Why Do Investment Banks Buy Put Options from Companies?

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Abstract

Companies have collected billions in premiums from privately sold put options written on their own stock. It is puzzling that counterparties, investment banks, would agree to make such transactions with better-informed companies which have extraordinary ability to time the market as documented by Jenter et al. (2011). To resolve this puzzle, we develop a model that shows that investment banks, by offering to buy put options from better-informed parties, receive private information about issuing companies. Our model also incorporates the practice of firms (such as Microsoft) of sometimes repurchasing their own put options and thus providing additional private information to investment banks. Empirically, we find support for our theory from an abnormal 9% increase in the stock prices and a 40% increase in the trading volumes around the put sales. Examination of 13D filings reveals that trading by upper management insiders cannot completely account for the change in volume.

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1 Introduction

In February 1991, the Securities and Exchange Commission (SEC) issued a ruling that allowed publicly traded companies to sell put options written on their own stock. This practice began modestly with IBM, which realized profits in 1992 in excess of $2 million from its put option sales.[1] The practice quickly spread to companies such as Microsoft, which over a seven-year period beginning in 1993, received over $2 billion in total premiums from sales of puts including $766 million in 1999 alone.[2] The practice of companies writing put options on their own stock abated in the wake of the 2000-2002 bear market; however, usage of these deals has reemerged. For instance, in 2011, Qualcomm Inc. received $75 million in put option proceeds. (Qualcomm mentions its right to sell put options as part of its repurchase program in its September 2015 10Q. Currently, Qualcomm has an active repurchase program as mentioned in its December 2018 10Q.)

Although the original spirit of the SEC ruling was to allow companies to issue put options publicly on an organized exchange like the Chicago Board Options Exchange (CBOE), most companies placed their options privately with investment banks or other qualified institutional buyers.[3]

Gibson et al. (2006) and Jenter et al. (2011) empirically show that one side (the companies writing the puts) are consistently timing the market in terms of stock and accounting performance. So why would an investment bank agree to such a transaction with a better informed party when the writing of a put option is a zero-sum game. What is further intriguing, while most options expired worthless, many of the remaining options were settled before the expiration date, as shown in Table 1.[4]

[1] See Eades and Posell (1992).

[2] For a detailed Microsoft case study see Gyoshev (2001).

[3] The initial ruling to allow the sale of put options was in fact made in favor of a request submitted by the CBOE.

[4] Since put options are insurance policies, in general it is not unusual in and of itself that they expired worthless. The probability of expiring out of the money depends upon the strike price and the volatility of the underlying stock.

We offer a plausible but somewhat insidious explanation as to why the counterparty would agree to these bets. Since there is a delay before these transactions are reported, as shown in Table 1, the counterparty can make use of the positive information conveyed by buying shares (if the firm is willing to sell a put option, the outlook must be positive).

Our explanation builds upon the working papers of Gibson and Singh (2001) and Gibson et al. (2006) which provide a signaling model of put option sales. In their models, companies with strong outlooks choose to signal their long-term expected value in order to increase the price of their stock in the short term (companies maximize a weighted sum of short-term and long-term share prices). However, in those models, the counterparty is willing to buy the options since they are sold at a fair price (and neither side profits directly from the transaction). This is not fully supported by the empirical findings of Jenter et al. (2011) since the companies selling the puts are found to time the market. Prices increase before the options are publicly announced.

We build a model in Section 3 that captures the information content of the initial put issues of the Gibson and Singh (2001) and Gibson et al. (2006) models. However, we allow for sales to be actuarially unfair since the buyer could lose money on the sale, but gain through market purchases of the underlying stock. The aforementioned models also imply that the transaction was initiated by the company, when it is quite possible the investment bank approached the companies.[5]

In our model, we have an additional stage where the option can be bought back by the company. This second stage provides a means for the put owner to obtain new information acquired by the company after the first stage. While the purchasers may lose money from the transactions (and the companies gain), the

[5]For example, Tom Pratt (1994) cites Paul Mazzilli at Morgan Stanley & Co. as stating that "a large portion of the companies that do [repurchase] programs with me have been introduced to [selling put derivatives], and use the strategy." This makes it more of a situation of screening rather than signaling.

purchasers gain information. While outside the model, the purchasers can profit overall if this privately obtained information is used in trading on the company's stock.

This put buyback option, which we believe may be present either explicitly or implicitly in contracts, allows the company to buy back the put options at market prices (and may have implicitly been exercised in the past such as by Microsoft). However, this option might make raise the question as to whether the put buyback option could disrupt the original separating equilibrium. We also explore this possibility and show that not only can the original separating equilibrium remain intact, but there can be an additional stage of separating where only those companies with a low final value will make use of this option. This use shows that the tool of the put option with a buyback gives a purchaser the ability to screen the market in both directions and enables them to discover both the signal received by the company about its future valuation but also potentially learn the value before the market.

Our model yields insight as to why investment banks purchase put options from companies and we empirically explore the data for consistency with the model. To start, in Section 5.1, we reinvestigate Jenter et al.'s (2011) result of abnormal stock performance around the put transaction.[6] Here, we find a 9.08% abnormal return in the stock prices over 60 days compared to the 4.68% found by Jenter et al. (2011) over 100 days. This abnormal return further supports the hypothesis that the companies had private information about their future stock performance and used this information to time the sale of put options to when the stock was undervalued. We also note that the 2.01% short term abnormal return (compared with the 9.08% 60-day abnormal return and 11.67% one year return) indicates that either the market is underreacting to the put option issue or not fully aware of the issues at the time of the sales. Both possibilities are consistent with our explanation about companies using their information to gain from the put sale.

[6]In contrast to Jenter et al. (2011), we only look at the first put transaction used by a company since the information content can vary in strength over repeated put option sales (as Gyoshev, 2001, suggests). We also use a slightly different set of companies which we describe in Section 4.

In section 5.2, we extend the Jenter et al. (2011) results by testing for abnormal volume around put option sales and document an increase of 40%. This increase indicates that a party gained and used information beyond a private put sale and is consistent with our model. Furthermore, we find no significant change in the number of outstanding shares and treasury shares, indicating that the company itself was not actively involved in the increase in volume.

To further explore which parties are making the trades, in Section 5.3, we examine 13D. An examination of 13D filings reveals that upper management insiders (but not shareholder insiders, i.e., those with more than a 10% stake in voting shares) increased their long position on the stock around the put sale - consistent with them having private information. However, the magnitude of the volumes and the lack of change in the shares outstanding indicate that other informed parties might also have acted. Hence, leaving room for those that gained information from the put sales to have profited.

In the next section, we review both the theoretical and empirical literature.

2 Literature Review

2.1 Theoretical Literature

Our model first demonstrates how the company can privately reveal information to the buyer of the put option via screening (or signaling). Similarly, two working papers, Gibson and Singh (2001) and Gibson et al. (2006) provide a two-type model on how put options sold by a company can convey information to the purchasers of the option. Namely, a company with a good outlook should wish to increase its short-term price by signaling its value via a (public) put sale. The purchaser is willing to buy the options since they are sold at a fair price (and neither side profits directly from the transaction). Only strong companies are willing to sell the put options since the price is set that a weak company would lose money in expectation.

There are other related papers about how information can be revealed through financial transactions based upon the company's own stock. Vermaelen (1981, 1984) first presents the classic signaling story of repurchases. Firms offer a premia over the market price in order to signal their information of the stock being underpriced. Oded (2005) demonstrates how information can be publicly revealed in a signaling model of repurchase program announcements.

Oded (2011) takes into account that when a company makes a tender offer to its shareholders to repurchase its shares as a means to distribute excess cash, there is an asymmetry of information between the company buying back the shares and the shareholders. Due to this asymmetry, the company must pay a premium since the shareholders do not profit from the information they acquire. Bond and Zhong (2016) have a dynamic model of equity offerings and market repurchases with asymmetric information. Signaling also has been applied by Kim and Kallberg (1998) to show how information can be revealed by converting (or not converting) bonds.

2.2 Empirical Literature

There exists some empirical literature on put options sold by firms. Gyoshev (2001) is the first to empirically examine the synthetic repurchase programs via put options. Gibson et al. (2006) compare the accounting performances of companies with put option sales to a matched sample and document that companies with these sales have significantly higher return on assets (ROA), operational return on assets (OpROA), and net income return on assets (NIROA) for the first three years after the put sales (with the lone exception the first year of NIROA). Jenter et al. (2011) reports an abnormal mean stock return of

4.68% over 100 days after a put option sale along with a 3.36% abnormal mean return around the first earnings announcement after the sale (from 5 days before to 40 days after). The findings of Gibson et al. (2006) and Jenter et al. (2011) suggest that companies time the market with their put sales (potentially taking advantage of privately held information). Similarly, De Cesari et al. (2012) discover that open market share repurchases are timed to benefit non-selling shareholders. Closely related in terms of empirical methodology to our paper, Ben-Rephael et al. (2014) find that an increase occurs after the announcement of an actual repurchase in their company report (as opposed to the announcement of the repurchase program).

There is a large empirical literature covering several reasons for why companies repurchase their stock (see Dittmar, 2000, Vermaelen, 2005, and Manconi et al., 2019) of which many would also apply to put options since put options sales are an enhancement of ongoing repurchase programs. Indeed, Angel et al. (1997) found that put option sales occurred in a significant number (10%) of stock repurchase programs, as asserted by Pratt (1994).

Many empirical papers verify the signaling theory of repurchases starting with Vermaelen (1984). This was then refined in that Ikenberry et al. (1995) find there are abnormally high market returns only for value stocks and Liano et al. (2003) find the performance may be industry dependent. The signaling theory was further confirmed by Manconi et al. (2019) who uncover excess returns around repurchase announcements using non-US data. Consistent with signaling, Busch and Obernberger (2016) find that after repurchases, company stocks are priced more efficiently. Also consistent with signaling, Evgeniou et al. (2018) document repurchase announcements occur more often when there is higher uncertainty since it creates an option to repurchase underpriced shares.

Papers also show that credibility matters with signaling. Chan et al. (2010) show that announcing open market repurchases may lack commitment power to follow through in purchasing the shares thus weakening its signal strength. However, earnings forecast reputation is found to matter in the strength of a repurchase announcement signal (Ota et al., 2019) and repurchase completion rates (Bonaimé, 2012).

Some literature found insider trading affects signaling strength. Babenko et al. (2012) show prior insider purchases of shares strengthens the signaling power of an announcement of a repurchase program, while Cziraki et al. (2019) also finds that insiders trade prior to announcements of stock repurchases and offerings in accordance to their potential information.

Beyond signaling, there are other explanations for repurchases and some studies find support for them. Grullon and Michaely (2004) and Dunn et al. (2011) empirically support Jensen's (1986) agency cost of free cash flow theory. Repurchasing of shares can also be a means of transferring cash to shareholders and may be useful for tax efficiency reasons instead of dividends (see Bierman and West, 1966, Moser, 2007, and Hsieh and Wang, 2008). Billett and Xue (2005) show that stock repurchases are used to deter takeovers and this reason is more prevalent in smaller firms. Harrison and Swanson (2016) suggest that repurchases may be done successfully to support the price of shares.

Repurchases are also found to be a means of compensation and rewarding insiders. Cuny et al. (2009) and Babenko (2009) show that firms repurchase shares to increase the value of executive pay via stock options. Young and Yang (2011) find that companies with earning per share compensation contracts have higher repurchase activity. Bonaimé and Ryngaert (2013) uncover evidence that company stock repurchases may be a means for insiders to sell shares in illiquid markets without depressing the stock price.

Repurchasing stock can be the best investment opportunity of the firm (see D'Mello and Shroff, 2000). Dunn et al. (2011) document that returns are highest to repurchase announcements when a company's management consider repurchases as their best investment opportunity (as stated in their SEC filings). There is also evidence that they are used simply to rebalance the debt-equity ratio (Bierman and West, 1966, and Hovakimi et al., 2001). While in principle, repurchases may harm bondholders (lowers liquidity and diversity of assets), Alderson et al. (2019) find no evidence of this in contrast to an earlier study by Maxwell and Stephens (2003).

In our next section, we move to our theoretical model.

3 Theoretical Model

One reason that investment banks are willing to buy put options from better informed parties is that while they may lose in that transaction, they gain private information from those companies that issue the put options. In a similar manner, the investment banks can act merely as an intermediaries for clients where each client may lose in the transaction but gain information. If true, this reasoning requires that companies make decisions that depend upon their information about future company value. In other words, the companies must be in a separating equilibrium in regards to put contracts. This equilibrium allows investment banks or their clients to screen for companies with positive outlooks and distinguish them from companies with negative outlooks.

In this section, we demonstrate how this separating equilibrium exists in a screening model where the contracts are offered by a buyer to a company.[7] To ease exposition, we do not explicitly model how buyers profit from information gained nor how they decide upon what terms to offer the company, only

[7]While we believe the actual situation more resembles a screening model consistent with Pratt (1994) and Angel et al. (1997) (one where the uninformed buyer initiates the transaction) our solution would also work framed as a signaling model (where the informed seller initiates the transaction). The difference being the side which initiates the transaction would have more bargaining power against the other side which would have an outside option that must be met.

how they may gain information from particular contracts.

