Security Issue Timing:
What Do Managers Know, and When Do They Know It?

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ABSTRACT

We study put option sales undertaken by corporations during their repurchase programs. Put sales' main theoretical motivation is market timing, providing an excellent framework for studying whether security issues reflect managers' ability to identify mispricing. Our evidence is that these bets reflect timing ability, and are not simply a result of overconfidence. In the 100 days following put option issues, there is roughly a 5% abnormal stock price return, and the abnormal return is concentrated around the first earnings release date following put option sales. Longer term effects are generally not detected. Put sales also appear to reflect successful bets on the direction of stock price volatility.

1 Introduction

This paper examines corporate put option sales undertaken by U.S. corporations during their repurchase programs in the 1991-2004 period. Using a comprehensive, hand-collected dataset, we study the firms and the put sale transactions. Our contribution is two-fold. First, put sales are an interesting financial innovation in their own right, and our study is the only large-scale empirical analysis. Second and more importantly, put option sales provide an excellent setting to study managers' market timing ability. Put option sales are gambles that the firm's stock price will rise. Market timing is the main theoretical justification for put option sales in previous work (see Section 2), and our main tests focus on the evidence. More broadly, our study advances an extensive literature on the relation between corporate transactions and market timing (see Eckbo, Masulis, and Norli, 2006 and Baker, Ruback, Wurgler, 2006 for surveys).

When the firm's securities are mispriced and managers can identify the mispricing, this can affect investment, financing, and other corporate decisions. For example, if managers know that the firm's stock is overpriced, they can take advantage by issuing equity. Despite the extent of the literature, the importance of market timing explanations for corporate behavior is hotly debated and still unresolved (Baker, Ruback, Wurgler, 2006).

Since there are many motives for corporate security issues, distinguishing among alternative explanations for why they occur is problematic. Other pieces of evidence on timing ability are not very informative. Survey evidence shows that CFOs feel that their security transactions can time the market (Graham and Harvey, 2001), but this may simply reflect overconfidence. Potentially informative evidence on managers' market timing ability could come from insider trading studies. Yet recent studies raise serious doubts about whether there is significant market timing ability within large firms (see Lakonishok and Lee, 2001, Jenter, 2005).

We provide direct evidence on whether key assumptions of market timing stories– both mispricing and the ability to identify it–are empirically relevant in corporate decisions. Our 137 sample companies are typically large, including firms such as Bank of

America, Boeing, IBM, MacDonald's, Microsoft, and Proctor and Gamble. The median firm is in the S&P 500. If put option sales reflect timing ability, it shifts our priors and increases our confidence in the potential importance of timing explanations for a broader cross-section of firms and a wider range of transactions. If put option sales do not reflect timing ability, this would lend credence to alternative hypotheses, in particular that managers do not have private information but are overconfident about their own abilities to predict future returns. Many papers examine the implications of managerial overconfidence, and recent empirical work suggests that there is an association between managerial overconfidence and aggressive corporate policies (Ben-David, Graham, and Harvey, 2006). Put sales do represent an aggressive bet, but the underlying motivation is ultimately an empirical question.

The put option sale setting provides an experimental design with many useful features. First, unlike debt or equity issues, put sales have no simultaneous effect on investment activity. We argue that management's belief that it can time the market (i.e., distinguish between prices and fundamental value) represents the most likely rationale. Thus, any abnormal stock returns subsequent to these transactions cannot be attributed to contamination from investment effects. Second, this setting could reduce errors of inference because the typical put option issued has a maturity of only 6 months. Given the short maturities, our timing tests can focus on the detection of short-horizon effects. This avoids the well-known difficulties associated with long-horizon return studies (see Fama, 1998, and Kothari and Warner, 2006 for overviews). Third, the fact that firms issuing these options are choosing short maturities is itself of interest. It suggests that what management thinks it knows about mispricing is short-term in nature. Whether in fact such short term predictability exists is a question on which we provide evidence. Finally, put option issues represent bets not only on the stock price, but on volatility. If management has private information that volatility will be lower than what put buyers expect, then put sales will be profitable. We examine volatility patterns to see if timing ability and management's information extends to higher order moments of the stock return distribution.

We find strong evidence that managers can predict future returns on the firm's stock. In the 100 trading days following put option issues, there is roughly a 5% abnormal

return. Much of the abnormal return is concentrated around the first earnings release date following the put sale. Further, the results are robust to specification of the abnormal return model. Longer term effects are generally not detected. The evidence also seems consistent with timing ability extending to volatility timing. Volatility declines after a firm's initial put sale and increases after a put sale program terminates.

Our findings are also related to the literature on corporate hedging. Some papers in this area raise questions about whether activities labeled hedging are actually attempts to exploit information and make directional bets (see Baker, Ruback, Wurgler, 2006), and statements by CFOs raise the same possibility. For example, in a 1999 interview, the Microsoft CFO stated that "the vast majority of (hedging) programs are straight hedges…I expect they will continue to make money" (CFO Magazine, October 1999). Our evidence suggests that put option sales reflect timing ability. Although put option sales undertaken in conjunction with repurchase programs are sometimes referred to as a hedge by practitioners, this is true only in the sense that the option premium reduces the cash required to repurchase shares. Since the return to the put selling firm is positively correlated with the return on the firm's shares, firm risk is increased, not reduced, by a put option sale.

Section 2 gives background and discusses institutional features of put option issues, as well as the paper's testable propositions. Section 3 describes the data. Section 4 discusses the stock return performance around put option issues. Section 5 concludes.

2 Background

2.1 Institutional Features

Put option programs are a financial innovation characterized by a dramatic rise, and an equally dramatic fall. A 1991 SEC ruling allows firms with repurchase programs to issue puts in their own stock. The ruling, in the form of a "no action" letter, states that the SEC will take no enforcement action against put issuers for manipulation of stock prices

under the Securities Acts of 1933 and 1934.[1] Few specific restrictions apply to the put issues, but they must be out of the money at issue.

The use of put options in conjunction with share repurchase programs surged in the 1990s. Although the impetus for the 1991 ruling came from the CBOE, the put sales were generally structured as privately negotiated transactions. The counterparty was typically an investment bank, who hedged the purchase by buying shares. The transactions were highly touted in the financial press.[2] Advantages cited include the general profitability, the tax-free proceeds[3], and the minimal disclosure requirements. Players in this market included Salomon Brothers and Morgan Stanley. In the latter case, Morgan purchased the software which had been developed in-house by IBM, an early issuer, in conjunction with its own put option sales.

Since 2002, however, transactions have largely dried up. Many issuing firms lost money in the Internet bubble, with Microsoft taking a reported loss of 1.3 billion (McDonald, 2003). In addition, FAS No. 150 in 2003 likely had a damaging effect (see Bear Stearns, 2006). It changed the balance sheet classification of all put option sales from equity to liability. It also increased the transparency of put option sales and their effect on earnings volatility, because changes in fair value of put options had to be recorded through earnings.[4]

2.2 Firms' Motivation

While there is a practitioner and academic literature on put option sales, there is a big gap in our knowledge. The literature is a mix of description, theory, and small sample or case analyses.[5] Because most firms do not publicize their use of such contracts, the relevant data are difficult to obtain. To fill this gap, we assemble a comprehensive sample

[1] For further details of the history, see Posell and Eades (1992a, b). Regulatory issues are also discussed in CBOE Investor Series Paper #2 "Corporate Stock Repurchase Programs and Listed Options" (2001).
[2] For example, The Business Week headline on February 23, 1998 stated that "Hedging techniques are earning millions in tax free income for savvy companies".
[3] Sale proceeds are tax free under Section 1032 of the Internal Revenue Code, and do not increase accounting earnings.
[4] Under Emerging Issues Task Force (EITF) issue 88-9, put warrants were recorded at fair value in permanent equity. EITF issue 00-19 during our sample period also appears to have increased disclosure requirements.
[5] A Darden School case and teaching note provides an analysis of IBM's 1992 put sales. (Posell and Eades, 1992a, b); the empirical analysis in McDonald (2003) focuses mainly on Dell and Microsoft.

of put option issuers, based on largely hand-collected data. We document the features of put option sales, and provide evidence on firms' motivation.

