Volatility and the Buyback Anomaly

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Abstract

We find that, inconsistent with the low volatility anomaly, post-buyback announcement long-term abnormal returns are higher when the pre-announcement (idiosyncratic) volatility is high. This is consistent with Stambaugh, Yu, and Yuan (2015) who find a positive relation between returns and idiosyncratic volatility for undervalued stocks, and with the prediction that a repurchase authorization is an option for undervalued stocks (Ikenberry and Vermaelen, 1996). The buyback anomaly also survives when using the five-factor model of Fama and French (2015a). Combining volatility with undervaluation indicators proposed by Peyer and Vermaelen (2009) improves the predictive power of excess returns after buyback announcements.

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I. Introduction

The main purpose of this paper is to test whether there is a link between two well-known anomalies: the net issue anomaly, i.e. the fact that share buybacks (equity issues) are followed by long run positive (negative) excess returns[1], and the volatility anomaly, i.e. the fact that (idiosyncratic) volatility is negatively related to expected returns (Ang, Hodrick, Xing, and Zhang, 2006). This link is plausible considering the fact that Stambaugh et al. (2015) find that the relation between idiosyncratic volatility and future returns reverses and becomes *positive* for undervalued stocks.[2] They argue that their result is consistent with the costly *arbitrage hypothesis*: idiosyncratic volatility represents risk that deters arbitrage and the resulting reduction in mispricing, hence among underpriced stocks, the stocks with the highest idiosyncratic volatility should be the most underpriced. As the positive (negative) long run returns after buybacks (equity issues) are generally interpreted as evidence of undervaluation (overvaluation), we would predict also a positive (negative) relation between volatility and future returns after firms announce a buyback (equity issue).

A positive relation between volatility and future returns after buyback authorization announcements is also expected based on the *option hypothesis* of Ikenberry and Vermaelen (1996): a repurchase authorization is an option to take advantage of undervaluation and this option should be more valuable for high volatility stocks. If markets underestimate the value of this option at the time of the buyback authorization, long term excess returns should be positively correlated with volatility. Note that this option hypothesis makes no

[1]For evidence on long-term excess returns after buybacks see e.g., Ikenberry, Lakonishok, and Vermaelen (1995); Peyer and Vermaelen (2009); Manconi, Peyer, and Vermaelen (2015). For evidence on underperformance after equity issues see e.g., Loughran and Ritter (1995); Spiess and Affleck-Graves (1995); Eckbo, Masulis, and Norli (2000); Dittmar and Thakor (2007); Brav, Geczy, and Gompers (2000).

[2]They define undervaluation on the basis of a combination of 11 return anomalies reported in the literature, including net equity issuance.

predictions about excess returns after equity issues which, unlike buyback authorizations, are firm commitments, not options.

In the volatility literature idiosyncratic volatility is estimated by the residual variance of an asset pricing model such as the Fama-French three factor model. Empirically there is a very high correlation between residual variance and total variance (97.60% in this study) so for the remainder of this paper we will use the latter when we refer to just volatility, the volatility anomaly, or the hypotheses above. We also use an alternative measure of idiosyncratic volatility that is not correlated (24.24% in this study) with volatility: $1 - R^2$. For the remainder of the paper we will use this when we refer to *idiosyncratic* volatility. It measures to what extent the volatility of stock returns is explained by company-specific (non-factor related) information [see also Li, Rajgopal, and Venkatachalam (2014)]. The hypothesis that managers are able to time the market [e.g., Ikenberry et al. (1995)] is based on the assumption that managers have superior knowledge about company-specific information. Hence the prediction of the *information advantage hypothesis* is that buyback announcements of firms with high idiosyncratic volatility will also generate higher long term excess returns.

Before proceeding with examining the link between anomalies, it is important to verify that these anomalies are real and not simply a proxy for risk, or have disappeared in recent years as has happened with many other ones (McLean and Pontiff, 2016). Excess returns in previous research are calculated using the Fama and French (1993) three-factor model or the Carhart (1997) 4-factor model as benchmarks. However, Fama and French (2015b) argue that many anomalies are weakened or do not survive after using the more recent Fama and French (2015a) five-factor asset pricing model as a model of expected returns. This model incorporates new evidence that profitability and investment patterns, besides market to book and size, explain stock returns (Novy-Marx, 2013). They find that the volatility anomaly survives for small firms, but the net issue anomaly does not. If buybacks (equity issues) are done by firms with high (low) profitability and few (many) investment opportunities, then these factors may well explain the excess returns reported in previous research. Note, however, that Fama and French (2015b) do not exactly replicate the papers that first reported the anomalies. First, they assume investors buy after the completion of the buyback and the equity issue, not around the announcement date as e.g., Peyer and Vermaelen (2009). For buybacks this may be an issue as repurchases may be completed several years after the buyback authorization (Stephens and Weisbach, 1998). Moreover Fama and French (2015b) do not examine repurchases and equity issues separately: they calculate returns after net equity issues (funds spent on buybacks minus funds spent on equity issues). The part of their sample where net equity issues are positive is defined as the "buyback sample". But this sample still contains some equity issuers, which may introduce a downward bias in the excess returns calculations. Moreover the idea of pooling buybacks and equity issues in "net issues" assumes that the decision to issue equity is simply the mirror of buying back shares. However, issuing stock to new investors is not the same as buying back stock from "old" selling investors. In the first case, the management has to face new shareholders that may face potential losses, while in the second case the firm only affects selling shareholders who leave the firm. So before concluding that the buyback and equity issue anomalies have disappeared, they have to be examined separately, using announcement dates.

So the second purpose of this paper is to verify whether the buyback and equity issue anomalies still exist using the more recent Fama and French (2015a) five-factor model, for buyback and equity announcements during the period 1985-2015.[3] We confirm the Fama and French (2015b) conclusion that the five-factor model makes the equity issue anomaly

[3] Using throughout this paper the q-factor model of Hou, Xue, and Zhang (2015) instead of the five-factor model of Fama and French (2015a) leads to the same conclusions.

disappear, but the buyback anomaly remains statistically and economically significant. However, even though we find that equity issues are not followed by significant negative excess returns in general, it turns out that using a SEO announcement as a sell signal improves the performance of a buyback portfolio. An interpretation is that firms that are timing the market by buying back shares when they are cheap are also successful timing the market when stocks are expensive. We also confirm that the Undervaluation Index developed by Peyer and Vermaelen (2009) is a good predictor of excess returns, although it emphasizes smaller firms. The buyback anomaly is also persistent over time and does not seem to become less significant in recent years, which is inconsistent with the hypothesis that the growth of institutional investors and the reduction in trading costs may have made markets more efficient as argued by Fu and Huang (2015).

It remains a fact though that the buyback anomaly is to some extent a small firm anomaly, as also found by Peyer and Vermaelen (2009): value-weighting all the events (as suggested by Mitchell and Stafford (2000)) makes the (Calendar Time event study method) alphas disappear, although *not* for high volatility stocks as we note below.[4] So the anomaly does not challenge the view that 99% of all stocks may well be priced efficiently. It simply shows that small cap firms are priced less efficiently and managers of these firms are able to take advantage of undervaluation, at least on average. Moreover, while we do not value-weight the events, as argued by Peyer and Vermaelen (2009), if anything, to increase the power of the test to detect mispricing, any weighting should be based on the inverse of size. However the negative relation between size and alpha may partly explain why this anomaly persists after 30 years and has attracted very little attention in the asset management industry.[5]

[4] Value weighted Calendar Time method results are available upon request.

[5] For example, a Google search for "buyback funds" gives very few results: Powershare Buyback Achievers fund, KBC Buyback America, S&P 500 Buyback ETF, Catalyst/Equity Compass Buyback Strategy fund, and PV Buyback USA. The first 3 funds focus on large caps after buyback completions although the academic

Indeed because management fees are proportional to fund size one expects relatively less interest in anomalies concentrated in small caps or microcaps.

After having established that the buyback anomaly survives the Fama-French five factor model and is robust over time, we test for the relation between volatility measures and long term excess returns. We find a significant *positive* relation between excess returns and volatility as well as idiosyncratic volatility measured by $1 - R^2$. In summary, the positive relation between volatility and excess returns is consistent with the costly arbitrage hypothesis of Stambaugh et al. (2015) as well as with the option hypothesis of Ikenberry and Vermaelen (1996), while the positive relation between $1 - R^2$ and excess returns is consistent with the information advantage hypothesis.

Combining total volatility and idiosyncratic volatility with the Peyer and Vermaelen (2009) Undervaluation Index into an Enhanced Undervaluation Index (EU-Index), improves the predictability of excess returns. In particular, during the four years following the buyback announcement, the high EU-Index Index portfolio generates an excess return of 0.85% per month with the Calendar Time event study method. Using the IRATS method the cumulative excess return reaches 69.41% after 48 months.

This paper is organized as follows. In section 2 we describe our data. In section 3 we test whether the buyback and equity issue anomalies survive when we use the Fama and French (2015a) five-factor model. We also compare firms that buy back stock and issue equity within 48 months of a buyback announcement with firms that do not issue stock subsequently. In section 4 we test whether the buyback anomaly is robust across time and investment horizon. In section 5 we test whether (total) volatility as well as idiosyncratic

research shows abnormal returns are more significant in small, under-priced, value stocks and the relevant event is not the completion of the buyback but the buyback authorization. We are also not aware of event-driven hedge funds that buy repurchasing firms and short equity issuers; typical event-driven strategies are for example based on M&A arbitrage, capital structure arbitrage or on investing in distressed securities.

volatility $(1 - R^2)$ can improve the predictability of excess returns, relative to simply using the Undervaluation Index proposed by Peyer and Vermaelen (2009). Section 6 concludes.

II. Data

Our sample spans the period from January 1985 to December 2015. We start in 1985 as SDC's coverage is poor before that year. We stop in 2015, the last year all CRSP and Compustat data were available. We retrieved buyback authorization announcements and announcements of Secondary Equity Offerings (SEO's) from the Securities Data Corporation (SDC) database. Daily and monthly returns, pre-announcement daily closing prices and market capitalization data were taken from CRSP. Book value of equity (BE) was taken from Compustat. The Fama-French factors were obtained from Kenneth French's website.

For the buybacks we combined all open market repurchase announcements from both the SDC Repurchases data base and the SDC US mergers and acquisitions ($M\&A$) data base.[6] We ended up with a total of 24,501 repurchases events, out of which 12,205 were only from the SDC Repurchases database, 6,624 only from the SDC $M\&A$ database and 5,672 from both. Finally, we removed the following events: no CRSP returns or not all Compustat data available (6,120 events); the percent of shares authorized was larger than 50% (76 events), or the closing price was less than \$1 for events before 1995 or \$3 for the other (906 events), or the primary stock exchange was not the NYSE, the Nasdaq, or Amex (1,939 events). Finally, we removed all events from firms in the Financial and Utilities sectors (4,389 events).[7] At the end we are left with 11,337 buyback events made by 3,990

[6] More information is available upon request. An interactive online tool to explore data variations and robustness analyses of all results in this paper, as well as all the source code, will also be available at tevgeniou.github.io/BuybacksIssuers.

[7] We are using the industries from Kenneth French's Website. The Financial Sector consists of all firms

firms. The average percent of shares authorized for these firms was 7.20% (median of 5.80%), the average Market Capitalization at announcement was $6,199 Million (median of $857.40 Million), while the BE/ME was on average 0.60 (median of 0.50).

For the issuers, we started with 13,072 events from SDC, filtered to exclude rights issues, pure secondary offerings where existing shareholders sell shares without generating proceeds for the company, issues made by non-U.S. firms or in non-U.S. markets, issues made by closed-end funds or unit investment trusts, as well as block trades, accelerated offers and best efforts. We removed all SDC events for which either the event date (1,923 events) or the CUSIP (2,355 events) was missing or where we found duplicate events with mismatching information (40 events), a total of 3,963 events - given the overlap between these cases. Finally, as for the buybacks, we removed the following events: no CRSP returns or not all Compustat data available (2,814 events); the percent of shares authorized was larger than 50% (52 events), or the closing price was less than $1 for events before 1995 or $3 for the other (365 events), or the stocks were not listed on the NYSE, Nasdaq or Amex (431 events). We again removed all events from firms in the Financial and Utilities sectors (915 events). Our final sample contains 4,058 events made by 2,925 firms. The average percent of shares issued was 17.10% (median of 16%), the average Market Capitalization on the announcement day was $1,116 Million (median of $304.40 Million), while the BE/ME was on average 0.30 (median of 0.20).