3.1 Example with Put Sales Only

In this subsection, we provide a basic example of how the separating equilibrium occurs with just put option sales before proceeding to an example of the put buybacks. Such an equilibrium is necessary for screening to occur on behalf of an investment bank or their clients.

For simplicity we assume that the future value can be one of two types: high or low. A company receives a signal about the likelihood that its value is high. This signal also can be either high or low. A company with a high signal is willing to sell put options at a specified premium and strike price, while a company with a low signal is not willing to sell put options under these conditions. These conditions allow the buyer of the put option to deduce the company's signal.

A company has exactly one project that has an uncertain value v. This is the entire worth of the company. The company receives a signal about the distribution of the value of the project. The signal can be h (high) or ℓ (low) with equal probability. If the signal is h, then there is a $\frac{4}{5}$ chance that the company is worth $\$200,000$ (a high value) and a $\frac{1}{5}$ chance it is worth $\$100,000$ (a low value). If the signal is ℓ then there is a $\frac{1}{5}$ chance the company is worth $\$200,000$ and a $\frac{4}{5}$ chance it is worth $\$100,000$. There are $1,000$ shares of stock. The company's objective is to maximize its expected (future) share price (keeping the outstanding shares constant). Note that this setup differs from Gibson and Singh (2001) and Gibson et al. (2006), who assume a company's objective is to maximize a weighted average of its expected future share price and current share price.

As is, the stock price is $150. Now assume that the company sells 500 put options for a combined premium of $\$10,000$ with a strike price of \$150. As a function of value, the stock price s must satisfy:

$$s = \frac{v + 10,000 - 500 \cdot \max\{150 - s, 0\}}{1000}. \tag{1}$$

Note that we assume that the company pays in cash rather than shares for an exercised option. This assumption simplifies the analysis and makes no difference in the results.[8,9] If $v \geq 140,000$, then the equilibrium price is $s = \frac{v}{1000} + 10$. On the other hand, if $v \leq 140,000$, then $s = \frac{v}{1000} + 10 - 75 + \frac{s}{2}$. This last equation can be simplified to $s = \frac{v}{500} - 130$. Thus, with a high value the stock is worth $s = 210$ and with a low value the stock is worth $s = 70$.

A company with a signal of h has an expected stock price before the sale of $E[s] = \frac{4}{5}200 + \frac{1}{5}100 = 180$ and after the sale of $E[s] = \frac{4}{5}210 + \frac{1}{5}70 = 182$. Therefore, selling the put options is worthwhile to the company. A company with a signal of ℓ has an expected stock price before the sale of $E[s] = \frac{1}{5}200 + \frac{4}{5}100 = 120$ and after the sale of $E[s] = \frac{1}{5}210 + \frac{4}{5}70 = 98$. Therefore, selling the put options are not worthwhile to the company.

Hence, a separating equilibrium exists in which only companies that receive a high signal sell put options. Notice that in this particular example, the company selling the put options, on average, has a gain from the sale. In a full screening model, the buyer chooses the put option and premium to create the minimum benefit to the company that is necessary to ensure (1) that the management participates and (2) separating.

[8] In practice, the put options gave the company the choice of settling the options in cash or company stock, but the options were never settled in stock. For example, Microsoft 10-Q, filing date 11/14/96, states, "The warrants expire at various dates between the second quarter of fiscal 1997 and the second quarter of fiscal 1998, are exercisable only at maturity, and are settleable in cash at Microsoft's option."

[9] We see this equivalence by the following example. If a company has two shares outstanding, a sole investment worth \$200, and an outstanding put option with a strike price of \$120, the company can settle for stock and pay \$120. In this case, the remaining share is worth \$80. Otherwise, the company can pay the cash difference of \$40 and then have two shares worth \$80 each (which would be the market price beforehand).

For instance, here, the strike price can be set to 160. This would lower the share price in the low state to 60, whereby, the expected share price after the sale is $E[s] = \frac{4}{5}210 + \frac{1}{5}60 = 180$. (This strike price makes the put options actuarially fair since there is a $1/5$ chance of them being in the money making $160 - 60 = 100$ per put.) However, this strike price could be limited by both the bargaining power of the buyer and the information structure. (See the end of Section 3.3 for a longer explanation.)

After the put option is sold (or not sold), the party buying the put option could then use this information to make an additional bet on the stock price such as buying the stock and betting that the share price will go up (or if the put option is not sold, it could sell the stock short betting the price will go down). While not explicitly modeled, these profits from trading on information will come at the expense of liquidity traders (see Kyle, 1989).

3.2 Example with Put Buybacks

Now let us add to the above example, put buybacks. This happens when the company has additional information after the put sale.[10]

Let us say that the company has a μ chance ($0 < \mu \leq 1$) of knowing the value of the project before the market (but after the put transaction).[11] The company can buy the puts back for a price of b per put. Since the puts are only in the money when the value of the project is $v = 100,000$, the company only buys them back in that case. A timeline is presented in Figure 1 and a game tree of the options (excluding those of the bank) is presented in Figure 2.

[10] There is no example of a company defaulting on their put options. This is perhaps surprising since if the put options expired in the money, it would imply a very financially stressful situation for the company. Buying back of options offers an explanation as to why.

[11] We assume that μ is independent of both the signal and the actual value, although similar results would hold with dependency.

<<< Insert Figure 1 >>>

<<< Insert Figure 2 >>>

If the company buys back the puts, then the stock price is then $s = 110 - b/2$.[12] (Note that they only do so if $b \leq 80$ since the strike price is 150 and the stock price with the buyback will be 70.)

A company with a signal of h has an expected stock price before the sale of $E[s] = \frac{4}{5}200 + \frac{1}{5}100 = 180$ and after the sale of $E[s] = \frac{4}{5}210 + \frac{1}{5}\left[\mu\left(110 - \frac{b}{2}\right) + (1-\mu)70\right]$. Therefore, to maximize the expected share price, selling the put options is worthwhile if $\mu\left(40 - \frac{b}{2}\right) \geq -10$.

A company with a signal of ℓ has an expected stock price before the sale of $E[s] = \frac{1}{5}200 + \frac{4}{5}100 = 120$ and after the sale of $E[s] = \frac{1}{5}210 + \frac{4}{5}\left[\mu\left(110 - \frac{b}{2}\right) + (1-\mu)70\right]$. Therefore, the options are not worth selling if $27.5 \geq \mu\left(40 - \frac{b}{2}\right)$.

Thus, we can have separation at two different times in three different ways. First, we can have separation as in the previous example where only the companies with the h signal sell puts but do not buy them back after learning their value such as when $b > 80$. Second, only the companies with the h signal sell puts and then they buy them back only if the outcome is bad. For example, if $b = 30$ and $\mu = 0.9$. Third, for a small enough b and a large enough μ, we can have no separation occurring when the put is sold, but there is separation when the put is bought back such as when $b = 22$ and $\mu = 0.95$.

[12] The stock price is equal to the value (100,000) plus the premiums from selling puts (10,000) minus the cost of buying back the put contracts $(500 \cdot b)$, all divided by the number of shares outstanding (1000).

3.3 Two-Type Model with Buybacks.

We now proceed to generalize the basic example into a two-type screening model with put buybacks and two possible outcomes. After describing the basic setup of the model, we provide conditions for the equilibria. We then follow with propositions that use the conditions delineate when different types of equilibria emerge: double separating equilibrium, separating equilibrium via buybacks, or a separating equilibrium without buybacks.

In our model (similar to our prior examples), there is a company that has an uncertain value v with N_s shares of stock outstanding with current stock price s. The company gets a signal, h (high) or ℓ (low), about the distribution of its value. If the signal is h, then there is a θ chance (where $1/2 < \theta < 1$) the company is worth v_h (a high value), and a $(1-\theta)$ chance it is worth v_ℓ (a low value) where $v_h > v_\ell$. If the signal is ℓ, then there is a $(1-\theta)$ chance the company is worth v_h, and a θ chance it is worth v_ℓ. Again, the company has a chance ($0 < \mu \leq 1$) of knowing the value of the project before the market (but after any put sale) and can buy the puts back for a price of $b > 0$ per put. Again, the timeline of this setup is the same as that in Figure 1 and the game tree is the same as that in Figure 2.

A company is offered a take-it-or-leave-it contract of $(N_p, p, x, b) \in \{1, \ldots, N_s\} \times \mathbb{R}^+ \times \mathbb{R}^+ \times \mathbb{R}^+$ where N_p is the number of put options ($N_p < N_s$), p is the put option premium per share, x is the strike price, and b is the buyback price.

Condition C1$_\ell$: $v_\ell \leq xN_s - pN_p$ *(the cutoff is above the low value).*

Condition C1$_\mathbf{h}$: $xN_s - pN_p \leq v_h$ *(the cutoff is below the high value).*

Condition C1$_\ell$ avoids the trivial cases where the options are always out of the money and the investment bank would never want to buy them. Together with Condition C1$_\mathbf{h}$ allows us to analyze the case when the option is only in the money when the value is low. Thus, without buybacks in a high state the stock is worth $s = \frac{v_h + pN_p}{N_s}$ and in a low state the stock is worth $s = \max\{\frac{v_\ell + N_p(p-x)}{N_s - N_p}, 0\}$.

Condition C2: *$xN_p \leq v_\ell + pN_p$ (no bankruptcy).*

Condition C2 is consistent with the empirical finding that no issuing company went bankrupt. However, having such a risk only strengthens the argument that the trade is unprofitable for the buyer without gaining information in return.

Condition C3$_\ell$: *$b < \frac{xN_s - pN_p - v_\ell}{(N_s - N_p)}$ (put buyback is priced sufficiently low).*

Condition C3$_h$: *$b > \frac{xN_s - pN_p - v_h}{(N_s - N_p)}$ (high value is sufficiently high).*

Note that C3$_\ell$ and C3$_h$ can both hold together, however if C3$_\ell$ does not hold, then C3$_h$ holds. Likewise, if C3$_h$ does not hold, then C3$_\ell$ holds. In sum, at least one of the two conditions must hold.

Condition C4: *$b > p$.*

This condition satisfies what is sufficient in Lemma 1 for the firm to sell a put option.

We now present the main result of the model section which describes three types of equilibria that convey information to the buyer of the put option. The proofs are in the Appendix.

Proposition 1. *(a) If Conditions C1$_\ell$, C1$_h$, C2, C3$_\ell$, C3$_h$ and C4 hold, a double separating equilibrium (via purchase and buyback) exists if and only if*

$$\frac{\theta}{1-\theta} \geq \mu \cdot \frac{b-p}{p} + (1-\mu)\left(\frac{N_s(x-p) - v_\ell}{p\,(N_s - N_p)}\right) \geq \frac{1-\theta}{\theta}. \tag{2}$$

(b) If Conditions C1$_\ell$, C2, C3$_\ell$, C3$_h$, C4 hold and C1$_h$ does not hold, a double separating equilibrium (via

purchase and buyback) exists if and only if

$$\frac{1-\theta}{\theta} \leq \left[\frac{(N_s - N_p)}{(v_h - N_s(x-p))}\right] \cdot \left[\mu \cdot (b-p) + (1-\mu) \cdot \left(\frac{N_s(x-p) - v_\ell}{(N_s - N_p)}\right)\right] \leq \frac{\theta}{1-\theta}. \tag{3}$$

We now present an example of the double separating equilibrium of Proposition 1.

Example 1. *Double Separating occurs when* $\theta = \frac{4}{5}$, $v_h = 200,000$, $v_\ell = 100,000$, $N_s = 1000$, $N_p = 500$, $x = 150$, $p = 20$, $\mu = 0.9$ *and* $b = 30$.

We then have constraint (2): $\frac{\theta}{1-\theta} \geq \mu \cdot \frac{b-p}{p} + (1-\mu)\left(\frac{N_s(x-p)-v_\ell}{p\left(N_s-N_p\right)}\right) \geq \frac{1-\theta}{\theta}$ simplify to $4 \geq \mu \cdot \frac{b-20}{20} + (1-\mu)\left(\frac{1000(150-20)-100,000}{20 \cdot 500}\right) \geq \frac{1}{4}$ or $4 \geq \mu \cdot \frac{b}{20} + 3 - 4\mu \geq \frac{1}{4}$. Substituting for μ and b, yields $4 \geq 0.75 \geq \frac{1}{4}$.

Furthermore, $C1_\ell$ is satisfied since $v_\ell \leq xN_s - pN_p$ simplifies to $100,000 \leq 150 \cdot 1000 - 20 \cdot 500$); $C1_h$ is satisfied since $xN_s - pN_p \leq v_h$ simplifies to $150,000 - 10,000 \leq 200,000$; C2 is satisfied, since $xN_p \leq v_\ell + pN_p$ simplifies to $75,000 \leq 100,000 + 10,000$; $C3_\ell$ is satisfied since $b < \frac{xN_s - pN_p - v_\ell}{(N_s - N_p)}$ simplifies to $30 < \frac{150,000-10,000-100,000}{(1000-500)}$; $C3_h$ is satisfied, since $b > \frac{xN_s - pN_p - v_h}{(N_s - N_p)}$ simplifies to $b < \frac{150,000-10,000-200,000}{(1000-500)}$.

Our next proposition characterizes a separating equilibrium via buybacks.