We focus on whether managers appear to have private information. This explanation pervades the put option sale literature. Other explanations are generally dismissed and have attracted less attention. Angel, Gastineau, and Weber (1997, p. 111) argue that the main rationale for using puts "is surprisingly simple: the underlying common stock is cheap"; in addition, these authors argue that puts are undervalued if management has private information that future volatility is lower than put buyers expect. Gibson, Povel, and Singh (2006) also presume that firms issuing put warrants have private information. In their model, put sales signal the firm's prospects (see also Gyoshev, 2001 for a similar argument). McDonald (2003) and Atanasov, Gyoshev, Szewczyk, and Tsetsekos (2004) question the signaling motive because most firms do not announce put option sales. Grullon and Ikenberry (2000, p.51) list managers' market timing abilities as a reason for the transactions, but they recognize that it is a strong assumption. At the same time, they are hard-pressed to find any other reason why put options are sold. They argue that there are potential costs: selling the options increases exposure to bad news and reduces flexibility because it precommits the firm to buy shares.

A number of explanations for put option issues are analyzed by McDonald (2003). These include regulation, off-balance sheet treatment, and private information. He generally dismisses all explanations he considers, concluding that "there is no one single obvious and compelling explanation for put sales". He is skeptical about private information explanations on theoretical grounds, and raises interesting questions about how firms could capture the gains. For example, since put sale transactions are not anonymous, one would expect that in an efficient market, the nature of the information would be incorporated into the put sale proceeds.[6] This point is addressed, however, in the theoretical model of Atanasov et al. (2004). In their analysis, investment bankers lose money on the options they purchase, but in equilibrium their relationship with the issuing firm allows them to make money by going long in the undervalued shares. Consistent with this, for a sample of 17 firms, they show that there is abnormal positive stock price

[6] In addition, he argues that the put sales are inefficient because they are tax-disadvantageous relative to an equivalent position which goes long in shares and borrows.

performance following initial put sales. Gyoshev (2001) finds similar evidence for a sample of 38 initial sales.

We treat the hypothesis that put sales are made because managers have private information as the paper's central economic question. While the literature offers little insight into other reasons that put option sales could create value, an interesting alternative hypothesis is that put sales are simply mistakes made by overconfident managers. This kind of alternative hypothesis is implicit in our tests. Further, we have data on each firms' transactions. As discussed later, this allows us to better examine both cross-sectional and time-series differences in abnormal returns subsequent to put option sales, and whether the transactions reflect private information, or just luck.

3 Data collection and descriptive statistics

We identify firms that sold put options on their own stock between 1991 and 2004 by searching all annual and quarterly reports available on the Lexis-Nexis, Factiva, and Edgar databases. We eliminate any put issues which are sold in conjunction with other equity or debt securities by the same firm, and retain only stand-alone put sales. We match the put sellers with data on firm characteristics from Compustat and data on stock returns from CRSP. The final, comprehensive sample contains 137 firms and 796 distinct put issues. Fig. 1 shows that the put sales start in 1991 (with two issues by Intel) and increase in number throughout the 1990s. Put issues peak at 122 sales by 52 firms in 2000 before declining to 48 issues in 2002 and finally dropping to just two issues in 2004.

3.1 Firm characteristics

Table 1 reports characteristics of the put selling firms, and presents the same characteristics for all Compustat firms and for firms with ongoing share repurchase programs. The latter comparison is relevant since put sale programs are framed and announced as part of share repurchase programs, and it is interesting to see whether put sellers differ from other repurchasing firms. We define a share repurchase program as ongoing in a fiscal quarter when a firm repurchases shares worth at least 0.5% of its prior-quarter book assets.

Table 1 shows that, on average, put issuers are larger than Compustat firms or firms with standard share repurchase programs. For example, the average book value of assets is $10.0 billion for put issuers, compared to $2.3 billion for both Compustat firms and repurchasing firms. Put sellers have average sales of $6.1 billion, compared to $1.2 billion for Compustat firms and $1.8 billion for repurchasers. Their large size is reflected in the fact that 75 out of 137 put sellers are in the S&P500 in some or all of the years in which they sell puts.

Put issuers are more profitable than other Compustat firms or repurchasers, with average ROA of 9% compared to –4% and 3%, respectively. They also have higher market valuations relative to book values: Put sellers have an average book-to-market ratio of 0.38, compared to 0.74 for Compustat firms and 0.63 for share repurchasers. All in all, put issuers tend to be large, profitable, and fast growing firms with high market valuations, and they outperform firms with standard share repurchase programs on all these dimensions.

3.2 Put characteristics

Table 2 presents descriptive statistics on the put options issued by the sample firms. Typically, put sellers make no pre- or post-sale announcements of specific put sale transactions, and all our data is collected from subsequent financial statements. The detail and quality of the reported information varies greatly across firms and is sometimes not highly detailed. For this reason the summary statistics are based on fewer observations than the total number of 796 put sales. The purchaser of the options is typically described as a financial investor or an investment bank, and its name is disclosed in only a small number of cases. None of the puts appears to have been issued on a public exchange. The options are described as European whenever that information is provided, which is the case for only a minority of the sales. Some of the puts have non-standard features, such as allowing the issuer to settle the options before expiration, but the information on these features is again incomplete.

Panel A reports statistics on individual put sale transactions. The exact date at which the put sale occurs is usually not reported, and we only know the month or quarter (or occasionally an even longer time period) during which the sale takes place, with most

sales reported as quarterly aggregates. This implies that the sales may reflect a single put issue if there was only one sale during the quarter, or they may be the aggregate of multiple issues that are reported together.

The average sale transaction creates put options on 4.9 million shares, corresponding to 0.88% of shares outstanding. The puts have an average face value, defined as the number of puts times the average strike price, of $67.6 million, and the issuing firm collects an average premium of $10.5 million per sale. The size distribution of the put sales is right-skewed, with the largest face value of a single sale equal to $2.6 billion and the largest premium collected equal to $402 million.

The vast majority of the puts are sold out of the money, with an average ratio of strike price to stock price during the put sale period of 0.95.[7] The median put sale has a maturity of six months, with a mean of 211 calendar days. Information on final put outcomes is provided for 447 of the 796 put sales, and, for this sub-sample, 36% of the put issues are exercised and 64% expire out of the money.

Panel B reports summary information on the overall put sale programs. The average program consists of 5.8 put sales that occur over a period of 2.1 years. If we restrict the sample to the 103 firms that allow us to pinpoint each sale to (at most) a quarter, we find that the majority of programs are concentrated in only a few quarters: 29 firms issue puts in a single quarter, 21 in two quarters, 11 firms in three quarters, and 5 firms in four quarters. Only 12 firms issue puts in ten or more quarters. The average put issuer in the full sample sells options on 21 million shares or 4.2% of shares outstanding in total, and receives proceeds of $53.4 million. The total face value, that is the total value put at risk through the put sales, has a mean of $223.4 million. The highest proceeds collected by a single firm are $2.1 billion by Microsoft, and the highest face value is $7.7 billion by Intel.

