and (ii) our full sample replication of O&P. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. Newey and West (1987) T-statistics with five lags are reported in parentheses. Panel B of this table reports various sums of the Panel A coefficients. Wald test p-values are reported in italics. 10%, 5% and 1% significance levels are indicated by *, ** and *** respectively.

Interpretation: O&P's photo pessimism effect is replicable.

Panel A – Equation 1 coefficient estimates for full sample

	VWRETD		S&P500	
	O&P	Replication of O&P	O&P	Replication of O&P
PhotoPes lag 1	–0.052**	–0.052**	–0.049**	–0.050**
	(–2.36)	(–2.37)	(–2.23)	(–2.29)
TextPes lag 1	–0.027	–0.030	–0.038	–0.039
	(–0.82)	(–0.95)	(–1.18)	(–1.23)
PhotoPes lag 2	0.056**	0.056**	0.052**	0.050*
	(2.09)	(2.08)	(1.98)	(1.88)
PhotoPes lag 3	–0.027	–0.026	–0.025	–0.023
	(–1.09)	(–1.05)	(–1.01)	(–0.94)
PhotoPes lag 4	0.032	0.032	0.026	0.028
	(1.39)	(1.40)	(1.13)	(1.21)
PhotoPes lag 5	0.051*	0.052**	0.053**	0.052**
	(1.94)	(2.00)	(2.02)	(1.99)
TextPes lag 2	–0.040	–0.044	–0.045	–0.044
	(–1.16)	(–1.23)	(–1.28)	(–1.23)
TextPes lag 3	–0.024	–0.020	–0.014	–0.014
	(–0.64)	(–0.55)	(–0.39)	(–0.39)
TextPes lag 4	–0.016	–0.016	–0.019	–0.019
	(–0.49)	(–0.47)	(–0.58)	(–0.56)
TextPes lag 5	0.090**	0.092**	0.093**	0.093**
	(2.49)	(2.46)	(2.60)	(2.51)
*PhotoPes*TextPes* lag 1	0.038*	0.035*	0.033*	0.032*
	(1.94)	(1.83)	(1.75)	(1.70)
Unreported regressor coefficients	Five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy			
Daily obs.	3044	3044	3044	3044
Adj. R-squared	0.037	0.027	0.043	0.034

Panel B – Sum of Panel A coefficients

	VWRETD		S&P500	
	O&P	Replication of O&P	O&P	Replication of O&P
PhotoPes lag 1 to 2		0.004 *0.91*		–0.000 *1.00*
PhotoPes lag 1 to 5	0.060 *0.17*	0.062 *0.16*	0.057 *0.19*	0.056 *0.20*
PhotoPes lag 2 to 5	0.112** *0.01*	0.114*** *0.01*	0.106** *0.01*	0.106*** *0.01*
TextPes lag 1 to 2		–0.075* *0.06*		–0.083** *0.04*
TextPes lag 1 to 5	–0.017 *0.57*	–0.018 *0.55*	–0.023 *0.45*	–0.023 *0.45*
TextPes lag 2 to 5	0.010 *0.82*	0.012 *0.76*	0.015 *0.70*	0.016 *0.68*

Table 5 – One-by-one single year regression evidence for O&P's photo pessimism effect

Description: This table reports the coefficients of the *PhotoPes* and *TextPes* lag 1 and lag 2, and *PhotoPes***TextPes* lag 1 regressors of the equation 1 regression with market return represented by the CRSP value-weighted market portfolio (VWRETD) for our full sample replication of O&P, and for one-by-one single year (2008 to 2020) data samples. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.

Interpretation: Equation 1's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is statistically significant for 2008 and 2011 single year regressions but is not statistically significant for any other single year regressions.

	Replication of O&P	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
PhotoPes lag 1	–0.052**	–0.934**	0.123	–0.067	–0.178**	–0.032	0.047	0.066	0.105	–0.043	–0.021	–0.038	–0.127	0.073
TextPes lag 1	–0.027	0.449	–0.021	–0.101	0.072	–0.060	0.147**	–0.064	–0.146	–0.084	–0.075*	–0.205	–0.147	–0.266
PhotoPes lag 2	0.056**	0.854**	0.042	0.086*	0.034	0.057	–0.045	–0.040	0.081	0.040	0.016	0.025	0.028	–0.076
TextPes lag 2	–0.040	–0.862**	–0.262*	–0.046	–0.217*	–0.058	–0.176***	–0.003	0.042	–0.033	–0.065	0.261**	0.132**	–0.143
*PhotoPes***TextPes* lag 1	0.038*	0.290	–0.040	0.081*	0.102**	0.040	–0.046	0.094	0.157*	0.005	–0.048	–0.184	–0.049	0.079
Unreported regressor coefficients	*PhotoPes* and *TextPes* lag 3, lag 4 and lag 5, five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy													
Daily obs.	3044	87	252	252	252	250	252	252	252	252	251	251	252	189

Table 6 – The influence of year-by-year data exclusions on O&P's photo pessimism effect

Description: This table reports the coefficients of the *PhotoPes* and *TextPes* lag 1 and lag 2, and *PhotoPes***TextPes* lag 1 regressors of the equation 1 regression with market return represented by the CRSP value-weighted market portfolio (VWRETD) for year-by-year (2008 to 2020) data exclusions, and for both 2008 and 2011 data exclusion from the full sample. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.
Interpretation: Equation 1's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is not statistically significant when year 2011 data is excluded from the regression but remains statistically significant when any other year's data is excluded. Removing both 2008 and 2011 data (the two single years for which the photo pessimism effect is evident in Table 5) brings the *PhotoPes* lag 1 coefficient even closer to zero and additionally relegates the *PhotoPes* lag 2 coefficient to statistical insignificance, which undermines the overarching photo pessimism effect followed by corrective reversal narrative for O&P's *PhotoPes* lag 1 and lag 2 evidence.