Proposition 2. *(a) If Conditions $C1_\ell$, $C1_h$, C2, $C3_\ell$, $C3_h$, and C4 hold, a separating equilibrium only via buybacks exists if and only if*

$$\mu \cdot \frac{b-p}{p} + (1-\mu)\left(\frac{N_s(x-p) - v_\ell}{p\,(N_s - N_p)}\right) \leq \frac{1-\theta}{\theta}. \tag{4}$$

(b) If Conditions $C1_\ell$, C2, $C3_\ell$,$C3_h$, C4 hold and $C1_h$ does not hold, a separating equilibrium only via

buybacks exists if and only if

$$\left[\frac{(N_s - N_p)}{(v_h - N_s(x-p))}\right] \cdot \left[\mu \cdot (b-p) + (1-\mu) \cdot \left(\frac{N_s(x-p) - v_\ell}{(N_s - N_p)}\right)\right] \leq \frac{1-\theta}{\theta}. \tag{5}$$

This next example demonstrates a separating equilibrium via buybacks described in Proposition 2.

Example 2. *A separating equilibrium only via buybacks occurs when* $\theta = \frac{4}{5}$, $v_h = 200,000$, $v_\ell = 100,000$, $N_s = 1000$, $N_p = 500$, $x = 150$, $p = 20$, $\mu = 0.95$ *and* $b = 22$.

We then have constraint (4), $\frac{1-\theta}{\theta} \geq \mu \cdot \frac{b-p}{p} + (1-\mu)\left(\frac{N_s(x-p)-v_\ell}{p(N_s-N_p)}\right)$, simplify to $\frac{1}{4} \geq \mu \cdot \frac{b}{20} + 3 - 4\mu = 0.245$. Again the other constraints are satisfied.

Finally, our third proposition characterizes when a separating equilibrium exists via put options but not buybacks.

Proposition 3. *(a) If Conditions C1$_\ell$, C1$_h$, C2, C4 hold, but Conditions C3$_\ell$ does not hold, a separating equilibrium via put options (but not buybacks) exists if and only if*

$$\frac{\theta}{1-\theta} \geq \frac{N_s(x-p) - v_\ell}{p\,(N_s - N_p)} \geq \frac{1-\theta}{\theta}. \tag{6}$$

(b) If Conditions C1$_\ell$, C2, C4 hold, but Conditions C1$_h$ and C3$_\ell$ do not hold, a separating equilibrium via put options (but not buybacks) exists if and only if

$$\frac{\theta}{1-\theta} \geq \frac{v_h - N_s(x-p)}{N_s(x-p) - v_\ell} \geq \frac{1-\theta}{\theta}. \tag{7}$$

While Condition C2 (no bankruptcy) is used in Proposition 3, one can get similar qualitative results when

C2 does not hold when the value is v_ℓ.

This next example demonstrates the type of equilibrium described in Proposition 3.

Example 3. *A separating equilibrium via put options (but not buybacks) occurs when* $\theta = \frac{4}{5}$, $v_h = 200,000$*,* $v_\ell = 100,000$, $N_s = 1000$, $N_p = 500$*,* $x = 150$, $p = 20$, *and* $b = 100$.

We then have constraint (6), $\frac{\theta}{1-\theta} \geq \frac{N_s(x-p)-v_\ell}{p\left(N_s-N_p\right)} \geq \frac{1-\theta}{\theta}$, simplify to $4 \geq \frac{1000(150-20)-100,000}{20(500)} = 3 \geq \frac{1}{4}$.

Note that Conditions $\mathrm{C1}_\ell$, $\mathrm{C1}_h$, and C2 hold as before, but $\mathrm{C3}_\ell$, $b < \frac{xN_s-pN_p-v_\ell}{(N_s-N_p)}$, does not hold since $100 > \frac{150,000-10,000-100,000}{(1000-500)}$.

Notice that in our three examples, the equilibrium that we present is unique. There is no indifference on the decision nodes (a)-(h) in Figure 2. This uniqueness also holds whenever the inequalities (2)-(7) are strict.

For a separating equilibrium to exist, we need $N_s > N_p$ (i.e., the number of put options sold should strictly be smaller than the number of shares outstanding). This is consistent with the way that the boards of directors authorize put-option sales for ongoing open market repurchase programs. Also higher premiums p might require a higher strike price x in order to maintain the possibility of the separating equilibrium. This is clear because a company with a low signal is more inclined to sell put options with a higher premium p and a higher strike price x might be necessary to deter them from doing so. Further, a smaller value in the low state v_ℓ might require a higher premium p and/or a lower strike price x in order to maintain the possibility of the separating equilibrium. A smaller value in the low state (when the option is in the money) makes the expected value of the option higher; hence, the option should command a higher premium (or be adjusted by a lower strike price).

If there is a possibility of a buyback ($\mu > 0$ and Condition C1 holds), then there is a trade-off between μ

and b. For a b sufficiently close to p and μ large, we get separation only in the second stage. A double separating equilibrium requires b to be in a mid-range for each μ: not so small as to entice a company with a low signal to sell puts, but not so high as to deter a company with a high signal from selling puts or buying back the puts when the company's value is low.

In summation of the propositions, we find there are three types of equilibria in which the company that sells put options conveys information. The first, a double separating equilibrium conveys information in two stages: only companies with high signals are willing to sell the put options; and once the put options are sold, only companies that discover their value is low before the market does, are willing to buy the put options back. There is another possible single separating equilibrium in which the price of the buyback is too high and only companies with high signals are willing to sell the put options, but they are not willing to buy them back even if their value is low. The third is a single separating equilibrium in which the put option sales do not convey any information (a company is willing to sell the put independent of their signal), but the buyback conveys information because only a company that discovers its value is low before the market is willing to buy back the put options.

This model shows that a financially strong company receives a reward for selling put options and certifying their quality, while financially weak companies choose not to participate because of large expected financial penalties of issuing the put option. This is an unusual way that information is revealed. In most examples of separating equilibria, a strong type must expend effort or spend cash in order to convey his or her strength. Here, the company conveys its strong financial future by selling the put option and receives cash flow for certifying its quality rather than enduring a cost from its action. However, the financially weak company finds the issuance expensive to mimic despite this possible reward.

This screening device allows the counterparties to separate the companies with positive signals from those with negative signals. From these companies with positive initial signals, the device allows the counterparties to separate those with an additional positive signal from those with an additional negative signal. This device represents a financial innovation by the investment banks.

While we don't explicitly model the bank (buyer of the put options), we can draw implications from the effect of the purchaser's behavior after purchasing a put option. These testable implications are: (1) the volume of shares transacted increases around the put option sale (it starts once it is clear the sale will go through), (2) there is an abnormal return on the share price after the put sale, and (3) the companies are likely to make a profit from the transaction, that is, premiums minus expected payouts are positive. Implication (1) is the result of the investment bank or its clients acting on the information gained from the put sale. Implication (2) indicates that the information gained is valuable because the companies that are more likely to sell a put are those more likely to have a gain in share price. The reasoning behind implication (3) is similar to implication (2); those companies that sell put options need to be enticed to do so, therefore, they are not likely to lose money overall. Although we predict that the counterparty might be able to take advantage of the information gained by those companies not willing to sell put options, it is not empirically testable because we have no data on when those failed negotiations took place.

While in practice, options do not explicitly allow the sellers to buy them back, an optimally designed contract might include this "callability" as a feature. For example, companies could try to issue and then possibly retire puts whenever they acquire new substantial information. Microsoft (MSFT) issued puts more or less in every quarter for several years and did indeed buy back their put options in 2000 that saved them significant sums after new information indicated a downswing in price.[13]

As mentioned earlier, a separating equilibrium can still exist when a company makes zero profits in expectation. Then, given that the buyer is the one proposing the transaction, why does the company make a profit as the empirical evidence suggests? While not explicitly modeled, we offer several non-exclusive possible explanations.

Like in the ultimatum game (Güth et al., 1982), the proposer might not be able to fully exploit his or her bargaining power due to a fear of rejection by the other side and might be forced to divide the pie more evenly. Further, the buyer might not have full bargaining power and therefore might negotiate the transaction rather than dictate it with a take-it-or-leave-it offer. The pie then is not a zero-sum result because it includes profit made from trading on the information gained, so a non-actuarially fair price is a feasible solution.

Another reason for why the seller might profit is that there might be more than one type that the buyer wishes to screen for. This gives some sellers information rents. For instance, there are different levels of high types and the buyer might want to know which is which. To do so, the buyer has to reward the higher high types so they do not pretend to be lower high types.

Finally, there may be a cost of issuing the put option borne by the management. The profit on the

[13]When the largest dollar amount of put options per quarter was issued by Microsoft (February 2000 was most likely the last month of issue), the stock price suffered the black swan event of both the dot-com crash (starting March 2000) and the Supreme Court ruling against Microsoft (April 3, 2000). During this tumultuous time, the investment bank allowed Microsoft to repurchase the put options at a loss of $1.4 billion (in the 2001 fiscal year). While substantial, this amount is in stark contrast to what might have happened if the bank didn't allow Microsoft to repurchase the put options. The per-share stock price fell from $111.87 in March 23, 2000, to $41.50 on December 20, 2000. Thus, out of the $12.2 billion potential repurchase obligation, Microsoft could have paid as much as $5.7 billion in the worst case or $2.4 billion using average stock prices.

Microsoft's 2000 Annual Report for the fiscal year ending on June 30, 2000, stated that "On June 30, 2000, warrants to put 157 million shares were outstanding with strike prices ranging from $70 to $78 per share. The put warrants expire between September 2000 and December 2002." Using the average stock price for this period of $58.85 and the mean strike price of $74, if the options were allowed to expire, Microsoft would have lost $2.4 billion. In the worst case scenario, using a strike price of $78 and a share price of $41.50, Microsoft would have lost $5.7 billion.

transaction itself covers this cost.

Furthermore, we claim here that the selection of a transaction also entails having a reasonably large number of option contracts (rather than an option contract on a single share). The buyer might want the stake contained in the put options to be fairly large. A more substantial stake gives the company incentives to both take measures to prevent mistakes (such as have the managers invest more time with the sale) and to invest in making a more accurate forecast through better information acquisition. Furthermore, it warrants management to monitor future developments and repurchase the options, as Microsoft did, when the situation deteriorates, giving the Investment Bank a second possibility to trade on the firm's stock.

4 Data and Summary Statistics

4.1 Data Sources

We search for all companies that sold put options from January 1991 through December 2000 by using 10-K and 10-Q statements available on the Lexis-Nexis database for the whole period and on the SEC's EDGAR database from January 1994 through December 2000.[14] We find 383 companies that have at least one of the key "put" phrases in at least one of their financial reports and have an ongoing repurchase program. Of these, we drop companies that sold put options only on interest rate, foreign exchange,

[14]The period encompasses not only the years in which companies were highly active selling puts on their own stocks (see Gyoshev, 2001, and Jenter et al. , 2011), but was also a relatively calm period between two recessions. We terminated our search period in 2000 when this calm period ended and where companies suspended their programs with the development of the prolonged bear market. We note, however, that put sales have been recently reintroduced by investment banks to a different set of companies. We are not using these sales since the companies did not release the necessary information to determine the sales date. In addition, Lee et al. (2020) document that there is a fundamental shift for the reasons behind stock repurchases after 2001. This shift is away from undervaluation making signaling less important. Although the Lexis-Nexis database started collecting the 10-K and 10-Q statements in 1988, the first company with a put options sale was IBM in 1992. On the other hand, the SEC's EDGAR database started in January 1994. We use the following search phrases: "put derivative", "put option", "equity put", "put feature", "stock put", "put provision", "put the shares", "sale of put", "sold put", "put sold", "put warrants", and "rights to put".

and/or debt securities. We are left with 53 companies that used their own stock as the underlying asset in the issuance of put options. For these remaining companies, we collect and analyze all of the 10-Q and 10-K reports from 1991 to 2000. These 53 companies came from 34 industries as indicated by their four-digit SIC codes. For these 53 companies, we looked for news articles and announcements in both Lexis-Nexis and Factiva for 60 days around the put option sales. From all sources, we do not find any announcements that released positive news around the put sales. [15]

4.2 Transaction Dates

Only 10 of the 53 companies report the exact date on which they sold put options for the first time. In order to find the date in the remaining cases, we look through all 10-K and 10-Q statements for references to the option expiration. Based on these references, we are able to estimate the date for an additional eight companies. Similarly, 11 companies report the month when they sold put options, and we infer the month for an additional 16 companies. Four companies report only the quarter, while the remaining four companies report only the year when they first issued put options.

The ten put contracts for which we know the exact sale date have expiration dates set 3, 6, 9, 12, 18, and 24 months after the sales. Using this knowledge, we are able to estimate the expiration date for eight other companies by combining information from different 10-Q or 10-K reports. For instance, the Clorox 10-Q report for the quarter ending on December 31, 1993, states that Clorox sold put options in the "first fiscal quarter of 1994" (between 7/1/93 and 9/30/93), while the Clorox 10-Q report for the quarter ending on March 31, 1994, states that "all put warrants expired unexercised on February 22, 1994." Therefore, we

[15] We searched Lexis-Nexus for relevant put programs finding 66 related terms in the period of 2010-2019 (we wanted a ten-year period for comparison). These were from 19 different companies. This contrasts to our sample period 1991-2000 where the total number of search results was 327 from 63 different companies, 53 of which had synthetic repurchase program. The 19 companies that did sell put options in connection with repurchase program did not disclose enough information (exact date of sale or expiration) to enlarge our sample of 18 companies on which we are performing some of the studies.

conclude that the date on which the contract was signed is six months prior to the expiration on August 22, 1993, since that is the only possible date that is within the specified dates and fits one of the possible customary contract lengths.

