Risk Arbitrage for Collared, Uncollared Stock Swap Offers

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This article explores the influence of deal specific factors and market uncertainty on the inclusion of collars in a stock swap offer. First, we find that the use of collars is positively correlated with expected market uncertainty, bidder and target market related risk exposure and bidding competition, and negatively correlated with relative target size. Second, we explore the impact of market conditions on a deal's outcome, finding that market environment is the dominating factor that causes a collared stock swap offer to fail. In contrast, relative target size, target resistance, and bidding competition play significant roles in determining the outcome of an uncollared stock swap offer, while market environment has an insignificant negative impact. Third, we compare the risk and return characteristics for risk arbitrage on collared and uncollared stock swap offers. We find that the return of the value weighted risk arbitrage portfolio on collared offers exhibits a stronger non-linear relationship (downside beta of 0.9) with the market index compared to that on uncollared offers (downside beta of 0.48). Our results suggest that adverse selection dominates the flexibility of the collar structure and makes collared offers more vulnerable to market downturns.
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1. Introduction

Risk arbitrage strategies are designed to profit from the positive spread between the value of the offer and the market price of the target firm's stock following a takeover attempt announcement. The appropriate risk arbitrage positions are closely linked with the structure of the deal's consideration. In a cash offer, arbitrageurs only need to purchase and hold the target's stock until deal completion when their position turns into cash. In a stock swap offer, arbitrageurs purchase the target's stock and then hedge their position by shorting α shares of the bidder's stock, where α represents the exchange ratio, specified at the time of the announcement. Upon consummation, the long position in the target's shares turns into the bidder's shares needed to cover the short position.

Some stock swap offers are structured with what are called "collars." These collars are designed to protect both the target and the bidder from major adverse moves in the bidder's stock price. The consideration embedded in a collar offer can be viewed as a combination of the bidder's shares and options on the bidder's shares. To establish hedging positions in such takeover attempts, risk arbitrageurs often use an option-type dynamic delta hedging strategy[1].

Risk and return have always been a central aspect of financial research and in particular in research involving risk arbitrage. Considerable attention has been given to exploring risk arbitrage strategies' risk and return characteristics. That literature is almost unanimous in concluding that risk arbitrage tends to generate positive risk-adjusted returns (e.g., Larker and Lys, 1987; Dukes, Frohlich and Ma, 1992; Mitchell and Pulvino, 2001; Baker and Savasoglu, 2002, Wang and Branch, 2009). The previous literature's results have, however, been derived from samples, which only include cash offers and simple stock swap offers. They do not include an analysis of stock swap offers that contain collars. And yet collars have become an increasingly popular deal structure. About 20% of stock swap mergers contain collars (Officer 2006).

Risk arbitrage on stock swap offers with collars exhibits interesting risk return characteristics

[1] Delta hedging is explained in more details in the next section.

and raises interesting questions. First, rather than being pre-specified at deal announcement, the exchange ratio between the bidder and the target for a collared offer is structured to depend upon the bidder's near deal-closing stock price. Accordingly, risk arbitrageurs need to determine how to set up a hedging position in light of the variable exchange ratio. Second, the collar structure may have an impact on the likelihood that the proposed transaction will consummate. Risk arbitrageurs often claim that because they take short and long market positions their strategy is market neutral. Mitchell and Pulvino (2001), however, find a positive correlation between the risk arbitrage strategy and market returns in a declining market, probably because the market decline raises the chance of deal failure. Does risk arbitrage involving collared offers involve a similar downside risk? Intuitively, the collar structure's greater flexibility should reduce the need for renegotiation when the bidder's and the target's stock prices change unexpectedly during the takeover process. This flexibility may allow some deals to survive that would not if they had to be renegotiated. Therefore, compared to uncollared offers, collared offers may be more likely to survive in a down market. However, adverse selection bias may also be in play. Deals that have a higher failure risk or greater vulnerability to market fluctuation may be structured as collars so as to provide additional flexibility in order to improve their chances of dealing with the unexpected. In fact, the literature has documented certain features associated with the bidders/targets involved in collared offers, which may influence the outcome (e.g. different industry membership, greater difference in market risk exposure, less return correlation, greater bidding competition, smaller target size). Some of these factors may negatively impact the chance that a deal will succeed, while others could have a positive influence. Accordingly, whether collared offers are more likely to fail in a declining market is unclear. How the downside beta for risk arbitrage on collared offers compares to that of uncollared offers is an interesting issue. Which offer is riskier in a declining market? These are the questions this paper explores.