	2008 excluded	2009 excluded	2010 excluded	2011 excluded	2012 excluded	2013 excluded	2014 excluded	2015 excluded	2016 excluded	2017 excluded	2018 excluded	2019 excluded	2020 excluded	2008&2011 excluded
Daily obs. deleted	87	252	252	252	250	252	252	252	252	251	251	252	189	339
PhotoPes lag 1	–0.043**	–0.057**	–0.055**	–0.034	–0.052**	–0.055**	–0.057**	–0.053**	–0.056**	–0.060**	–0.059***	–0.046**	–0.051**	–0.020
TextPes lag 1	–0.026	–0.049	–0.029	–0.043	–0.030	–0.041	–0.027	–0.018	–0.027	–0.032	–0.025	–0.023	–0.020	–0.039
PhotoPes lag 2	0.032	0.056**	0.051*	0.062**	0.057*	0.065**	0.063**	0.055*	0.057**	0.059**	0.055**	0.060**	0.058**	0.032
TextPes lag 2	–0.037	–0.045	–0.053	–0.018	–0.046	–0.038	–0.045	–0.053	–0.046	–0.045	–0.062*	–0.049	–0.044	–0.005
*PhotoPes***TextPes* lag 1	0.038**	0.037*	0.027	0.023	0.037*	0.040**	0.036*	0.035*	0.038*	0.040**	0.039**	0.033*	0.035*	0.026
Unreported regressor coefficients	*PhotoPes* and *TextPes* lag 3, lag 4 and lag 5, five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy													
Daily obs.	2957	2792	2792	2792	2794	2792	2792	2792	2792	2793	2793	2792	2855	2705

Table 7 – Year-by-year most influential observations impact on O&P's photo pessimism effect

Description: This table reports the coefficient of the *PhotoPes* lag 1 regressor for the equation 1 regression with market return represented by the CRSP value-weighted market portfolio (VWRETD) for our replication of O&P using the full sample but with removal of the 10 (20, 50, 100) most influential observations of a single year, for each year of the sample. The influence of an observation is specified to be the absolute value of its equation 1 DFBETA for the *PhotoPes* lag 1 variable. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively. Note that for the sample year 2008 there are only 87 observations.

Interpretation: Equation 1's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is not statistically significant when the 20 most influential observations of year 2011 are removed from the regression but remains statistically significant when the 20 most influential observations of any other single year are removed.

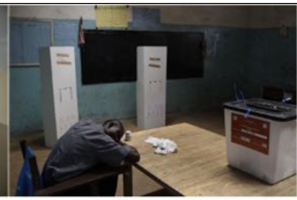
Number of most influential observations removed from a single year	Regression observations	Single year from which influential observations are removed												
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
10	3034	–0.043**	–0.059***	–0.057***	–0.040*	–0.053**	–0.053**	–0.055**	–0.047**	–0.054**	–0.056**	–0.054**	–0.052**	–0.051**
20	3024	–0.042**	–0.057***	–0.054**	–0.034	–0.051**	–0.053**	–0.056**	–0.047**	–0.053**	–0.057**	–0.056**	–0.050**	–0.051**
50	2984	–0.042*	–0.060***	–0.052**	–0.032	–0.052**	–0.053**	–0.055**	–0.050**	–0.053**	–0.058***	–0.056**	–0.048**	–0.054***
100	2934 (2957 for 2008)	–0.043**	–0.056***	–0.055**	–0.033	–0.052**	–0.055**	–0.056**	–0.053**	–0.055**	–0.059***	–0.058***	–0.047**	–0.052**

Table 8 – The most influential 2011 observations

Description: This table reports the details of the 20 most influential 2011 observations for O&P's photo pessimism effect. The influence of an observation is specified to be the absolute value of its equation 1 DFBETA for the *PhotoPes* lag 1 variable. The details provided are: the 2011 influential observation date; the publicly available winsorized and standardized *PhotoPes* lag 1 value; the CRSP value-weighted market portfolio return (VWRETD); salience status (such that the *PhotoPes* lag 1 value is classified as salient if it is in either the top or bottom decile of its full sample range); indication of whether the observation supports a negative relationship between *PhotoPes* lag 1 and market return; and the photos with the most and least negative sentiment for the lag 1 date from the WSJ Photos of the Day series with their sentiment scores as determined by O&P's photo sentiment classification methodology (i.e. the Inception V3 image classification model fine-tuned with You et al.'s (2015) sentiment-labelled images) and sentiment classifications (such that a sentiment score greater than 0.5 is deemed negative sentiment). *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day.

Interpretation: 19 (95%) of the 20 most influential 2011 observations occur in a four-month time period from 25 August to 28 December, and 15 (75%) entail a negative relationship between (standardized) *PhotoPes* lag 1 and market return in support of the photo pessimism effect. A personal assessment of photo sentiment may not align with the algorithmic assessment.