[7] In a small number of cases it is certain that puts are issued in the money because the strike price exceeds the stock price on all days of the put sale period. The 1991 SEC "no action" letter permits only the sale of out of the money puts, but explicitly deals only with exchange traded options. The over-the-counter options analyzed here are issued in a regulatory gray area, and some firms apparently did not feel bound by the restrictions in the "no action" letter.

4 Can managers time the market with put option sales?

We argue in Section 2 that market timing is the premier explanation for put option sales, and in this section, we test whether managers can time the market successfully.

4.1 Stock price performance after put option sales

Our first tests focus on detecting abnormal stock returns after put option sales. As explained in Section 3, we typically do not know the precise date at which the puts are sold. In most cases, we only know a time interval during which the sale occurs, usually a fiscal quarter, a calendar month, or sometimes multiple fiscal quarters. We call this time interval a "sale period" and we define an "event" as the last day of the sale period. If more than one put transaction occurs within the same sale period, we treat these transactions as one event in the subsequent analysis. In the following, we use the terms event and put sale interchangeably.

4.1.1 Basic findings

Fig. 2 shows average cumulative abnormal returns starting from trading day –100 to day 150 after the event. We have 651 events with abnormal returns available on day –100. To compute daily abnormal returns for each stock, we subtract the daily return on a benchmark portfolio from the corresponding stock return. In Fig. 2, we use as benchmarks the 49 industry portfolios and the 100 size and book-to-market portfolios from Ken French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/ (see also Fama and French, 1993 and 1997). The cumulative return from day –100 to t is then the sum of the daily abnormal returns during that period.

Fig. 2 is striking. The average cumulative abnormal return is close to zero during the 100 trading days leading up to the put sale, but increases immediately thereafter. For example, the mean industry-adjusted return is –0.55% on day 0, it increases to 1.87% during the first 50 trading days after the sale, and reaches 3.75% by day 100. The cumulative return appears flat during the following 50 days.

These findings suggest that managers are able to use private information to time put option sales. Moreover, managers' private information is relatively short lived: it affects

returns immediately after the event and is fully incorporated into prices within the following 100 trading days. This is much shorter than the long-run under- or overperformance associated with other corporate events, such as stock issues or repurchases.[8] Interestingly, returns are zero or negative during the last fiscal quarter before the event, even though in most cases the actual put sales occur during that quarter. As we show in Section 4.2, however, most of the post-sale abnormal returns are realized within a short window around the first post-sale earnings announcement, which is consistent with the return pattern in Fig.1.

In Table 3, we test whether the abnormal post-sale returns are statistically significant. We divide the event horizon into six 50-day intervals: from trading day –100 to –50, from trading day –50 to 0, etc., and report average cumulative returns and t-statistics for each of the 50-day intervals. If a given interval (e.g. –50 to 0) overlaps for different events of the same firm, we keep only the earlier event. The table confirms the findings in Fig. 2. Benchmark adjusted returns are positive and statistically significant for the first two intervals following the put sale. For example, the size and book-to-market adjusted return is 2.73% for the first 50 days after the put sale (t-statistic, 3.67), and it is 1.93% for the subsequent 50 days (t-statistic, 2.51). Benchmark adjusted returns are negative and not significant for the two time intervals before the put sale.

The t-statistics in Table 3 could be overstated because event horizons overlap for some firms. To address this issue, we use the rolling portfolio approach suggested by Fama (1998). Specifically, for each day in the sample period, we construct a backward-looking portfolio consisting of firms that have an event during the past 70 calendar days (we also look at the 140-day horizon; we choose the calendar-time horizons to match the horizons in Table 3). We then regress the portfolio excess returns on the excess returns on the market portfolio and the Fama and French (1993) size and book-to-market factors, and test whether the regression intercepts (alphas) are different from zero. Intuitively, this method collapses the overlapping stock returns for a given day into one portfolio return, so that the standard errors are adjusted for cross-correlation. The tests confirm the results in Table 3. The daily alpha obtained using the 70-day equal weighted portfolio is 0.07%

[8] See, for example, the survey articles by Fama (1998), Mitchell and Stafford (2000), Eckbo, Masulis, and Norli (2006), and Baker, Ruback, and Wurgler (2006).

(t-statistic, 3.32), and it is 0.05% (t-statistic, 2.93) for the 140-day equal weighted portfolio. The results for the value weighted portfolios are somewhat stronger with an alpha of 0.09% (t-statistic, 3.33) for the 70-day portfolio, and an alpha of 0.08% (t-statistic, 3.57) for the 140-day portfolio.

4.1.2 The put sale vs. the repurchase announcement effect

Put issuers typically have ongoing share repurchase programs, and several studies document positive abnormal returns following the announcements of repurchase programs (e.g., Ikenberry, Lakonishok, and Vermaelen (1995), Peyer and Vermaelen (2005)). Casual comparison suggests that the put sale effect is distinct from the repurchase announcement effect. First, comparing the size and book-to-market adjusted results in Table 3 to those in Peyer and Vermaelen, the repurchase announcement effect persists much longer (48 months compared to 100 trading days for put sales), but it is weaker at shorter horizons (after five months, it is only 1.89%, compared to 4.66% for the 100 trading days after put sales). Second, Peyer and Vermaelen report that the repurchase announcement effect is stronger for small high book-to-market firms, while the put sellers are typically large and have low book-to-market ratios. In fact, Peyer and Vermaelen find no abnormal returns at the five months horizon for either the top size quintile or the bottom book-to-market quintile formed from all Compustat firms.

To compare the two effects more directly, we re-run the results in Table 3 using size and book-to-market portfolio benchmarks formed from a broad sample of repurchasing firms. To match the put issuer sample as closely as possible, we define the "repurchaser sample" based on completed repurchase transactions rather than just repurchase announcements. Specifically, we define a firm-quarter as a "repurchase quarter" if the firm repurchases shares worth at least 0.5% of prior-quarter book assets. We then form the repurchaser sample consisting of all firms with at least one repurchase quarter. Each firm enters the sample on the first day after its first repurchase quarter and exits the sample two years after its last repurchase quarter. (We choose two years to match the abnormal return horizon documented for repurchasing firms.)[9] Finally, we form 25 size

[9] If a firm has a gap larger than two years between two repurchase quarters, the firm drops from the sample after the initial two-year gap and re-enters the sample after the subsequent repurchase quarter.

and book-to-market portfolios from the repurchaser sample, again using breakpoints from Ken French's website (the number of repurchasing firms is too small to form 100 portfolios), and we re-run the tests in Table 3.

We find that the put sale effect remains high after controlling for repurchases. For example, the size and book-to-market adjusted returns are 2.61% for the first 50 days after the put sale (t-statistic, 3.49), and they are 1.84% for the subsequent 50 days (t-statistic, 2.48). For comparison, when the 25 size and book-to-market portfolios are formed using all Compustat firms rather than just the repurchasing firms, the abnormal returns are 3.12% for the first 50 days (t-statistic, 4.12) and 2.15% for the subsequent 50 days (t-statistic, 2.83). Given that Ikenberry (1995) and Peyer and Vermaelen (2005) find little evidence of abnormal returns after repurchase announcements for large, low book-to-market firms, i.e. firms comparable to our sample of put issuers, it is not surprising that controlling for stock repurchases has little impact on our results.