Using a sample of 733 stock swap offers (including both collared and uncollared offers) announced and completed during the 1994–2003 period, we first illustrate an option type dynamic delta hedging strategy for risk arbitrage on collared offers. Second, we examine the influence of the deal-specific factors and market uncertainty on whether to include a collar clause. We find that the use of collars is positively correlated with the anticipated level of market uncertainty, difference in the bidder's and target's market-related risk exposure and bidding competition, and that it is negatively correlated with target size. Third, we explore the impact of market condition on the outcome of a deal. We find that market environment is the dominating factor that causes a collared deal to fall apart. In contrast, relative target size, target resistance, and bidding competition play significant roles in determining the outcome of an uncollared offer. Market environment has an insignificant negative impact. Fourth, we explore the risk and return characteristics of risk arbitrage applied to collared and uncollared offers. We find that the return of the value weighted risk arbitrage portfolio on collared offers exhibits a stronger non-linear relationship with the market index compared to that on uncollared offers. The downside beta is around 0.9 for collared offers and significant at the statistical level of 0.05, while the downside beta is around 0.48 for uncollared offers and significant at the statistical level of 0.2. Our results imply that the adverse selection factor dominates the flexibility of collars and exposes risk arbitrage positions in collared offers to greater downside risk than risk arbitrage applied to uncollared offers.

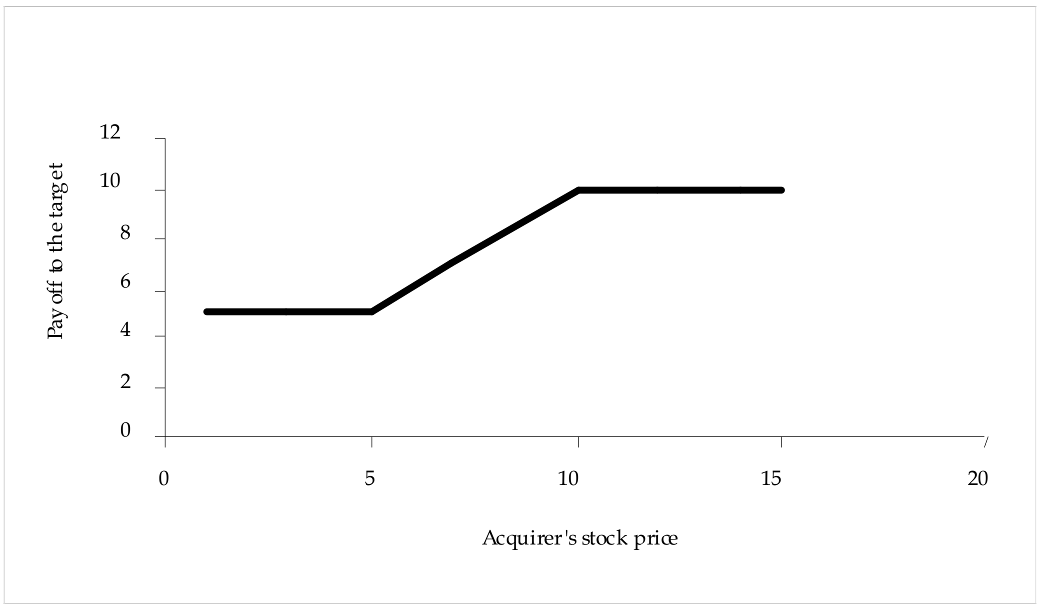
The remainder of this paper is organized as follows. Section 2 discusses the nature of collared offers and risk arbitrage strategy on collared offers. Section 3 develops hypotheses; it introduces the related literature on the determinants of deal structure and risk arbitrage performance. Section 4 describes the sample used in this paper. Section 5 presents the empirical analysis on the determinants of using collars. Section 6 explores the market impact on the deal's outcome. Section 7 presents the empirical analysis of the risk and return characteristics for risk arbitrage. Section 8 provides a conclusion.

