2σ **TWO SIGMA**

Street View

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EXECUTIVE SUMMARY

Corporate stock buybacks in the US have grown in frequency and size over the past decades, and many market commentators have suggested that the rise in stock buybacks has artificially propped up equity prices, suppressed market volatility, and weakened corporate balance sheets. We test these views by examining US stock buyback announcements data, and find little evidence to support these claims. There is some evidence that share buybacks are announced following a short-term period of stock price declines, which could either represent opportunistic purchasing at an attractive price or an attempt by management to stem the decline. However, on the whole, companies that announce share buybacks appear to have stronger-than-average fundamentals and long-term stock performance exceeding the market, with excess profits and cash flows that could reasonably be returned to shareholders.

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Inside:
Share Buybacks: A Brief Investigation

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SHARE BUYBACKS:
A BRIEF INVESTIGATION

1. INTRODUCTION

Corporate stock buybacks in the US have grown in frequency and size over the past decades (see Figure 1 on the next page), leading to a host of concerns from market commentators. Among the most frequent concerns are that share purchases may be artificially propping up equity prices, suppressing market volatility, and weakening corporate balance sheets to name a few. In this *Street View*, we test these views by examining nearly 25 years of US stock buyback announcements, and find little evidence to support the aforementioned concerns.

This *Street View* is structured as follows:

- Section 2 describes the buyback announcements data that underlies our study.

- Section 3 studies whether poor historical performance of a stock predicts a future buyback announcement. We find that an announcement is more likely if a firm has been performing well over the past one to three years but has suffered a short-term decline. Furthermore, we find that

short-term price volatility has little impact on the likelihood of a buyback announcement since the Global Financial Crisis.

- Section 4 examines the average price action leading up to, and following, buyback announcements, and suggests that while a stock generally sells off before a buyback, it doesn't necessarily recover and start to rally after a buyback is announced, thus, suggesting that buybacks are not propping up prices in the long term. Additionally, our examination of post-announcement share volatility fails to suggest that buybacks suppress market volatility.

- Section 5 looks at the characteristics of the firms that announced a stock buyback and suggests that such companies tend to have stronger fundamentals and lower levels of market-implied risk (as measured by both market beta and idiosyncratic volatility) on average.[1] This suggests that buybacks are not used by weak businesses to prop up their stock price.
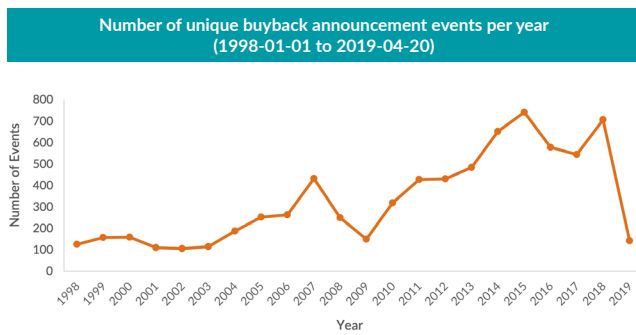
2. ABOUT THE DATA

We performed our study on Russell 3000 Index constituents[2] over a period spanning from Jan 1st, 1998 to Apr 30th, 2019. We used Bloomberg to obtain the list of share buyback announcement dates for these stocks over the period of study. There were a total of 9,698 buyback announcements,[3] though accounting for multiple announcements from the same company in the same month resulted in 7,327 unique buyback events.

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1 We would like to emphasize that our study does not directly examine the impact of share buybacks on the long-term economic fundamentals of a company, though we do find that companies announcing buybacks tend to be in significantly stronger financial shape than average. This study also does not opine on the socio-economic impact of share buybacks, though this has become a hot political topic in recent months.
2 We use a "Point-in-time" list of index underlyings. This means that on a past date, say, 2011-05-10, we consider in our analysis the stocks that were a member of the Russell 3000 Index on that date.
3 We focused on announcement dates instead of actual buyback execution date as one could argue that if the management of a company uses buybacks to signal confidence in the health of the company, then the mere announcement should be able to lift the stock price. Furthermore, there is precedent for studying anomalous stock returns around just the buyback announcement dates, such as https://www.lsvasset.com/pdf/research-papers/ShareRepurchases.pdf