In addition, by using the 10-K and 10-Q reports for 20 companies, we are able to identify at least the quarter that the put option sale was made in. In 16 of those, we are able to accurately estimate the month by combining information from different 10-Q and 10-K reports in a manner similar to that described above.

The most complete information on the put option sales tends to be provided by the first 10-Q or 10-K that reports the transaction. After the first report, the information gets less complete with each consecutive disclosure that prevents us analyzing subsequent sales.

4.3 Summary Statistics

In Table 1, we report the summary statistics for the put options issued by our sample companies. The majority of the companies, 32 of 53, issued European-style put options; only 11 issued American-style put options. Because only American-style options can be traded on the CBOE, it seems that few companies intended to place their put options publicly. This is directly confirmed by looking at the second column of Panel A in Table 1 where we report the type of buyers disclosed in the financial statements. Only one company publicly disclosed the sale of put options on an exchange. The rest sold their options to private counterparties. In most cases the identity of the buyer was not disclosed, but if disclosed, the buyer was usually either an investment bank or another institutional investor. More than 40% of the companies disclosed that their issues were long-term put options with maturities greater or equal to one year.

<<<Insert Table 1 here>>>

We report the descriptive statistics for the time until disclosure in the fourth column of Panel A in Table 1. We note that at the time of the put sale, the market is not aware of them. The median time from the date of the option sale to the date it was disclosed in the companies' financial statements is 99 days, while the average is 186 days. Only one company announced its intent to sell put options in advance of the deal. The maximum time between a deal transaction and announcement was a staggering 1,561 days, or more than four years.

Further, in Table 1, we examine both the initial and consecutive put option sales and report the extent to which the options were exercised or expired. We document that most of the options expired out of the money. In only two cases did companies state that all of the options were exercised (both these cases occurred when the company involved only issued one tranche of put options). In 32 cases, all of the options (for all the tranches) expired out of the money. In six cases, the put options for the last tranche only were settled early (including Microsoft that settled the option after 24th quarters of selling puts); and in eight cases, the last tranche of options were exercised with the initial tranches expiring worthless. Five of the companies did not report the outcome, which indicates that the put options expired worthless because otherwise they would have reported the sales as material events. We did not have any cases where the options were settled early or exercised and there was another tranche of put options sold afterwards.[16]

[16]We do know of one more recent case: Navios Maritime Acquisition Corporation which had options in 2016 exercised at strike $10 when their stock price was $8.

5 Empirical Results

5.1 Abnormal Stock Performance

Table 2 reports the average cumulative abnormal returns (CAR) for the 18 companies with an identifiable date for their first put option sale. We compute the cumulative average abnormal returns using the market model. The market model parameters are estimated using a window from 180 to 61 days before the event date, which is the day of the put-option sale. We use the CRSP value-weighted portfolio as our proxy for the market. Even though Table 1 shows that companies report the sale after more than six months, the average CAR for a two-day window after the date of the sale is slightly more than 2% (This is statistically significant at the 5% level despite the small sample size.) Moreover, the CAR for the 60-day window is 9.08% and is also statistically significant at the 5% level (see Table 2).[17] Figure 3 provides a graph of the CAR.

<<< Insert Figure 3 here >>>

Further, we find that the stock price performs negatively in the 60-day period before the put option sale. Our understanding from speaking with practitioners is that the sale of put options is a long drawn-out process that takes between one and three months. As we indicated in the model section, the company's managers engage in selling put options only if they feel the stock is undervalued. From the moment that negotiations of a put option sale are initiated until just before the completion date, the random-walk nature of the stock prices yields three basic scenarios: the stock could go up, down, or stay at the current price level. Once the sale is near completion, the managers still consider the sale only in the latter two

[17]The one-year buy-and-hold abnormal return is computed using the Lyon, Barber, and Tsai (1999) methodology and is 11.67% with a p-value of 0.03045.

scenarios. Hence, because the stock performance of those companies that have begun negotiations might go up during the negotiations, conditional on the sale, the stock's performance should be negative. This is a form of survivorship bias.[18]

<<< Insert Table 2 here >>>

This negative stock performance is also consistent with Stephens and Weisbach (1998) who find that share repurchases are negatively related to prior stock-price performance.

We recognize that event studies have potential weaknesses such as the cross-sectional correlation of the abnormal returns associated with clustering event dates (see Kliger and Gurevich, 2014, chapter 6, page 65–83, Kolari and Pynnönen, 2010). Our event dates are not clustered– they have a mean day difference of 128.9 and a median day difference of 83. By generating 100,000 random samples of event days over a similar period, we find a mean day difference of 128.167 and a median day difference of 92.4. Furthermore, we find that 32,291 of these samples have a larger difference between the mean and median than the difference from our event dates.[19]

[18]Note this negative performance opens the possibility that there is mean-reversion in the stock prices around the put option sale. To distinguish between our explanation and mean reversion, we take each of the 18 companies selling put options with identified dates and match it with all 26,500 CRSP companies. If company A sold a put option on March 1, 1997, and experienced an abnormal return of x% for the 60 days prior, we choose the closest 100 companies by their return y% (close defined by the smallest $(x-y)^2$). We observe that the sample that we get is not mean reverting, because the average return of those companies that sell put options is 9% while the return in the matched sample is close to zero. These returns are significantly different at the 1% level (Wilcoxon test, $p = 0.000$).

[19]The list of event dates are: 1992-09-16, 1993-03-30, 1993-08-22, 1994-04-04, 1994-06-26, 1994-08-03, 1994-08-07, 1996-01-22, 1996-03-03, 1996-07-16, 1997-07-13, 1997-09-01, 1997-09-18, 1997-10-23, 1997-11-05, 1998-04-26, 1998-09-15, and 1998-09-17.

5.2 Abnormal Stock Trading Volumes

Abnormal trading volumes perhaps positively influence the stock price and generate the positive abnormal returns in the short event windows. Figure 4 is generated by taking each company's daily volume and dividing it by the daily volume on day -60. This method normalizes the average volume across this time period to one. We then take the average of these adjusted volumes over all 18 companies. This method is a crude way to examine trading volume while treating each company equally independent of its size. The graph shows that the volume increases by 40% before the transaction date and stays relatively high until about ten days after the transaction date before drifting down. Consequently, we surmise that most of the increased volume occurs before the stock price starts increasing. This 40% increased volume could be a sign that the counterparties are accumulating shares as the transaction becomes more likely and doing so to a large extent without showing their hand.

<<< Insert Figure 4 here >>>

The cumulative abnormal relative volume (CARV) in Table 3 shows a similar story.[20] Although the overall volume significantly decreases from days -60 to -1, the volume is abnormally high from -10 to -1. It remains high between days 0 and 10. The overall abnormal volume does not remain statistically significant if we extend it from 10 to 60 days.[21] Note that the companies themselves did not purchase shares during this timespan (there is no substantial decrease in the number of shares outstanding or increase in treasury shares).[22]

[20] See Ajinkya and Jain (1989), Campbell and Wasley (1996) and Cready and Ramanan (1991) for how abnormal trading volume is computed.

[21] There was no such volume changes in the option markets. This is not surprising given that the overall volume of the put options on the stock was roughly 1% to 10% that of its volume. Hence, if someone wanted to make a profit from a rising stock price without significantly influencing the market, it would be easier with stocks rather than with options.

[22] We have computed the change in the shares outstanding using CRSP's monthly data and find the maximum change was less than 1% of average daily volume. Stephens and Weisbach (1998) show that this method yields a higher figure for repurchases than the three Compustat measures that they examine.

<<<Insert Table 3 here >>>

5.3 Evidence from Trading by Insiders

In this section, we find additional evidence in support of the theory that the management of the company is indeed informed about the undervaluation of the stock. Company insiders (upper management as well as shareholders with a larger than 5% stake) must report to the SEC on form 13D any transactions of the company's stock as well as type: purchased (P) or sold (S) on the open market, options that are exercised (M), or company stock or options that are awarded (A) to them. This report includes the day that the transaction occurred. (See Bonaimé and Ryngaert, 2013, Ben-Rephael et al., 2014, and Bonaimé, 2015, for analyzing 13D transactions with relation to share repurchases.) We document only one insider that was not upper management at the time of the transactions but was in the same year prior to the transactions.[23]

We break the dates of such transactions into three ranges: *before*, *during*, and *after*. These ranges are determined by the structural breaks in the volumes found in (online) Appendix B, that is, *before* is defined as -60 to -20 trading days before the sale, *during* is defined as days -19 to 12, and *after* is defined as days 13 to 60. We then look at how many transactions fall into each range and perform a binomial test on whether the proportion of transactions is in accordance with the number of days in the ranges. The results of these tests are in Table 4.

<<<Insert Table 4>>>

We find that A and S transactions in *during* are significantly less than the combination of *before* and *after,* at the 1% and 10% level, respectively. In addition, P transactions in *during* are significantly more than the

[23]All of his transactions occurred more than 60 days prior to the put sale and are not included in the analysis.

combination of *before* and *after,* at the 1% level. We also uncover that M and S transactions in *after* are significantly less than in *before*, at the 1% and 10% levels, respectively. In addition, we find that A, M, and S transactions in *during* are significantly less than *before*, at the 1%, 1% and 5% levels, respectively, while P transactions in *during* were significantly more than in *before* at the 10% level. Finally, we find that A transactions in during are significantly less than in after and that P transactions in during were significantly more than in after, both at the 1% level.

These results are consistent with our hypothesis that insiders are informed: An informed insider sells less and purchases more on the open market in *during*. Since the stock price still increases in *after*, we expect that the insider will sell less than in *before*. Again since the stock price increases in *after*, we expect that an informed insider will delay the exercise of call options.[24]

We also note that the company determines the *A* transactions. There are three possible scenarios. First, the company prefers to save money and thus does not want to award stock or options when they expect the stock price to increase. Second, the managers of the company want to award themselves stock or options at the lowest possible price and do so. Third, the legal department of the company (or fear of legal action) stops the managers from awarding themselves stock or options close to a material sale of puts. In the first case, we expect awards to be smaller in *during* and possibly smaller in *after*. In the second case, we expect awards to be higher in *during*. In the third case, we would expect awards to be smaller only in *during* and possibly higher in *after*. Thus, we find support for the first and third possibilities.

We note that Lie (2005) and Heron and Lie (2007) uncover evidence that during the period of our study the awarding of call options were retroactively set to coincide with lower stock prices. This is the opposite

[24]If they know with certainty the stock price will go up and the amount, then they are indifferent as to when they exercise their executive call options. However, since this increase is only expected and not certain, it is better to wait. Take for instance an option whose strike price is at the stock price in *during*. If there is a 90% chance the stock will continue to go up and a 10% chance it will go down, the optimal strategy is to wait to see the result and then exercise the option.

result from what we find: precisely when the price is lowest is when there is the least awarding of options. However, the explanation for this discrepancy is clear. The put options sold and the awarding of call options are a matter of record. Therefore if they coincide, then this could raise suspicions that could alert the SEC to their illicit behavior. Heron and Lie (2009) estimate that 29% of all firms were involved in such illegal manipulation. Thus, in view of this literature, our third possibility seems most likely. Furthermore, Dai et al. (2016) find support for firms restricting stock sales (not purchases) by insiders when they have inside information. This finding and the direction of good corporate governance explains why increased purchases and exercising of options were permitted around the put sales.

6 Policy Implications and Concluding Remarks.

Jenter et al. (2011) offer an explanation for why put option sales occur right before increases in stock prices, namely, that the managers are at timing their put option sales. We offer an alternative explanation: purchasers use the put option sales as a screening mechanism to acquire information. By making use of this information to purchase stocks, the purchasers cause the stock price to increase. In other words, the causation is in a different direction from Jenter et al. (2011). We find support for the idea that put option sales trigger increases in stock prices and increases in trading volumes, instead of stock prices causing the initiation of the put sales.[25] This provision of information story for put sales is consistent with Vermaelen (1981, 1984), Ikenberry et al. (1995), Kim and Kallberg (1998), Gibson and Singh (2001), Oded (2005), Gibson et al. (2006), Bonaime (2015), Busch and Obernberger (2016), Evgeniou et al. (2018), and Manconi et al. (2019), who find that share repurchases and other financial transactions can

[25]An endogenous price increase should occur shortly after the put option sale while any exogenous price increase should occur later (unless the price has already incorporated it). Jenter et al.'s (2011) explanation is that the time of the price change is exogenously predicted by the manager as opposed to our explanation that the timing of the price change is endogenously set by the manager through the sale of the puts.

act as signals.

We develop a theoretical model that shows how purchasers of put options from companies can gain information. If then the buyers of the put options start purchasing stock, this could be a trigger for an overall stock price increase. We document empirical evidence (adjusted for market risk and volume) in support of this trigger explanation. Our model shows that further information can be obtained by the purchasers when the options are in the money (or close to being so) and the purchasers negotiate to buy them back.