2. Collared Offers and Risk Arbitrage

Stock financed takeover offers structured with collars can be subdivided into two basic types:

fixed exchange ratio (FEX) collared offers and fixed value (FV) collared offers. A FEX collared offer has a pre-specified constant exchange ratio when the bidder's reference price stays within a certain range known as the "collar" and allows the exchange ratio to otherwise vary. The reference price is usually defined as the bidder's average closing price for 10 to 20 days prior to the deal's consummation. As an example, the bidder may offer to exchange one of its shares for each target's share if the bidder's average stock price near deal's completion is between $5 and $10. If its stock price rises above $10, then the bidder will exchange $10[2] worth of shares for each target's share; if its stock price falls below $5, then the bidder will exchange $5[3] worth of shares for each target's share, as illustrated in Figure I. The FEX collared structure protects the bidder from overpaying for the target's shares when the bidder's price rises dramatically, while it protects the target's shareholders from being underpaid when the bidder's price falls dramatically.

Figure I
Payoff to the Target: Fixed Exchange Ratio Collared Offer



A FV collared offer establishes the dollar value of the deal at a fixed amount as long as the bidder's average price is within the collar range and allows the dollar value to otherwise vary. For example, the bidder may offer to exchange $5 worth of shares for each target's share when the bidder's price is between $5 and $10. If the bidder's price rises above $10, then each target's share will receive 0.5[4] share of the bidder's stock; if the bidder's price falls below $5, then each target's share will receive 1[5] share of the bidder's stock, as illustrated in Figure II. With an FV collared structure, the target firm shares the gain when the bidder's price rises dramatically and shares the loss when the bidder's price falls dramatically.

How can risk arbitrageurs in collared offer situations set up the appropriate hedge position? As Figures I and II show, the consideration offered in a collared transaction can be viewed as a combination of the bidder's shares and options on the bidder's shares (e.g. Officer 2006). A FEX collared offer is a stock swap offer (assuming the exchange ratio is α) combined with the following

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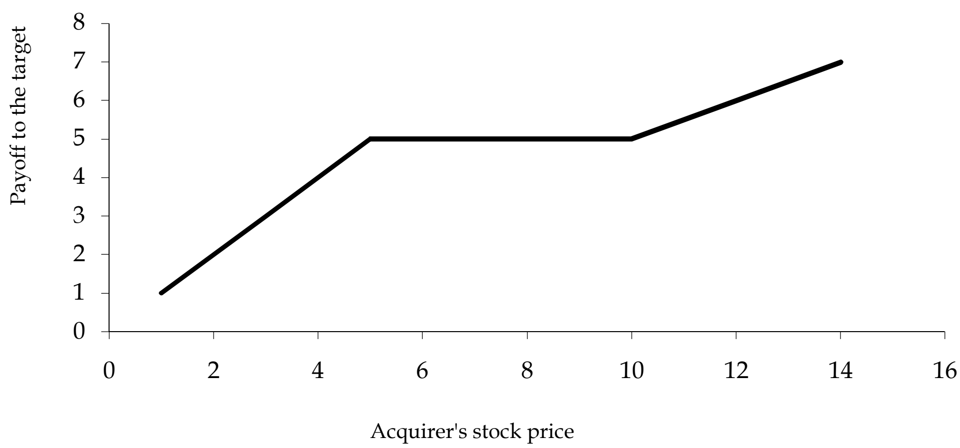
[2] 10=1*10, where 1 is the exchange ratio within the collar, 10 is the upper collar boundary.
[3] 5=1*5, where 1 is the exchange ratio within the collar, 5 is the lower collar boundary.
[4] 0.5=5/10, where 5 is the dollar value of the deal within the collar, 10 is the upper collar boundary.
[5] 1=5/5, where 5 in the numerator is the dollar value of the deal within the collar, 5 in the denominator is the lower collar boundary.

option package: a long position in α put options on the bidder's stock (strike = lower collar boundary, time to maturity = time to deal's consummation), and a short position in α call options on the bidder's stock (strike = upper collar boundary, time to maturity = time to deal's consummation).