Number of unique buyback announcement events per year (1998-01-01 to 2019-04-20)

Figure 1: *Number of unique stock buyback events per year. The last drop in the chart corresponds to the number of buyback events over the period, 2019-01-01 to 2019-04-30, which is only a third of a year.*
Source: Bloomberg

We base all the results presented in sections 3 and 4 on idiosyncratic returns to the Russell 3000 constituents relative to a CAPM-style risk model (i.e., after adjusting for the estimated market beta of each stock). [4]

3. DO BUYBACKS FOLLOW SELLOFFS?

We start by investigating the claim that companies tend to announce buybacks when their stock prices are declining or amid rising volatility, potentially as an attempt by management to support prices and/or reduce stock volatility. To test how past stock performance may affect the probability of a buyback announcement in the subsequent month, we use a logistic regression model[5] to estimate the probability of a firm announcing a share buyback in the next month conditional on two measures of trailing performance:[6]

- **Historical Sharpe ratio:** annualized Sharpe ratio of a stock's idiosyncratic monthly returns over the preceding *h* months, to see if positive or negative returns over different lookback periods are predictive of buyback announcements.

- **Ratio of short-term to long-term volatility:** ratio of a stock's realized daily idiosyncratic volatility over the previous month divided by its realized daily idiosyncratic volatility over the previous *h* months, to see if short-term increases or declines in stock-specific volatility are predictive.

We split our analysis into two discrete periods: before and after the Global Financial Crisis,[7] as we found notable differences in their results. To account for time-varying dispersion in the returns and volatilities of individual stocks, we also transform the historical Sharpe ratios and volatility ratios for all 3,000 stocks within each calendar month into cross-sectional z-scores before fitting the logistic regressions over all stock-month observations in each period.

The table below shows the z-scores quantifying the statistical significance of the dependence of the likelihood of a stock buyback announcement on the two measures of past performance we described above. A score with an absolute value greater than 2.0 roughly denotes a statistically significant relationship. A positive (negative) value of the score implies that the higher the value of the predictor, the higher (lower) the likelihood of a buyback announcement in the next month.

h (months)	Pre-GFC		Post-GFC	
	Historical Sharpe Ratio	*Ratio of short term to long term volatility*	*Historical Sharpe Ratio*	*Ratio of short term to long term volatility*
6	-5.47	3.25	-6.01	-0.38
12	0.47	3.57	1.99	-0.13
24	4.02	2.68	8.32	-1.52
36	4.33	1.47	11.42	-2.94

Table 1: *Z-scores of the multivariate logistic regression coefficients when the response indicates whether there was a buyback announcement in the subsequent month (1 if yes, 0 if no), and the predictors are: (a) historical Sharpe ratio computed over the preceding h months, and (b) the ratio of the short-term idiosyncratic volatility (over the past month) and the long-term idiosyncratic volatility (over the past h months).*

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4 Although not presented in this *Street View* for the sake of brevity, we found similar results both in size and statistical significance of effects when we repeated the analyses using raw returns; returns adjusted for both market and industry-specific factors; and returns adjusted for market, industry, and style factors.

5 Mathematically, logistic regression fits a linear function of potential predictors for an event (similar to linear regression) to a logarithmic transformation of the odds of the event occurring in the dataset's observations.

6 See Appendix 1 for the exact specification of the logistic regression model we use in our study.

7 "Pre-GFC" period results throughout this Street View cover 2,154 unique buyback announcement events from January 1995 to December 2008, inclusive, while the "post-GFC" period covers the 5,164 unique buyback announcement events from January 2009 to April 2019.

A handful of key results from Table 1 deserve highlighting:

- The z-scores for historical Sharpe ratio in both analyzed periods are strongly negative over a six-month lookback horizon and strongly positive over longer lookback horizons, implying that companies announcing buybacks tend to have strong long-term performance relative to the market but tend to announce after a recent sell-off.

- Recent increases in volatility appear much less predictive of a stock buyback announcement than the returns relative to the market, and the predictive direction for the post-GFC period is even in the opposite direction from what we would expect (stocks with declining short-term volatility are somewhat more likely to announce a buyback after controlling for historical Sharpe ratio).