A party that uses option purchases appears to bypass the illegal aspect of gaining insider information. Theoretically, a trader wants to gain insider information because this information allows the trader to predict stock-price movements and realize abnormal profits. When making put option purchases, investment banks do not directly gain any insider information on performance, but they do indirectly obtain the view of the company's management on the future performance of the stock price. Only the managers with positive outlooks are willing to sell put options to the investment banks. Furthermore, these investment banks have this information exclusively in their possession on average for more than six months, as per the current disclosure regulations.

While we present one explanation for why an investment bank or their clients would buy a put option directly from a company, there are alternative explanations. First, managers are overconfident about their company's future prospects.[26] Given this overconfidence, managers tend to underprice the options, and the investment bank exploits this underpricing. If the company's stock return abnormally declines following the sale of the put options, then this decline might indicate management overconfidence. However, for a sample of 18 companies that sell put options, we find a positive 60-day average cumulative abnormal

[26]See Hirshleifer, Low, and Teoh (2012) for both an overview of overconfidence and a reason why managerial overconfidence as a characteristic could be beneficial to the company.

return of 9.08% after the initial sale that is inconsistent with management overconfidence.

Another possibility is that the counterparties are hedging against declines in the company's stock price. The support for this explanation is that most of these put option transactions occurred between 1992 and 2000, which was a period in the midst of a prolonged bull market. The argument against hedging is the increased volumes and abnormal returns around the put option sales that point to increased share acquisition with the knowledge that the company is optimistic about the future price. Still, it could be that those purchasing put options are encouraged to buy shares rather than that they are hedging shares already owned; however, these volumes are higher than the number of put options.

Answering the question in the title of this paper is important. If acts by large market participants seem irrational, then perhaps we do not know the entire picture. We find that this is indeed possible. Investment banks could be rational: they (or their clients) might be trading on insider information obtained in a seemingly legal way. This explanation leads to the policy recommendation to shut down that loophole.[27]

Hence, from the policy perspective our results shed light on consequences of the permitted absence of immediate disclosure currently allowed in the US markets. The lack of regulations allows both companies and investment banks and their constituents to profit from trading in company-issued derivatives at the expense of broad market participants. However, even if we mandate full and immediate disclosure of all put option sales pursued by companies, then front-running (as indicated by the increased volume starting before the put sale) would still exist. The key change would instead be to make private sales of put options illegal to be replaced by exchange-traded put options, which Angel et al. (1997) argues can

[27] There has been recent increased activity of using accelerated share repurchases, ASR, (Bargeron et al., 2011). Like a put option, an ASR is a commitment by the firm to a financial transaction with another party (as opposed to a standard repurchase agreement which is on the open market and not a commitment). With a put option, the firm is committed to pay an extra if the price goes down. With an ASR, the firm is committed to pay extra if the price goes up (and receive extra if it goes down). Hence, a put option is more valuable as a signal that the firm expects the price to rise. Furthermore, the other party in an ASR transaction, might still gain some information but is less able to make use of it legally.

fulfill any legitimate firm's need for private put options. Requiring exchange-traded sales will prevent screening by buyers, but will still allow signaling by the companies, which would be seen by the market as preventing investors from privately profiting from information gained from such signals.

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Appendix A: Proof of Propositions 1, 2, and 3.

In this Appendix, we will prove Propositions 1, 2, and 3. We will start by proving a series of Lemmas that are used in the proofs of the Propositions. We follow this with the individual proofs of each Proposition.

For convenience, we list definitions of the model's variables in Table A1.

h, ℓ	Signal received by the company
v_ℓ, v_h	Value of the company's sole project
h	If h, then θ chance project is worth v_h
ℓ	If ℓ, then $1-\theta$ chance project is worth v_ℓ
N_s	Number of shares
N_p	Number of put options
p	Put option premium per share
x	Strike price
b	Buyback price
s	Stock price
$s_{nb,v\leq v^*}$	stock price w/o buybacks and $v \leq v^*$
$s_{nb,v\geq v^*}$	stock price w/o buybacks and $v \geq v^*$
s_b	stock price after buyback
s_h	stock price when the company receives signal h w/o put options
s_ℓ	stock price when the company receives signal ℓ w/o put options
$s_{h,p,b}$	stock price when the company receives signal h w/ put options and buybacks
$s_{\ell,p,b}$	stock price when the company receives signal ℓ w/ put options and buybacks
$s_{h,p,nb}$	stock price when the company receives signal h w/ put options and w/o buybacks
$s_{\ell,p,nb}$	stock price when the company receives signal ℓ w/ put options and w/o buybacks
μ	Chance the company learns the value before market.

Table A1: Model Definitions

A.1 Preliminary Lemmas

The following sequence of lemmas delineate the regions of parameters into where the company would sell put options, buyback the options, etc.

Lemma 1. *If $p \geq x$ or $b < p$, then the company will always accept the put contract.*

Proof. Since the stock price will be strictly positive, the maximal payment for each put contract is strictly less than x. Since a company receives p for each put contract, it will always make a profit when $p \geq x$.

Thus, it is worthwhile to accept such an offer.

If $b < p$, then it would be profitable for the company to sell the contract to the bank for p and instantly buy back the contract for a lower price of b. A company may not wish to buy back the put option, but even if the company knew ahead of time the state would be v_ℓ, it would be worthwhile to sell the put option. ■

Lemma 1 indicates the parameter region that would not be of interest since there would be no information conveyed by the company selling the put options.

We now gain insight about the regions where information can be acquired. The following lemma finds for which values the options are in the money, which must occur for low values if signaling exists via the purchase of the options.

Lemma 2. *If the company sells the options and does not buy them back, then the options are in the money at the expiration date if and only if the project value v is strictly less than $v^* = xN_s - pN_p$.*

Proof. If the company indeed sells the put options but does not exercise the buyback, then as a function of the value, the stock price (if positive) must satisfy:

$$s = \frac{v + pN_p - N_p \max\{x - s, 0\}}{N_s}. \tag{8}$$

By substitution x for s into equation (8), we can find the value v^* that causes $s = x$. This computes to $v^* = xN_s - pN_p$. We now see that the option is in the money if and only if $v < v^*$. Substituting $v = \Delta v + v^*$ into equation 8 and simplifying yields

$$\Delta v = -N_s(x - s) + N_p \max\{x - s, 0\}.$$

If $x > s$ then the RHS is strictly negative since $N_p < N_s$. If $\Delta v < 0$, then $x > s$ since otherwise, the RHS is greater than or equal to 0. Hence, the put option is in the money if and only if $v < v^*$.

■

Corollary 1. *If the cutoff is strictly higher than the high value ($xN_s - pN_p > v_h$), then the options are always in the money. If the cutoff is strictly lower than the low value ($v_\ell > xN_s - pN_p$), then the options are never in the money.*

If an option is either always in the money or always out of the money, then there is no information gained from the initial sale. Furthermore, if the options are never in the money, then the company would never buy back the options and there is no information gained from any buyback offer. Overall, a buyer would lose money from buying a put that reveals no information and always expires worthless. Thus, we would not expect to see such offers when the options are never in the money.

There are cases where there will be buybacks. The following lemma finds for which values a company will try to buyback the put options. This buyback must occur only for low values if signaling occurs via buybacks.

Lemma 3. *A buyback occurs only if $xN_s - pN_p - b(N_s - N_p) \geq v$.*

Proof. Without buybacks, if $v \geq v^*$, then $s_{nb,v\geq v^*} = \frac{v+pN_p}{N_s}$ is the equilibrium stock price. If $v \leq v^*$, then the equilibrium price $s_{nb,v\leq v^*}$ must satisfy:

$$s_{nb,v\leq v^*} = \frac{v}{N_s} + \frac{N_p}{N_s}(p - x + s_{nb,v\leq v^*}). \tag{9}$$

Solving for $s_{nb,v\leq v^*}$ yields

$$s_{nb,v\leq v^*} = \frac{v + N_p(p-x)}{N_s - N_p}. \tag{10}$$

If the company exercises the buyback, then the stock price s_b is instead

$$s_b = \frac{v-(b-p)N_p}{N_s} = \frac{v + pN_p - bN_p}{N_s}. \tag{11}$$

Clearly, the buyback can only occur if the put is in the money, i.e., $v \leq v^*$, since $s_{nb,v\geq v^*} > s_b$. Furthermore, when the put is in the money, the buyback can only occur if the value of the stock is higher with the buyback than with paying out the put. This can happen if and only if $s_b \geq s_{nb,v\leq v^*}$ or

$$\frac{v + pN_p - bN_p}{N_s} \geq \frac{v + N_p(p-x)}{N_s - N_p}. \tag{12}$$

This equation simplifies to

$$xN_s - pN_p - b(N_s - N_p) \geq v. \tag{13}$$

■

Corollary 2. *A buyback occurs only if the put is in the money and either b is sufficiently small or N_p is sufficiently high (close to N_s).*

A buyer may also be concerned about counter party risk. Hence, in the following Lemma, we look at when this would be of concern.

Lemma 4. *The company will not be able to pay all the put obligations if and only if $xN_p > v_\ell + pN_p$.*

Proof. The worst case for the company (and maximum payoff on the put option for the company) occurs when the project has a low value v_ℓ. It would not be able to pay the put option, if and only if, the share price drops to 0. The total liability is xN_p and the total assets are $v_\ell + pN_p$, which is the value of the project plus the put premiums. ■

A.2 Proof of Proposition 1

We start by proving part (1a). By Lemma 3, Condition C3$_\ell$ and C3$_h$ assure that a buyback will only occur for a low value. In Figure 2, Condition C3$_\ell$ assures that the company would choose left (buy) at nodes d and g, while Condition C3$_h$ assures that the company would choose right (not buy) at nodes e and h. Condition C4 assures that the decision at nodes c and f would consistent with the decision nodes a and b. This is because there is no gain of information for the company and if the company wanted to sell a put for a premium p, they would not want to buy it back for a price b strictly larger than p.

Given now the decisions at nodes c to h, we now compute the share price of the company under several options in order to check the incentive constraints such that the company chooses not to sell a put option at node a and chooses to sell a put option at node b.

h signal, no put option: A company with a signal of h that chooses not to sell a put option has an expected stock price of

$$s_h = \theta \frac{v_h}{N_s} + (1-\theta)\frac{v_\ell}{N_s}. \tag{14}$$

h signal, put option sale and separating buyback: If C1$_h$ holds, with chance θ, the value is v_h, and the stock price is worth $\frac{v_h + pN_p}{N_s}$. With chance $(1-\theta)$, the value is v_ℓ, and the company has a μ chance of buying back the puts leading to a stock price of $\frac{v_\ell + N_p(p-b)}{N_s}$ and a $(1-\mu)$ chance of being forced to pay out the put option (by Lemma 2, since C1$_\ell$ holds), which results in a stock price of $\frac{v_\ell + N_p(p-x)}{N_s - N_p}$, which is positive due to Condition C2. Overall, the expected stock price is:

$$s_{h,p,b} = \theta \frac{v_h + pN_p}{N_s} + (1-\theta)\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu)\cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right]. \tag{15}$$

ℓ signal, no put option: Likewise, a company with a signal of ℓ that does not sell the put option will have an expected stock price of

$$s_\ell = (1-\theta)\frac{v_h}{N_s} + \theta \frac{v_\ell}{N_s}. \tag{16}$$

ℓ signal, put option sale and separating buyback: A company with a low signal and a separating buyback will have an expected stock price of

$$s_{\ell,p,b} = (1-\theta)\frac{v_h + pN_p}{N_s} + \theta\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu)\cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right]. \tag{17}$$

Hence, we can have a double separating equilibrium, where only the company with a high signal sells the puts and a company with a low value buys back the puts, if and only if $s_h \leq s_{h,p,b}$ (weakly preferred to sell a put option at node b) and $s_\ell \geq s_{\ell,p,b}$ (weakly preferred to not sell a put option at node a). By substitution from equations (14)-(17), we have

$$\theta \frac{v_h}{N_s} + (1-\theta)\frac{v_\ell}{N_s} \leq \theta \frac{v_h + pN_p}{N_s} + (1-\theta)\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu)\cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right], \tag{18}$$

$$(1-\theta)\frac{v_h}{N_s} + \theta \frac{v_\ell}{N_s} \geq (1-\theta)\frac{v_h + pN_p}{N_s} + \theta\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu)\cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right]. \tag{19}$$

These conditions can be simplified to

$$0 \le \frac{\theta}{1-\theta} + \frac{N_s}{pN_p} \cdot \left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu) \cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p} - \frac{v_\ell}{N_s}\right], \tag{20}$$

$$0 \ge \frac{1-\theta}{\theta} + \frac{N_s}{pN_p} \cdot \left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu) \cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p} - \frac{v_\ell}{N_s}\right]. \tag{21}$$

Combining yields

$$\frac{1-\theta}{\theta} \le \frac{N_s}{pN_p} \cdot \left[\frac{v_\ell}{N_s} - \mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} - (1-\mu) \cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right] \le \frac{\theta}{1-\theta}. \tag{22}$$

This reduces to inequality (2).