2011 observation influence rank	1st	2nd	3rd	4th	5th
2011 influential observation date	30 Nov	2 Sep	22 Sep	30 Sep	8 Dec
PhotoPes lag 1	2.70	3.14	1.69	3.14	2.17
VWRETD (%)	4.39	–2.47	–3.44	–2.47	–2.29
Salient *PhotoPes* lag 1?	Yes	Yes	Yes	Yes	Yes
Supports *PhotoPes* lag 1 negative predictiveness of VWRETD?	No	Yes	Yes	Yes	Yes
WSJ Photos of the Day most negative sentiment photo for lag 1 date					
	EMBASSY RUN: Police chased some protesters from the British Embassy in Tehran, Iran, Tuesday. Students stormed the complex two days after Iranian Parliament approved a bill that reduces diplomatic relations with Britain	GATOR GONE: Officials inspected a bridge where an alligator attacked Margaret Webb, 90, in Copeland, Fla., Wednesday. They called off the search Thursday for the eight-foot long alligator that lunged out of a canal and nearly severed the victim's leg, which doctors later amputated.	FROM THE FRONT LINE: People looked inside a vehicle as a casualty form the front lines was brought to a hospital in Misrata, Libya, Tuesday.	GET THE LOOK: A model waited backstage before the Alternative Hair Show in Moscow.	CLOSER TO ALLAH: A truck driver performed evening prayers atop an oil tanker in Karachi, Pakistan, Wednesday.
Photo sentiment score (classification)	0.84 (negative)	0.54 (negative)	0.77 (negative)	0.49 (non-negative)	0.72 (negative)
WSJ Photos of the Day least negative sentiment photo for lag 1 date					
	IN MEMORIAM: Activists held flags during a candlelight vigil Tuesday in Islamabad, Pakistan, for Pakistani military troops who were killed in a NATO airstrike over the weekend. At least 24 people were killed in an incident that remains shroudedin confusion and contradiction.	LUNCHING WITH THE PRESIDENT: President Dmitry Medvedev ate lunch next to a student at the Presidential Cadet School on Knowledge Day in Stavropol, Russia, Thursday. Knowledge Day marks the end of summer and the beginning of the school year in Russia.	ON THE STREET: A homeless family sat on a sidewalk in Kolkata Wednesday. India's Planning Commission told the Indian Supreme Court Tuesday that villagers earning more than 50 cents a day shouldn't qualify for welfare. Activists condemn the figure.	HANDS-ON PROTEST: A woman displayed her hands, painted red, symbolizing bloodshed, and blue, symbolizing peace, during a demonstration demanding the ouster of Yemen's President Ali Abdullah Saleh in San'a Wednesday.	ROUNDED UP: Opposition supporters were detained in a police truck at a protest in Kinshasa, Congo, Wednesday. Partial results make it all but certain that President Joseph Kabila will be declared the winner. Rival Etienne Tshisekedi's supporters have vowed to take to the streets.
Photo sentiment score (classification)	0.00 (non-negative)	0.00 (non-negative)	0.01 (non-negative)	0.01 (non-negative)	0.00 (non-negative)

2011 observation influence rank	6th	7th	8th	9th	10th
2011 influential observation date	1 Nov	3 Nov	27 Oct	9 Nov	31 Oct
PhotoPes lag 1	0.98	–2.09	–1.13	1.03	–1.37
VWRETD (%)	–2.86	1.92	3.63	–3.79	–2.47
Salient *PhotoPes* lag 1?	No	Yes	No	No	Yes
Supports *PhotoPes* lag 1 negative predictiveness of VWRETD?	Yes	Yes	Yes	Yes	No
WSJ Photos of the Day most negative sentiment photo for lag 1 date	 SEVEN BILLION: A newborn baby slept in the arms of her mother at a Community Health Center in Mall, Uttar Pradesh, India, on Monday. The world's population will reach seven billion on Oct. 31, according to projections by the United Nations.	 MAKESHIFT SPLINT: A man carried a wounded child after forces loyal to President Ali Abdullah Saleh clashed with opposition fighters in Taiz, Yemen, Wednesday.	 SPRUCING UP: A painter worked at a cemetery Wednesday near Malaga, Spain, ahead of All Saints' Day, when relatives will visit the graves of their loved ones.	 TAKING A BREAK: An election worker slept next to a ballot box in an empty polling station in Monrovia, Liberia, Tuesday. Turnout for the presidential runoff, which the opposition boycotted, was low.	 NOT FINISHED: Russian police arrested an activist from the 'Other Russia' opposition movement during a protest outside a courthouse in Moscow Friday. Two members and three other men were convicted Friday and given prison terms for their roles in violence in Manezh Square in December.
Photo sentiment score (classification)	0.99 (negative)	0.97 (negative)	0.62 (negative)	0.84 (negative)	0.76 (negative)
WSJ Photos of the Day least negative sentiment photo for lag 1 date	 ON THE WAY TO WORK: Commuters stood at the open doorway of a suburban train during the morning rush hour in Mumbai on Monday.	 SIGN OF DISAPPROVAL: Traders gave thumbs-down at the Philippine Stock Exchange in Manila where share prices fell Wednesday. The main index lost 73.13 points.	 OBSTRUCTED VIEW: A woman stood near banana leaves that she bought at a market for Diwali, the festival of lights, in Hyderabad, India, Wednesday.	 KIMCHI MADE WITH CARE: Volunteers made kimchi in front of Seoul City Hall Tuesday. The fermented dish, made of cabbage, other vegetables and chili, will be donated to the needy.	 FINDING HOPE: A pilgrim carried statues of St. Jude, the patron saint of lost causes, into St. Hipolito Church in Mexico City Friday, the saint's feast day.
Photo sentiment score (classification)	0.00 (non-negative)	0.00 (non-negative)	0.03 (non-negative)	0.00 (non-negative)	0.05 (non-negative)