4.1.3 Initiations and terminations of put option programs

Finally, we look in more detail at the first and the last sale undertaken by each firm. The first sale is close to the decision to initiate the put sale program, so first sales may be better predictors of subsequent returns than the follow-up sales. Similarly, the last sale is followed by the decision to terminate the program, which may be driven by negative information, suggesting zero or even negative subsequent returns. Unfortunately, limiting the analysis to the first or last sales substantially reduces the sample size. We have only 129 first sales and 122 last sales with available data on day one, after dropping seven last sales that occur during or after 2003 (the 2003 accounting changes described in Section 2 could be responsible for terminations during that period). A further complication is that a last sale indicates that managers continue to bet on rising stock prices, so subsequent returns may reflect either managers' positive inside information at the time of the sale, or negative news that lead to the program termination.

We find similar return patterns around put option sales, independent of when in a put sale program they occur. For initiations, the size and book-to-market adjusted return for the first 50 trading days is 3.45% (t-statistic, 2.26), followed by 1.17% for the subsequent 50 days (t-statistic, 0.74). For comparison, the corresponding point estimates for all sales

in Table 3 are 2.73% and 1.93%. This suggests that managers are able to time the follow-up sales at least as successfully as the initial transactions. The point estimates for last sales are again similar: 3.55% for the first 50 days and 1.77% for the subsequent 50 days (the t-statistics are 1.88 and 0.79, respectively). This is consistent with the idea that the terminations results are driven – at least partly – by the positive post-sale effect documented in Table 3.

4.2 Stock price reaction to earnings announcements after put option sales

The positive excess returns after put sales raise the question what kind of inside information managers have. The prior literature on share repurchases (Grullon and Michaely (2004), Lie (2005)) examines whether managers have information about future changes in profitability at the announcement of a share repurchase program and finds mixed results. If managers use private information about future cash flows when they sell put options, then investors should be positively surprised by earnings announcements following put option sales. To test this hypothesis we examine abnormal stock price reactions around the first, second, and third quarterly earnings announcement after the sale.

Fig. 3 shows the average benchmark adjusted cumulative returns for trading days –40 to 40 around the first quarterly earnings announcement. Similar to Fig. 2, we use 49 industry portfolios and 100 size and book-to-market portfolios as benchmarks. Interestingly, the cumulative returns are almost zero up to 5 days before the announcement and increase sharply during the subsequent 35 trading days. For example, the industry-adjusted return is 0.1% on day –6 and reaches 2.75% on day 30. More than 30% of the 100-day post-sale effect documented in Table 3 occurs during the 10-day window around the first quarterly earnings announcement.

Table 4 shows the average cumulative returns and t-statistics for various windows around the first, second, and third earnings announcement after the sale. The bottom panel focuses on the 5-day, 11-day, and 21-day windows centered at the announcement. Consistent with the results in Fig. 2, the cumulative abnormal returns are positive and statistically significant for all three windows around the first announcement. For the second announcement, the returns are still positive but – except in one case – not

statistically significant, and there is no evidence of abnormal returns around the third announcement. Thus any mispricing disappears relatively quickly after investors learn the most recent earnings results.

Overall, the return analysis suggests that managers use inside information about future profitability to time corporate transactions, and that they do so successfully. Although we cannot reject the notion that some managers are overconfident, our results show that, on average, overconfidence does not inhibit managers' ability to time securities sales.

4.3 Changes in operating performance around put option sales

Given that the market is positively surprised by the post-sale earnings announcements, we next analyze the put issuers' operating performance before and after the sales. We examine both raw and benchmark adjusted performance to better understand what type of information investors miss when forecasting post-sale earnings.

Following Lie (2001 and 2005), we use two sets of control firms. We calculate industry adjusted performance by selecting control firms that are in the same 2-digit SIC industry and are closest to the sample firms in terms of beginning-of-quarter book assets. We construct a second set of control firms by selecting firms that are from the same 2-digit industry, have similar pre-sale operating performance (measured as ROA in the four quarters ending in the pre-sale quarter), and similar pre-sale market-to-book ratios (measured in the beginning of the sale quarter). The matching procedure is described in detail in the Appendix. Matching on pre-sale performance allows us to control for predictable mean reversion in accounting earnings.

Table 5 presents operating performance around the 606 put sale quarters for which the matching procedure was successful. There are three interesting findings in the table. First, the unadjusted operating performance of the put sellers deteriorates starting before the put sale and continuing after the sale. For example, the mean change in operating ROA from quarter –1 to quarter 4 (the sale quarter is denoted as quarter zero) is –0.54 percentage points (t-statistic –2.48), and the mean change from quarter –1 to quarter 8 is –0.69 percentage points (t-statistic –2.90). Second, the industry adjusted numbers show

that put sellers strongly outperform their size matched industry peers both before and after the put sales. There is some evidence that the outperformance declines after the put sale, which may be caused by predictable mean reversion in ROA.

The final two columns in Table 5 report put issuers' operating performance relative to their industry, performance, and market-to-book matched control firms. The put issuers outperform their benchmarks starting in the quarter of the put sale, and the outperformance increases over time. For example, the mean change in adjusted ROA from quarter –1 to quarter 4 is 1.27 percentage points (t-statistic 3.82), and the mean change from quarter –1 to quarter 8 is 1.63 percentage points (t-statistic 4.56). Hence, even though ROA declines after put sales, the decline is smaller than that of control firms with similar pre-sale performance. This pattern is qualitatively similar to the results found by Lie (2005) for the announcements of share repurchase programs, but the outperformance after put sales is several times larger than the outperformance after repurchase announcements. The results in Table 5, combined with the positive excess returns around post-sale earnings announcements in Table 4, suggest that investors may have overestimated earnings declines for put issuers, and that firms sold puts to take advantage of the resulting undervaluation.

4.4 Do managers time volatility?

The value of a put option increases with the volatility of the underlying stock, so it is possible that managers sell put options when they expect future volatility to be lower than predicted by the market. In this section, we examine volatility changes around the initiations and terminations of put sale programs, as well as around intermediate sales. Finding that volatility declines after programs are initiated, stays low or declines further after subsequent sales, and finally increases after programs are terminated would be consistent with volatility timing. One limitation of this analysis is, however, that we do not know investors' actual volatility forecasts and have to rely on changes in realized volatility instead.

Fig. 4 shows volatility around the firms' first, last and all other put sales. Volatility on a given day is estimated as the standard deviation of daily stock returns over the prior 50 trading days. The figure shows that average volatility declines around the time when put

option programs are initiated: it is 3.1% on day –20, drops to 2.7% on day 20, and stays close to this level for the subsequent 180 trading days. Consistent with this pattern, there are no significant volatility changes around the intermediate sales: it appears that volatility remains low – compared to the pre-initiation level – throughout the duration of the programs. Interestingly, volatility increases again around the time of the final sale: it is 2.9% on day –20, compared to 3.1% on day 20 after the last sale. This suggests that private information about volatility may influence both the initiation and the termination decisions. The pattern of volatility shifts in Figure 4 is similar if instead of using mean volatility we examine the median (cross-sectional) volatility. This suggest that the results are not driven by a small subsample of firms.

In Table 6 we test whether the volatility changes documented in Fig. 4 are statistically significant. Panel A shows average changes in volatility from before to after put option sales. We estimate volatility as the standard deviation of daily stock returns over 50, 100, or 200 trading days before or after the put sale. We control for changes in market volatility in two ways, either by subtracting a benchmark portfolio returns from the raw returns before computing volatility (Panel A), or by subtracting a benchmark portfolio volatility from the volatility of the raw returns (Panel B). We use the same benchmark portfolios as in Table 3, and the results are similar across the different specifications.