We now prove part (1b), which states constraints when a separating equilibrium only via buybacks exists. Like for part (1a), Conditions C3$_\ell$, C3$_h$, and C4 assures that the decisions at nodes c to h will be consistent with a separating equilibrium via a buyback. For the decisions at nodes a and b to be consistent, we must have $s_\ell \le s_{\ell,p,b}$ (weakly preferred to sell a put option at node b) and $s_h \le s_{h,p,b}$ (weakly preferred to sell a put option at node a). By substitution from equations (14)-(17), we have

$$\theta \frac{v_h}{N_s} + (1-\theta)\frac{v_\ell}{N_s} \le \theta \frac{v_h + pN_p}{N_s} + (1-\theta)\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu) \cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right], \tag{23}$$

$$(1-\theta)\frac{v_h}{N_s} + \theta \frac{v_\ell}{N_s} \le (1-\theta)\frac{v_h + pN_p}{N_s} + \theta\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu) \cdot \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right]. \tag{24}$$

Since $\theta > \frac{1}{2}$, the second inequality (24) implies the first inequality (23). Hence, we have this type of equilibrium if and only if (4) holds.

A.3 Proof of Proposition 2

We now prove part (2a). $C1_\ell$, $C1_h$, C2, C4 hold, but Conditions $C3_\ell$ does not hold,

By Lemma 3, the fact that Condition $C3_\ell$ does not hold assures that a buyback will not occur for a low value (and hence also not for a high value). This and Condition C4 assures that the decisions at nodes c to h will be consistent with a separating equilibrium without a buyback.

h signal, put option sale and no buybacks: If $C1_h$ holds, with chance θ, the value is v_h, and the stock price is worth $\frac{v_h+pN_p}{N_s}$. With chance $(1-\theta)$, the value is v_ℓ the company pays out the put option, which results in a stock price of $\frac{v_\ell+N_p(p-x)}{N_s-N_p}$, which is positive due to Condition C2. Overall, the expected stock price is:

$$s_{h,p,nb} = \theta \frac{v_h + pN_p}{N_s} + (1-\theta)\left[\frac{v_\ell + N_p(p-x)}{N_s - N_p}\right]. \tag{25}$$

ℓ signal, put option sale and no buybacks: and after the sale of the put option an expected stock price of

$$s_{\ell,p,nb} = (1-\theta)\frac{v_h + pN_p}{N_s} + \theta\left[\frac{v_\ell + N_p(p-x)}{N_s - N_p}\right]. \tag{26}$$

Hence, we can have a separating equilibrium without buybacks if and only if $s_h \le s_{h,p,nb}$ (weakly preferred to sell a put option at node b) and $s_\ell \ge s_{\ell,p,nb}$ (weakly preferred not to sell a put option at node a). By substitution from equations (14), (16), (25), (26) we have

$$\theta\frac{v_h}{N_s} + (1-\theta)\frac{v_\ell}{N_s} \le \theta\frac{v_h + pN_p}{N_s} + (1-\theta)\left[\frac{v_\ell + N_p(p-x)}{N_s - N_p}\right] \tag{27}$$

$$(1-\theta)\frac{v_h}{N_s} + \theta\frac{v_\ell}{N_s} \ge (1-\theta)\frac{v_h + pN_p}{N_s} + \theta\left[\frac{v_\ell + N_p(p-x)}{N_s - N_p}\right] \tag{28}$$

Simplifying

$$
\begin{aligned}
\left[\frac{v_\ell}{N_s} - \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right] &\leq \frac{\theta}{(1-\theta)}\frac{pN_p}{N_s} \\
\left[\frac{v_\ell}{N_s} - \frac{v_\ell + N_p(p-x)}{N_s - N_p}\right] &\geq \frac{(1-\theta)}{\theta}\frac{pN_p}{N_s}
\end{aligned}
$$

These further simplify to inequality (6).

We now continue by proving part (2b). The company can have a high value v_h that is also in the money (since $C1_h$ does not hold) but we still have a double separating equilibrium. Again, we must show that $s_\ell \leq s_{\ell,p,b}$ and $s_h \leq s_{h,p,b}$ and these are equivalent to (the difference is the share price of a company selling puts in the high state is now worth $\frac{v_h+N_p(p-x)}{N_s-N_p}$ instead of $\frac{v_h+N_pp}{N_s}$):

$$
\theta\frac{v_h}{N_s} \leq \theta\frac{v_h + N_p(p-x)}{N_s - N_p} + (1-\theta)\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu)\cdot\frac{v_\ell + N_p(p-x)}{N_s - N_p} - \frac{v_\ell}{N_s}\right], \quad (29)
$$

$$
(1-\theta)\frac{v_h}{N_s} \geq (1-\theta)\frac{v_h + N_p(p-x)}{N_s - N_p} + \theta\left[\mu \cdot \frac{v_\ell + N_p(p-b)}{N_s} + (1-\mu)\cdot\frac{v_\ell + N_p(p-x)}{N_s - N_p} - \frac{v_\ell}{N_s}\right]. \quad (30)
$$

Combining inequalities (29) and (30) yields inequality (3). Notice when v_h goes to v^*, (3) reduces to the condition when v_h is not in the money.

A.4 Proof of Proposition 3

We start by proving part (3a). The difference between this part and part (1b) is that Condition $C1_h$ does not hold. Similar to the last part, we must use $\frac{v_h+N_p(p-x)}{N_s-N_p}$ instead of $\frac{v_h+N_pp}{N_s}$, but now replacing in inequality

(24), which becomes:

$$(1-\theta)\frac{v_h}{N_s}+\theta\frac{v_\ell}{N_s} \leq (1-\theta)\frac{v_h+N_p(p-x)}{N_s-N_p}+\theta\left[\mu\cdot\frac{v_\ell+N_p(p-b)}{N_s}+(1-\mu)\cdot\frac{v_\ell+N_p(p-x)}{N_s-N_p}\right].$$

Rearranging yields:

$$\theta\left[-\mu\cdot\frac{v_\ell+N_p(p-b)}{N_s}-(1-\mu)\cdot\frac{v_\ell+N_p(p-x)}{N_s-N_p}+\frac{v_\ell}{N_s}\right] \leq (1-\theta)\left(\frac{v_h+N_p(p-x)}{N_s-N_p}-\frac{v_h}{N_s}\right)$$

which simplifies to inequality (5).

We now prove part (3b). Again, we must use $\frac{v_h+N_p(p-x)}{N_s-N_p}$ instead of $\frac{v_h+N_p p}{N_s}$, but now in inequalities (27) and (28). Doing so yields:

$$\begin{aligned}
0 &\leq \theta\left[\frac{v_h+N_p(p-x)}{N_s-N_p}-\frac{v_h}{N_s}\right]+(1-\theta)\left[\frac{v_\ell+N_p(p-x)}{N_s-N_p}-\frac{v_\ell}{N_s}\right],\\
0 &\geq (1-\theta)\left[\frac{v_h+N_p(p-x)}{N_s-N_p}-\frac{v_h}{N_s}\right]+\theta\left[\frac{v_\ell+N_p(p-x)}{N_s-N_p}-\frac{v_\ell}{N_s}\right].
\end{aligned}$$

These further simplify to:

$$0 \leq \theta\left[-N_s(x-p)+v_h\right]+(1-\theta)\left[-N_s(x-p)+v_\ell\right], \tag{31}$$

$$0 \geq (1-\theta)\left[-N_s(x-p)+v_h\right]+\theta\left[-N_s(x-p)+v_\ell\right]. \tag{32}$$

Combining yields (7).

Appendix B

Analysis of structural breaks in prices and volumes can be found online at < Insert URL >

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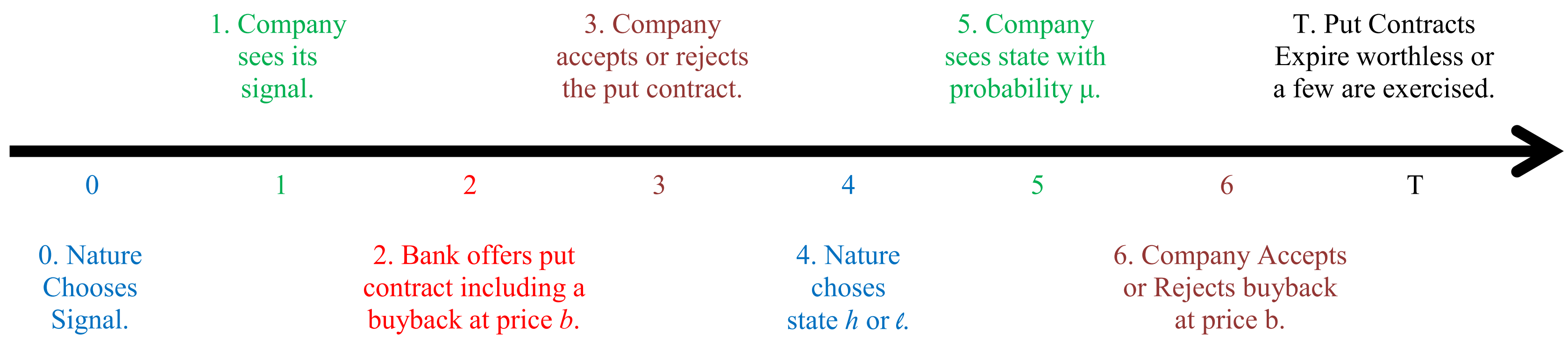

Figure 1.

The model timeline.

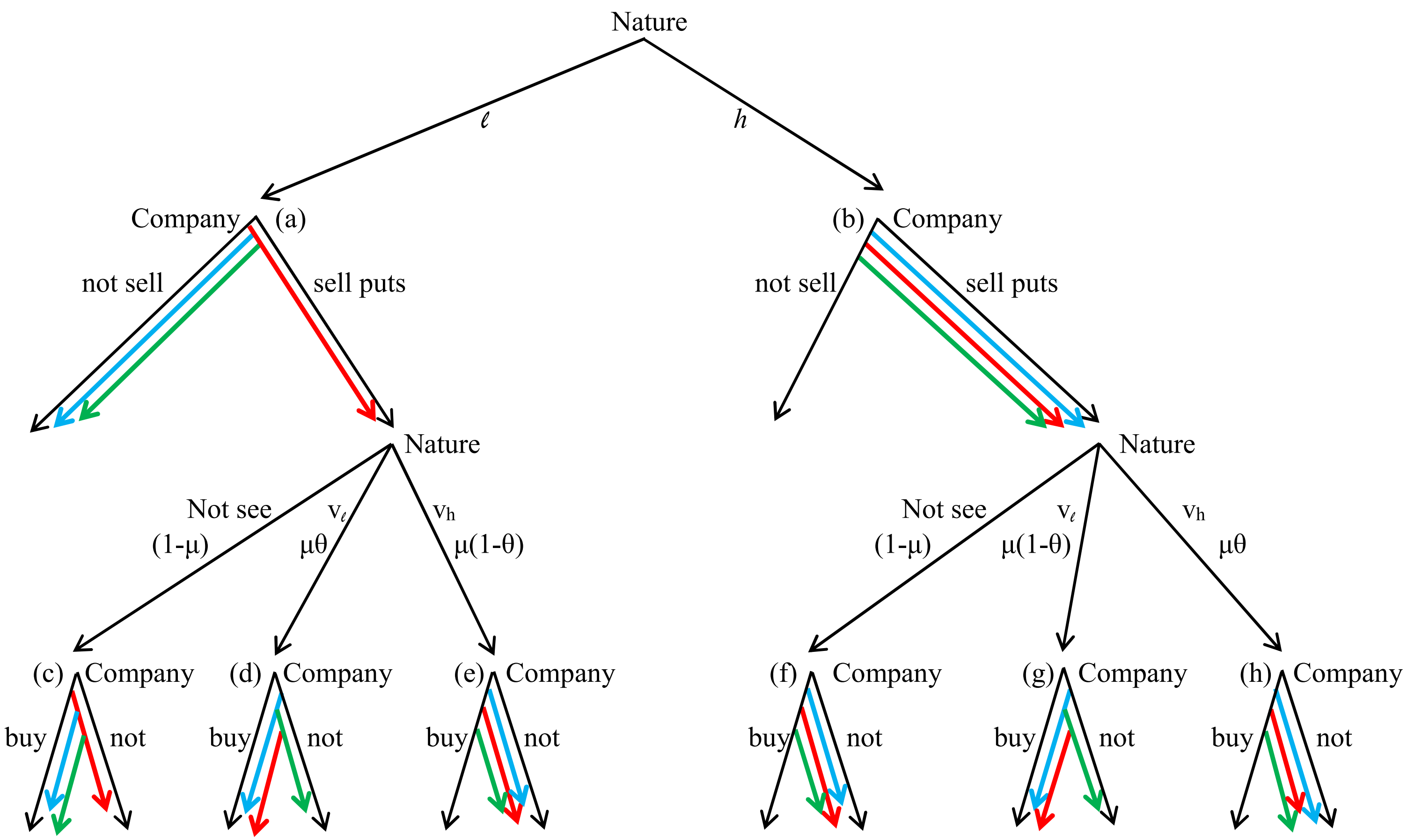

Figure 2.

The game. Note that for simplicity we do not include the bank as a player. We have color coded stages with: (1) **Double separating equilibrium**; (2) **Separating equilibrium via buybacks only**. (3) **Separating equilibrium via puts options only**. Company decision notes are labeled (a) to (h). ℓ is low signal, h is high signal, v_ℓ is the low value of the project, v_h is the high value of the project, μ is the probability that the company will know its projects value, θ is the probability that the value of the project is consistent with the signal.