Figure II
Payoff to the Target: Fixed Value Collared Offer



In our previous FEX example, a target's share is analogous to 1 share of the bidder's stock, 1 put with a strike price of \$5 and a short position of 1 call with a strike price of \$10, as illustrated in Figure III. A FV collar can be viewed as a cash offer plus an option package: a long position in α bidder's call options (strike = upper collar boundary, time to maturity = time to deal's consummation, $\alpha = dollar\ value\ with\ the\ collar\ /\ upper\ collar\ boundary$) and a short position in β bidder's put options (strike = lower collar boundary, time to maturity = time to deal's consummation, $\beta = dollar\ value\ with\ the\ collar\ /\ lower\ collar\ boundary$). In our previous FV example, a target's share is analogous to \$5 worth of the bidder's stock plus a long position of 0.5 bidder's call option (strike = \$10) and a short position of 1 bidder's put option (strike = \$5), as illustrated in Figure IV. As with any portfolio of options, collared offers can be delta hedged. For FEX collared offers, traders purchase 1 target share, and short ($\alpha + \delta$) shares of the bidder's stock, where α represents the exchange ratio within the collar range, δ is the delta of the option package and equals $\alpha * \delta_{put} - \alpha * \delta_{call}$. Theoretical values for δ_{put} and δ_{call} can be determined using the Black-Scholes formula. The hedge position is readjusted on a daily basis. For FV collared offers, risk arbitrageurs simply short δ shares of the bidder's stock, where δ is the delta of the option package and equals $\alpha * \delta_{call} - \beta * \delta_{put}$, where $\alpha = dollar\ value\ with\ the\ collar\ /\ upper\ collar\ boundary$, and $\beta = dollar\ value\ with\ the\ collar\ /\ lower\ collar\ boundary$. Officer (2006) suggests that the implicit option package should be viewed as the options on the combined firm rather than on the bidder. Shorting stocks on the combined firm, however, is not possible prior to the merger. Therefore, we view the implicit options as options on the bidder's stocks.

Since the market price of the underlying asset is typically measured as the average price of the bidder's stock over a pre-specified pricing period, the implicit options are not exactly European options. This price averaging is a feature of an Asian option. Accordingly, the hedge ratios may be better determined using Monte Carlo simulation. However, due to the uncertainty in the averaging period at the time of the announcement, we simply use the Black-Scholes formula as an approximation and leave the modification for future research. We suspect that the impact of this simplification is small.

Figure III
Replication of a Fixed Exchange Ratio Collar Structure

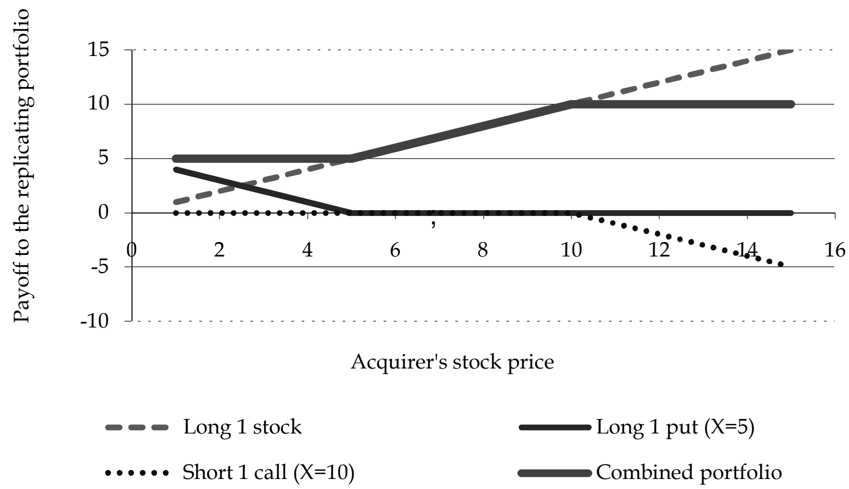
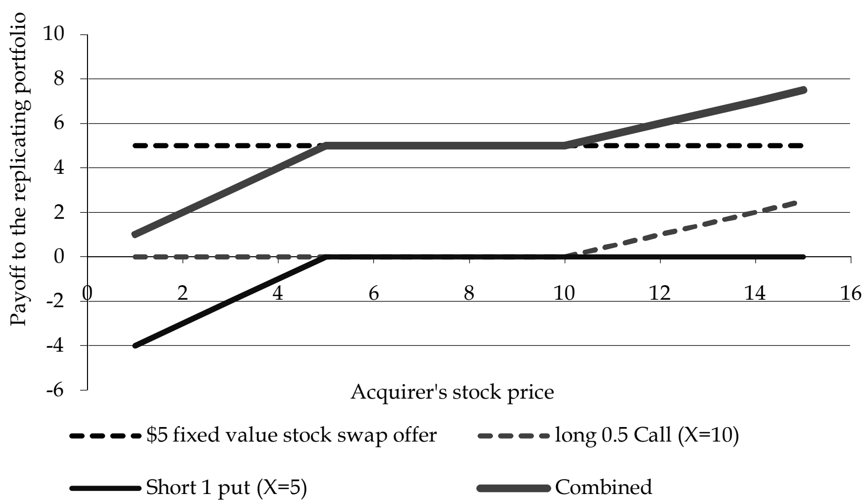