Consistent with the results in Fig. 4, we find that, on average, volatility declines after initiations and increases after terminations, and that there are no significant volatility changes around all other issues. The volatility declines around the initial sales are statistically significant for the 100-day and the 200-day horizons (t-statistics from –1.99 to –4.26) and are not significant for the 50-day horizon (t-statistics from –1.00 to –1.65). Similarly, the volatility increases around the final sales are statistically significant for the 50-day and the 100-day horizons (t-statistics from 1.88 to 3.15) and are not significant for the 200-day horizon (t-statistics from 0.47 to 1.79). Thus it appears that put option programs coincide with periods of relatively low volatility, which is consistent with market timing.

5 Conclusions

The relevance of market timing explanations for corporate behavior continues to be an unresolved issue. We provide some of the first evidence that firms issue securities for the sole purpose of taking advantage of mispriced equity. Prior literature on market timing examines equity issues, equity repurchases, and debt issues, all of which can be motivated by reasons other than mispricing. Put sales, on the other hand, have no obvious motivation in investment activity or capital structure, and management's belief that it can time the market seems the only plausible rationale.

We find strong evidence that managers are able to predict future stock returns. Put issuers outperform their risk-based benchmarks by 4.66% in the 100 trading days after a put sale. Much of the outperformance is realized around the first earnings announcement following the put issue, suggesting that managers may base their put sale decisions on inside information about future profitability. We also find evidence that managers successfully time the volatility of their stock returns. Realized volatility declines significantly after the first put sale and increases following the last sale. Hence put sale programs seem to coincide with periods of unusually low volatility for issuers, as would be expected if they have information about future volatility which put purchasers do not.

Our results provide support for the idea that managers can identify mispriced equity and use securities issues to time the market. This is consistent with managers' self-professed belief in their ability to market time, but shows that this belief is based on more than managerial overconfidence. While our study does not provide direct evidence that market timing is a factor behind equity issues and repurchases, the results shift our priors on the potential importance of timing explanations for a broader set of securities transactions than examined here.

Appendix

We construct the performance-based matching sample in Section 4.3 based on methodology in Lie (2001 and 2005). We measure performance as return on assets (ROA) defined as operating income in percent of the average of beginning- and end-of-quarter cash adjusted assets (cash adjusted assets is the book value of assets less cash and short-term securities[10]). For each put issuer, we identify all Compustat firms in the same 2-digit SIC industry that have: (1) ROA in the quarter before the put sale (quarter −1) within ±20% or within ±1 percentage point of the put issuer; (2) ROA for the four quarters ending in quarter −1 within ±20% or within ±1 percentage point of the put issuer; and (3) market-to-book ratio in the beginning of the sale quarter within ±20% or within ±0.1 of the put issuer. If no firm meets all criteria, we select firms from the same 1-digit SIC industry, and finally without any industry requirement. If still no suitable firms are found, we disregard the performance and market-to-book criteria. Finally, among all candidate firms, we select the matching firm with performance characteristics closest to the put issuer, where distance is defined as:

$$
\begin{aligned}
& \left|ROA_{\text{Quarter } -1,\text{ put seller}} - ROA_{\text{Quarter } -1,\text{ matched firm}}\right| \\
+ \; & \left|ROA_{\text{Quarters } -5 \text{ to } -1,\text{ put seller}} - ROA_{\text{ Quarters } -5 \text{ to } -1,\text{ matched firm}}\right| \\
+ \; & \left|M/B_{\text{Quarter } -1,\text{ put seller}} - M/B_{\text{Quarter } -1,\text{ matched firm}}\right|
\end{aligned}
$$

This procedure requires that both put issuers and matching firms have ROA data for the four quarters preceding the put sale available. To avoid matching with very small firms, we exclude matching firms with book assets less than $10 million.

[10] Lie (2005) advocates subtracting cash from book assets since the scaled operating performance of firms that repurchase shares may increase solely because cash is removed from the balance sheet to fund repurchases.

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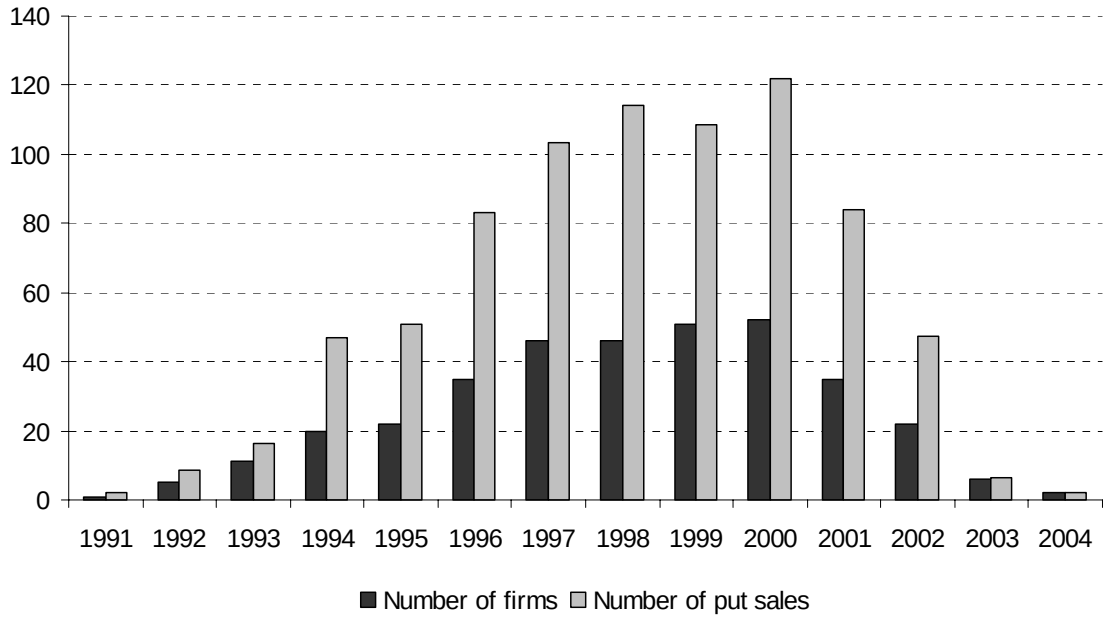

Fig. 1. Number of put sales and put issuing firms by year. There are 137 put issuing firms and 796 put sales from 1991-2004. Depending on available data, a put sale represents either an individual transaction or several transactions occurring within one reporting period, usually a fiscal quarter. The precise date of the put sale is usually not reported, and the figure is based on the last day of the "sale period", which is usually the fiscal quarter during which the sale takes place.