Figure 1 shows the number of announcements per year in the sample period as well as the (standardized) level of the $S\&P$ 500. Buyback activity rises prior to stock market increases and tends to fall afterwards, especially during the financial crisis of 2008 when buyback

with SIC code at the time of the buyback announcement that belonged in the "Banks" or "Fin" industries (SIC codes 6000 to 6300 and 6700 to 6799). The Utilities Sector consists of all firms with SIC code 4900 to 4942.

announcements fell to a 15 year low. Note the structural decline in equity issues since 2000. A similar decline in IPOs is also observed by Gao, Ritter, and Zhu (2013).

III. Share Buybacks, Equity Issues and Abnormal Returns

We start with revisiting past research but now using a longer and more recent time period and the five-factor model of Fama and French (2015a) to measure expected returns. In particular, we test whether buyback (equity issue) announcements are followed by significant positive (negative) long term excess returns, and if so, whether the returns can be explained by proxies for undervaluation as proposed by Peyer and Vermaelen (2009).

A. Share buybacks and Equity Issues in Isolation

Table I, Panel A, shows long-term cumulative excess returns for various holding periods after the announcement using the Ibbotson RATS event study method. Each event month t we run cross-sectional regressions of stock returns against the factors. The intercept in the regression measures the average abnormal excess return in event month t. We then accumulate these excess returns over various time horizons (up to 48 months after the event). The advantage of this method is that each event gets the same weight and that factor betas are allowed to change in event time, something that may be important as capital structure changes may signal a change in risk (Grullon and Michaely, 2004). The table compares the excess returns using the Fama and French (1993) three-factor model and the Fama and French (2015a) five-factor model. The results show that, although using a five-factor model lowers excess returns, the excess returns are statistically significantly positive over all investment horizons and reach 12.92% after 4 years (t=12.72). So the buyback anomaly does not disappear when we use a five-factor model. In all the tables we also calculate cumulative excess returns in the 6 months prior to the buyback. Consistent with past research [see e.g., (Peyer and Vermaelen, 2009)] buyback authorization announcements are preceded by significant negative excess returns of around -6%. This is consistent with the hypothesis that the typical repurchase announcement is triggered by a stock price decline that insiders may feel is not justified given their long-term prospects about the company.

Table II, Panel A, shows the results for all equity issues, using the same methodology as in Table I, Panel A. Our results are largely consistent with Fama and French (2015b). Using the three-factor model, we find statistically significant long term (after 48 months) negative cumulative excess returns of -7.06% (t=-3.14). However, once we use the five-factor model as a benchmark, excess returns fall and become statistically insignificant after 48 months. This indicates that when searching for anomalies, buybacks and equity issues should not be pooled in a "net issue" measure, as done by numerous authors. Unlike buybacks, equity issues are firm commitments announced and completed at the same point in time. Using actual shares issued, the measure used by Fama and French (2015b), and equity announcements (our measure) should therefore produce similar results. Buyback authorization announcements on the other hand are not firm commitments and are often executed over a long period after the announcement. Actual repurchase dates thus do not correspond to announcement dates. Note also that equity issues are typically preceded by large positive excess returns of around 36% in the 6 months prior to the equity issue. However, the lack of post announcement negative excess returns shows that this was not reflecting "irrational exuberance" but rather that, for example, these firms possibly experienced a substantial increase in growth opportunities and issued equity to finance them.

One critique of the Ibbotson (1975) RATS method is that the result may be time-specific. Indeed as every event is equally weighted the cumulative average abnormal returns are dominated by periods when there are a large number of events. So we also use the Calendar Time method where in each calendar month we form an equally-weighted portfolio of all firms that announced a buyback (or an equity issue) in the previous t months. We then run a time series regression of the portfolio returns against the factors. The intercept of the regression is the average monthly excess return in the t months after the event. The results are shown in Panel B of Tables I and II and are similar to Panel A of the same tables. Abnormal returns after buybacks are smaller when the five-factor model is used but remain statistically significant over all horizons. For example, over the 48 month horizon the average monthly excess return is 0.21% (t=2.86) which corresponds to 9.92% over 48 months. Note also that excess returns fall when the investment horizon increases. The largest monthly excess return (0.61%) is earned by the portfolio that holds buyback stocks for one month (not reported in Table I) and the smallest excess return (0.21%) is earned by the portfolio that picks buybacks announced during the previous 48 months. This clearly shows that forming portfolios after buybacks are completed, as is done by measuring net issues in Fama and French (2015b), is introducing a downward bias as many repurchase programs are completed several months (sometimes years) after the buyback announcement. Waiting until the buyback is completed means missing the largest excess returns earned shortly after the buyback authorization. Finally, there are no statistically significant excess returns after equity issues, regardless whether we use the three or five-factor model.

So far all our events are equally weighted. Mitchell and Stafford (2000) argue that events should be value weighted to test whether they represent an economically important anomaly. However, as we know from past research, for theoretical as well as empirical reasons, one would expect that managers in small firms are better able and willing to take advantage of mispricing than in large firms. So value weighting would simply bias the results toward zero. And indeed, when we value-weight the events (results available upon request) long-term excess returns become statistically insignificantly different from zero when using the total sample of events. So the buyback anomaly is not economically important and does not challenge the basic premise that "the market" represented by a value-weighted index is priced correctly.

Next we test whether the "Undervaluation Index" (U-index) developed by Peyer and Vermaelen (2009) using buyback announcements from 1991 to 2002 is a robust indicator to separate companies that are buying back stock because they are undervalued from companies that repurchase shares for other reasons. We calculate the U-index as follows. Companies get a size score from 1 (large firms) to 5 (small firms) depending on the quantile of their market value of equity in the month prior to the buyback announcement. Then, we calculate the 11-months pre-announcement absolute returns of months -12 to -1 before announcement for all events and assign a score of 5 to the low returns firms and 1 to the high returns ones. Finally, companies get a book value to market value (BE/ME) score depending on the quantile of their BE/ME value of equity in the year prior to the buyback announcement, with a score of 1 to small BE/ME firms and 5 to large ones. Like Peyer and Vermaelen (2009) we use all CRSP companies to define the quantile thresholds each month.

We sum up these three scores for each firm and we then define as "high U-index" the firms with total score more than 10 and as "low U-index" those with total score less than 6. Note that unlike Peyer and Vermaelen (2009) we do not consider the stated reasons for the buyback in the press release, hence we define different thresholds for the high U-index and low U-index buyback firms. We end up with 2,238 "high U-index" buyback stocks (19.74%

of all buyback events), and 1,602 "low U-index" ones (14.13% of all buyback events). The distribution of the U-index of all buyback events is shown in Figure 2.

Table I, Panel A, shows the three-factor as well as the five-factor IRATS for high U-index and low U-index firms. The interesting conclusion is that using the five-factor model improves the predictive power of the U-index: high U-index firms earn 4 year excess returns of 31.06% (t=10.07) while low U-index firms only earn 9.24% (t=4.28), hence 21.82% less than the high U-index ones. Starting from 12 months after the announcement, high U-index firms always beat low U-index firms. When we use the three-factor model, we find similar conclusions, but the results are weaker. For example after 48 months the high U-index firms now earn excess returns of 28.56%, which is only 13.29% higher than the low-U-index firms. Note that, consistent with Peyer and Vermaelen (2009) the low U-index buyback stocks earn significant positive excess returns too. It is difficult to find a portfolio of buyback stocks that under-performs in the long run. So the term "overvaluation" should be interpreted with caution. The Undervaluation Index is a proxy for the likelihood that the buyback is driven by undervaluation. It does not imply that low U-index firms are overvalued. It means that for these firms the buyback is less likely to be driven by undervaluation, but by other reasons such as managing capital structure, avoiding dilution from executive stock options etc.

Table I, Panel B, shows that this conclusion holds when we use the Calendar Time method. Regardless of the horizon, high U-index stocks almost always beat low U-index stocks. As in the case of IRATS, the five-factor model improves the selectivity of the Undervaluation Index: low U-index now earn marginally significant excess returns after 48 months.

B. *Buybacks followed by Equity Issues*

The results so far show that firms that repurchase shares are good at market timing, in particular the small beaten up value stocks. On the other hand the average equity issuer does not seem to be driven by market timing in general. However, firms that are good at market timing when buying back undervalued stock are perhaps also good at recognizing when their shares are overvalued. Note that successful market timing requires two managerial characteristics: ability to time the market as well as willingness, i.e., accepting the idea that using superior information to benefit long term shareholders at the expense of other shareholders is the "right" thing to do.

During our sample period (1985-2015) 1,298 companies in our data set both announced buybacks and issued equity, but in only 659 cases a company announced a subsequent equity issue within 4 years after the buyback announcement. Of the 659 such events, 131 SEOs happen within 1 year from the buyback announcement, 328 happen within 2 years and 518 happen within 3 years. Note that this grouping of the events is done with hindsight: it is not possible to know at the time of the buyback announcement whether there will be a subsequent SEO or not. We are simply asking the question whether those firms that announced a buyback when they appeared undervalued issued equity when they were overvalued. Figure 3 shows the percentage of repurchasing firms that announced an equity issue within 48 months. The average percentage is 5.60% and there are only 2 years (1989 and 1990) where the percentage is larger than 10%.

Table III shows that repurchasing firms that issued stock within 48 months after the buyback are remarkable timers. Long-term excess returns after 4 years are 41.80% (t=8.85), about four times as large as for the overwhelming majority of firms that do not issue stock subsequently. These results are graphically displayed in Figure 4 (Panel A). Repurchases by firms that do not issue equity in the next 48 months are followed by long term excess returns of only 10.84%. One interpretation is that these firms believe they are undervalued but as long as they remain undervalued they do not think it is appropriate to issue stock.

The Calendar Method results in Panel B of Table III show a relatively large drop of the excess returns over time (e.g., from 0.77% after 12 months to 0.60% after 48 months) indicating potential benefits of exiting a buyback position when there is a subsequent issue. Figure 4 (Panel B) shows the benefits of exiting early. The figure shows a strategy with hindsight where, starting in 1985, we invest in an equally weighted portfolio of only firms that announced a buyback and subsequently issued equity within the 48 months after the buyback announcement. The dashed line shows the cumulative excess return if we sold the stock whenever the firm issued shares within 48 months (the "exit strategy"). The solid line shows the cumulative excess returns if we only sold 48 months after the buyback announcement (the "no exit strategy"). The investor who had followed the exit strategy would have earned (after 30 years) a cumulative excess return of 558%, compared to the 268.10% of a buy and hold for 48 months strategy. Note, however, that because very few firms that buy back stock issue equity within 48 months, a strategy "without hindsight" where one bought all companies after a buyback and sold only those after a subsequent equity issue would not substantially increase excess returns.

IV. How robust is the buyback anomaly?

The results so far are based on a sample of all buyback and equity announcements over a thirty-year period. As the equity issue anomaly does not survive the Fama and French (2015a) five-factor model, the remainder of the paper focuses on better understanding the buyback anomaly and uses the five-factor model as a benchmark.[8] The purpose of this section is to test the robustness of this anomaly: has it become less important over time because markets have become more efficient? How sensitive is it to the length of the investment period?

A. Robustness across time periods and investment horizons

Table IV shows excess returns, using both the IRATS and Calendar Time method for different time periods. We consider time periods, which overlap to some extent with past research [Ikenberry et al. (1995); Peyer and Vermaelen (2009); Manconi et al. (2015); and Fu and Huang (2015)]: 1985-1990; 1991-2000; 2001-2015 and 2008-2015. The last period was chosen to incorporate the financial crisis and to test whether indeed markets have become more efficient in recent years, or whether managers have for example been discouraged from market timing by the obvious mistakes that were made by buying back shares before a major financial crisis.

Table IV shows that, regardless of the time period chosen or the method to calculate excess returns, the buyback anomaly remains economically and statistically significant and there is no clear time trend in the data that suggests that markets have become more efficient over time. There is one exception to the consistency between the IRATS and the Calendar Time results: in the period of 1991-2000, the IRATS method generates excess returns after 48 months of 20.63% (t=10.77) but the Calendar Time method produces statistically insignificant excess returns of 0.16% per month. This result appears to also be inconsistent with Peyer and Vermaelen (2009). However, if one includes the financial sector firms or considers the three-factor model, as Peyer and Vermaelen (2009) do, the calendar method

[8] All analyses below are also done for equity announcements. However, in agreement with the results in Section III.A, we find no consistent/robust results for issuers. All issuers results are available upon request.

abnormal returns do become significant.[9]

Table V re-examines whether the U-index of Peyer and Vermaelen (2009) predicts the five factor excess returns for different time periods. The first two columns show the IRATS results and the last two columns show the Calendar Time results. Regardless of the method to compute excess returns, the U-index is an excellent predictor: except for the very short 1985-1990 period when we also have few events, buybacks announced by high U-index firms are followed by significantly larger returns than buybacks announced by low U-index firms.