Figure IV
Replication of a Fixed Value Collar Structure



Notes: Figure III and IV show the replicating portfolios to FEX and FV collared offers. For example, for the FEX collared offer, a target's share is analogous to 1 share of the bidder's stock, 1 put option with a strike price of $5 and a short position of 1 call option with a strike price of $10. For the FV collared offer, a target's share is analogous to $5 worth of the bidder's stocks plus a long position of 0.5 bidder's call option (strike = $10) and a short position of 1 bidder's put option (strike = $5).

3. Literature Review and Hypotheses

Numerous variables are related to the payment method of a proposed merger deal. Here we review the literature and develop our hypotheses on why firms may include collars in the deal structure.

3.1 Common Industry Membership

Gaughan (1991) argues that a collared offer is more likely to be used when the bidder's and the target's industries differ. Two companies in the same industry are likely to be exposed to many of the same economic shocks and may react in a similar way, thus reducing the need for adding collars to a stock swap offer. Thus, our first hypothesis is as follows:

H1: The inclusion of collars in stock swap offers is reduced by common industry membership

3.2 Bidder's and Target's Return Correlation

As a measure for the sensitivity of the bidder's offer to changes in the value of the combined firm, Houston and Ryngaert (1997) introduce bid elasticity, which is defined as the percent revaluation of the target's consideration from the merger relative to the percent revaluation of the bidder's consideration caused by a change in the value of the combined firm. A pure stock offer has elasticity of 1 and a cash offer has elasticity of 0. A collared offer has elasticity between 0 and 1. Houston and Ryngaert (1997) argue that the more correlated are the historical returns of the bidder and the target, the more likely it is that a high elasticity offer will be used. Their explanation relies on two factors: first, since highly correlated (positive) returns suggest that the bidder and target are affected by similar economic forces, it is less likely that the bidder will be able to mislead the target. Second, if the bidder's and the target's values tend to move together, then fixed common stock exchange ratio terms (a high elasticity offer) are more likely to remain "fair" to both parties when the deal closes. They find supportive evidence.

Given that a stock swap offer has a higher bid elasticity than collar offers, our second hypothesis is as follows:

H2: The higher the correlation between the bidder's and the target's stock returns, the lower the likelihood of a collar.

3.3 Bidder's and Target's Exposure to Market Risk

According to Officer (2004), when the two parties negotiate the proposed transaction, they consider the differences in their market values' historical sensitivities to systematic economic shocks. Officer (2004) separates the bidder's and target's return variation into market-related and idiosyncratic risk components, and finds that the difference in bidder's and target's market exposure influences the decision to use a collar. Furthermore, he finds that the correlation between the bidder's and the target's stock returns, the variable reported by Houston and Ryngaert (1997), loses significance when the market risk component is added.

Our next hypothesis, based on Officer (2004), is as follows:

H3: The inclusion of collars in stock swap offers is positively correlated with the differences in the market exposure between the bidder and the target.

3.4 Target Size

Martin (1996) argues that the concern related to information asymmetry is greater as the target size increases. He predicts that the bidder is more likely to use stock rather than cash when the target firm is large. Officer (2004) links the relative size of the target to the bid elasticity and predicts a positive correlation between the relative target size and bid elasticity. In other words, use of collars is negatively correlated with the relative size of the target, a claim supported by Fuller (2003). Therefore, our fourth hypothesis is as follows:

H4: The inclusion of collars in stock swap offers is negatively correlated to the size of the target in relation to that of the bidder.

We use the ratio of target's market capitalization/ bidder's market capitalization as a proxy for relative size.

3.5 Target/Bidder Market to Book Ratio

Information asymmetry appears to be an important factor in determining the offer structure. Hansen (1987) argues that stock financing forces the target shareholders to share the risk that the bidder may have overpaid. Accordingly, he hypothesizes that a stock offer (as opposed to a cash one) is used when the target value is especially uncertain, an assertion for which Martin (1996) provides supporting evidence. Fuller (2003) and Officer (2004) use the target market to book value ratio as a proxy for target value uncertainty and hypothesize that collared offers are more likely to be used when the target uncertainty (market to book ratio) is low. However, they failed to find a significant relationship between the use of collars and the target market to book ratio. We repeated the test and came up with the following hypothesis:

H5: The inclusion of collars in stock swap offers is negatively correlated with the target market to book ratio.