- The tendency for strong 2- and 3-year returns versus the market to positively predict a share buyback announcement grew significantly stronger in the post-GFC period, even after accounting for the larger number of observations in this period.

We can check the robustness of these regression results by also looking at the empirical frequency of buyback announcements for stock-month observations with historical Sharpe ratio or volatility ratio z-scores falling into particular narrow ranges, and plotting those empirical frequencies against the estimated probability from our logistic regression. Figure 2 shows these plots for the post-GFC period with a 36-month lookback window for both stock performance metrics. Again, there are a handful of results to highlight:

- Buybacks are a relatively infrequent occurrence in the dataset, with the average stock having a 1.9% chance of announcing a buyback in any given month.

- The empirical fit of the logistic regressions looks quite good overall, except for the more extreme performance z-scores, where there are considerably fewer observations.

- Firms with extremely low long-term returns relative to the market appear even less likely to announce a share buyback than the fitted logistic curve would suggest.

- Firms with sharply increasing idiosyncratic volatility appear even less likely to announce a share buyback than the fitted logistic curve would suggest.
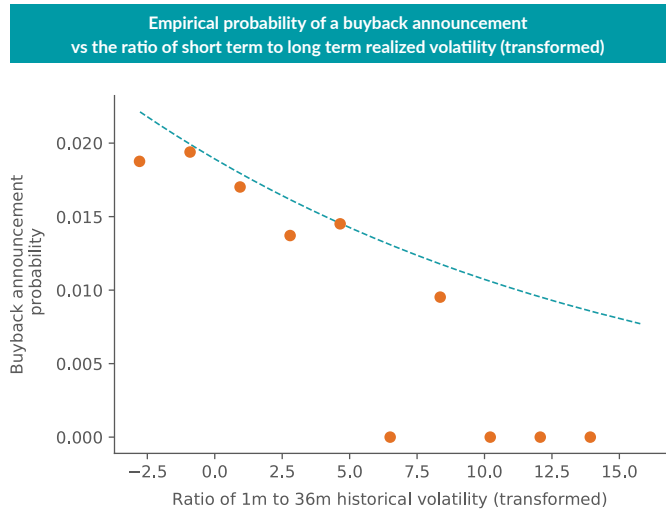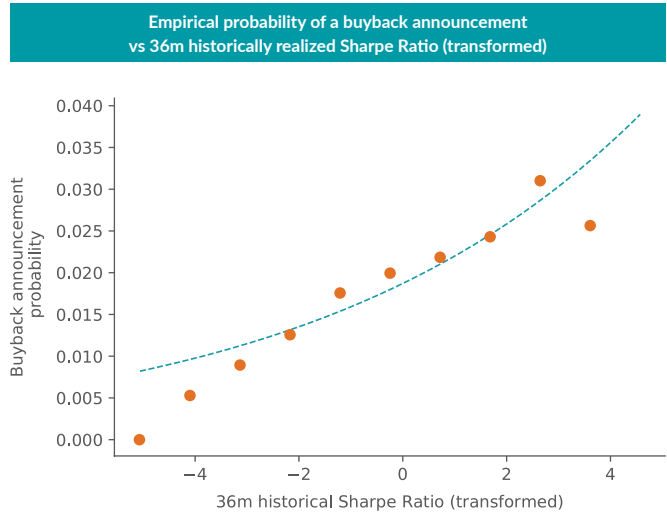

Figure 2: *The orange dots in the top plot show the empirical probability of a buyback announcement given the realized Sharpe Ratio over the past 36 months. The green curve shows the fitted univariate logistic regression function. The bottom plot shows the same but as a function of the ratio of a stock's market adjusted return's volatility realized over last 1 month and 36 months. All estimates are over the post-GFC period.*

More broadly, these results suggest that buybacks tend to come from firms with strong long-term performance whose share prices had recently hit a rough patch, but without much rise in volatility. This provides some support for the hypothesis that management tends to opportunistically announce buybacks when shares appear undervalued, or as a short-term price support.[8]

The post-GFC data especially does not support the hypothesis that share buybacks have been suppressing broader market volatility, as buybacks tend to be announced more often by firms with level or declining volatility compared to history. However, this finding does not rule out the counterfactual possibility that firms announcing buybacks avoided a rise in share price volatility that would have otherwise occurred. To investigate the potential impact of share buybacks on the broader market's returns and volatility, we now turn to analyzing the average impact on share prices before and after the announcement.