B. Robustness with respect to estimation of factor betas

Note that both event study methods measure alpha (excess return) and betas jointly. In other words, we do not use prior (to investing) information to estimate risk. An investor who wants to exploit the anomaly, however, may want to hedge market (and other) risk and would need to estimate betas using past data. If the buyback signals a change in risk (Grullon and Michaely, 2004) it is not obvious that such a hedged strategy would work, which may make a buyback strategy impractical for some funds.

To further study the robustness of the buyback anomaly, we simulate a portfolio investment strategy starting in 1985. The strategy uses past data to estimate the factor betas and measures the abnormal returns of buyback portfolios over different investment horizons. While this is not an accurate measure of the returns of a buyback fund - as we do not consider transaction costs, turnover issues, or other operational issues as discussed for example in Mitchell and Pulvino (2001) - it provides us with an estimate of what would have happened to an investor who starts investing in 1985 in an equally weighted portfolio of buyback stocks and holds them over various horizons.

[9] Details available upon request.

Specifically, we consider the following trading strategy: construct the first day of every month an equally weighted portfolio of all companies that announced buybacks during the previous N months, for a given holding period of length N (which can be chosen). Thus, once a company makes an announcement, it enters the portfolio on the first day of the following month and remains there for N months. Note that the portfolio is re-balanced (the first day of) each month. This "unhedged" strategy generates a time series of returns. Each month (when we re-balance the portfolio) we also use the previous 18 monthly returns of this time series to calculate the (portfolio level) time series betas of all five factors. This allows an investor to determine the betas for the factor risks using data available at the time of portfolio formation, and then hedge these factor risks (including the market) using these betas to get a "hedged" portfolio.

Despite using pre-portfolio formation data to estimate the betas, unlike both the IRATs and Calendar Time methods that use hindsight to estimate risk, the hedged portfolio indeed has very low betas with the five factors. For example for the $N = 12$ months holding period, the betas for the five factors Market, SMB, HML, RMW, and CMA are respectively 0.00, 0.02, 0.01, 0.02 and -0.17. The corresponding betas for the "unhedged" strategy are 1.03, 0.56, 0.18, 0.19 and -0.09. This indicates that the returns of the hedged strategy are indeed close to "excess" returns, i.e. returns that have basically eliminated all factors risk. This is also consistent with the hypothesis that the buyback announcement itself does not materially change the risk of the repurchasing firms (in the short term).

We report the returns (unhedged strategy) and excess returns (hedged strategy) of such a portfolio strategy for different holding months $N = 1, 3, 6, 12, 24, 36, 48$ in Figure 5.[10] The basic conclusion is that the shorter the investment horizon the larger the excess returns.

[10]Results for other holding periods, as in Figure 5, are available upon request.

Specifically, at the end of 2015 the cumulative excess returns from the 1 month, 6 month, 12 month, 24 month, 36 month and 48 month holding periods are respectively equal to 285%, 231.50%, 139.20%, 112.40%, 97.90%, 104.90% and 103.10%. This is not surprising as the Calendar Time results in Table I show that the monthly excess returns decline when the investment horizon becomes longer. However, Figure 5 also allows us to verify that the excess returns are not simply the result of outperformance during a particular time period.

V. Excess returns and volatility

Having established the robustness of the buyback anomaly also after using the 5-factor Fama-French model, we turn to our main question: are the buyback and volatility anomalies related? One of the most puzzling findings in the large literature on volatility and stock returns[11] is the fact that total volatility and idiosyncratic volatility (measured by residual variance which is, as noted above, highly correlated with total volatility, e.g., 97.60% in this study) are negatively correlated with future abnormal returns, when expected returns are calculated using the 3-factor Fama and French (1993) model [see e.g., Ang et al. (2006) (Table VII)]. Fama and French (2015b) find that this volatility anomaly also survives after using the Fama and French (2015a) 5-factor model, at least for small firms. Perhaps the buyback and the volatility anomaly are related: are the buyback firms with the largest excess returns also firms with the smallest volatility? Or can we make arguments that the opposite is true, if we accept a key proposition of this paper, i.e. that excess returns are related to the fact that managers are on average successful in taking advantage of an undervalued stock price? In that case we expect a negative relation using the Stambaugh et al. (2015)

[11] For the most recent overview of the literature and potential hypotheses, see Li, Sullivan, and Garcia-Feijoo (2016).

arbitrage hypothesis and the Ikenberry and Vermaelen (1996) option hypothesis. Moreover, what about $1 - R^2$, a measure of "standardized" idiosyncratic risk that unlike residual variance is little correlated with total volatility and measures more precisely the fraction of total volatility explained by company-specific news?[12] We start with the latter first, then consider the former, and finally we combine the two in the next section.

A. *Standardized Idiosyncratic Risk and excess returns*

The main "theory" behind the buyback anomaly is that firms may have superior *company-specific* information. Such situations are more likely in industries or companies where the volatility is largely driven by company-specific volatility. So if buybacks are driven by market timing this superior information hypothesis predicts that there should be a positive relation between excess returns and the percentage of the volatility explained by company-specific factors, i.e. our measure of idiosyncratic volatility $(1-R^2)$, however not to be confused with residual variance.

To test this hypothesis, for each event we measure the five-factor regression R^2 using the 6-months daily returns just before the event announcement.[13] We define two types of events: "low idiosyncratic" (high R^2) and "high idiosyncratic" (low R^2) events, depending on whether the five-factor regression R^2 was in the top or bottom 20% of the R^2 of all CRSP companies: each month we use the daily returns of all CRSP stocks for the previous 6 months until the one before last day of the previous month to calculate all companies' five-factor regression R^2. We also define the idiosyncratic score of a firm to be the percentile

[12] As noted above, in our sample the correlation between $1-R^2$ and residual variance (the typical measure of idiosyncratic risk in the literature) is only 24.24%, compared to that between residual variance (the measure of idiosyncratic risk used in the literature) and total volatility which is 97.60%. See also Li et al. (2014) for a related discussion on this issue.

[13] Using shorter time windows, e.g., 1 month, leads to the same conclusions - results available upon request.

of its $1 - R^2$ across all CRSP firms that month. Table VI, columns (1) and (2) show the percentage of high and low idiosyncratic risk events across all industries for which we have at least 100 buyback events in our sample. The healthcare industry has the largest percentage of firms classified as "high idiosyncratic", while cyclical industries such as steel, construction and chemicals contain a large number of "low idiosyncratic" firms.

Table VII shows the IRATS and Calendar Time abnormal returns for high and low idiosyncratic buyback events-companies. Focusing on IRATS, high idiosyncratic buyback stocks earn 30.46% after 48 months, more than the excess returns of the low idiosyncratic announcements. The results using the Calendar Time method confirm these findings. Table VII also tests whether adjusting for idiosyncratic risk improves the predictive power of the U-index. Regardless of the time horizon and the event study method, the U-index works only for idiosyncratic companies. After 48 months, based on the IRATS methods, high U-index high idiosyncratic companies earn 51.28% (t=10.59). Low idiosyncratic high U-index firms have only an insignificant excess return of 9.44% (t=0.77), while for low idiosyncratic firms the low U-index IRATS excess returns are marginally significant (6.84%, t=1.76). Note however that we only have few events in low idiosyncratic, high U-index (122 events) and high idiosyncratic, low U-index (125 events) categories. The Calendar Time results provide the same picture: only for the high idiosyncratic, high U-index firms we obtain significant (t=4.47) monthly excess returns of 0.77%. The high idiosyncratic and low U-index firms have non-significant (t=-0.75) monthly excess returns of -0.25%.[14]

Figure 6 summarizes our results. It shows the CAR based on IRATS (Panel A for the high

[14] We also calculated the returns of a hedged strategy similar to Figure 5 (Panel B). Starting in 1985 we form a portfolio of all stocks that announced a buyback during the previous N months and hold the stock for N months. High idiosyncratic companies earn cumulative excess returns of 95.90% (157.90%) for the 12 (48) month holding strategy. These excess returns are higher than the 56.30% (52.90%) of the corresponding low idiosyncratic sample.

U-index firms, B for the low U-index firms, and C for all firms). In agreement with Table VII, the striking result (Panel A) is that the U-index is not a good predictor of excess returns for stocks largely driven by market factors (low idiosyncratic firms). This is strong evidence that excess returns after buybacks are driven by superior company-specific information of the management.

B. Volatility and excess returns

The announcement of a buyback program is not a firm commitment, but an option to buy back stock. Ikenberry and Vermaelen (1996) model this flexibility as an exchange option in which the market price of the stock is exchanged for the true value of the stock. They predict that, as with all options, the value increases with the volatility. The intuition is that the larger the volatility, the larger the probability that the market price may deviate from the true value. This enhances the timing ability of the manager-insider. They show that this option can have large value, something that may not be realized at the time of the announcement of the buyback authorization. For example, the market may underestimate the maturity of the option if they do not realize that firms who are announcing a buyback authorization for say 2 years are likely to renew the authorization many times in the future. Moreover, although Stambaugh et al. (2015) argue that idiosyncratic volatility, and not total volatility, should be positively related to future returns for undervalued stocks, the empirical fact is that their estimate of idiosyncratic volatility (residual variance) is highly correlated (97.60%) with total volatility. Their argument is that idiosyncratic volatility represents risk that deters arbitrage and therefore creates mispricing. Using a proxy for mispricing based on 11 anomalies they find indeed a positive relation between residual variance and future returns for undervalued stocks. But considering the very high correlation between residual variance and total variance, their hypothesis would also predict a positive correlation between total volatility and future returns for undervalued stocks. Hence, perhaps total volatility is a better prediction of excess returns than (standardized) idiosyncratic volatility (defined as $1 - R^2$) or the U-index of Peyer and Vermaelen (2009). Or perhaps volatility can be an additional, next to the U-index and idiosyncratic volatility, indicator of the likelihood that the buyback is driven by undervaluation.

For each event we measure their pre-announce returns volatility with the standard deviation of their daily stock returns over the 6 months prior to the buyback announcement. We define two types of events: "low volatility" and "high volatility" events, depending on whether volatility was in the top or bottom 20% of the volatilities of all CRSP companies, as we did for R^2 above: each month we use the daily returns of all CRSP stocks for the previous 6 months until the one before last day of the previous month to calculate all companies' daily returns volatilities. We also define the volatility score of a firm to be the percentile of its volatility across all CRSP firms that month. For simplicity we focus again on the two extreme quantiles only. In total we have 2,268 "high volatility" buybacks-events and 2,268 "low volatility" ones. Table VI, columns (3) and (4) show the percentage of high and low volatility events across all industries for which we have at least 100 buyback events in our sample. Software and chips tend to be the most volatile sectors and they are also two of the three sectors where buybacks are more frequent.

Table VIII shows the IRATS and Calendar Time abnormal returns for high and low volatility buybacks events-companies.[15] Focusing on IRATS, high volatility buyback stocks

[15] We also calculated the returns of a hedged strategy similar to Figure 5 (Panel B). Starting in 1985 we form a portfolio of all stocks that announced a buyback during the previous N months and hold the stock for N months. High volatility companies earn cumulative excess returns of 226.20% (223.40%) for the 12 (48) month holding strategy, which are higher than the 69.20% (79.50%) of the corresponding low volatility sample.

earn 38.61% after 48 months, while low volatility events have non significant abnormal returns for any period. The results using the Calendar Time method confirm these findings.[16] So we find support for the Stambaugh et al. (2015) costly arbitrage hypothesis as well as the option hypothesis proposed by Ikenberry and Vermaelen (1996).

Table VIII also tests whether the U-index can further differentiate high volatility events, as well as whether adjusting for volatility improves the predictive power of the U-index. Regardless of the time horizon and the event study method, the U-index works for high volatile companies. After 48 months, based on the IRATS methods, high U-index high volatility companies earn 54.97% (t = 9.10). Low U-index high volatility companies earn 22.50% (t = 2.35). The Calendar Time results provide the same picture. Figure 7 summarizes the results for the total sample and the high and low U-index sample.