The role of the bidder's market to book ratio is more complicated. Officer (2004) points out that the influence of the bidder's market to book ratio is twofold. On one hand, the information asymmetry hypothesis suggests that bid elasticity should decrease with the bidder's market to book ratio. For example, we should see more collared offers when the bidder's market to book ratio is high. On the other hand, an extremely high bidder's market to book ratio may simply reflect the market's overly optimistic valuation of the bidder's stock. In that case, bid elasticity would increase in the bidder's market-to-book ratio and the likelihood of stock offers should vary directly with the ratio. Therefore, we do not formulate a specific hypothesis on the relationship between the bidder's market to book ratio and the inclusion of collars. The market to book ratio is calculated using the book value and the market value at the end of the year prior to the merger announcement.

3.6 Competition

Fishman (1989) and Berkovitch and Narayanan (1990) develop theoretical models demonstrating that potential competition from other interested acquirers increases the likelihood of a cash offer. Houston and Ryngaert (1997) and Officer (2004) generalize this argument by hypothesizing that anticipated competition should result in low elasticity bid offers. We use the number of bidders[6] after the merger announcement as a proxy for bidding competition and hypothesize:

H6: The inclusion of collars in a stock swap offer is positively correlated with the number of bidders.

3.7 Market Uncertainty

One variable that may play an important role in whether to use collars is market uncertainty. We hypothesize that the use of collared offers is positively correlated with market uncertainty. Our reasoning is straightforward. If the bidder and the target expect greater uncertainty in the market during the bid process, a collar clause is more likely to be included as protection for both parties. This hypothesis is also consistent with the theory that the two firms take account of the renegotiation costs when negotiating the initial bid offer. Our next hypothesis is as follows:

H7: The inclusion of collars in a stock swap offer is positively correlated with market uncertainty.

We use the implied VIX from the CBOE to measure the perceived stock market risk or uncertainty. VIX represents the implied volatility of the S&P index options (e.g. Fleming, Ostdiek and Whaley (1995)) We choose to use VIX rather than the market index's historical return volatility as our measure of perceived stock market risk because the recent literature finds that implied volatility provides a more accurate measure than does historical return volatility (Blair and Taylor (2001), David and Veronesi (2001)).

4. Data Description

First we obtained from the Thomson Financial SDC Platinum (SDC) database a list of uncollared stock swap offers and collared stock swap offers announced and completed between 1994 and 2003.

[6] Number of bidders is an ex-post measure of bidding competition; however, measures of anticipated competition are not available.

Then we used two filters to select the sample: 1. Both the target and the bidder must be listed in CRSP. 2. Detailed deal information, including offer price, exchange ratio and collar type, must be available and verified using merger news information in Lexis-Nexis. Table 1 contains summary statistics for the sample used in this study, reported by announcement year and collar type. Our final sample contains 733 merger deals: 539 uncollared offers, and 194 collared offers (133 are FV collars, 61 are FEX collars).

Table 1
Sample Distribution by Announcement Year and Collar Type

Year	Stock Swap Offers	All Collar Offers	FEX Collar Offers	FV Collar Offers
1994	27	16	10	6
1995	56	18	7	11
1996	47	10	4	6
1997	79	23	9	14
1998	87	30	7	23
1999	87	46	12	34
2000	83	15	1	14
2001	42	21	7	14
2002	13	10	3	7
2003	18	5	1	4
Total	539	194	61	133

5. Determinants of the Use of Collars

We used a logistic regression model to explore the decision to include or exclude collars. We tested for a relationship between that decision and a number of independent variables which have been hypothesized to have an impact: relative size of the target, bidder's/target's market to book ratios, bidder's/target's market exposure, common industry membership, bidder's/target's return correlation, competition in the bidding process, and market uncertainty. The logistic regression model for the likelihood of using a collared offer is specified as follows:

$$Collared\_offer = \frac{1}{1+\exp(-\beta X)}$$

$$\beta X = \beta_0 + \beta_1 TS + \beta_2 BM2B + \beta_3 TM2B + \beta_4 Diff\_Mkt + \beta_5 IN + \beta_6 Comp + \beta_7 Corr + \beta_8 VIX_{t-i} \quad (1)$$