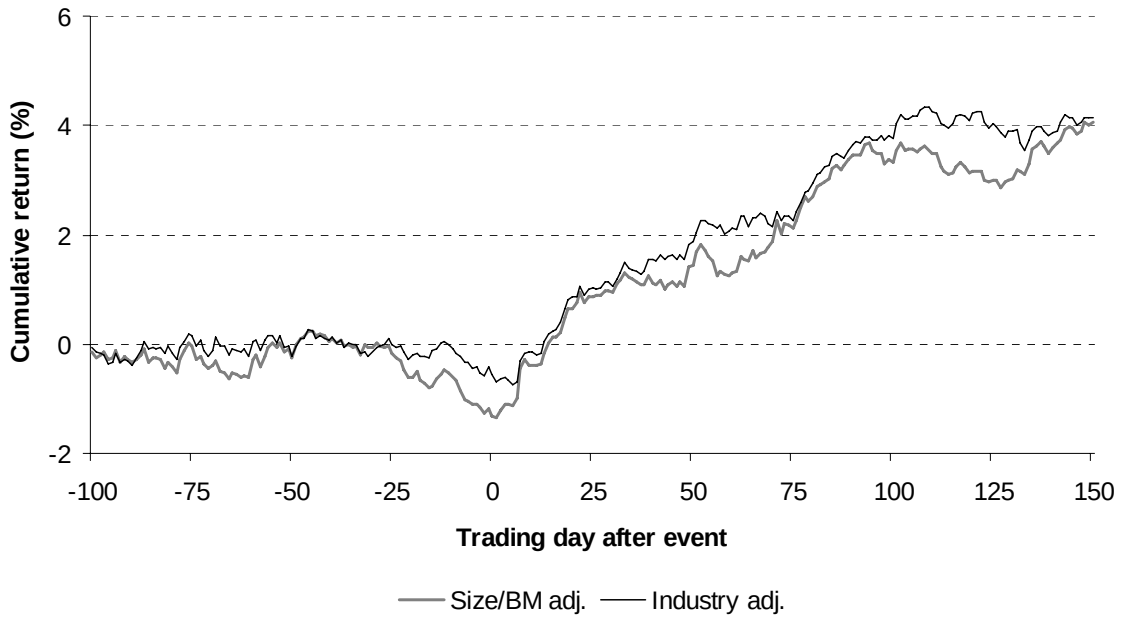

Fig. 2. Cumulative abnormal returns around put option sales. The figure shows average benchmark adjusted cumulative returns from trading day –100 to 150 after the put sale event (put sale event is defined in Table 3). There are 137 put selling firms and 651 put sale events from 1991-2004 with available return data on day –100. Cumulative return for trading day t is the sum of daily returns from trading day –100 to t. Daily abnormal returns are computed by subtracting the daily return on a benchmark portfolio from the corresponding stock return. We use two benchmarks: the 49 industry portfolios and the 100 size and book-to-market portfolios from Ken French's website (see Fama and French, 1993 and 1997).

Fig. 3. Cumulative abnormal returns around the first earnings announcement after a put option sale. The figure shows average benchmark adjusted cumulative returns from trading day –40 to 40 after the first earnings announcement following a put sale event (put sale event is defined in Table 3). There are 137 put selling firms and 631 put sale events from 1991-2004 with available announcement and return data. Cumulative return for trading day t is the sum of daily returns from trading day –40 to t. Daily abnormal returns are computed by subtracting the daily return on a benchmark portfolio from the corresponding stock return. We use two benchmarks: the 49 industry portfolios and the 100 size and book-to-market portfolios from Ken French's website (see Fama and French, 1993 and 1997).

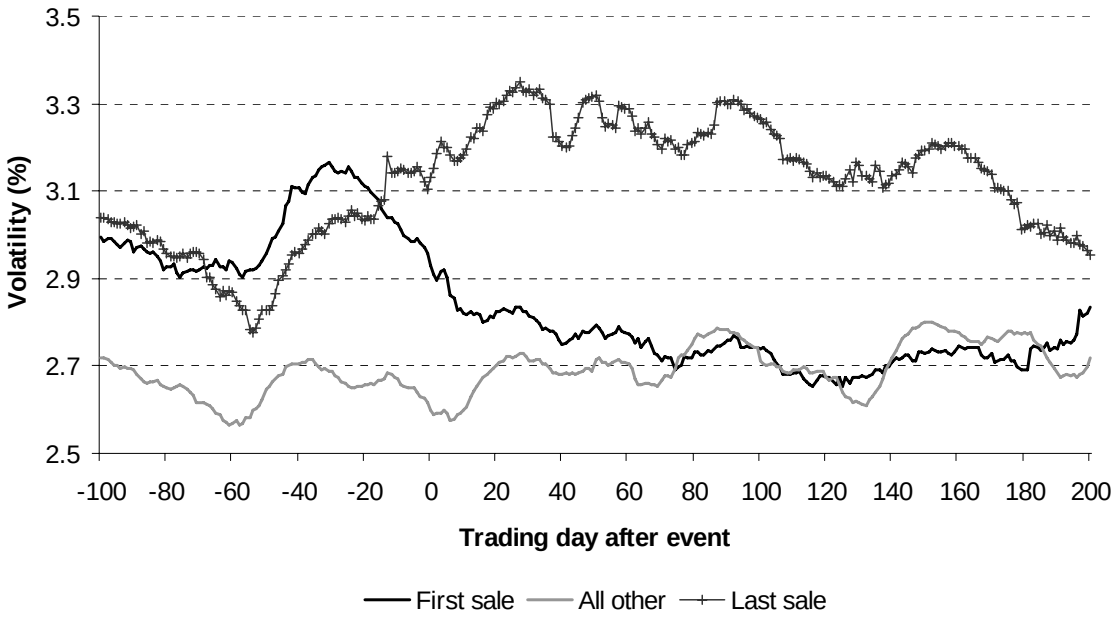

Fig. 4. Stock return volatility around put option sales. The figure shows average stock return volatility estimated for rolling windows around the put sale event (put sale event is defined in Table 3). Volatility on trading day t is the standard deviation of daily stock returns from t-50 to t. We require that returns are available for 50 trading days for each estimate. The figure shows estimates for windows ending on day –100 to 200 after the put sale event. The mean volatility is computed separately for the firms' first, last, and all other put option sales. There are 129 first sales, 124 last sales, and 426 all other sales with available volatility estimates for day 0.

Table 1
Descriptive statistics for put issuers, repurchasing firms, and all Compustat firms during 1991-2004. The samples consist of 137 put issuers (355 firm-years), 5,523 repurchasing firms (13,087 firm-years), and 14,263 Compustat firms (99,546 firm-years). A firm-year is included in the put issuer sample if the firm has at least one put option sale in the fiscal year. A firm-year is included in the repurchasing firm sample if the firm repurchases shares worth at least 0.5% of the prior-quarter book assets in at least one quarter of the fiscal year. ASSETS and SALES are book assets and sales ($billions). B/M is the ratio of the book value to the market value of common stock. R&D, PPE, and CASH are R&D expense, PP&E plus inventory, and cash plus short-term investments scaled by book assets. R&D and PPE are set to zero if they are missing on Compustat. ROA is net income scaled by the prior-year book assets. Dividend is a dummy variable equal to one if the firm pays a dividend. Leverage equals total debt divided by the sum of total debt and the book value of common stock. Net stock sale is the difference between the sale and the purchase of common and preferred stock scaled by the prior-year market value of common stock. Some variables are not available for the full samples. All variables are winsorized at the 1st and the 99th percentile in the Compustat sample.

	Put issuers			Repurchasing firms			All Compustat firms		
	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
Assets	10.01	2.58	15.61	2.31	0.26	7.00	2.32	0.18	8.01
Sales	6.06	2.11	7.83	1.83	0.25	4.49	1.19	0.10	3.70
B/M	0.38	0.31	0.30	0.62	0.47	0.54	0.72	0.56	0.65
R&D	0.05	0.02	0.06	0.04	0.00	0.08	0.04	0.00	0.10
PPE	0.40	0.39	0.25	0.37	0.36	0.25	0.36	0.34	0.28
Cash	0.16	0.09	0.18	0.18	0.10	0.21	0.17	0.07	0.22
ROA	0.09	0.07	0.11	0.03	0.06	0.20	-0.04	0.02	0.25
Dividend	0.61	1.00	0.49	0.47	0.00	0.50	0.39	0.00	0.49
Leverage	0.33	0.33	0.26	0.25	0.20	0.24	0.32	0.29	0.27
Net stock sale	-0.03	-0.02	0.04	-0.01	-0.02	0.11	0.04	0.00	0.14

Table 2
Summary statistics for put option sales and programs. The total number of firms with put sales programs is 137, and the total number of put sales is 796. We exclude 32 maturity extensions of previously sold puts from the sample. The number of observations is reduced further because of missing data. The face value of a put issue is the number of puts sold times the average strike price. The moneyness of a put issue is the ratio of the average strike price to the issuer's stock price on the put sale date, or averaged over the sale period (usually the fiscal quarter of the sale). The maturity of a put issue is the number of days between the put sale date (or the midpoint of the sale period) and the maturity date (or the midpoint of the maturity period). The fraction of all put issues exercised or settled is reported only for issues that can be traced from sale to maturity and for which the final outcome is reported by the issuer.