C. An Enhanced U-index for Buybacks

Table IX shows how the high/low U-index high/low idiosyncratic risk, and high/low volatility buyback events overlap, while Table X shows the correlations between the idiosyncratic, volatility, and U-index scores. Overall we see that although high U-index firms tend to have high idiosyncratic risk and high volatility, while high idiosyncratic risk firms tend to also have high volatility, the overlap is not very high. For example from Table IX we see that only 36.20% of the high volatility stocks that are classified as having either high or low idiosyncratic risk - note that we only consider the 20% tails - have high idiosyncratic risk. From Table X we infer that the correlation between idiosyncratic risk and volatility scores is only 30.80%. A natural question is therefore whether one can further enhance the Peyer and Vermaelen (2009) U-index by incorporating information about the firms' pre-announce

[16] As mentioned in Section I, the value weighted Calendar Time method alphas are also significant for the high volatility sample: for example the alpha after 48 months is 0.53% (t = 2.06).

idiosyncratic risk and volatility. We consider one such combination where we simply take an equal-weighted combination of the 4 criteria into one "Enhanced Undervaluation Index" (EU-index). Specifically, in the spirit of the U-index of Peyer and Vermaelen (2009), we calculate the EU-index simply as the sum of three numbers: high U-index firms get a score of 2, low get a 0; high idiosyncratic firms get a score of 2, low get a 0; and high volatility firms get a score of 2, low get a 0. Firms that get neither 0 nor 2 (hence are in the middle of the range) get a score of 1 for each of these 3 scores.

Figure 8 shows the distribution of the EU-index. The index has a symmetric distribution with a mean of 3.06. Table XI shows how the EU-index relates to a number of firm characteristics. Firm leverage, based on data the year before announcement, is defined as the ratio $debt/(debt + equity)$.[17] "ISS later" measures the percentage of firms that announced an equity issue within 48 months after the buyback announcement. Next, we measure the percentage of buybacks financed with cash (CASH) when the data is available (this data was available only for 7,865 of the events) and whether the reported purpose (available only for 8,373 events) included the term "Undervalued", or "Enhance Shareholder Value" or "stock option plan".

First there is a striking negative relation between the EU index and financial leverage. This makes sense according to the static trade-off theory of optimal capital structure: high risky firms have more financial distress and should have less debt. High EU index firms are also more likely to mention "undervaluation" as a motivation for the buyback and to use

[17]We use the definitions from `http://www.ivo-welch.info/professional/leverage.placebo/`Ivo Welch's website following `http://www.ivo-welch.info/professional/leverage.placebo/r-sourcecode/mksane.R`. Debt is the sum of the Compustat variables $dlc + dltt$, where dlc is "Debt in Current Liabilities" and $dltt$ is "Long Term Debt - Total". Equity is the Compustat variable seq which is "Total Parent Stockholders' Equity". We use the most recent data pre-announce, and make the winsorization and other adjustments as in the websites above. Note that we followed the same steps as in these websites to handle negative book value of equity (in the BE/ME calculations) and any other Compustat data issues.

cash. This could of course be related to the fact that risky firms should have more cash holdings. They also tend to follow up more often with equity offerings after the buyback which suggests that they are more likely to be in the "market timing" business. Note that all these firm characteristics have not been used to define the EU-Index.

The table also shows a strong negative relation between market-to-book ratios and market capitalization and the EU index, which is not surprising as these are components of the index. It should be noted that the EU6 portfolio (consisting of all firms with EU index equal to 6) is composed of very small stocks with an average market capitalization of $126.40 million. The average market capitalization of portfolios with long term (after 48 months) monthly excess return of larger than 0.5% (i.e. portfolios EU5 - EU6 in Table XIII) is $198.40 million (not indicated in the Table). So the buyback anomaly is to some extent a small cap anomaly.

Tables XII and XIII show respectively the IRATS and Calendar Time monthly abnormal returns for all values of the EU-index. Focusing on IRATS, as the EU-index increases, the long term abnormal returns increase (from -0.80% to 69.40%). Figure 9 show the same results over time for each EU-index. Long-term cumulative excess returns after 48 months are becoming statistically significantly positive at EU-index levels of 3 and higher, and then steadily increase from 6.30% to 69.40%. The Calendar Time results are similar although they only show significance starting at EU-index levels of 5. Investing in the very high EU index firms (EU=6) generates alphas of 0.85% per month for 48 months.[18]

The bottom line is that combining volatility, idiosyncratic risk and the U-index in one EU-index generates a more selective predictor of excess returns than each of the indica-

[18]We also calculated the returns of a hedged strategy similar to Figure 5 (Panel B). Starting in 1985 we form a portfolio of all stocks that announced a buyback during the previous N months and hold the stock for N months. The 12-month holding period high EU-index portfolio has average annual excess returns of 5.90%, while the low EU-index one earns only 2.30% annual excess returns. For the 48-month holding periods the high and low EU-index portfolio earn annual excess returns of respectively, 8.70% and 1.90%.

tors separately. Indeed, high U-index stocks, stocks with high idiosyncratic risk, and high volatile stocks generate cumulative excess returns of respectively 31.06% (Table I), 30.46% (Table VII) and 38.61% (Table VIII).

D. Robustness of the EU-index over Time

As volatility and idiosyncratic risk are time dependent, the performance of the new EU-index may not be robust over time - e.g., relative to the U-index of Peyer and Vermaelen (2009). Tables XIV (IRATS) and XV (Calendar Time method), like Table V for the U-index, show the relative performance of high and low EU-index repurchases. In order to have roughly similar number of under/overvalued firms as when we use the U-index, we define low EU-index firms to be those for which the EU-index is 0-1, and high for which it is 5-6 (the index takes values from 0 to 6). With this definition we have 1,291 low EU-index and 1,667 high EU-index firms in our sample (in comparison with 1,602 low U-index and 2,238 high U-index ones).

Tables XIV and XV indicate that the EU-index is robust over time, with the exception of the 1985-1990 period. However during this period our high EU index sample only contains 85 observations which results in statistically insignificant excess returns.

VI. Conclusion

The buyback anomaly first reported by Ikenberry et al. (1995) is still present and robust. Long term excess returns are large, highly statistically significant and robust even when we replace the Fama-French three-factor model with the Fama-French five-factor model. We believe that the difference with the conclusions of Fama and French (2015b) is a result of the fact that we do not pool buybacks and equity issues in a "net issuance" anomaly, which unfortunately has become the standard in the anomaly literature. A buyback is not simply the inverse of an equity issue, especially in a world with asymmetric information. Managers who buy back undervalued stock from selling investors benefit their long-term shareholders at the expense of selling shareholders who are "leaving" the company. Issuing overvalued stock hurts new investors and therefore may not be in the interest of long-term shareholder value. Moreover buyback authorizations are options, not firm commitments such as equity issues. Using net issues as a measure of (negative) buyback activity ignores the reality that an actual repurchase may occur several months, if not years after a buyback authorization. By the time the buyback is completed the firm may already have experienced significant excess returns.

Not all buybacks are the same: we find that buybacks made by small beaten up risky low market to book companies earn the largest excess returns. We find that both idiosyncratic risk (small R^2) and total risk are positively correlated with future returns. This result is inconsistent with Ang et al. (2006) but consistent with Stambaugh et al. (2015) who show that for undervalued firms residual variance (almost perfectly correlated with total volatility) is positively related to future returns. It is also consistent with the argument of Ikenberry and Vermaelen (1996) that a buyback authorization creates an option to take advantage of an undervalued stock, and options on high volatility stocks are more valuable. We combine these characteristics in a new measure: the EU index or Enhanced Undervaluation Index, building on the analysis of Peyer and Vermaelen (2009). Investing in very high EU index firms generates Fama-French five-factor adjusted returns of 0.85% per month during the 48 months after the buyback announcement. These are also firms that are more likely to mention in their press releases that they are buying back stock because they are undervalued.

However investing in high EU index firms to some extent implies investing in small caps and micro-caps, which may explain partially why the anomaly persists as these firms may not satisfy, for example, liquidity risk constraints of many funds.

Table I
Buyback announcements during 1985-2015

The table presents the abnormal returns for firms after open market repurchase announcements from the announcement date until t months after announcement. We include a version of the abnormal returns for the full sample and one for both companies with a high U-index and a low U-index. Panel A reports monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (1993) three-factor model and the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regressions are run each event month j:

$$(R_{i,t} - R_{f,t}) = a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + \epsilon_{i,t},$$
$$(R_{i,t} - R_{f,t}) = a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors. Panel B reports monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

Panel A: IRATs Cumulative Abnormal Returns

	All 3F		All 5F		High U-index 3F		Low U-index 3F		High U-index 5F		Low U-index 5F	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-6.48**	-23.686	-6.71**	-23.716	-27.98**	-42.309	20.55**	27.853	-27.52**	-40.347	19.77**	25.78
+12	3.89**	9.118	2.76**	6.172	2.9*	2.369	4.32**	4.611	2.89*	2.247	2.62**	2.675
+24	8.73**	13.437	6.5**	9.523	13.63**	7.148	6.29**	4.499	14.1**	6.984	3.89**	2.657
+36	13.56**	16.641	10.4**	12.138	21.44**	8.852	10.93**	6.273	22.92**	8.918	6.68**	3.655
+48	17.21**	17.867	12.92**	12.721	28.56**	9.862	15.28**	7.45	31.06**	10.07	9.24**	4.28
Observations	11337		11337		2238		1602		2238		1602	

Panel B: Calendar Time Method Monthly Abnormal Returns

	All 3F		All 5F		High U-index 3F		Low U-index 3F		High U-index 5F		Low U-index 5F	
	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat
-6	-0.9**	-9.628	-0.96**	-10.405	-4.52**	-19.948	3.19**	18.633	-4.51**	-19.093	3.03**	17.27
+12	0.3**	3.484	0.24**	2.762	0.22	1.419	0.48**	4.222	0.22	1.35	0.34**	3.05
+24	0.31**	4.014	0.23**	2.908	0.34*	2.462	0.34**	3.406	0.33*	2.34	0.23*	2.3
+36	0.3**	4.124	0.22**	2.986	0.4**	3.152	0.33**	3.364	0.41**	3.128	0.2*	2.06
+48	0.28**	3.968	0.21**	2.859	0.44**	3.465	0.31**	3.271	0.47**	3.53	0.18^{+}	1.948
Observations	11337		11337		2238		1602		2238		1602	

Table II
Issue announcements during 1985-2015

The table presents the abnormal returns for firms after issue announcements from the announcement date until t months after the announcement. Panel A reports monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (1993) three-factor model and the Fama French (2015) five-factor model for the sample of firms that announced equity issuance plus various subsamples. The following regressions are run each event month j:

$$
\begin{aligned}
(R_{i,t} - R_{f,t}) &= a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + \epsilon_{i,t}, \\
(R_{i,t} - R_{f,t}) &= a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},
\end{aligned}
$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors. Panel B reports monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

Panel A: IRATs Cumulative Abnormal Returns

	All 3F		All 5F	
	CAR	t-stat	CAR	t-stat
-6	36.34**	41.249	37.55**	40.54
+12	-0.99	-1.036	2.04*	2.042
+24	-8.2**	-5.839	-2.4	-1.642
+36	-11.83**	-6.408	-3.97*	-2.06
+48	-7.06**	-3.135	1.56	0.659
Observations	4058		4058	

Panel B: Calendar Method Monthly Abnormal Returns

	All 3F		All 5F	
	AR	t-stat	AR	t-stat
-6	5.52**	24.308	5.73**	24.354
+12	-0.03	-0.154	0.24	1.399
+24	-0.26^{+}	-1.832	-0.02	-0.153
+36	-0.24^{+}	-1.657	-0.01	-0.044
+48	-0.14	-0.985	0.06	0.389
Observations	4058		4058	

Table III
Buybacks with and without subsequent issue

The table presents the long-run abnormal returns for firms repurchase announcements for events with and without a subsequent SEO announcement. Panel A reports monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regression is run each event month j:

$$(R_{i,t} - R_{f,t}) \quad = \quad a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors. Panel B reports monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

Panel A: IRATs Cumulative Abnormal Returns

	No Issue		Issue	
	CAR	t-stat	CAR	t-stat
-6	-6.5**	-22.55	-9.53**	-6.94
+12	2.31**	5.08	10.07**	4.62
+24	5.26**	7.57	25.14**	7.79
+36	8.53**	9.78	37.74**	9.32
+48	10.84**	10.48	41.8**	8.85
Observations	10678		659	

Panel B: Calendar Method Monthly Abnormal Returns

	No Issue		Issue	
	AR	t-stat	AR	t-stat
-6	-0.96**	-10.57	-0.8*	-2.4
+12	0.2*	2.36	0.77**	3.03
+24	0.19*	2.36	0.77**	4.12
+36	0.18*	2.4	0.75**	4.33
+48	0.17*	2.36	0.6**	3.59
Observations	10678		659	