4. EXPECTED PRICE ACTION AROUND BUYBACK ANNOUNCEMENTS

By performing an event time study, we estimated the cumulative average abnormal returns (CAAR) in excess of the market earned by Russell 3000 Index constituents that announce a share buyback over the period immediately preceding and following the announcement month. Our results, in Figure 3, suggest that while a typical buyback announcer is selling off in the six months leading up to the buyback announcement (as shown in the previous section), the post-announcement recovery is relatively weak.

Cumulative average abnormal market adjusted return around a share buyback PreGFC and PostGFC
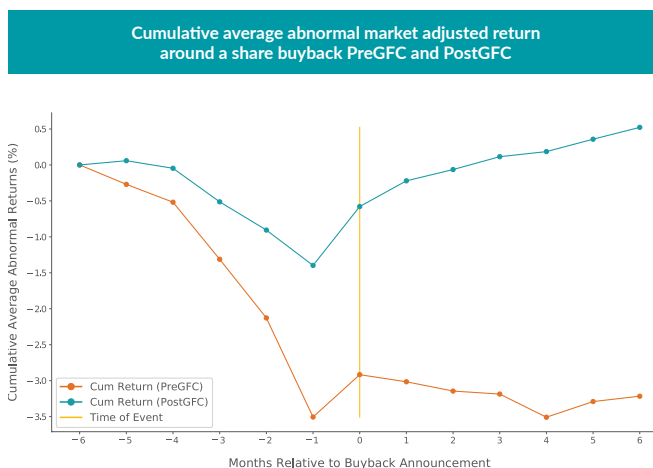
Figure 3: *The plot of cumulative average abnormal market-adjusted return earned by a typical Russell 3000 Index constituent, starting from six months prior to the buyback announcement date, over the six months leading up to, and following, a stock buyback announcement. The orange vertical line shows the month of buyback announcement (marked as 0 on the horizontal axis) and demarcates the pre- and post- buyback announcement stock performance.*

Leading up to the buyback announcement, the average announcer's share price has been selling off, with noticeably larger negative CAAR for the pre-GFC period than post-GFC. This squares with the logistic regression results in Table 1: both periods show that buybacks tend to be more likely following a six-month period with a negative idiosyncratic returns Sharpe ratio, but the pre-GFC period also shows buybacks tend to follow rising idiosyncratic volatility, while there is no such effect in the post-GFC period. As the historical Sharpe ratio measure used in this study divides the average idiosyncratic returns by the idiosyncratic volatility, the larger denominator (from rising volatility) in the pre-GFC period suggests we should also see more strongly negative returns in the numerator.

The announcement month itself shows a positive market response, with roughly 0.5-0.75% average excess returns in both the pre- and post-GFC datasets.[9] Here, the results from the two periods diverge again, as buyback announcers do not recover any further on average over the pre-GFC period, while the post-GFC period shows an average recovery roughly to the pre-selloff level. Although the total trough-to-peak recovery for buyback announcers in the post-GFC period appears strongly statistically significant,[10] the total CAAR from the beginning of the sell-off to six months after the announcement is less than 0.5%

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8   We do not believe these two explanations to be mutually exclusive.
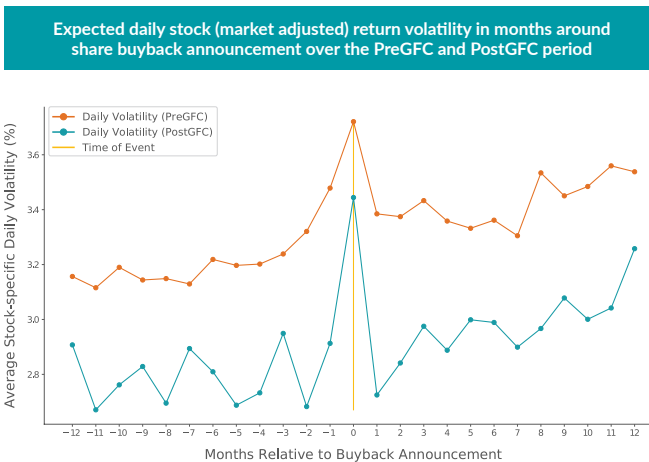9   This announcement-month effect is strongly statistically significant in the post-GFC period and just on the verge of statistical significance for the pre-GFC period due to the smaller sample size (t-statistics of 5.60 and 2.05, respectively, using robust standard errors with Driscoll-Kraay adjustments for time-series and cross-sectional correlations).
10   The CAAR from month -1 to month 6 in the Post-GFC period has a t-statistic of 4.67.