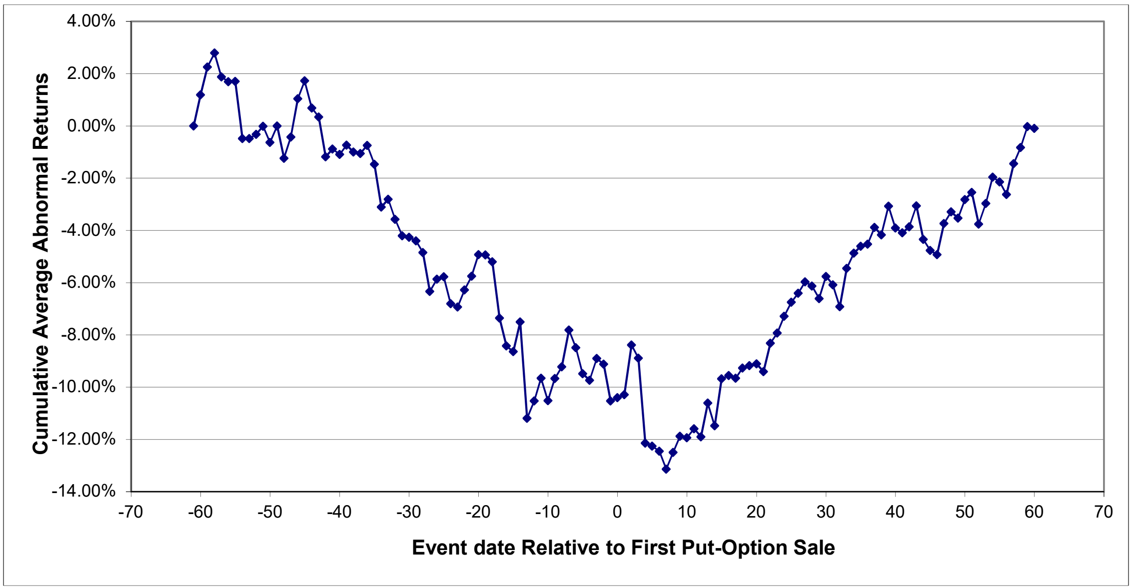

Figure 3.

Cumulative average abnormal returns for put option issuers from trading days –60 to +60 relative to the first put-option sale. We compute the cumulative average abnormal returns using the market model. The market model parameters are estimated using a window from 180 to 61 days before the event date, which is the day of the put-option sale. We use the CRSP value-weighted portfolio as our proxy for the market. We only include the ten companies that disclose the exact date when they sold put options for the first time and the eight companies for which the date can be inferred as explained in the data section.

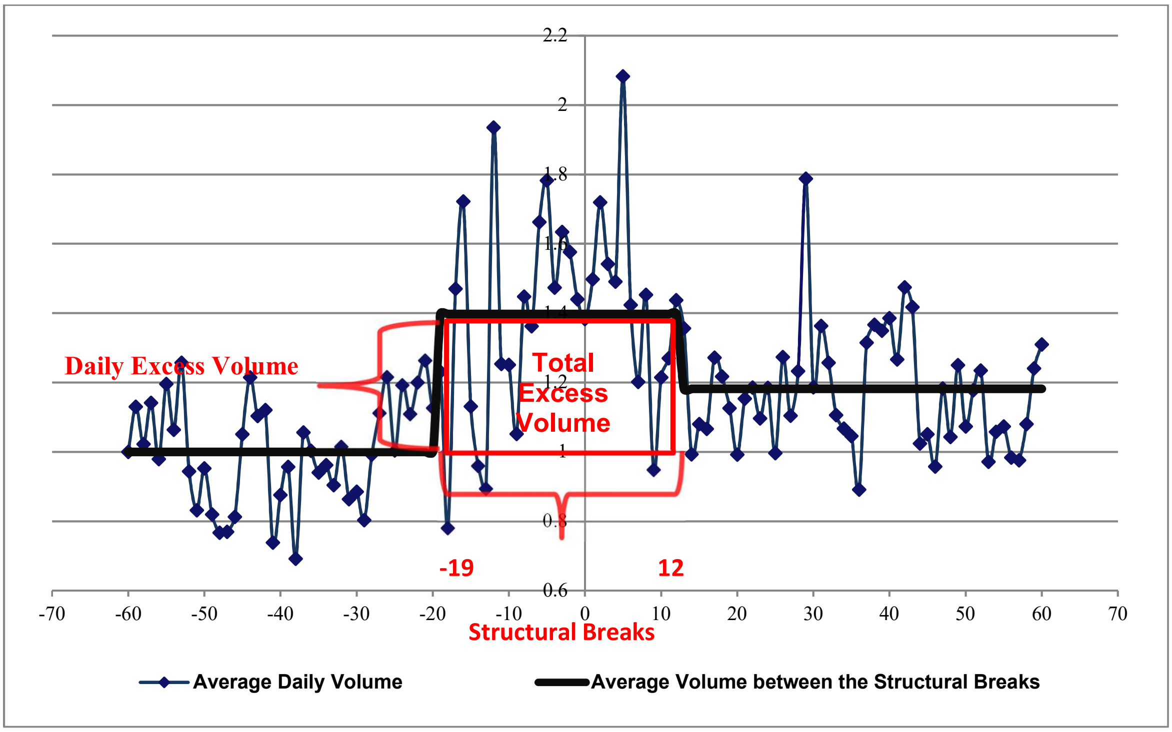

Figure 4.

Trading volumes for put option issuers from –60 to +60 days relative to the put-option sale date. The event date, day 0, is the day of the put-option sale. All volumes are normalized by taking each company's daily volume and dividing it by the daily volume at day -60. The "Average Daily Volume" is the adjusted volumes over all 18 companies (ten companies with the exact put sales date and eight companies for which the date can be inferred). The "Average Volume between the Structural Breaks" is the average weighted volume over the periods separated by the structural breaks in the volume series at days -19 and 12. Daily Excess Volume is the difference between the "Average Daily Volume" before the first structural break at day -19 and the "Average Daily Volume" over the periods separated by the structural breaks in the volumes at days -19 and 12. Total Excess Volume is the Daily Excess Volume multiplied by the number of days between the two structural breaks. We break the dates into three ranges: before, during, and after. These ranges are determined by the structural breaks in the volumes found in Appendix B, that is, before is defined as -60 to -20 trading days before the sale, during is defined as days -19 to 12, and after is defined as days 13 to 60.

Table 1
Summary Statistics of the Put Option Contracts and Selling Companies

Panel A:		For the whole program				Panel B:	For the first put-option sale		
Option Type # of companies		Buyer Type # of companies		Option Outcome # of companies		Option Maturity # of companies		Days till Disclosure # of days	
European	32	IB with ID	5	All Tranches Expired Worthless	32	Below six months	13	Average	186
American	11	IB no ID	1	Last Tranche Settled	6	Between six month and one year	13	Median	99
Both A & E	1	Financial Intermediary	1	Last Tranche Exercised	8	Exactly one year	9	Minimum	-5
Exotic	1	Independent third party	14	The only Tranche Exercised	2	Greater than one year	11	Maximum	1,561
N/A	8	Private placement	16	N/A	5	N/A	7	N/A	5
		N/A	14						
		Open market	1						
		Investment Trust	1						

The "IB with ID" denotes the cases in which the exact identity of an investment bank is reported as a buyer. The "IB no ID" denotes the cases where the companies only state that the buyer is an investment bank. Only ten of the 53 companies report the exact date on which they have sold put options for the first time. Based on references to the option expiration in other 10-Q and 10-K forms, we are able to infer an exact date for an additional eight companies. Eleven companies report only the month when they sold put options, and we infer the month for an additional 16 companies. In order to compute the number of days till disclosure, we assume in these cases that the date is in the middle of the month. Four companies report only the quarter. For these companies we assume that the date is the middle of the quarter. The remaining five companies report only the year when they first issued put options, and we report these as N/A.

Panel B (Continued): First issue of put derivatives sold by firms on their own stock

	Size of the First Put Issue	Put Option Premium	Maximum Potential Repurchase Obligation	Size = Total Assets	Size = Market Value	Book to Market	Leverage
Mean	1,404,678	$5,333,260	$39,069,385	16,631.786	34,675.001	1.4159	0.1207
SD	1,114,802	$9,947,345	$43,973,762	33,125.099	74,798.618	1.8458	0.1438
Minimum	50,000	$31,304	$375,000	3.432	42.662	0.0349	0.0000
Median	1,156,000	$1,910,500	$24,900,000	16,631.786	34,675.001	1.4159	0.1207
Maximum	4,000,000	$49,000,000	$203,000,000	175,752.000	460,767.938	9.5322	0.8017

Panel C: Distribution of the 53 companies SIC codes

One-Digit SIC code	1	2	3	5	6	7	8	Total
Number of firms with that 1-digit SIC code	5	5	18	4	10	8	3	53

There are 28 2-digit SIC codes represented by our firms. There are maximum 8 within one 2-digit SIC code.
There are 39 3-digit SIC codes represented by our firms. There are maximum 7 within one 3-digit SIC code.

Table 2
Cumulative Abnormal Returns around the Put-Option Sale

Event Window	Average CAR %	Median CAR %	% Negative	% Positive
(-60,-1)	-9.21*** (0.0034)	-7.65** (0.0494)	66.7	33.3
(-30,-1)	-5.00** (0.0131)	-3.18 (0.1846)	55.6	44.4
(-10,-1)	-0.41 (0.1410)	-0.94 (0.3994)	50.0	50.0
(0,1)	0.29 (0.1488)	1.14 (0.2212)	27.8	72.2
(0,2)	2.01** (0.0198)	2.12 (0.0269)	33.3	66.7
(0,3)	1.49* (0.0646)	1.66 (0.1061)	33.3	66.7
(0,10)	-1.39 (0.4301)	3.48 (0.1144)	33.3	66.7
(0,20)	1.98 (0.1155)	4.88** (0.0770)	38.9	61.1
(0,30)	4.3 (0.1131)	4.58* (0.0649)	33.3	66.7
(0,60)	9.08** (0.0441)	3.40* (0.0649)	33.3	66.7

The CAR denotes the cumulative abnormal returns. We compute the CARs by using a market model. The market model parameters are estimated using a window from 180 to 61 days before the event date, which is the day of the put-option sale. We use the CRSP value-weighted portfolio as our proxy for the market. We include only 18 companies (ten companies with the exact put sales date and eight companies for which the date can be inferred). We report the CARs for ten different event windows: from 60 days to one day before the put-option sale, i.e., (-60, -1); from 30 days to one day before the put-option sale (-30, -1); from ten days to one day before the put-option sale (-10, -1); from the day of the sale to one day after (0, 1); from the day of the sale to two days after (0, 2); from the day of the sale to three days after (0, 3); from the day of the sale to ten days after (0, 10); from the day of the sale to 20 days after (0, 20); from the day of the sale to 30 days after (0, 30); and from day 0 to 60 days after (0, 60). The *p*-value for the *t*-test that the average CAR equals zero and a Wilcoxon Rank test for the median are in parenthesis. The % Positive (Negative) is the percentage of companies with positive (negative) CARs during the corresponding event window.[1]

[1] The one-year buy-and-hold abnormal return is computed using the Lyon, Barber, and Tsai (1999) methodology and is 11.67% with a p-value of 0.03045.

Table 3
Cumulative Abnormal Relative Volume around the Put Option Sale

Event Window	Average CARV %	Median CARV %	% Negative	% Positive
(-60,-1)	-828.19***	-783.78	61.1	38.9
	(0.0001)	(0.1061)		
(-30,-1)	-83.7	45.08	50.0	50.0
	(0.388)	(0.4831)		
(-10,-1)	136.88***	126.22	38.9	61.1
	(0.0001)	(0.1323)		
(0,1)	46.43***	27.12*	33.3	66.7
	(0.0034)	(0.0708)		
(0,2)	64.54***	55.22	38.9	61.1
	(0.0021)	(0.1231)		
(0,3)	81.6***	68.33	44.4	55.6
	(0.0018)	(0.1419)		
(0,10)	130.32**	52.4	44.4	55.6
	(0.0165)	(0.2212)		
(0,20)	120.35	-45.44	55.6	44.4
	(0.1012)	(0.4661)		
(0,30)	127.85*	-68.94	66.7	33.3
	(0.0958)	(0.383)		
(0,60)	-94.1	-242.95	55.6	44.4
	(0.1862)	(0.3669)		
(-60,-19)	-929.07***	-990.76***	72.2	27.8
	(0.0001)	(0.0069)		
(-19,12)	218.20***	148.97	55.6	44.4
	(0.0056)	(0.2899)		
(12,60)	-240.56**	-533.48	80.0	20.0
	(0.0165)	(0.2475)		

The CARV denotes the cumulative abnormal relative volume for only the 18 companies (ten companies with the exact put sales date and eight companies for which the date can be inferred). We compute the abnormal trading volume by following Ajinkya and Jain (1989), Campbell and Wasley (1996), and Cready and Ramanan (1991). We report the CARVs for the same ten event windows as in Table 2 plus three additional windows corresponding to the windows defined by the structural breaks in Appendix B. The *p*-value for the *t*-test that the average CARV equals zero, and a Wilcoxon Rank test for the median are in parenthesis. The % Positive (Negative) is the percentage of companies with positive (negative) CARs during the corresponding event window.