Table IV
Buyback returns over different time periods

The table presents the long-run abnormal returns for firms after repurchase announcements for different time periods. Panel A reports monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regression is run each event month j:

$$(R_{i,t} - R_{f,t}) \quad = \quad a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors. Panel B reports monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

Panel A: IRATs Cumulative Abnormal Returns

	1985-1990		1991-2000		2001-2015		2008-2015	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-3.62**	-3.614	-11.58**	-22.635	-2.23**	-6.003	-2.42**	-4.984
+12	5.89**	3.927	4.3**	4.902	3.73**	7.153	4.95**	6.7
+24	6.8**	2.669	10.55**	7.951	7.84**	10.068	9.13**	8.6
+36	5.34^{+}	1.763	17.07**	10.324	11.04**	11.181	13.18**	9.842
+48	12.02**	3.253	20.63**	10.772	13.45**	11.177	14.68**	8.997
Observations	809		4667		5861		2939	

Panel B: Calendar Method Monthly Abnormal Returns

	1985-1990		1991-2000		2001-2015		2008-2015	
	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat
-6	-0.86**	-3.99	-1.84**	-9.759	-0.4**	-3.599	-0.45**	-3.797
+12	0.29	1.65	0.25	1.314	0.39**	3.965	0.38**	3.036
+24	0.15	0.891	0.11	0.616	0.42**	4.14	0.4**	3.375
+36	0.07	0.489	0.22	1.482	0.42**	4.084	0.41**	3.597
+48	0.21^{+}	1.777	0.16	1.156	0.39**	3.807	0.41**	3.595
Observations	809		4667		5861		2939	

Table V
Buyback returns for the U-index over time

The table presents the long-run abnormal returns for firms after open market repurchase announcements for high and low U-index firms in different time periods and shows significantly larger returns by buybacks announced by high U-index firms compared to those with a low U-index. We report both the IRATS cumulative average abnormal returns (CAR, Panel A) and the calender time method (AR, Panel B) abnormal returns on the full sample. *t*-Statistics are provided and stars indicate significance at the 5% (*), and 1% level (**).

1985-1990	High U-index (IRATS)		Low U-index (IRATS)		High U-index (CAL)		Low U-index (CAL)	
	CAR	*t*-stat	CAR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-30.68**	-9.623	15.1**	6.529	-5.22**	-6.141	2.14**	5.524
+12	4.76	0.91	9.92**	3.116	0.25	0.545	0.59*	2.121
+24	1.74	0.211	11.11*	2.397	0.14	0.336	0.4^{+}	1.753
+36	0.71	0.067	12.58*	2.216	0.26	0.744	0.28	1.306
+48	22.21	1.547	21.02**	3.159	0.72*	2.251	0.42*	2.09
Observations	130		121		130		121	

1991-2000	High U-index (IRATS)		Low U-index (IRATS)		High U-index (CAL)		Low U-index (CAL)	
	CAR	*t*-stat	CAR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-30.84**	-27.32	20.62**	13.593	-5.07**	-11.925	2.94**	8.389
+12	7.08**	3.171	6.35**	2.797	0.2	0.55	0.62*	2.398
+24	25.21**	7.316	7.87*	2.368	0.35	1.085	0.19	0.825
+36	39.02**	9.043	12.12**	2.944	0.56^{+}	1.903	0.23	1.089
+48	51.29**	10.241	13.91**	2.923	0.59*	2.165	0.11	0.555
Observations	1114		523		1114		523	

2001-2015	High U-index (IRATS)		Low U-index (IRATS)		High U-index (CAL)		Low U-index (CAL)	
	CAR	*t*-stat	CAR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-21.67**	-23.421	20.04**	20.117	-3.73**	-15.073	3.34**	13.284
+12	2.39	1.524	0.66	0.6	0.37^{+}	1.875	0.11	0.755
+24	10.07**	4.118	3.4*	2.076	0.45*	2.495	0.24^{+}	1.751
+36	13.56**	4.293	6.77**	3.31	0.46**	2.725	0.27^{+}	1.894
+48	17.81**	4.522	10.58**	4.302	0.44**	2.67	0.28*	2.013
Observations	994		958		994		958	

2008-2015	High U-index (IRATS)		Low U-index (IRATS)		High U-index (CAL)		Low U-index (CAL)	
	CAR	*t*-stat	CAR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-22.64**	-18.21	18.6**	13.086	-3.85**	-12.413	3.17**	9.634
+12	4.24^{+}	1.809	1.93	1.364	0.34	1.222	0.2	1.467
+24	12.24**	3.387	4.83*	2.38	0.47^{+}	1.915	0.3*	2.406
+36	17.56**	3.86	9.68**	3.75	0.5*	2.21	0.37**	3.041
+48	21.45**	3.846	12.75**	3.971	0.5*	2.36	0.39**	3.26
Observations	495		517		495		517	

Table VI
Industry Characteristics

Percentage of high and low idiosyncratic risk and volatility companies for all industries for which we have at least 100 events in our sample.

	H Idsync. (1)	L Idsync. (2)	H Vol. (3)	L Vol. (4)	U/valued (5)	O/valued (6)
Software	21.6	14.7	40.5	5.1	19.8	15.1
Retail	16.6	13.5	14.1	13.4	14.3	20.2
Business Serv.	27.0	12.5	22.9	14.5	23.7	13.9
Chips	17.5	25.3	41.7	7.0	26.2	10.9
Insurance	16.1	28.3	4.4	42.5	19.3	6.6
Med. Equip.	24.5	13.4	21.1	22.5	16.4	18.3
Meals	27.0	9.7	13.6	14.4	20.2	11.9
Computers	19.8	29.6	29.8	8.3	23.2	16.6
Machinery	15.9	21.6	14.4	18.2	19.2	13.7
Chemicals	8.9	29.8	8.3	41.7	5.9	19.9
Wholesale	19.1	16.9	16.7	27.3	21.6	8.7
Pharm. Prod.	20.1	22.9	23.2	21.8	11.0	26.8
Transportation	14.7	19.3	17.7	9.5	24.5	11.0
Oil	13.3	30.3	10.9	23.8	13.6	10.2
Lab Equip.	17.2	22.7	23.4	14.3	19.8	11.0
Consumer Goods	20.2	14.3	14.7	25.2	19.0	21.3
Construct. Mat.	21.9	27.1	11.7	33.6	23.1	5.7
Healthcare	30.6	9.3	24.5	14.4	24.5	14.8
Autos	19.1	31.2	14.0	16.3	22.8	11.2
Telco	16.8	24.0	14.9	34.1	18.8	11.5
Food Prod.	24.2	23.2	7.1	46.0	13.1	18.7
Personal Serv.	32.3	14.0	16.7	11.8	21.5	12.4
Paper	22.7	24.4	8.0	30.7	15.9	14.8
Apparel	25.6	7.6	15.1	10.5	28.5	7.6
Steel	13.2	25.1	17.4	15.0	28.1	6.6
Construction	14.1	27.6	14.7	6.1	33.7	5.5
Print Pub.	15.7	19.3	7.9	47.9	17.9	15.0
Elec. Equip.	22.3	30.0	16.2	30.0	18.5	13.1
Recreation	29.8	9.7	23.4	9.7	20.2	13.7
Entertainment	26.2	12.6	32.0	19.4	27.2	14.6

Table VII
Buyback for Low and High idiosyncratic and for Low and and High U-index companies

This table presents the long-term abnormal return after open market repurchase announcements from the announcement date until t months after, for low and high idiosyncratic and for low and high U-index companies. Regardless of event study method and time horizon, the U-index works only for idiosyncratic companies. Panel A reports monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regression is run each event month j:

$$(R_{i,t} - R_{f,t}) \quad = \quad a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors. Panel B reports monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

Panel A: IRATs Cumulative Abnormal Returns

	Low Id.		High Id.		Low Id./High U-Ind.		Low Id./Low U-Ind.		High Id./High U-Ind.		High Id./Low U-Ind.	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-3.05**	-5.653	-9.87**	-12.899	-30.24**	-12.729	16.37**	13.718	-24.92**	-23.02	41.25**	7.315
+12	0.49	0.577	4.82**	3.963	-0.37	-0.077	3.85*	2.178	6.83**	3.161	-4.87	-1.282
+24	2.42+	1.908	13.21**	7.173	2.54	0.327	6.15*	2.299	22.94**	7.101	-1.77	-0.308
+36	3.86*	2.437	22.69**	9.737	12.78	1.234	7.16*	2.181	38.62**	9.396	2.84	0.408
+48	2.17	1.175	30.46**	11.07	9.44	0.774	6.84+	1.764	51.28**	10.592	5.5	0.627
Observations	2268		2268		122		458		966		125	

Panel B: Calendar Method Monthly Abnormal Returns

	Low Id.		High Id.		Low Id./High U-Ind.		Low Id./Low U-Ind.		High Id./High U-Ind.		High Id./Low U-Ind.	
	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat
-6	-0.39*	-2.4	-1.49**	-6.6	-3.32**	-7.295	2.42**	8.724	-4.02**	-12.942	5.09**	5.965
+12	0.15	0.988	0.22	1.496	0.03	0.072	0.49*	2.535	0.29	1.279	-0.96*	-2.435
+24	0.15	1.109	0.35**	2.707	0.25	0.683	0.28+	1.769	0.67**	3.492	-0.34	-0.908
+36	0.12	1.002	0.4**	3.207	0.59+	1.759	0.19	1.356	0.72**	4.021	-0.41	-1.284
+48	0.06	0.58	0.42**	3.44	0.41	1.325	0.13	1.047	0.77**	4.467	-0.25	-0.75
Observations	2268		2268		122		458		966		125	

Table VIII
Buyback for Low and High Volatility and for Low and and High U-index companies

This table presents the long-term abnormal return after open market repurchase announcements from the announcement date until t months after, for low and high volatility and for low and high U-index companies. Regardless of event study method and time horizon, the U-index works only for idiosyncratic companies. Panel A reports monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regression is run each event month j:

$$(R_{i,t} - R_{f,t}) \quad = \quad a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors. Panel B reports monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

Panel A: IRATs Cumulative Abnormal Returns

	Low Vol.		High Vol.		Low Vol./High U-ind.		Low Vol./Low U-ind.		High Vol./High U-ind.		High Vol./Low U-ind.	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-1.09**	-3.47	-13.68**	-13.951	-14.28**	-8.499	9.92**	15.58	-35**	-25.061	45.77**	9.979
+12	-0.88	-1.588	8.59**	5.878	-3.63	-1.05	0.87	0.773	5.67*	2.141	3.09	0.698
+24	-1.12	-1.233	19.3**	8.76	-6.42	-1.191	0.96	0.56	23.84**	5.917	6.63	1.037
+36	-0.05	-0.039	30.98**	11.337	-4.96	-0.664	0.87	0.396	39.86**	7.898	12.7	1.62
+48	1.52	1.044	38.61**	12	-2.58	-0.247	1.77	0.671	54.97**	9.1	22.5*	2.354
Observations	2268		2268		124		480		861		183	

Panel B: Calendar Method Monthly Abnormal Returns

	Low Vol.		High Vol.		Low Vol./High U-ind.		Low Vol./Low U-ind.		High Vol./High U-ind.		High Vol./Low U-ind.	
	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat	AR	t-stat
-6	-0.12	-1.356	-2.26**	-7.006	-2.03**	-7.419	1.71**	10.244	-5.36**	-14.37	6.2**	8.601
+12	0.05	0.553	0.62**	2.827	-0.38	-1.163	0.07	0.505	0.33	1.19	0.51	1.108
+24	0.04	0.525	0.58**	3.005	-0.1	-0.392	0.07	0.585	0.58*	2.389	0.84*	1.975
+36	0.08	1.052	0.55**	3.05	-0.06	-0.234	0.06	0.595	0.65**	2.949	0.65^{+}	1.803
+48	0.09	1.223	0.58**	3.23	-0.18	-0.732	0.08	0.729	0.73**	3.283	0.6^{+}	1.848
Observations	2268		2268		124		480		861		183	

Table IX
Relations across firm characteristics for Buybacks

Relation between Under/Overvaluation, High/Low Idiosyncratic Risk, High/Low volatilityfor buybacks. Numbers indicate percentage of firms in the row that are also categorized as noted in the columns.