and not statistically significant.[11] While the buyback announcement does appear to provide share price support in the more recent dataset, the recovery to pre-selloff levels suggests that buybacks on average do not appear to lead to "artificially" elevated valuations.[12]

Figure 3 implies a stark difference in the recovery of a stock's price after a share buyback announcement across the pre and post GFC periods. This could point to the possibility of markets becoming more efficient in pricing a buyback announcement over recent years that now leads to quicker price recovery than what is observed pre GFC. Many other possibilities exist, such as a significant change in financial regulation post GFC, changes in market structure due to an increased flow of capital into quantitative trading strategies, and etc. This difference is an interesting question in itself and we defer its investigation to a future *Street View*.

We now turn to the effects on share price volatility, with Figure 4 presenting the average daily idiosyncratic volatility of a buyback announcer over the twelve months preceding and following the announcement month. As suggested by the regression results in Section 3, the pre-GFC period shows a rise in short-term volatility in the months leading up to the buyback announcement, while this effect is much less clear in the post-GFC data. Volatility spikes in the announcement month for both periods as the market digests the news, with a positive average outcome as seen in Figure 3.

Expected daily stock (market adjusted) return volatility in months around share buyback announcement over the PreGFC and PostGFC period

Figure 4: The plot of the average daily volatility of the market adjusted return of a typical Russell 3000 Index constituent, over the 12-month before and after the stock buyback announcement.

However, share price volatility is not suppressed after a buyback is announced. In fact, the average level of idiosyncratic volatility post-announcement is slightly higher than the preannouncement volatility in both the pre- and post-GFC periods.[13] We note that this effect is actually in the direction that a simple corporate finance model would suggest, as a share buyback should increase the leverage of a company's equity while leaving the underlying business risk unchanged, thus boosting the expected equity volatility.

5. CHARACTERISTICS OF STOCKS THAT ANNOUNCE BUYBACKS.

Finally, we want to take a deeper look at the fundamental characteristics of companies that announce share buybacks versus the broader market, to see if the data supports beliefs that companies are significantly weakening their balance sheets or foregoing worthwhile investment to return capital. To test for significant differences between firms announcing a buyback and the average Russell 3000 firm, we used the style factor definitions from MSCI Barra's most recent US risk model: the US Total Market Equity Trading Model. These style factor exposures

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11   The CAAR from month -6 to month 6 in the Post-GFC period has a t-statistic of 0.85.
12   Extending the CAAR analysis up to 12 months after the share buyback announcement shows little further cumulative excess returns even in the Post-GFC period.
13   We find that for the post GFC period, the average volatility of the 12 months after the buyback announcement is higher than the average volatility of the preceding 12 months by ~15bp with a t-statistic of 1.45. The same number is 20bp for pre GFC period with a t-statistic of 1.65.

per stock provide point-in-time scores for how each individual stock compares to the rest of the US market on a large number of dimensions, including technical factors such as momentum, beta, and residual volatility; fundamental factors such as firm profitability, earnings quality (mostly driven by cash earnings being in line with accounting earnings), and leverage; and measures combining market prices and fundamentals such as valuation metrics and market capitalization.

We investigated which characteristics most strongly differentiated buyback announcers from the rest of the market by comparing the distribution of scores (or loadings) on each style factor for stocks on the day before their buyback announcements to the loadings of all the stocks in our study. We performed a difference-of-means test between the two distributions to determine which style factor loadings showed statistically significant differences from the market as a whole, and the results of this analysis for the factors with the most significant differences between the buyback announcers and the broad market are presented in Figure 5 below.