2011 observation influence rank	11th	12th	13th	14th	15th
2011 influential observation date	25 Oct	28 Nov	16 Mar	14 Dec	25 Aug
PhotoPes lag 1	–1.64	1.29	2.32	2.70	2.60
VWRETD (%)	–1.99	3.06	–1.67	–1.27	–1.59
Salient *PhotoPes* lag 1?	Yes	Yes	Yes	Yes	Yes
Supports *PhotoPes* lag 1 negative predictiveness of VWRETD?	No	No	Yes	Yes	Yes
WSJ Photos of the Day most negative sentiment photo for lag 1 date	 CHIPPING AWAY: Work continued on the demolition of the Alaskan Way Viaduct in Seattle Monday. The aging highway, which carried about 110,000 vehicles a day, is being partially demolished as part of a $3.2 billion project to replace it with a tunnel under downtown Seattle.	 MAN OF THE MIST: A man rowed his boat on Dal Lake on a foggy day in Srinagar, the summer capital of Indian-controlled Kashmir, Friday.	 PEEK-A-BOO: A boy peered between the skirts of women protesting against the government in San'a, Yemen, Tuesday. Thousands of protesters took to the streets in the southern provinces of Taiz, Aden and Hadramawt.	 WAITING HIS TURN: A woman held a baby boy as he waited to be seen by a medic from the Kenyan Defense Forces in Ras Kamboni, Somalia, Tuesday.	 COLLISION: A bus and a tractor-trailer collided on the New Jersey Turnpike in South Brunswick, N.J., Wednesday. About a dozen people were injured. State police said most of the injuries were minor, but at least one person was critically injured and two others sustained serious injuries.
Photo sentiment score (classification)	0.99 (negative)	0.96 (negative)	0.75 (negative)	0.87 (negative)	0.94 (negative)
WSJ Photos of the Day least negative sentiment photo for lag 1 date	 SCAREDY CAT: A cat was displayed at a pet exhibit in Wuhan, Hubei Province, China, Sunday.	 UP, UP, UP! Competitors participated in the annual 'Stair Race' at Azrieli Tower in Tel Aviv Friday. Hundreds of people each year race to see who can climb the the 1,144 steps in the 51-story tower the fastest.	 IN DESPAIR: A hospital employee in Manama, Bahrain, on Tuesday was overwhelmed by the constant stream of patients coming in from the Shiite town of Sitra, where witnesses said pro-government vigilantes had gone on a rampage.	 ROOM TO GROW: Mustafa Ahmed, 11 years old, who was wounded by a bomb during the 2003 invasion of Iraq, was fitted for a new prosthetic leg in Baghdad Tuesday.	 LOOKING UP: Holden Orr, 6, watched as men weatherproofed his grandfather's house in Mineral, Va., after the chimney was damaged when an earthquake struck Tuesday. The 5.8-magnitude earthquake rattled the East Coast from South Carolina to New England.
Photo sentiment score (classification)	0.00 (non-negative)	0.00 (non-negative)	0.00 (non-negative)	0.00 (non-negative)	0.00 (non-negative)

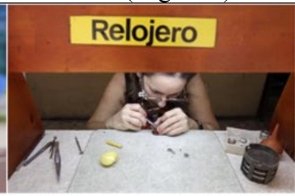
2011 observation influence rank	16th	17th	18th	19th	20th
2011 influential observation date	28 Sep	3 Oct	28 Dec	26 Aug	18 Oct
PhotoPes lag 1	1.65	–0.81	3.14	–2.44	–2.02
VWRETD (%)	–2.37	–3.19	–1.37	1.64	2.08
Salient *PhotoPes* lag 1?	Yes	No	Yes	Yes	Yes
Supports *PhotoPes* lag 1 negative predictiveness of VWRETD?	Yes	No	Yes	Yes	Yes
WSJ Photos of the Day most negative sentiment photo for lag 1 date					
	FIRED UP: A shipyard worker protesting the lack of work at a local factory waved at others during a clash with police in Seville, Spain.	REMAINS RETURNED: Members of a Namibian delegation paid their respects to two Namibian skulls in Berlin Friday. The 20 skulls in the collection were returned to tribal leaders more than a century after they were taken by German colonial forces for racial experiments.	READY FOR THE SHOW: LaQuita Staten listened as her husband, Corey Staten, welcomed the audience to the Attucks Theatre's sixth annual Kwanzaa concert in Norfolk, Va., Monday.	HELD BACK: Police blocked supporters of activist Anna Hazare from marching to Prime Minister Manmohan Singh's residence in New Delhi Thursday. Mr. Singh called on lawmakers to discuss Mr. Hazare's calls for anticorruption reforms and for Mr. Hazare to end his hunger strike.	KING OF THE CLOTHES PILE: A man stood atop a pile of used jackets and coats for sale along a road in Quetta, Pakistan, Monday.
Photo sentiment score (classification)	0.94 (negative)	0.93 (negative)	0.98 (negative)	0.75 (negative)	0.99 (negative)
WSJ Photos of the Day least negative sentiment photo for lag 1 date					
	HOLY CROSS: A Christian woman kissed a wooden cross during the Exaltation of the Holy Cross ceremony at the Church of the Holy Sepulchre in Jerusalem Tuesday.	MASKED, BALL: Cadets from the Russian Cadet Boarding School 'Preobrazhensky Cadet Corps' attended ceremonies and performances marking the tenth anniversary of the boarding school's foundation in Moscow Friday.	DETAIL WORK: A watchmaker plied her trade at a state workshop in Havana, Cuba, Tuesday. In 2012, the communist country will open up more of its retail services to the private sector, in President Raul Castro's latest attempt to reinvigorate the economy.	PENSIONERS PROTEST: Pensioners protested against austerity measures outside the prime minister's residence in Lisbon Thursday. The sign attached to the umbrella roughly translates to 'government has lied to the retired.'	HAPPY WORKER: A worker dried persimmons in Hsinchu, Taiwan, Monday.
Photo sentiment score (classification)	0.00 (non-negative)	0.00 (non-negative)	0.00 (non-negative)	0.00 (non-negative)	0.00 (non-negative)