	H Idiosync.	L Idiosync.	H Vol.	L Vol.
high U-index	43.2	5.5	38.5	5.5
low U-index	7.8	28.6	11.4	30.0
High Idiosync.	100.0	0.0	36.2	9.7
Low Idiosync.	0.0	100.0	11.2	35.7
High Vol.	36.2	11.2	100.0	0.0
Low Vol.	9.7	35.7	0.0	100.0

Table X
Correlations of Buybacks Characteristics

Correlation between the three buybacks characteristics considered: Idiosyncratic score (percentile across all CRSP companies of firm's $1 - R^2$, 0 to 1), Volatility score (percentile across all CRSP companies, 0 to 1) and U-index score (0 to 15). All scores are defined using the universe of all CRSP companies at the time of the announcement with data up to the month before the announcement.

	Idiosyncratic Score	Volatility Score	U-Index Score
Idiosyncratic Score	1.00	0.31	0.37
Volatility Score	0.31	1.00	0.33
U-Index Score	0.37	0.33	1.00

Table XI
EU relations with Firm Characteristics

Firm characteristics for each of the 7 EU-index samples. Percentages indicated for all but the last 3 rows, and averages for the last 3 rows. We consider firm *leverage*, based on data the year before announcement, defined as the ratio $debt/(debt + equity)$. *ISS later* measures the percentage of firms that announced an equity issue within 48 months after the buyback announcement. Next, we measure the percentage of buybacks financed with cash ($CASH$) when the data is available and whether the reported purpose included the term *Undervalued*, *Enhance Shareholder Value* or *stock option plan*. Market Cap. is in millions, BE/ME Score is from 1, for firms below the 4^{th} Fama-French BE/ME breakpoint, to 5 for firms above the 16^{th}. Percentage Shares is the percentage shares authorized at announcement.

	EU0	EU1	EU2	EU3	EU4	EU5	EU6
Low Leverage	1.6	5.4	10.7	19.4	29.6	34.0	36.2
High Leverage	32.6	31.9	26.5	19.0	13.9	11.4	9.4
ISS Later	6.2	3.9	5.1	5.9	6.3	7.0	8.0
Cash	5.7	5.5	5.2	6.6	6.6	8.3	7.3
Good purpose	16.1	17.3	20.8	21.6	22.2	22.9	23.5
Undervalued	0.0	1.3	1.5	3.1	4.6	5.8	8.5
Enhance Shareholder Value	14.5	14.8	19.6	19.1	17.7	17.9	15.3
Stock Option Plan	4.1	2.9	2.9	2.9	3.9	3.2	3.1
Market Cap.	29076.1	20917.0	10506.0	3350.8	1076.2	333.9	126.4
BE/ME Score	0.2	0.3	0.4	0.4	0.5	0.6	0.7
Percentage Shares	5.1	5.7	5.9	6.2	6.8	7.6	7.3

Table XII
Buyback announcements IRATS for all EU-index Values

IRATS five factor cumulative abnormal returns after open market repurchase announcements for each Enhanced Undervaluation Index value from 0 to 6. We calculate the EU-index simply as the sum of three numbers: high Peyer and Vermaelen (2009) U-index terms get a score of 2, low get a 0; high idiosyncratic terms get a score of 2, low get a 0; and high volatility terms get a score of 2, low get a 0. Firms that get neither 0 nor 2 (hence are in the middle of the range) get a score of 1 for each of these 3 scores. For each EU-index value, we report the monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regression is run each event month j:

$$(R_{i,t} - R_{f,t}) \quad = \quad a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors.

	EU-index 0		EU-index 1		EU-index 2		EU-index 3	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	9.14**	9.348	4.03**	7.535	1.66**	3.691	-6.02**	-12.936
+12	1.67	0.943	0.06	0.065	0.02	0.031	2.23**	2.968
+24	1.56	0.56	0.09	0.067	0.88	0.817	3.45**	3.032
+36	1.97	0.549	1.04	0.615	2.86*	2.08	5.05**	3.55
+48	-0.79	-0.186	1.15	0.566	3.58*	2.179	6.34**	3.747
Observations	193		1098		2534		3659	

	EU-index 4		EU-index 5		EU-index 6	
	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-12.01**	-15.291	-20.71**	-18.74	-31.66**	-15.899
+12	4**	3.467	6.29**	3.623	7.83^{+}	1.87
+24	10.18**	5.645	15.68**	5.742	29.6**	4.875
+36	14.6**	6.45	26.14**	7.485	54.36**	7.139
+48	15.34**	5.706	39.31**	9.186	69.41**	7.916
Observations	2186		1242		425	

Table XIII
Buyback announcements Calendar Time for all EU-index Values

IRATS five factor cumulative abnormal returns after open market repurchase announcements for each Enhanced Undervaluation Index value from 0 to 6. We calculate the EU-index simply as the sum of three numbers: high Peyer and Vermaelen (2009) U-index terms get a score of 2, low get a 0; high idiosyncratic terms get a score of 2, low get a 0; and high volatility terms get a score of 2, low get a 0. Firms that get neither 0 nor 2 (hence are in the middle of the range) get a score of 1 for each of these 3 scores. For each EU-index value, we report the monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors (the difference between the risk-free rate and the return on the equally weighted CRSP index, the monthly return on the size, book-to-market factor, profitability factor and investment factor in month) as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

	EU-index 0		EU-index 1		EU-index 2		EU-index 3	
	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	1.05**	5.016	0.77**	6.144	0.23*	2.016	-0.96**	-7.332
+12	0.07	0.427	0.06	0.587	0.14	1.33	0.16	1.413
+24	0.12	0.72	0.01	0.067	0.11	1.147	0.12	1.184
+36	0.14	0.99	0.02	0.257	0.11	1.21	0.09	0.941
+48	0.08	0.578	0.02	0.208	0.09	1.003	0.07	0.845
Observations	193		1098		2534		3659	

	EU-index 4		EU-index 5		EU-index 6	
	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-2.01**	-9.185	-3.11**	-9.737	-4.91**	-9.932
+12	0.17	0.986	0.55*	2.372	0.26	0.791
+24	0.15	1.113	0.46*	2.473	0.69*	2.415
+36	0.16	1.308	0.52**	2.891	0.84**	3.199
+48	0.12	1.013	0.65**	3.585	0.85**	3.384
Observations	2186		1242		425	

Table XIV
Long-run IRATS abnormal returns after open market repurchase announcements for low and high EU-index companies over different time periods.

Long-run abnormal returns five factor monthly abnormal returns after open market repurchase announcements for low and high Enhanced Undervaluation (EU) Index companies over different time periods. We define low EU-index firms those for which the EU-index is 0-1, and high for which it is 5-6 (note that the index takes values from 0 to 6). IRATS five factor cumulative abnormal returns after open market repurchase announcements for each EU-index value from 0 to 6. We calculate the EU-index simply as the sum of three numbers: high Peyer and Vermaelen (2009) U-index terms get a score of 2, low get a 0; high idiosyncratic terms get a score of 2, low get a 0; and high volatility terms get a score of 2, low get a 0. Firms that get neither 0 nor 2 (hence are in the middle of the range) get a score of 1 for each of these 3 scores. For each EU-index value, we report the monthly cumulative average abnormal returns (CAR) in percent using Ibbotson (1975) returns across time and security (IRATS) method combined with the Fama and French (2015a) five-factor model for the sample of firms that announced an open market share repurchase plus various subsamples. The following regression is run each event month j:

$$(R_{i,t} - R_{f,t}) \quad = \quad a_j + b_j(R_{m,t} - R_{f,t}) + c_j SMB_t + d_j HML_t + e_t RMW_t + f_t CMA_t + \epsilon_{i,t},$$

where $R_{i,t}$ is the monthly return on security i in the calendar month t that corresponds to the event month j, with $j = 0$ being the month of the repurchase announcement. $R_{f,t}$ and $R_{m,t}$ are the risk-free rate and the return on the equally weighted CRSP index, respectively. SMB_t, HML_t, RMW_t, CMA_t are the monthly returns on the size, book-to-market factor, profitability factor and investment factor in month t, respectively. The numbers reported are sums of the intercepts of cross-sectional regressions over the relevant event-time-periods expressed in percentage terms. The standard error (denominator of the t-statistic) for a window is the square root of the sum of the squares of the monthly standard errors.

	1985-1990: High-EU		Low-EU		1991-2000: High-EU		Low-EU	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-23.26**	-5	2.4*	1.98	-29.05**	-18.858	3.04**	3.493
+12	10.92	1.62	5.91**	2.886	12.22**	4.098	-2.15	-1.446
+24	8.61	0.797	6.57*	2.282	33.65**	7.504	-2.25	-1.021
+36	3.82	0.274	7.96*	2.246	55.39**	9.906	-2.36	-0.85
+48	19.15	0.915	11.28**	2.753	74.76**	11.506	-4.56	-1.395
Observations	85		189		813		576	
	2001-2015: High-EU		Low-EU		2008-2015: High-EU		Low-EU	
	CAR	t-stat	CAR	t-stat	CAR	t-stat	CAR	t-stat
-6	-16.69**	-12.196	7.22**	11.831	-18.66**	-10.265	6.63**	8.778
+12	4.4*	2.243	0.89	0.87	7.08*	2.48	2.65*	2.021
+24	11.7**	3.966	1.25	0.8	11.99**	2.723	4.47*	2.385
+36	17.33**	4.571	3.46^{+}	1.739	17.24**	3.125	8.68**	3.561
+48	24.52**	5.308	5.68*	2.244	25.71**	3.761	12.53**	4.231
Observations	769		526		392		303	

Table XV
Calendar method monthly abnormal returns after open market repurchase announcements for low and high EU-index companies over different time periods.

Long-term monthly abnormal returns after open market repurchase announcements for low and high Enhanced Undervaluation (EU) Index companies over different time periods. We define low EU-index firms those for which the EU-index is 0-1, and high for which it is 5-6 (note that the index takes values from 0 to 6). We calculate the EU-index simply as the sum of three numbers: high Peyer and Vermaelen (2009) U-index terms get a score of 2, low get a 0; high idiosyncratic terms get a score of 2, low get a 0; and high volatility terms get a score of 2, low get a 0. Firms that get neither 0 nor 2 (hence are in the middle of the range) get a score of 1 for each of these 3 scores. For each EU-index value, we report the monthly average abnormal returns (AR) of equally weighted Calendar Time portfolios using the Fama and French (2015a) five-factor model. In this method, event firms that have announced an open market buyback in the last calendar months form the basis of the calendar month portfolio. A single time-series regression is run with the excess returns of the calendar portfolio as the dependent variable and the returns of five factors (the difference between the risk-free rate and the return on the equally weighted CRSP index, the monthly return on the size, book-to-market factor, profitability factor and investment factor in month) as the independent variables. The significance levels are indicated by +, *, and ** and correspond to a significance level of 10%, 5%, and 1% respectively, using a two-tailed test.