Panel A: Individual put sales, n=796

	Mean	10th Pctile	Median	90th Pctile	Obs.
Number of puts sold (mil. of shares)	4.9	0.10	0.8	8.0	657
… scaled by number of shares outstanding	0.88%	0.08%	0.40%	2.05%	657
Face value ($ mil.)	67.6	2.70	18.0	131.0	461
… scaled by equity market capitalization	0.83%	0.07%	0.42%	1.61%	461
Proceeds ($ mil.)	10.5	0.25	2.1	20.0	475
… scaled by equity market capitalization	0.09%	0.01%	0.04%	0.22%	475
Moneyness (strike price / stock price)	95%	81%	96%	108%	567
Maturity (days)	211	81	182	367	574
Fraction of put sales that are exercised or settled	36%	-	-	-	447

Panel B: Put sale programs, n=137

	Mean	10th Pctile	Median	90th Pctile	Obs.
Number of put sales	5.8	1	4	13	137
Number of puts sold (mil. of shares)	21.0	0.40	2.6	25.2	108
… scaled by number of shares outstanding	4.15%	0.52%	1.84%	9.37%	108
Face value ($ mil.)	223.4	5.20	43.7	286.0	68
… scaled by equity market capitalization	3.47%	0.56%	1.84%	7.99%	68
Proceeds from put sales ($ mil.)	53.4	0.43	5.8	85.1	84
… scaled by equity market capitalization	0.42%	0.03%	0.14%	1.18%	84
Program length (years)					
… from the first to the last put sale	2.1	0.08	1.3	5.3	137
… from the first put sale to the last exercise or expiration	2.8	0.59	2.0	6.3	137
Number of quarters with a put sale	5.4	1	4	11	137

Table 3
Abnormal returns around put option sales. The table shows average abnormal cumulative returns and t statistics for various windows around the put sale event. The precise date of the put sale is usually not reported, and we define an event as the last day of the "sale period", which is usually the fiscal quarter during which the sale takes place. If multiple sales occur during one sale period, we treat these sales as one event. There are 137 put selling firms and 664 put sale events from 1991-2004 with available return data on the event day. Cumulative returns are computed for six 50-day intervals: from trading day –100 to –50, from trading day –50 to 0, etc. If a given interval (e.g. –50 to 0) overlaps for different events of the same firm, we keep only the earlier event. Cumulative return is the sum of daily returns during the 50-day interval. Daily abnormal returns are computed by subtracting the daily return on a benchmark portfolio from the corresponding stock return. We use three benchmarks: the value-weighted CRSP index, the 49 industry portfolios and the 100 size and book-to-market portfolios from Ken French's website (see Fama and French, 1993 and 1997).

Trading days	Mean returns				T-statistics				
after event	Raw returns	Market adj.	Size/BM adj.	Industry adj.	Raw returns	Market adj.	Size/BM adj.	Industry adj.	N
-100 to –50	2.01	-0.07	-0.22	-0.22	**2.44**	-0.09	-0.29	-0.30	601
-50 to 0	0.58	-1.15	-1.02	-0.34	0.65	-1.48	-1.37	-0.48	605
0 to 50	4.91	3.04	2.78	2.47	**5.72**	**3.98**	**3.74**	**3.66**	603
50 to 100	4.68	2.26	1.88	1.88	**5.60**	**2.89**	**2.44**	**2.61**	602
100 to 150	3.57	1.71	1.32	1.04	**4.23**	**2.20**	1.68	1.42	596
150 to 200	2.01	0.48	0.34	0.59	**2.38**	0.62	0.44	0.83	593

Table 4
Cumulative returns around earnings announcements following put option sales. The table shows average cumulative returns and t-statistics around the first three earnings announcements (EA) following a put sale event (put sale event is defined in Table 3). The sample consists of 137 put selling firms and 631 earnings announcements from 1991-2004. Panel A shows cumulative returns from trading day –5 to 40 after the first announcement; Panel B shows cumulative returns for shorter windows centered around the first, second, and third announcement. In Panel B, the sample of 338 second announcements does not include announcements numbered second and first for subsequent events of the same firm. Similarly, the sample of 242 third announcements does not include announcements numbered third as well as second and/or first. Cumulative return is the sum of daily returns during the even window. Daily abnormal returns are computed by subtracting the daily return on a benchmark portfolio from the corresponding stock return (the benchmarks are described in Table 3).

EA# after event	Trading days	Mean cumulative returns			T-statistics			N
		Market adj.	Size/BM adj.	Industry adj.	Market adj.	Size/BM adj.	Industry adj.	
Panel A: Cumulative returns from trading day –5 after earning announcement								
1	-5	0.10	0.05	0.10	0.74	0.42	0.83	631
	-4	0.35	0.26	0.24	**2.08**	1.60	1.61	631
	-3	0.47	0.35	0.36	**2.43**	**1.85**	**2.00**	631
	-2	0.72	0.61	0.53	**3.36**	**2.87**	**2.69**	631
	-1	0.99	0.88	0.74	**4.12**	**3.73**	**3.45**	631
	0	1.16	1.02	0.83	**3.98**	**3.58**	**3.21**	631
	1	1.40	1.22	1.02	**4.11**	**3.70**	**3.43**	631
	2	1.50	1.31	1.04	**4.27**	**3.87**	**3.37**	631
	3	1.64	1.44	1.17	**4.56**	**4.16**	**3.64**	631
	4	1.72	1.46	1.24	**4.47**	**3.93**	**3.61**	631
	5	1.94	1.66	1.44	**4.79**	**4.24**	**4.04**	631
	10	2.17	1.87	1.64	**4.69**	**4.19**	**4.10**	631
	20	3.10	2.72	2.20	**5.78**	**5.22**	**4.61**	631
	30	3.42	2.93	2.68	**5.34**	**4.78**	**4.73**	630
	40	3.36	2.84	2.96	**4.69**	**4.17**	**4.69**	629
Panel B: Cumulative returns for the interval in Col. 2 around earnings announcement								
1	-2, 2	1.03	0.96	0.67	**3.20**	**3.06**	**2.41**	631
	-5, 5	1.94	1.66	1.44	**4.79**	**4.24**	**4.04**	631
	-10, 10	2.15	1.84	1.69	**4.26**	**3.73**	**3.74**	631
2	-2, 2	0.42	0.54	0.23	1.00	1.31	0.59	338
	-5, 5	0.92	0.92	0.44	1.65	1.64	0.85	338
	-10, 10	1.13	1.28	0.52	1.62	1.82	0.83	338
3	-2, 2	-0.28	-0.35	-0.72	-0.48	-0.62	-1.35	242
	-5, 5	0.14	0.10	-0.40	0.21	0.14	-0.63	242
	-10, 10	0.89	0.60	-0.04	1.01	0.68	-0.06	242

Table 5
Quarterly operating performance around put sales. Operating performance is measured as operating income scaled by average cash-adjusted assets. The put sale occurs in quarter 0. Industry-adjusted performance is the performance of put issuers less the performance of industry- and size- matched control firms. Performance-adjusted performance is the performance of put issuers less the performance of industry-, performance-, and market-to-book-matched control firms. The matching procedure is described in Section 4.3 and Appendix 1. T-statistics for means and Z-statistics from Wilcoxon signed-rank tests for medians are reported in brackets.