Where Collared_offer has a value of 1 if a collar is used and 0 otherwise, TS represents the relative target size, defined by target's market value/bidder's market value. BM2B, TM2B represent bidder's and target's market to book ratio, respectively, one year prior to the merger announcement. Diff_Mkt represents the difference in market risk exposure between the two companies prior to the merger announcement. Following Officer (2004), Diff_Mkt is calculated by taking the difference between the bidder's market related return standard deviation and the target's market related return standard deviation. Market related return standard deviation is calculated using a simple market model estimated using the historical return data 250 days to 50 days prior to the merger announcement. Common industry membership is represented by IN which is set equal to 1 if the two companies are in the same industry and zero otherwise. Comp represents number of bidders for a deal after the merger announcement. Corr represents the return correlation between the bidder and the target, measured using historical returns 250 days to 50 days prior to the merger announcement. VIX_{t-i} is the volatility index obtained from CBOE. We run the analysis using three lagged VIX as robustness check. VIX_{t-1}, VIX_{t-2}, VIX_{t-3} represent the average VIX one month, two months, three months prior to the merger announcement respectively.

Descriptive statistics for the independent variables are shown in Table 2 (continuous variables) and Table 3 (categorical variables). The maximum, minimum, and standard deviation figures indicate that all variables have wide ranges of values, promising good results with regression analysis. The Pearson correlation coefficients between the variables are presented in Table 4. The correlation coefficients between the lagged VIX indexes are high and thus we put them in different models to avoid multicollinearity.

Table 2
Descriptive Statistics: Continuous Variables

Variable	Mean	Median	Std Dev	Maximum	Minimum
TS	0.87	0.87	0.09	1.15	0.6
BM2B	4.36	2.88	4.93	29.92	-25.54
TM2B	2.94	1.94	3.83	26.34	-19.12
Diff_Mkt	-0.01	-0.01	0.36	1.75	-1.43
Corr	0.07	0.05	0.13	0.65	-0.42
VIX_{t-1}	23.64	23.08	4.95	38.2	11.75
VIX_{t-2}	23.67	23.48	5.14	38.2	11.75
VIX_{t-3}	23.38	23.08	4.95	38.2	11.75

Note: This Table shows the descriptive statistics for the continuous variables. TS represents the relative target size, defined by target market value/bidder market value. Corr represents the return correlation between the bidder and the target. Diff_Mkt represents the difference in market risk exposure between the two companies. BM2B, TM2B represent bidder and target market to book ratio respectively one year prior to the merger announcement. VIX_{t-1}, VIX_{t-2}, VIX_{t-3} represent the average VIX one month, two months, three months prior to the merger announcement respectively.

Table 3
Descriptive Statistics: Categorical Variables

Industry	
Same Industry	603
Different Industries	130
Total	733
Number of Bidders	
1	703
2	23
3	6
4	1
Total	733

Note: This table shows the distribution of the categorical variables. Same industry represents number of deals involving targets and bidders in the same industry. Different industries represent number of deals involving targets and bidders in different industries. Number of deals involving various numbers of bidders is also listed.

Table 4
Pearson Correlation Coefficients

	TS	BM2B	TM2B	Diff_Mkt	Corr	VIX_{t-1}	VIX_{t-2}	VIX_{t-3}
TS	1.00							
BM2B	-0.19	1.00						
TM2B	0.06	0.39	1.00					
Diff_Mkt	-0.01	-0.03	-0.09	1.00				
Corr	0.22	0.01	0.03	-0.01	1.00			
VIX_{t-1}	-0.02	-0.02	-0.05	0.04	0.01	1.00		
VIX_{t-2}	-0.02	-0.01	-0.08	0.02	0.06	0.74	1.00	
VIX_{t-3}	-0.03	0.03	-0.07	-0.02	0.12	0.45	0.76	1.00

Note: This table shows the Pearson correlation coefficients between the independent variables used in the regressions.