	1985-1990: High-EU		Low-EU		1991-2000: High-EU		Low-EU	
	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-4.12**	-3.971	0.37	1.234	-4.8**	-7.401	0.73**	2.935
+12	0.5	0.815	0.3	1.39	0.59	1.184	-0.05	-0.22
+24	-0.1	-0.184	0.23	1.453	0.7	1.617	-0.29	-1.58
+36	0.16	0.344	0.19	1.246	1.02*	2.532	-0.11	-0.727
+48	0.99*	2.274	0.25	1.637	1.04**	2.785	-0.21	-1.531
Observations	85		189		813		576	

	2001-2015: High-EU		Low-EU		2008-2015: High-EU		Low-EU	
	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat	AR	*t*-stat
-6	-2.92**	-8.498	1.21**	8.101	-3.07**	-7.836	1.17**	8.415
+12	0.47*	2.3	0.11	0.876	0.58^{+}	1.909	0.2^{+}	1.88
+24	0.48**	2.614	0.11	0.969	0.57*	2.157	0.18^{+}	1.874
+36	0.5**	2.836	0.13	1.099	0.55*	2.175	0.22*	2.437
+48	0.51**	2.956	0.12	1.036	0.62*	2.548	0.24**	2.671
Observations	769		526		392		303	

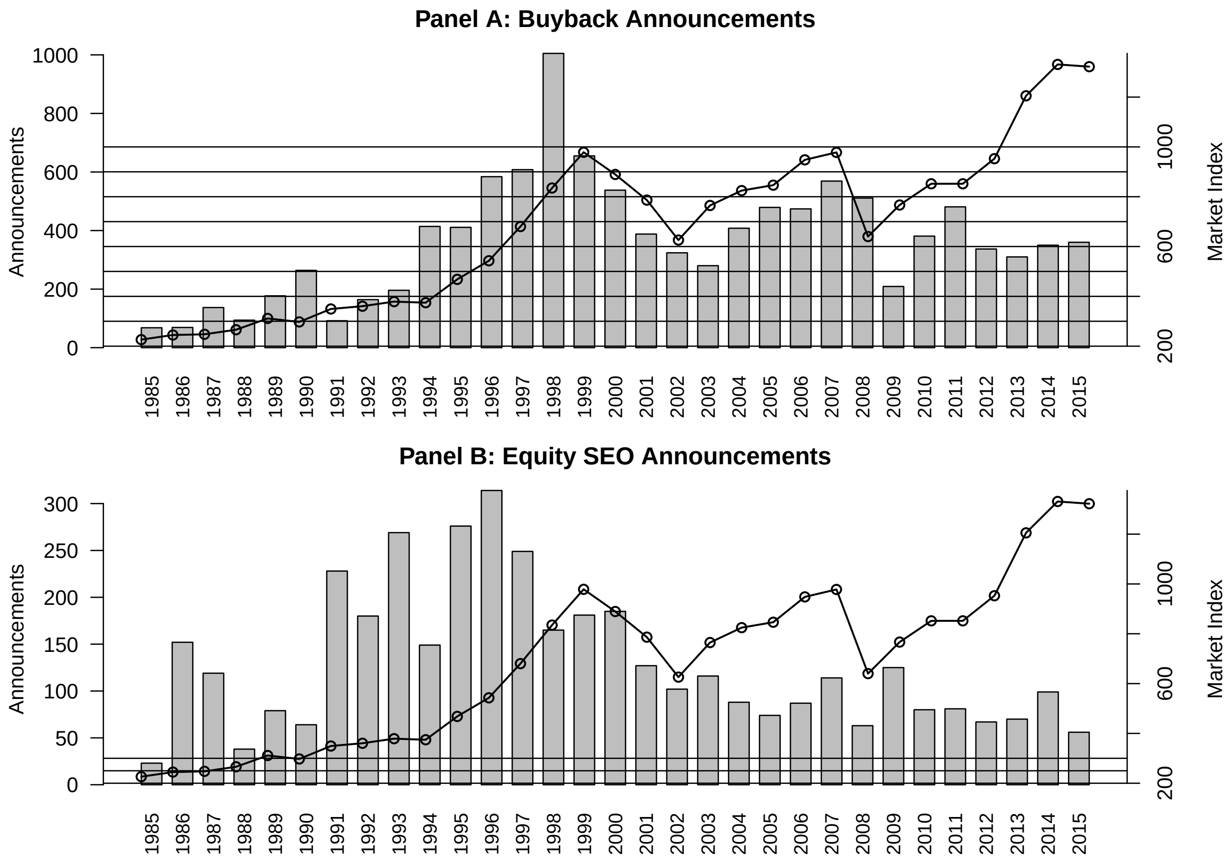

Figure 1. Buyback and equity announcements. Number of announcements per year. Panel A: Buyback announcements; Panel B: Equity SEO announcements. Solid line and right hand axis shows the $S\&P$ index at the end of each year, starting from 100 in January 1985. Buyback activity rises prior to stock market increases and tends to fall afterwards. Also note the structural decline in equity since 2000.

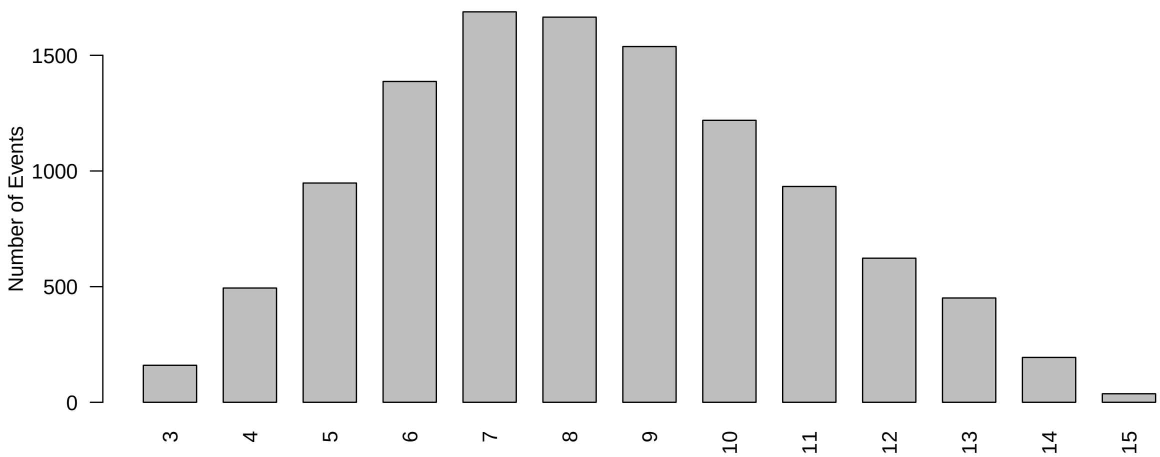

Figure 2. Distribution of the Undervaluation Index of all buyback events.

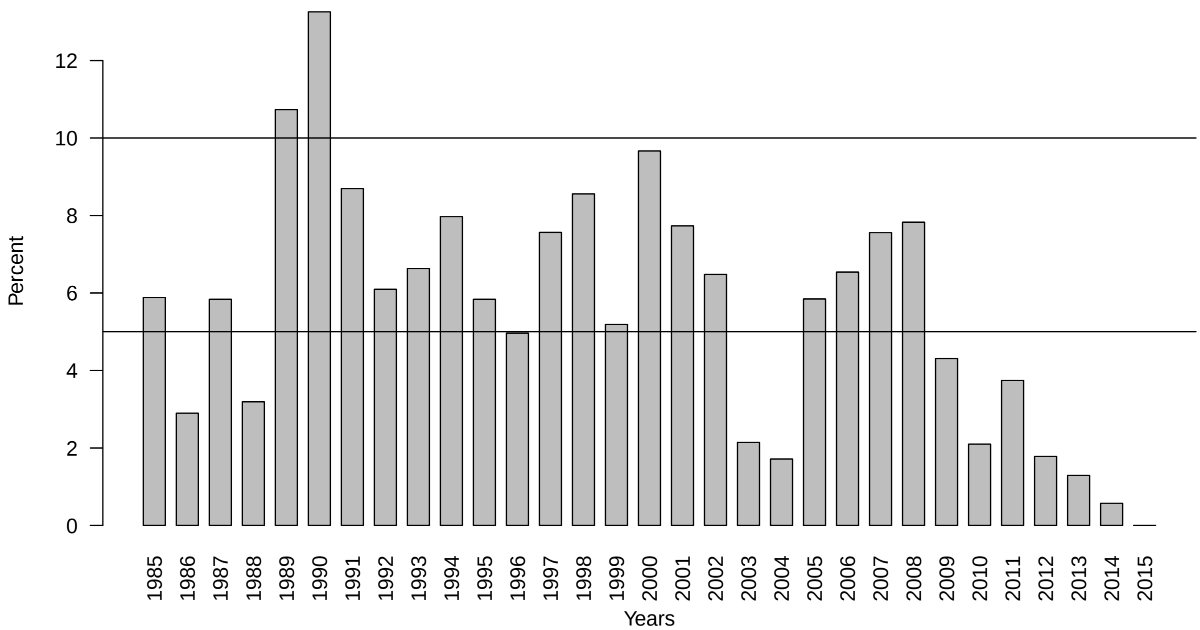

Figure 3. Buybacks with a follow-up equity issue within 48 months. We show the percent of announced buyback events each year, that had a follow-up issue within 48 months after the event. The average percentage is 5.60% and there are only 2 years (1989 and 1990) where the percentage is larger than 10%.

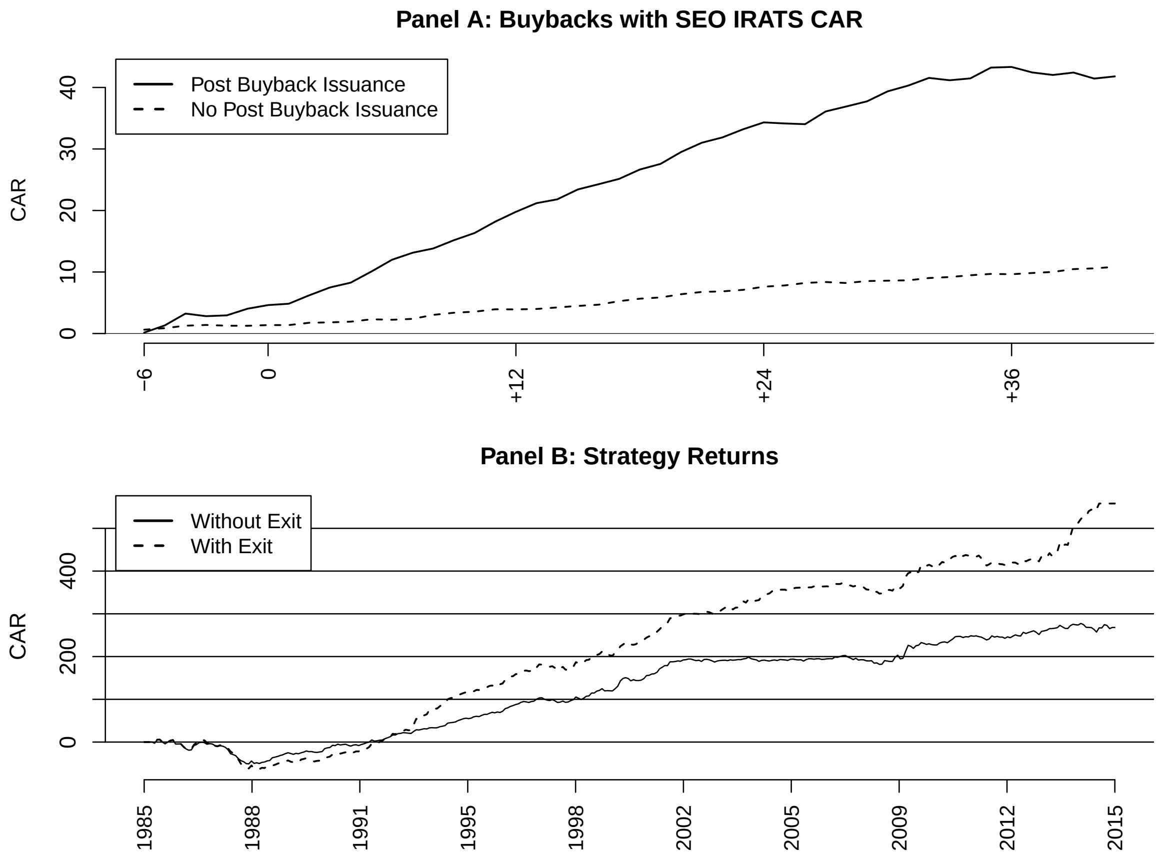

Figure 4. Buybacks followed by equity issues within 48 months. Top Panel A: Five factor IRATS CAR for all buyback events that had (with hindsight) no subsequent SEO event within the 48 months post buyback announcement (solid line) versus those that did have (dashed line). Bottom Panel B: Abnormal (five-factor rolling hedged) returns of buybacks portfolio for only the 659 events for which there was a subsequent issue within 4 years. Dashed line is if we exit these positions the month after the subsequent SEO announcement.