Table 4
Insider Trading Reported in SEC Schedule 13D around the Put-Option Sale

Range	Interval = # Days	Awarded Options	(A)	Exercised Options	(M)	Purchased	(P)	Sold	(S)
Before:	[-60, -20] = 41	35		29		5		29	
During:	[-19, 12] = 32	6		10		10		11	
After:	[13, 60] = 48	38		12		3		21	
During vs. Outside:	Prob(During<=actual)	0.0000	***	0.1720		0.9980		0.0857	*
Outside vs. During:	Prob(During>=actual)	1.0000		0.9006		0.0083	***	0.9539	
Before vs. After:	Prob(Before<=actual)	0.6705		0.9996		0.9011		0.9666	
After vs. Before:	Prob(Before>=actual)	0.4179		0.0012	***	0.2811		0.0607	*
During vs. Before:	Prob(During<=actual)	0.0000	***	0.0100	***	0.9800		0.0300	**
Before vs During:	Prob(During>=actual)	1.0000		0.9941		0.0644	*	0.9890	
During vs After:	Prob(During<=actual)	0.0001	***	0.7720		0.9987		0.3233	
After vs During:	Prob(During>=actual)	1.0000		0.3756		0.0078	***	0.7954	

Company insiders (upper management as well as shareholders with a larger than 5% stake) must report on SEC form 13D any transactions of the company's stock as well as type: purchased (P) or sold (S) on the open market, options that are exercised (M), or company stock/options that are awarded (A) to them. We examine the intervals *Before*: [-60, -20] = 41 days, *During*: [-19, 12] = 32 days, and *After*: [13, 60] = 48 days, defined by the structural breaks reported in Appendix B. From the 18 companies (ten companies with the exact put sales date and eight companies for which the date can be inferred), we are able to include only eight in this analysis because another 8 of the dates are before 1996 when SEC Schedule 13D became available, and for the two of the companies, Dell and Ultrak, there are no insider trading events reported in WRDS for the [-60, 60] interval. We report the number of times that insider trade in the first part of the table and we test for difference in means using a binomial distribution in the second part of the table for During vs. Outside; Before vs. After; Before vs. After and During vs After. For During vs. Outside Prob(During<=actual), we compute the probability that the number of events occurring in During are less than or equal to the actual that occurred given the frequency. Using Excel, this can be done for transaction A by the command BINOMDIST(6, 35+6+38, 32/(41+32+48),1), where 6 are events in During, 35+6+38 are events in Overall, and 32/(41+32+48) is the proportion of days During vs. Overall.

Appendix B: Online Appendix

B.1 Structural Breaks in Stock Prices

We test if a structural break exists in the average abnormal returns around the date of the put option sales (where a structural break is a sharp unexpected directional change in the trend). Such a structural break is an indication that there is an endogenous change produced by the sale of the put options. In other words, a change trading behavior occurred because information gained from the put sales.

Therefore, here we follow Andrews (1993) and Andrews and Ploberger (1994) to test for an endogenous structural break in the stock prices. We compute the bootstrapped p-value following Hansen (2000).

We start by testing for a structural break in the average abnormal returns of the 18 companies on the exact date of the put option sales. As reported in Panel A of Table B1, the Chow (1960) breakpoint test rejects the null hypothesis that no structural break exists at the exact date of the transaction (day 0) at the 1% level (p = 0.0022).

<< Insert Table B1 here >>

To better understand the nature of this structural break, we try to find the most likely structural break point from days -25 to 25 by making use of stock prices from days -60 to 60 (under the assumption of at most one structural break). In Panel B of Table B1 we report that the structural break is seven days after the sale of the put options. The p-values for the SupF statistics (Andrews, 1993) as well as for the ExpF and AveF statistics (Andrews and Ploberger, 1994) are statistically significant at the 5% level. Hence, we find supporting evidence that the purchaser of the put options is not only trading on information but doing so skillfully and not making the trading immediately transparent to the market.

For robustness, we test for a structural break in Panels C and D of Table B1 for the ten companies with reported sales dates only and also find that the break remains seven days afterwards (but it is not statistically significant). When we test for a structural break in the eight remaining companies with inferred transaction dates, we find the structural break is at the day of the sale and is significant at the 5% level. This result gives support for our technique of inferring transaction dates.

Overall, the timing and the statistical significance of the structural break confirms a sharp unexpected directional change in the trend of the stock prices. Jenter et al. (2011) suggest instead that the market upswing is exogenous and that the company managers are using insider information to correctly time this upswing (See Chan et al., 2007, for why pseudo-market timing is unlikely to be an explanation). The location of our structural break indicates that their timing seems to indeed be impeccable especially in the face of potentially long-lasting negotiations. Moreover, Jenter et al. (2011) state that "discussions with market participants suggest that such offers were extended to all large companies with share repurchase programs and high stock market liquidity." This statement implies that the investment bank initiates the timing of the negotiations rather than the seller.

Another plausible explanation has the causality reversed. Rather than put sales being placed right before the upswing, the upswing comes right after the put sale. Given that the sales have not been publicly disclosed, the likely source of an upswing in this causality direction is the active buying of the company's stock by the purchaser of the put options. This finding also supports our explanation that the reason why the put option transaction is initiated is to acquire and trade on information.

B.2 Structural Breaks in Stock Trading Volumes

An analysis of the trading volume around the event day could demonstrate in retrospect the degree of abnormal activity that results from the private information of the parties in the put option sale. As with stock prices, we test for structural breaks in the daily trading volumes of the selling companies' stock around the put option sales. Using similar techniques to those used for stock prices in subsection B.1, we test for a structural break in the stock volumes at the event day. We make adjustments for our sample companies by accounting for market volume and report three analyses for patterns of relative trading volumes.

Panel A of Table B2 reports a structural break, which is statistically significant at the 1% level with p = 0.0001 (for all methods we use). Panel B of the same Table shows the results of the tests for structural breaks in the stock volumes for any day between -25 and 25 around the event day. We find that the most likely structural break is at day -19, which is statistically significant at the 1% level with $p < 0.0001$ (for all methods we use). In Panel B of Table B2, we report a second structural break in the time frame of -19 to 60 at day 12, which is statistically significant at the 5% level with p = 0.0176 (for all methods we use). As explained above the put-sale negotiation process is a one to three month long process. These statistical results are consistent with an informed party starting to trade on the information obtained during the negotiation process 19 days before the transaction is completed. This trading is skillful because it does not change the trend of the stock price until seven days after the put option sale where the stock price's structural break occurs. The results are also consistent with the informed party reducing purchases at day 12 after the sale where there is another structural break in the volume.

As reported in Table 2 of the paper, over the 10-day period following the put option sales the average abnormal return is negative at -1.39%, but over the 60-day period following the put option sales the average abnormal return is positive at 9%, yet the high volume decreases at date 12. The 60-day period's abnormal return is significantly different from zero at the 5% level (p=0.04, t-test). Our claim is that the increased price is not a mere artifact of the increased trading, but a reflection of the information learned by one party. We note that at the time of the put sale the market is not aware of them. As Table 1 of the paper indicates, 52 out of 53 companies announced the sales afterwards with a median lag of 99 days (average lag of 186 days). Hence, the sustained price is consistent with our claim that the investment banks or their clients are screening the companies in order to gain non-public information and are profitably trading on that information.

<< Insert Table B2 here >>

Overall these results support the existence of both an abnormal return and an abnormal trading volume around the put option sales.

Table B1
Tests for a Structural Break in the Cumulative Abnormal Returns around the Put-Option Sale

Panel A: Tests for a structural break at the event date in the cumulative abnormal returns around the put-option sale of the 18 companies

Null Hypothesis:	No breaks at specified breakpoints		
Chow Breakpoint Test:	0		
Equation Sample:	1,121		
Varying regressors:	All equation variables		
F-statistic	9.764534	Prob. F(1,119)	0.0022
Log likelihood ratio	9.542293	Prob. Chi-Square(1)	0.0020
Wald Statistic	9.764534	Prob. Chi-Square(1)	0.0018

Panel B: Tests for a structural break at any date during the event period in the CARs around the put-option sale of the 18 companies

Estimated Breakpoint (index): 7
(Day 0 is the Event date)
Percentage of Sample: 0.561983
Bootstrap Replications: 5000

	Test Statistic	Andrews *P*-value	Bootstrap *P*-value	Hetero-Corrected *P*-value
SupF	7.352160	0.050764	0.046600	0.040800
ExpF	2.252957	0.038070	0.036600	0.030200
AveF	3.881367	0.030671	0.029400	0.018200

Panel C: Tests for a structural break at any date during the event period in the CARs around the put-option sale of the ten companies with disclosed sale dates

Estimated Breakpoint (index): 7
(Day 0 is the Event date)
Percentage of Sample: 0.561983
Bootstrap Replications: 5000

	Test Statistic	Andrews *P*-value	Bootstrap *P*-value	Hetero-Corrected *P*-value
SupF	3.747035	0.268700	0.251800	0.253800
ExpF	0.940642	0.194738	0.210000	0.196000
AveF	1.687371	0.170027	0.180800	0.155400

Panel D: Tests for a structural break at any date during the event period in the CARs around the put-option sale of the eight companies with inferred sale dates				
Estimated Breakpoint (index):		0		
(Day 0 is the Event date)				
Percentage of Sample:		0.504132		
Bootstrap Replications:		5000		
	Test Statistic	Andrews *P*-value	Bootstrap *P*-value	Hetero-Corrected *P*-value
SupF	6.133544	0.089607	0.0838	0.0654
ExpF	1.913732	0.056954	0.0590	0.0514
AveF	3.188776	0.051351	0.0532	0.0442

The CAR denotes the cumulative abnormal returns. We compute the CARs by using a market model. The market model parameters are estimated using a window from 180 to 61 days before the event date, which is the day of the put-option sale. We use the CRSP value-weighted portfolio as our proxy for the market. We include only 18 companies (ten companies with the exact put sales date and eight companies for which the date can be inferred). We follow Andrews (1993) and Andrews and Ploberger (1994) to test for an endogenous structural break in stock prices. We compute the bootstrapped p-value following Hansen (2000). Panel A tests for a structural break in the average abnormal returns of the 18 companies on the exact date of the put-option sales. Panel B finds the most likely structural break point over the range from days -25 to 25 making use of stock prices from days -60 to 60 (under the assumption of at most one structural break). For robustness, in Panel C, we test for the structural break with only the ten companies with reported sales dates. Panel D tests for the structural break of the eight remaining companies with inferred transaction dates.

Table B2
Tests for a Structural Break in the Cumulative Abnormal Relative Volumes around the Put-Option Sale

Panel A: Tests for a structural break at the event date of the CARV around the put-option sale of the 18 companies

Null Hypothesis:	No breaks at specified breakpoints		
Chow Breakpoint Test:	0		
Equation Sample:	1,121		
Varying regressors:	All equation variables		
F-statistic	16.29990	Prob. F(1,119)	0.0001
Log likelihood ratio	15.53280	Prob. Chi-Square(1)	0.0001
Wald Statistic	16.29990	Prob. Chi-Square(1)	0.0001

Panel B: Tests for a structural break at any date of the CARV around the put-option sale of the 18 companies

Estimated Breakpoint (index): -19
(Day 0 is the Event date)
Percentage of Sample: 0.347107
Bootstrap Replications: 5000

	Test Statistic	Andrews *P*-value	Bootstrap *P*-value	Hetero-Corrected *P*-value
SupF	66.440340	0.000000	0.000000	0.000000
ExpF	29.758617	0.000000	0.000000	0.000000
AveF	23.648257	0.000000	0.000000	0.000000

Panel C: Tests for a second structural break of the CARV around the put option sale of the 18 companies at any date after the first structural break

Estimated Breakpoint (index): 12
(Day 0 is the Event date)
Percentage of Sample: 0.400000
Bootstrap Replications: 5000

	Test Statistic	Andrews P-Value	Bootstrap P-Value	Hetero-Corrected P-Value
SupF	15.539198	0.002301	0.002200	0.017600
ExpF	5.344512	0.000088	0.001200	0.009600
AveF	8.167059	0.000020	0.000400	0.000600

The CARV denotes the cumulative abnormal relative volume. We compute the abnormal trading volume following Ajinkya and Jain (1989), Campbell and Wasley (1996), and Cready and Ramanan (1991) for the 18 companies (ten companies with the exact put sales date and eight companies for which the date can be inferred). We follow Andrews (1993) and Andrews and Ploberger (1994) to test for an endogenous structural break in stock prices. We compute the bootstrapped *p*-value following Hansen (2000). Panel A tests for a structural break in the stock volumes at the event day. Panel B tests for a structural break in the stock volumes for any day between -25 and 25 around the event day. In Panel B, we find a structural break at day -19, which divides the whole sample into two subsamples: from days -60 to -20 and from days -19 to 60. In Panel C, we apply the structural break test on the second subsample of -19 to 60. We find a second structural break of the CARV around the put-option sale after the first structural break point on day 12.