Table 9 – Influential data sensitivity of the *PhotoPes* lag 1 coefficient for "true model" and Type I error time series simulations

Description: This table reports the sensitivity to influential data of the equation 1 *PhotoPes* lag 1 coefficient for "true model" and Type I error time series simulations for comparison with that of the empirical time series. "True model" time series simulations are obtained using the equation 3 model with independent and identically distributed standardized residuals generated from (i) the standard normal distribution and (ii) the Student's T distribution with five degrees of freedom ("T5" distribution); then equation 1 regressions are used to identify "true model" time series simulations with the *PhotoPes* lag 1 coefficient in the range [–0.056, –0.048] with 5% statistical significance so as to be similar to the empirical coefficient value. Time series simulations with no true relationship between *PhotoPes* lag 1 and market return are created by combining randomly shuffled time orderings of the daily groupings of the equation 1 $\mathbf{L5}(PhotoPes_t)$, $\mathbf{L5}(TextPes_t)$ and $(PhotoPes * TextPes)_{t-1}$ sentiment variable values with the empirical (true) daily time ordering of all other variable values; then equation 1 regressions are used to identify Type I error time series simulations with the *PhotoPes* lag 1 coefficient in the range [–0.056, –0.048] with 5% statistical significance so as to be similar to the empirical coefficient value. For each similar "true model" and similar Type I error time series simulation: the single year of data with the most influence on the value of the equation 1 *PhotoPes* lag 1 coefficient is identified and removed and the reduced time series' *PhotoPes* lag 1 coefficient and T-statistic are recorded; and for each single year of data the 20 observations ranked as having the most individual influence on the equation 1 *PhotoPes* lag 1 coefficient are identified, then the particular 20 most influential observations from a single year with the greatest combined impact on the *PhotoPes* lag 1 coefficient are identified and removed and the reduced time series' *PhotoPes* lag 1 coefficient and T-statistic are recorded. Presented are the summary statistics for the equation 1 *PhotoPes* lag 1 coefficients and T-statistics before and after removal of each time series simulation's most influential year of data and most impactful set of the 20 most influential data observations from a single year, along with a percentile ranking comparison of the empirical *PhotoPes* lag 1 coefficient against the simulation coefficients. Panel A (B, C) presents the results for 202 (205, 200) similar "true model" time series simulations with standard normal residuals (similar "true model" time series simulations with standardized Student's T5 residuals, similar Type I error time series simulations). Newey and West (1987) T-statistics with five lags are reported in parentheses.

Interpretation: The sensitivity of the empirical *PhotoPes* lag 1 coefficient to the removal of influential data is similar to that which would be expected if the full time series significance is a Type I error (Panel C), and not similar to that which would be expected if the estimated empirical model is a "true model" (Panels A and B).

Panel A – Influential data sensitivity of the *PhotoPes* lag 1 coefficient for similar "true model" time series simulations with standard normal residuals

	Full time series	After removal of the most influential year of data	After removal of the most impactful set of the 20 most influential data observations from a single year
Empirical time series			
PhotoPes lag 1 coefficient and T-statistic	–0.052 (–2.37)	–0.034 (–1.45)	–0.034 (–1.63)
202 similar "true model" time series simulations with standard normal residuals			
Average *PhotoPes* lag 1 coefficient and average T-statistic	–0.053 (–2.10)	–0.040 (–1.51)	–0.043 (–1.74)
Median *PhotoPes* lag 1 coefficient and its T-statistic	–0.053 (–2.21)	–0.040 (–1.58)	–0.044 (–1.73)
Least negative *PhotoPes* lag 1 coefficient and its T-statistic	–0.048 (–2.00)	–0.024 (–0.91)	–0.034 (–1.43)
Most negative *PhotoPes* lag 1 coefficient and its T-statistic	–0.056 (–2.31)	–0.049 (–1.93)	–0.051 (–2.05)
Percentile ranking of the empirical coefficient against the (least negative to most negative) simulation coefficients	34.4%	10.8%	0.5%

Panel B – Influential data sensitivity of the *PhotoPes* lag 1 coefficient for similar "true model" time series simulations with standardized Student's T5 residuals

	Full time series	After removal of the most influential year of data	After removal of the most impactful set of the 20 most influential data observations from a single year
Empirical time series			
PhotoPes lag 1 coefficient and T-statistic	–0.052 (–2.37)	–0.034 (–1.45)	–0.034 (–1.63)
205 similar "true model" time series simulations with standardized Student's T5 residuals			
Average *PhotoPes* lag 1 coefficient and average T-statistic	–0.053 (–2.12)	–0.039 (–1.52)	–0.043 (–1.75)
Median *PhotoPes* lag 1 coefficient and its T-statistic	–0.053 (–2.05)	–0.040 (–1.69)	–0.043 (–1.95)
Least negative *PhotoPes* lag 1 coefficient and its T-statistic	–0.048 (–1.96)	–0.025 (–0.89)	–0.031 (–1.29)
Most negative *PhotoPes* lag 1 coefficient and its T-statistic	–0.056 (–2.24)	–0.048 (–1.95)	–0.052 (–2.09)
Percentile ranking of the empirical coefficient against the (least negative to most negative) simulation coefficients	35.7%	11.4%	1.0%