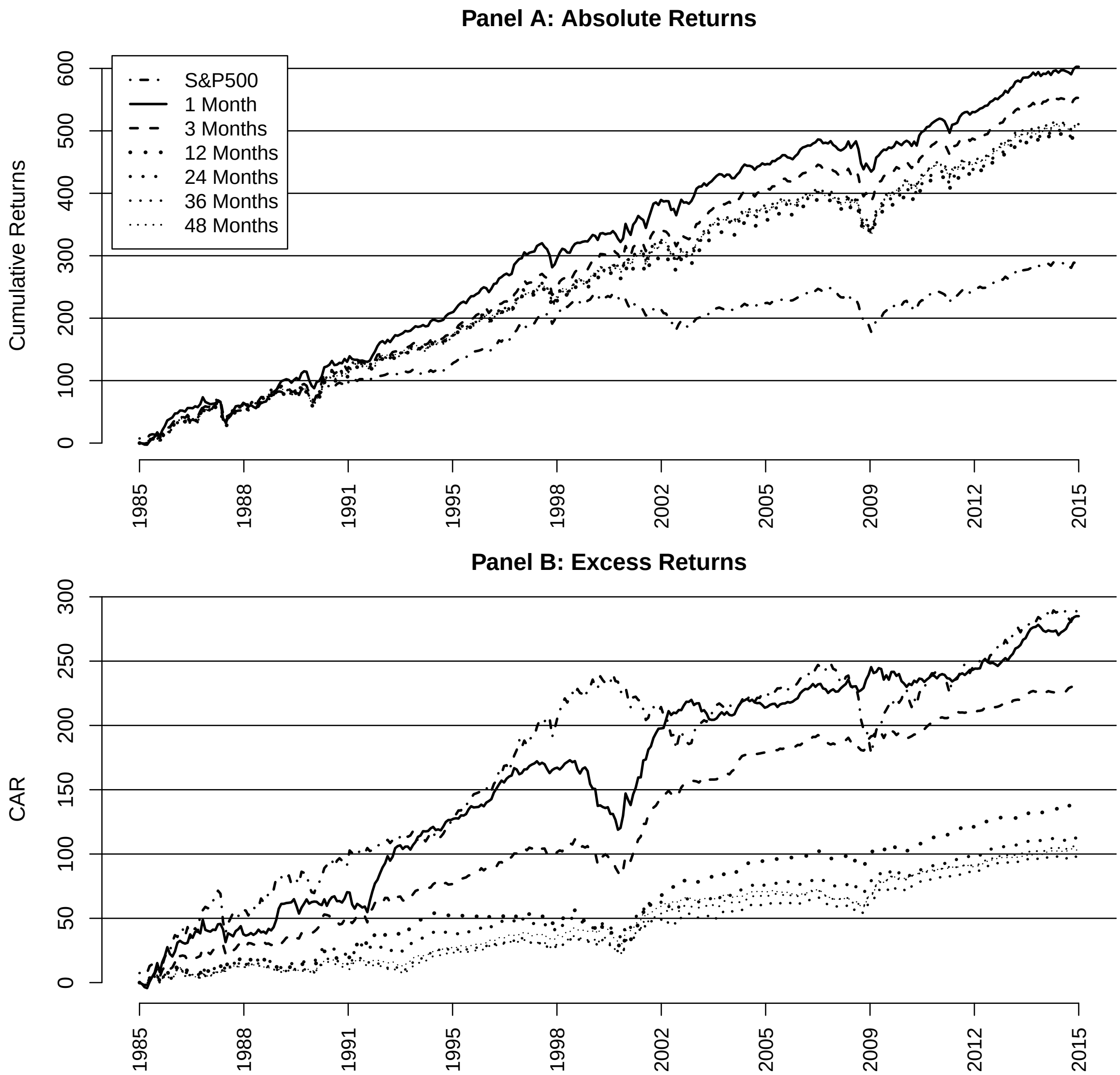

Figure 5. Cumulative returns of portfolios of all buybacks for different holding periods. Panel A: Absolute returns; Panel B: five-factor Rolling Hedged Abnormal returns using a rolling window of 18 months, lagging 1 month. Dotted-dashed line (e.g., lowest one in Panel A) is the cumulative returns of the $S\&P$ Index, for comparison; solid line is with 1-month holding period, dashed line is with 3 months holding period; dotted lines are, from the most to the least dark ones, for 6, 12, 24, and 48 months holding periods. Note that the last few lines overlap to a large extend (especially in Panel A). We assume we enter each position 1 day after the corresponding event announcement.

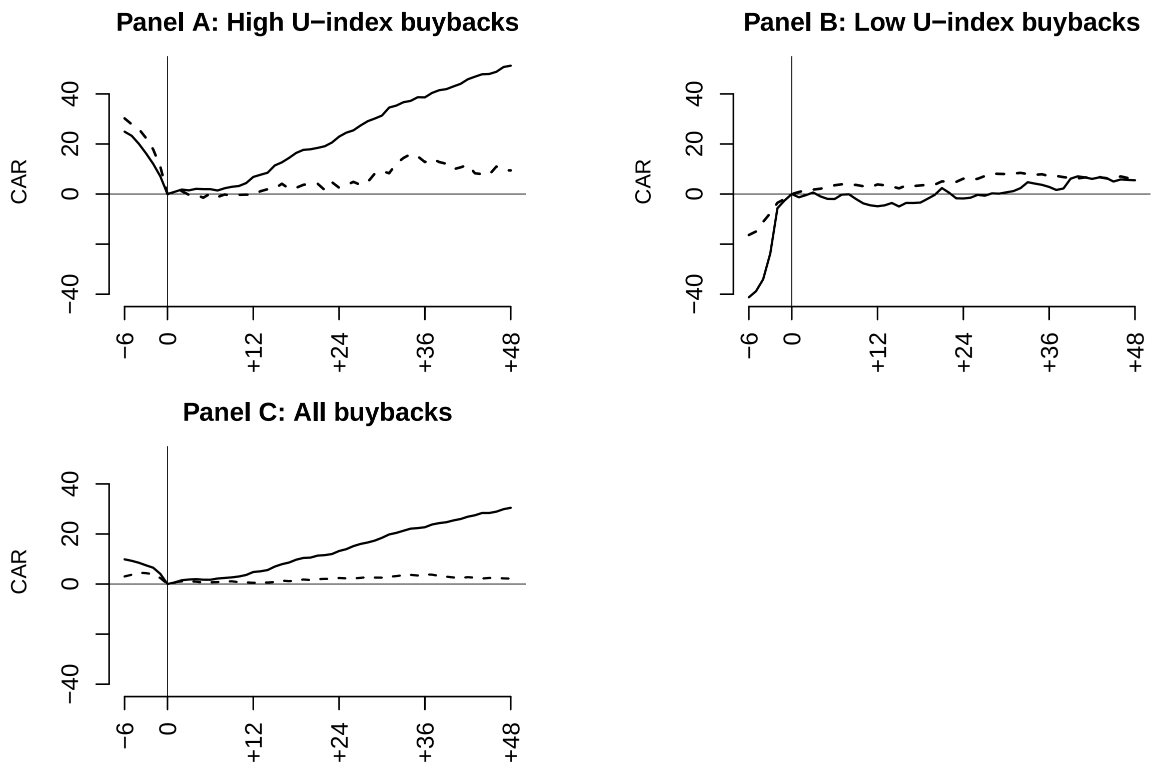

Figure 6. Long-run five factors cumulative average abnormal returns (IRATS) of high (solid line) and low (dashed line) idiosyncratic buybacks. The x-axis indicates months from the date of the event announcement. Panel A shows only the high U-index companies, Panel B the low U-index ones, and bottom Panel C includes the whole sample.

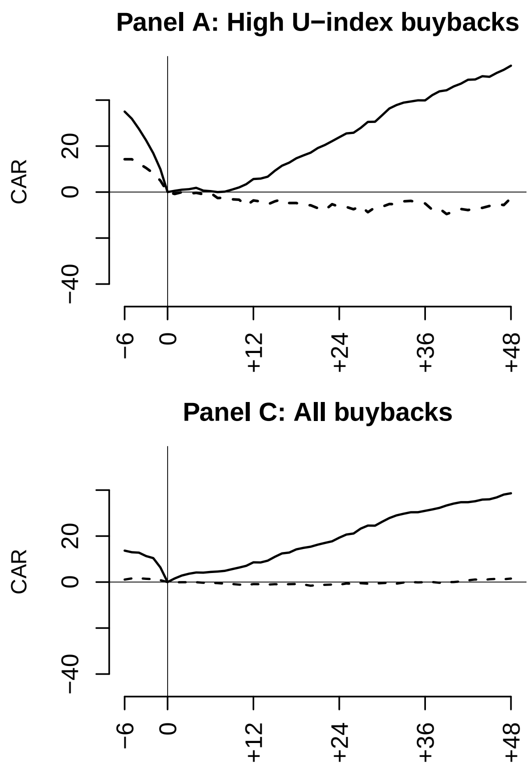

Figure 7. Volatility and the U-index. Long-run five factors cumulative average abnormal returns (IRATS) of high (solid line) and low (dashed line) volatility buybacks. The x-axis indicates months from the date of the event announcement. Panel A shows only the high U-index companies, Panel B the low U-index ones, and bottom Panel C includes the whole sample.

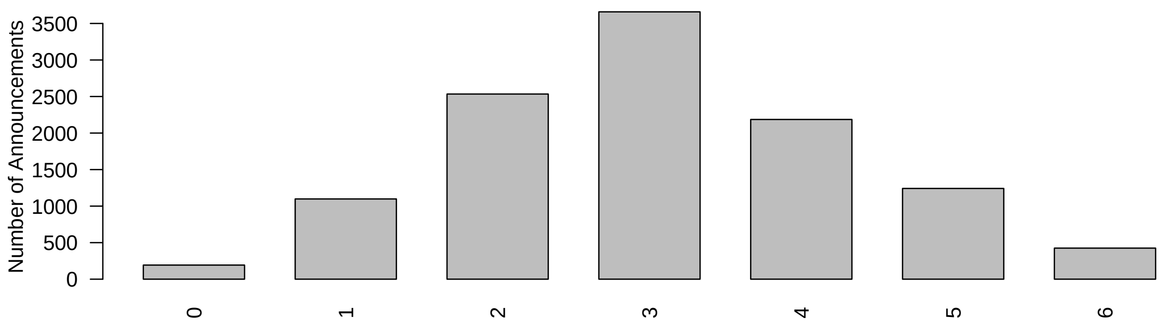

Figure 8. EU-index. Distribution of the EU-index of all buyback events.

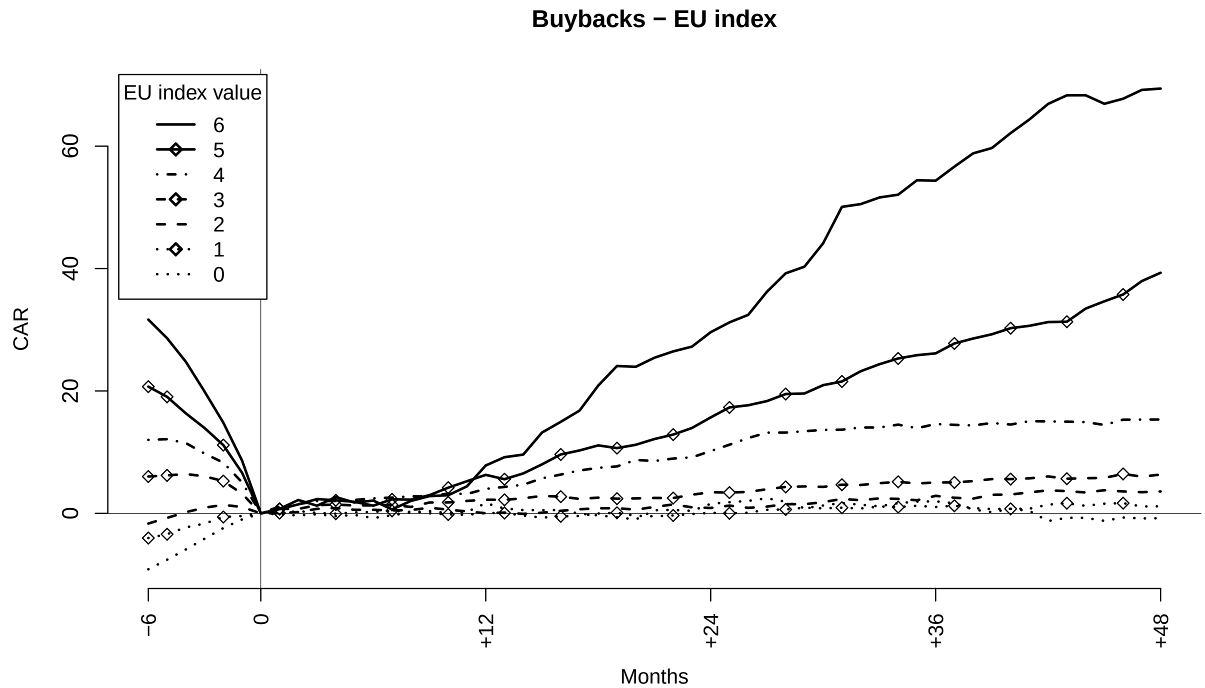

Figure 9. Long-run IRATS five factors cumulative abnormal returns of buybacks depending on the EU-index. From the highest to the lowest lines: solid line is for EU-index 6, solid with diamonds for EU index 5, dotted-dashed for EU index 4, dashed with diamonds for EU index 3, dashed for EU index 2, dotted with diamonds for EU index 1, and finally the lowest dotted line is for EU index 0. The x-axis indicates months from the date of the event announcement.

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