Style Factor Exposures for Firms Announcing Buybacks versus Russell 3000 Average
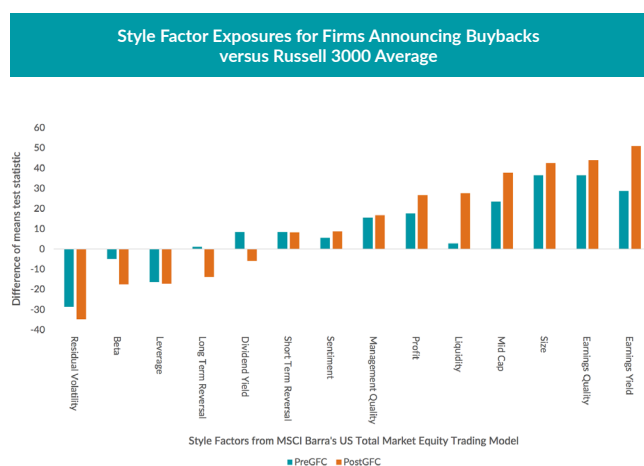
Figure 5: *The plot below shows the value of the "difference of means" test statistic for all the USFASTD Style factors. A positive (negative) value for a factor means that the average loading of all stocks to that factor, a day before they announced a stock buyback, is higher (lower) than the average loadings of all stocks to that factor (irrespective of whether there was a buyback announcement in them or not).*

Stocks announcing a share buyback tend to have

significantly stronger fundamentals than average, with higher scores on Earnings Yield (i.e., lower price-to-earnings ratio), Earnings Quality (i.e., more cash earnings), and Profitability (i.e., higher return on equity and return on assets). These firms also tend to be larger (positive Size and Mid-Cap loadings), with lower Leverage and lower market-implied risk (both lower Beta and lower Residual Volatility).

These results suggest that corporations buying back stock are exactly those with the greatest ability to return cash to shareholders while still supporting future growth, and provide little evidence that the firms are endangering themselves through excess leverage to fund the capital returns.

6. CONCLUSION

Contrary to the worst claims about share buybacks, we find little evidence from our large-scale study of individual buyback announcements that they are artificially suppressing market volatility or requiring companies to forgo otherwise profitable investments or take on excess leverage. There is some evidence that share buybacks are announced following a short-term period of stock price declines, which could either represent opportunistic purchasing at an attractive price or an attempt by management to stem the decline.[14] However, on the whole, companies that announce share buybacks appear to have stronger-than-average fundamentals and long-term stock performance exceeding the market, with excess profits and cash flows that could reasonably be returned to shareholders.

Our study points towards a noticeable difference in the extent of post buyback announcement price recovery across the pre and post GFC periods. One could think of a few *a priori* explanations for this difference (that we mention in Section 4); we pose this as an open question to the wider Financial Economics research community and plan to revisit this topic in a future *Street View*.

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14   We believe the sustained post-announcement drift back toward valuations prior to the short-term decline in the post-GFC period may support the former explanation, as any buyback program would only provide temporary support to the share price without broader agreement from other investors in the market.

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APPENDIX 1: LOGISTIC REGRESSION SET-UP

To study the claim that buyback announcements usually arrive after a stock has sold off, we investigated whether two intuitive measures of historical performance of a stock had any statistically significant predictive power in portending a buyback announcement. We performed this analysis at a monthly frequency.

Specifically, we set up the following multivariate logistic regression:

$$P(Y_{i,t+1} = 1|\, t) = \frac{1}{1 + e^{-\beta_0 - \beta_1 z[SR(h)_{i,t}] - \beta_2 z[VR(h)_{i,t}]}}$$

where:
- $Y_{i,t+1}$ is an indicator random variable which is equal to 1 if the stock i has seen at least one buyback announcement in the month $t+1$. Otherwise, it takes a value of 0.
- $P(Y_{i,t+1} = 1|\, t)$ is the probability of stock i undergoing a buyback in the month $t+1$ given the market performance of the stock till month t.
- $SR(h)_{i,t}$ is the annualized Sharpe ratio[15] at which stock i's monthly returns, in excess of the market factor, have been performing over the months between t-h to t (both ends inclusive).
- $VR(h)_{i,t}$ is the ratio of stock i's volatility realized by its daily returns (adjusted for the market factor) over the month t to its volatility realized by its daily returns (adjusted for the market factor) over the months t-h to t (both ends inclusive).