Panel C – Influential data sensitivity of the *PhotoPes* lag 1 coefficient for similar Type I error time series simulations

	Full time series	After removal of the most influential year of data	After removal of the most impactful set of the 20 most influential data observations from a single year
Empirical time series			
PhotoPes lag 1 coefficient and T-statistic	–0.052 (–2.37)	–0.034 (–1.45)	–0.034 (–1.63)
200 similar Type I error time series simulations			
Average *PhotoPes* lag 1 coefficient and average T-statistic	–0.052 (–2.11)	–0.034 (–1.46)	–0.036 (–1.58)
Median *PhotoPes* lag 1 coefficient and its T-statistic	–0.052 (–2.31)	–0.034 (–1.63)	–0.036 (–1.51)
Least negative *PhotoPes* lag 1 coefficient and its T-statistic	–0.048 (–1.97)	–0.018 (–0.88)	–0.016 (–0.74)
Most negative *PhotoPes* lag 1 coefficient and its T-statistic	–0.056 (–2.28)	–0.048 (–2.00)	–0.046 (–2.03)
Percentile ranking of the empirical coefficient against the (least negative to most negative) simulation coefficients	48.6%	47.6%	29.3%

Table 10 – The influence of pre and post 2011 data on O&P's photo pessimism effect

Description: This table reports the coefficients of the *PhotoPes* and *TextPes* lag 1 and lag 2, and *PhotoPes**TextPes* lag 1 regressors of the equation 1 regression with market return represented by the CRSP value-weighted market portfolio (VWRETD) or the S&P500 Index for four data subsamples of the 2008 to 2020 full sample: (i) 2008 to 2010 data; 2008 to 2011 data; 2011 to 2020 data; and 2012 to 2020 data. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.

Interpretation: Equation 1's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is not statistically significant when the regression is applied to pre 2011 or post 2011 data ranges (which exclude 2011 data) but is statistically significant when the regression is applied to pre 2012 or post 2010 data ranges (which include 2011 data).

	VWRETD				S&P500			
	2008 to 2010	2008 to 2011	2011 to 2020	2012 to 2020	2008 to 2010	2008 to 2011	2011 to 2020	2012 to 2020
PhotoPes lag 1	–0.048	–0.128**	–0.049**	–0.027	–0.059	–0.121**	–0.047**	–0.030
TextPes lag 1	–0.023	0.028	–0.041	–0.065**	–0.027	0.021	–0.047	–0.072**
PhotoPes lag 2	0.163**	0.092*	0.019	0.011	0.152**	0.086*	0.017	0.010
TextPes lag 2	–0.144	–0.112	–0.043	0.005	–0.136	–0.105	–0.040	0.005
*PhotoPes**TextPes* lag 1	0.046	0.085**	0.031	0.005	0.050	0.079**	0.023	–0.002
Unreported regressor coefficients	*PhotoPes* and *TextPes* lag 3, lag 4 and lag 5, five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy							
Daily obs.	591	843	2453	2201	591	843	2453	2201

Table 11 – O&P's photo pessimism effect using Getty Images

Description: This table reports the coefficients of the *PhotoPes* and *TextPes* lag 1 and lag 2, and *PhotoPes***TextPes* lag 1 regressors of the equation 1 regression with the photo pessimism index derived from Getty Images photos ($PhotoPes_{Getty}$) with market return represented by the CRSP value-weighted market portfolio (VWRETD) or the S&P500 Index for 2008 to 2018. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.
Interpretation: Equation 1's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is not statistically significant when O&P's photo pessimism measure is derived from Getty Images photos instead of WSJ photos.

	VWRETD	S&P500
$PhotoPes_{Getty}$ lag 1	–0.030	–0.031
TextPes lag 1	–0.041	–0.038
$PhotoPes_{Getty}$ lag 2	–0.028	–0.028
TextPes lag 2	0.038	0.038
$PhotoPes_{Getty}$*TextPes* lag 1	0.024	0.026
Unreported regressor coefficients	*PhotoPes* and *TextPes* lag 3, lag 4 and lag 5, five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy	
Daily obs.	2091	2091

Table 12 – O&P's photo pessimism effect across variables

Description: This table reports the results of regressions of market return represented by the CRSP value-weighted market portfolio (VWRETD) against various combinations of *PhotoPes*, *TextPes* and *PhotoPes***TextPes* lag 1 and lag 2 regressors, with different combinations of control variables chosen from five lags of market return and market return squared, day-of-week (except Monday) dummies, and a recession dummy. Note that, in comparison to the equation 1 regression, *PhotoPes***TextPes* lag 2 is additionally considered as a regressor, and *PhotoPes* and *TextPes* lag 3, lag 4 and lag 5 are excluded. The Panel A (B; C; D) regressions include all (five lags of market return and market return squared; five lags of market return; no) control variables. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.
Interpretation: The statistical significance of the *PhotoPes* lag 1 (lag 2) coefficient is (is not) dependent upon the selection of regressors and control variables.