Quarter	N	Unadjusted		Industry-adjusted		Performance-adjusted	
		Mean	Median	Mean	Median	Mean	Median
Panel A: Levels of operating performance							
−4	606	**7.92**	**5.77**	**3.27**	**1.60**	**0.46**	**0.15**
		(27.56)	(20.93)	(10.25)	(9.76)	(2.96)	(2.77)
−3	606	**7.83**	**5.78**	**3.12**	**1.48**	**0.35**	0.03
		(27.83)	(21.02)	(10.00)	(9.76)	(2.55)	(1.54)
−2	606	**7.88**	**5.73**	**3.47**	**1.61**	0.19	-0.06
		(28.41)	(21.24)	(11.04)	(10.36)	(1.27)	(0.34)
−1	606	**7.73**	**5.63**	**3.39**	**1.48**	**0.21**	-0.01
		(27.14)	(20.96)	(10.62)	(9.92)	(2.48)	(0.68)
0	597	**7.72**	**5.67**	**3.55**	**1.57**	0.38	**0.21**
		(27.07)	(20.92)	(10.98)	(10.11)	(1.84)	(2.58)
+1	588	**7.56**	**5.35**	**3.41**	**1.25**	**0.71**	**0.06**
		(26.51)	(20.78)	(10.53)	(9.40)	(3.25)	(2.19)
+2	576	**7.51**	**5.32**	**3.35**	**1.31**	**0.79**	**0.22**
		(24.46)	(20.21)	(9.95)	(9.04)	(2.75)	(2.56)
+3	566	**7.40**	**5.19**	**3.21**	**1.33**	**1.07**	**0.15**
		(23.59)	(19.79)	(9.04)	(8.32)	(3.34)	(3.14)
+4	559	**7.43**	**5.23**	**3.37**	**1.46**	**1.46**	**0.28**
		(23.48)	(19.91)	(9.16)	(8.78)	(4.42)	(3.34)
+5	552	**7.32**	**5.20**	**3.01**	**1.44**	**1.38**	**0.12**
		(23.54)	(19.55)	(8.30)	(8.06)	(4.18)	(2.63)
+6	547	**7.40**	**5.37**	**3.21**	**1.47**	**1.49**	**0.10**
		(24.25)	(19.80)	(9.17)	(8.58)	(4.71)	(2.77)
+7	544	**7.42**	**5.25**	**3.11**	**1.42**	**1.72**	**0.45**
		(24.03)	(19.88)	(8.66)	(8.27)	(5.49)	(3.77)
+8	540	**7.27**	**5.11**	**3.07**	**1.34**	**1.88**	**0.33**
		(23.56)	(19.38)	(8.14)	(8.00)	(5.18)	(3.83)
Panel B: Changes in operating performance							
−1 to 0	597	-0.03	-0.01	0.14	0.02	0.17	0.16
		(-0.30)	(-0.66)	(0.92)	(0.91)	(0.88)	(1.66)
−1 to +1	588	-0.16	-0.08	0.07	-0.06	**0.50**	0.06
		(-1.14)	(-1.40)	(0.40)	(0.04)	(2.34)	(1.61)
−1 to +2	576	-0.31	**-0.17**	0.06	-0.07	**0.63**	**0.18**
		(-1.69)	(-2.49)	(0.28)	(-0.27)	(2.22)	(2.08)
−1 to +4	559	**-0.54**	**-0.32**	-0.08	-0.20	**1.27**	**0.07**
		(-2.48)	(-3.96)	(-0.31)	(-1.26)	(3.82)	(2.54)
−1 to +8	540	**-0.69**	**-0.66**	-0.34	**-0.34**	**1.63**	**0.33**
		(-2.90)	(-4.56)	(-1.07)	(-2.15)	(4.56)	(3.31)

Table 6
Changes in stock return volatility from before to after put option sales. The table shows the average change in volatility from before to after a put sale event (put sale event is defined in Table 3) and the corresponding t-statistics. All statistics are shown separately for the firms' first, last, and all other put sale events. In Panel A, volatility is the daily standard deviation of benchmark adjusted stock returns; in Panel B, volatility is the daily standard deviation of raw returns minus the daily standard deviation of a benchmark portfolio returns computed over the same period. We use three benchmarks: the value-weighted CRSP index, the 49 industry portfolios and the 100 size and book-to-market portfolios from Ken French's website. Volatility is computed over 50, 100, or 200 trading days before and after the event, and we require that returns are available for at least 50 trading days for each estimate. For "all other" sales, if a given horizon (e.g. 50-day after sale) overlaps for different sales of the same firm, we drop the overlapping days before computing volatility. More precisely, for each volatility estimate after (before) the sale, we drop days that overlap with the same-length horizon for the subsequent (previous) sale. There are 129 first sales, 122 last sales, and 361 all other sales with available estimates of volatility changes.

Event	Tr. days	Changes in volatility before to after				T-statistics for changes			
		Raw returns	Market adj.	Size B/M adj.	Indust. adj.	Raw	Market adj.	Size B/M adj.	Indust. adj.
Panel A: Volatility = daily std of benchmark adjusted returns (%)									
First sale	50	-0.15	-0.11	-0.09	-0.09	-1.42	-1.12	-1.00	-0.96
	100	-0.20	-0.17	-0.15	-0.18	**-2.36**	**-2.10**	**-1.99**	**-2.31**
	200	-0.19	-0.17	-0.15	-0.16	**-2.56**	**-2.31**	**-2.19**	**-2.43**
All other	50	0.10	0.08	0.09	0.07	1.96	1.62	1.80	1.55
	100	0.05	0.03	0.05	0.04	1.02	0.74	0.99	0.86
	200	0.06	0.05	0.06	0.05	1.35	1.04	1.27	1.11
Last sale	50	0.24	0.21	0.23	0.19	**2.34**	**2.24**	**2.53**	**2.12**
	100	0.32	0.30	0.30	0.26	**3.11**	**3.15**	**3.05**	**2.75**
	200	0.17	0.13	0.12	0.12	1.79	1.42	1.28	1.25
Panel B: Volatility = daily std of raw returns minus daily std of benchmark portfolio returns (%)									
First sale	50	-0.15	-0.17	-0.13	-0.14	-1.42	-1.65	-1.34	-1.49
	100	-0.20	-0.23	-0.22	-0.26	**-2.36**	**-2.96**	**-2.79**	**-3.45**
	200	-0.19	-0.27	-0.25	-0.31	**-2.56**	**-3.89**	**-3.45**	**-4.26**
All other	50	0.10	0.03	0.03	-0.02	1.96	0.70	0.67	-0.35
	100	0.05	0.01	0.01	-0.03	1.02	0.24	0.22	-0.63
	200	0.06	0.02	0.02	-0.01	1.35	0.40	0.50	-0.31
Last sale	50	0.24	0.18	0.21	0.15	**2.34**	1.88	**2.28**	1.61
	100	0.32	0.27	0.26	0.21	**3.11**	**2.94**	**2.82**	**2.38**
	200	0.17	0.08	0.07	0.04	1.79	0.92	0.81	0.47