We cross-sectionally z-score $SR(h)_{i,t}$ and $VR(h)_{i,t}$ for all the stocks every cycle, t, and use the transformed Sharpe ratios and Volatility ratios as predictors in the regression above which we denote by $z[SR(h)_{i,t}]$ and $z[VR(h)_{i,t}]$ respectively.

A note on the coefficients β_0, β_1 and β_2 of the above model:
- β_0, or the intercept, governs the level of unconditional probability of observing a buyback for a stock in the absence of any stock level information.
- β_1 denotes the dependence of the probability of a buyback announcement for a stock on the historically realized Sharpe of its market adjusted returns. A negative and statistically significant value of β_1 would suggest that past stock level selloffs do increase the likelihood of a future buyback announcement for that stock.
- β_2 denotes the dependence of the probability of a buyback announcement for a stock on recent rise in its volatility in comparison to its long term level (which is what, in essence, is quantified by the stock-wise variable VR). A positive and statistically significant value of β_2 would suggest that recent rises in volatility do increase the likelihood of a future buyback announcement for that stock.

We estimated the above regression model over two time periods: (i) Pre-Global Financial Crises (PreGFC) defined as the period spanning 1995-01-01 to 2008-12-31, and (ii) Post-Global Financial Crises (PostGFC), defined as the period spanning 2009-01-01 to 2019-04-30.

Table 1 presents the z-scores of the coefficients β_1 and β_2 for the two periods for some reasonable choices of the historical look-back window of h months.

Appendix 2: Event study set-up

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15 Annualized Sharpe Ratio over a period is defined as sqrt(252) times the ratio of the mean daily return over the period and standard deviation of the daily returns over the same period.

APPENDIX 2: EVENT STUDY SET-UP

We performed the following regression to study the average abnormal market adjusted return realized by a stock around a buyback announcement -

$$r_{i,t} = \alpha + \beta_{-12}1_{\{E(t+12)=1\}} + \beta_{-11}1_{\{E(t+11)=1\}}+\ldots+ \beta_0 1_{\{E(t)=1\}}+\ldots+\beta_{11}1_{\{E(t-11)=1\}} + \beta_{12}1_{\{E(t-12)=1\}} + \epsilon_{i,t}$$

where:
- $r_{i,t}$ is the market adjusted return of stock i in month t.
- α denotes the mean market adjusted return earned by a stock in our sample.
- $1_{\{E(t+k)=1\}}$ is the indicator random variable that is one when a stock buyback has occurred in the month $t+k$ ($-12 \leq k \leq 12$).
- β_k is the average abnormal market adjusted return in the kth month after (before) a buyback is announced when k > 0 (< 0).

We do a weighted regression with weights as 1 / monthly sd of the stock and apply adjustments to the covariance matrix of residuals to correct for heteroskedasticity, and serial and cross-sectional correlations.

The cumulative average abnormal return, CAAR, over the period of 6 months before and after the buyback announcement is defined as:

For $t \in [-6, 6]$, CAAR(t) = $\sum_{i=-6}^{i=t} \beta_i$.

A similar regression is performed to measure the changes in daily realized volatility around the month of buyback announcement. We describe it below -

$$\sigma_{i,t} = \lambda + \gamma_{-12}1_{\{E(t+12)=1\}} + \gamma_{-11}1_{\{E(t+11)=1\}}+\ldots+ \gamma_0 1_{\{E(t)=1\}}+\ldots+\gamma_{11}1_{\{E(t-11)=1\}} + \gamma_{12}1_{\{E(t-12)=1\}} + \epsilon_{i,t}$$

where:
- $\sigma_{i,t}$ is the volatility of market adjusted return of stock i in month t.
- λ denotes the mean market adjusted return volatility of a stock in our sample.
- $1_{\{E(t+k)=1\}}$ is the indicator random variable that is one when a stock buyback has occurred in the month $t+k$ ($-12 \leq k \leq 12$).
- γ_k is the average abnormal market adjusted volatility in the kth month after (before) a buyback is announced when k > 0 (< 0).

We do not perform a weighted regression in this case, but still apply adjustments to the covariance matrix of residuals to correct for heteroskedasticity, and serial and cross-sectional correlations.

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