Panel A – All control variables

PhotoPes lag 1	–0.032		–0.038*	–0.040*		–0.046**
PhotoPes lag 2		0.056**	0.061**		0.050**	0.056**
TextPes lag 1				–0.026		–0.013
TextPes lag 2					–0.031	–0.025
*PhotoPes***TextPes* lag 1				0.036*		0.035*
*PhotoPes***TextPes* lag 2					0.031	0.028
Unreported regressor coefficients	Five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy					

Panel B – Lagged market return and market return squared control variables

PhotoPes lag 1	–0.030		–0.037	–0.039*		–0.045**
PhotoPes lag 2		0.057**	0.061**		0.051**	0.057**
TextPes lag 1				–0.022		–0.009
TextPes lag 2					–0.032	–0.029
*PhotoPes***TextPes* lag 1				0.036**		0.036*
*PhotoPes***TextPes* lag 2					0.030	0.026
Unreported regressor coefficients	Five lags of market return and market return squared					

Panel C – Lagged market return control variables

PhotoPes lag 1	–0.030		–0.036	–0.039*		–0.045**
PhotoPes lag 2		0.053**	0.057**		0.048**	0.054**
TextPes lag 1				–0.031		–0.017
TextPes lag 2					–0.036	–0.029
*PhotoPes***TextPes* lag 1				0.040**		0.041**
*PhotoPes***TextPes* lag 2					0.026	0.022
Unreported regressor coefficients	Five lags of market return					

Panel D – No control variables

PhotoPes lag 1	–0.032		–0.038	–0.042*		–0.049**
PhotoPes lag 2		0.056**	0.060**		0.052**	0.059**
TextPes lag 1				–0.024		–0.010
TextPes lag 2					–0.031	–0.028
*PhotoPes***TextPes* lag 1				0.041**		0.041**
*PhotoPes***TextPes* lag 2					0.019	0.016

Table 13 – The influence of year-by-year data exclusions on O&P's salient photo pessimism effect

Description: This table reports the coefficients of the *PhotoPes* and *TextPes* lag 1 and lag 2, and *PhotoPes***TextPes* lag 1 regressors of the equation 2 regression when news photos are salient (i.e. for the dummy variable condition $E_t = 1$ indicating that *PhotoPes* lag 1 is in the top or bottom decile of its full sample range) with market return represented by the CRSP value-weighted market portfolio (VWRETD) for the following circumstances: (i) as determined by O&P and reported in their Table 5; (ii) our full sample replication of O&P; (iii) with year-by-year (2008 to 2020) data exclusions from the sample; and (iv) with 2011 data excluded plus re-specification of salient news photo days as those for which *PhotoPes* is in the top or bottom decile of the sample range with 2011 excluded. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.

Interpretation: Under condition of salient news photos, equation 2's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is not statistically significant when year 2011 data is excluded from the regression but remains statistically significant when any other year's data is excluded.

	For salient news photo days when *PhotoPes* is in the top or bottom decile of its full sample range regardless of data exclusions															2011 excl. + re-spec. of salience
	O&P	Replication of O&P	2008 excluded	2009 excluded	2010 excluded	2011 excluded	2012 excluded	2013 excluded	2014 excluded	2015 excluded	2016 excluded	2017 excluded	2018 excluded	2019 excluded	2020 excluded	
PhotoPes lag 1	–0.070**	–0.062**	–0.052**	–0.062**	–0.065**	–0.045	–0.067**	–0.064**	–0.075***	–0.053*	–0.059**	–0.068**	–0.069**	–0.060**	–0.063**	–0.040
TextPes lag 1	0.047	0.048	0.090*	0.000	0.062	0.004	0.046	0.040	0.059	0.061	0.054	0.046	0.049	0.051	0.062	–0.027
PhotoPes lag 2	0.100***	0.092***	0.058**	0.093***	0.093***	0.107***	0.094***	0.098***	0.102***	0.090***	0.093***	0.095***	0.091***	0.096***	0.072**	0.094***
TextPes lag 2	0.044	–0.013	–0.032	–0.016	–0.004	0.023	–0.009	0.005	–0.011	–0.010	–0.017	–0.020	–0.025	–0.011	–0.047	–0.009
PhotoPes **TextPes* lag 1	0.034	0.017	0.020	0.017	0.009	0.001	0.020	0.020	0.025	0.009	0.015	0.021	0.020	0.016	0.026	–0.002
Unreported regressor coefficients	*PhotoPes* and *TextPes* lag 3, lag 4 and lag 5, five lags of market return and market return squared, day-of-week (except Monday) dummies, recession dummy															
Daily obs.	3044	3044	2957	2792	2792	2792	2794	2792	2792	2792	2792	2793	2793	2792	2855	2792

Table 14 – O&P's photo pessimism effect for high and low IVOL portfolios

Description: This table reports the coefficients of the *PhotoPes* lag 1 and lag 2 regressors for equation 1, and for equation 2 for the *PhotoPes* salience condition $E_t = 1$, with the daily market return dependent variable replaced by either the return or abnormal return (with respect to the Fama-French-Carhart four factor asset pricing model) of a value-weighted portfolio of high-idiosyncratic return volatility (IVOL) stocks, a value-weighted portfolio of low-IVOL stocks, and the corresponding high-IVOL minus low-IVOL long-short portfolio, for the full sample period and with year 2011 data excluded from the sample. For Panel A (Panel B), high-IVOL and low-IVOL stocks are identified each month from the cross-section of CRSP stocks as those in the highest and lowest IVOL quintiles, respectively, where IVOL is calculated as the standard deviation of the prior one month (three months) of daily return residuals with respect to the Fama-French-Carhart four factor asset pricing model. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.

Interpretation: Under condition of salient news photos, equation 2's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is statistically significant when year 2011 data is excluded but only if the regression is applied to a portfolio of high-IVOL stocks identified from three-month daily IVOL (Panel B).

Panel A – High-IVOL and low-IVOL stocks identified from one-month daily IVOL

	IVOL portfolio	Equation 1		Equation 2 with salient *PhotoPes* condition	
		PhotoPes lag 1	*PhotoPes* lag 2	*PhotoPes* lag 1	*PhotoPes* lag 2
Full sample	Low	–0.040**	0.044**	–0.047**	0.071***
	High	–0.082**	0.085**	–0.099**	0.129***
	High-low	–0.045**	0.040*	–0.056**	0.052**
2011 data excluded	Low	–0.025	0.047*	–0.033	0.082***
	High	–0.053	0.097**	–0.070	0.157***
	High-low	–0.033	0.050*	–0.044	0.067**
Full sample, abnormal returns	Low	0.000	0.003	–0.003	–0.001
	High	0.014	0.000	0.018	–0.012
	High-low	0.013	–0.001	0.022	–0.013

Panel B – High-IVOL and low-IVOL stocks identified from three-month daily IVOL

	IVOL portfolio	Equation 1		Equation 2 with salient *PhotoPes* condition	
		PhotoPes lag 1	*PhotoPes* lag 2	*PhotoPes* lag 1	*PhotoPes* lag 2
Full sample	Low	–0.036**	0.041**	–0.043**	0.067***
	High	–0.086**	0.099**	–0.116***	0.145***
	High-low	–0.053**	0.053**	–0.078***	0.073**
2011 data excluded	Low	–0.023	0.045**	–0.032	0.079***
	High	–0.061	0.113**	–0.098**	0.176***
	High-low	–0.043	0.064**	–0.071**	0.091**
Full sample, abnormal returns	Low	0.002	0.004	–0.002	–0.002
	High	0.011	0.006	0.004	–0.005
	High-low	0.010	0.004	0.006	–0.002

Table 15 – O&P's photo pessimism effect for large and small MCAP portfolios

Description: This table reports the coefficients of the *PhotoPes* lag 1 and lag 2 regressors for equation 1, and for equation 2 for the *PhotoPes* salience condition $E_t = 1$, with the daily market return dependent variable replaced by either the return or abnormal return (with respect to the Fama-French-Carhart four factor asset pricing model) of a value-weighted portfolio of large-market capitalization (MCAP) stocks, a value-weighted portfolio of small-MCAP stocks, and the corresponding small-MCAP minus large-MCAP long-short portfolio, for the full sample period and with year 2011 data excluded from the sample. For Panel A (Panel B), large-MCAP and small-MCAP portfolio returns correspond, respectively, to the top and bottom MCAP quintile portfolio returns based on annual (monthly) sorting of the cross-section of NYSE, AMEX and NASDAQ stocks into portfolios based on the MCAP quintile breakpoints of only NYSE (all NYSE, AMEX and NASDAQ) stocks. *PhotoPes* is the proportion of sample WSJ news photos classified as negative sentiment each day, and *TextPes* is the average pessimism score for sample WSJ news articles each day. 10%, 5% and 1% significance levels based on Newey and West (1987) T-statistics with five lags are indicated by *, ** and *** respectively.
Interpretation: Equation 1's *PhotoPes* lag 1 coefficient, which is the critical indicator of O&P's photo pessimism effect, is statistically significant when year 2011 data is excluded but the regression is applied to a portfolio of small-MCAP stocks identified from the MCAP quintile breakpoints of NYSE stocks (Panel A).

Panel A – Large-MCAP and small-MCAP NYSE, AMEX and NASDAQ stocks identified from annual MCAP quintile breakpoints of only NYSE stocks

	IVOL portfolio	Equation 1		Equation 2 with salient *PhotoPes* condition	
		PhotoPes lag 1	*PhotoPes* lag 2	*PhotoPes* lag 1	*PhotoPes* lag 2
Full sample	Low	–0.049**	0.050*	–0.056**	0.085***
	High	–0.086***	0.062*	–0.106***	0.099**
	High-low	–0.040**	0.012	–0.057***	0.015
2011 data excluded	Low	–0.033	0.055*	–0.041	0.099***
	High	–0.061**	0.072**	–0.086**	0.119***
	High-low	–0.035*	0.016	–0.057**	0.020
Full sample, abnormal returns	Low	0.002	–0.000	0.003	–0.000
	High	–0.024*	0.006	–0.037**	0.009
	High-low	–0.025*	0.006	–0.040**	0.009

Panel B – Large-MCAP and small-MCAP NYSE, AMEX and NASDAQ stocks identified from monthly MCAP quintile breakpoints of all NYSE, AMEX and NASDAQ stocks

	IVOL portfolio	Equation 1		Equation 2 with salient *PhotoPes* condition	
		PhotoPes lag 1	*PhotoPes* lag 2	*PhotoPes* lag 1	*PhotoPes* lag 2
Full sample	Low	–0.052**	0.052*	–0.059**	0.088***
	High	–0.018	0.032*	–0.033*	0.061***
	High-low	0.030*	–0.011	0.014	–0.024
2011 data excluded	Low	–0.034	0.058*	–0.043	0.104***
	High	–0.008	0.042*	–0.028	0.083***
	High-low	0.023	–0.003	0.003	–0.013
Full sample, abnormal returns	Low	–0.000	0.001	–0.001	0.001
	High	0.023*	–0.003	0.018	0.008
	High-low	0.023*	–0.003	0.019	0.007