Regression results are presented in Table 5. Using VIX lagged by 1, 2 and 3 months, leaves the coefficient for the other independent variables largely unchanged. Thus herein we discuss our results based on the estimates using the VIX three months ahead of the deal announcement. We find that the use of collars is negatively correlated with the relative size of the target, positively correlated with the difference in market risk exposure between the two firms, positively correlated with the bidding competition and positively correlated with the expected market uncertainty. We find the influence of bidder's/target's market to book ratio (proxy for bidder's/target's uncertainty), common industry membership and the return correlation between the two firms insignificant. These findings imply that adverse selection exists for the decision to include collar clauses. Greater difference in market risk exposure between the two firms, greater bidding competition, greater market uncertainty all have a negative impact on the success of a merger attempt; smaller target size and the flexibility of the collar structure have a positive impact on the success of a deal. Which force dominates is an empirical issue and will be explored in the next section.

Table 5
Influence of Deal Specific Factors and Market Uncertainty on the Use of Collars—Logistic Regression Results

	Expected Sign	t-3	t-2	t-1
Intercept		-0.380	-0.230	-0.310
TS	-	-2.640**	-2.650**	-2.490*
BM2B	?	-0.037	-0.038	-0.031
TM2B	-	-0.049	0.046	0.050
Diff_Mkt	+	89.670**	86.680**	84.330**
IN	-	-0.080	-0.091	-0.100
Comp	+	0.640**	0.670**	0.660**
Corr	-	-0.900	-0.990	-0.970
VIX_{t-i}	+	0.044**	0.055***	0.050**

Notes: This table presents the empirical results for estimating the following logistic regression:

$$Collared\_offer = \frac{1}{1+\exp(-\beta X)}$$

$$\beta X = \beta_0 + \beta_1 TS + \beta_2 BM2B + \beta_3 TM2B + \beta_4 Diff\_Mkt + \beta_5 IN + \beta_6 Comp + \beta_7 Corr + \beta_8 VIX_{t-i}$$

TS represents the relative target size, defined by target market value/bidder market value. BM2B, TM2B represent bidder and target market to book ratio respectively one year prior to the merger announcement. Diff_Mkt represents the difference in market risk exposure between the two companies prior to the merger announcement. Common industry membership is represented by IN which is set equal to 1 if the two companies are in the same industry and zero otherwise. Comp represents number of bidders for a deal after the merger announcement. Corr represents the return correlation between the bidder and the target prior to merger announcement. VIX is the volatility index obtained from CBOE. We run the analysis using three lagged VIX as robustness check. VIX_{t-1}, VIX_{t-2}, VIX_{t-3} represent the average VIX one month, two months, three months prior to merger announcement respectively. ***, **,and * indicate statistical significance at the level of 0.01 , 0.05 and 0.1, respectively.

6. The Impact of Market Returns on Deals' Outcome

Mitchell and Pulvino (2001) find that merger deals are more likely to fail in market downturns. In this section, we compare the influence of market condition on the outcome of a deal for both collared and uncollared offers. Similar to Mitchell and Pulvino (2001), we proxy for market condition with lagged monthly market returns prior to deal completion. Our model includes the following control variables: relative target size, friendly versus hostile deal, and bidding competition. Hoffmeister and Dyl (1981) find firm size to be an important factor in predicting the success of a takeover attempt. They contend that the larger the target (absolute market value), the lower the merger success rate. Branch and Yang (2003) find relative target size plays a role in determining the outcome of a deal. Hoffmeister and Dyl (1981) find that the resistance of targets is one of several major factors helping to determine the success of merger attempts. Schwert (2000) finds that unnegotiated hostile offers have the lowest success rates. Walkling (1985) argues that multiple bid offers for a given deal decrease the probability that any one offer will be successful and finds an insignificant negative correlation. Accordingly, our model is specified as:

$$Success = \frac{1}{1+\exp(\beta X)}$$

$$\beta X = \beta_0 + \beta_1 TS + \beta_2 Friendly + \beta_3 Comp + \beta_4 Mkt_t + \beta_5 Mkt_{t-1} + \beta_6 Mkt_{t-2} \quad (2)$$

Where success is 1 for a successful takeover offer, and 0 otherwise. TS is relative target size. Friendly is a dummy variable equal to 1 if the deal is friendly, 0 if hostile. Comp represents the number of bidders for the target. Mktt is the monthly return of the value weighted CRSP index for the month that the deal closes. Mktt-1, and Mktt-2 are the monthly returns of value weighted CRSP index return one and two months prior to deal closing respectively.

The empirical results are presented in Table 6. For collared offers, market condition and bidding competition are the dominating factors of a deal's outcome. All three monthly market returns have positive correlation with the success of a deal, as predicted. The coefficients for Mktt-1, Mktt-2 are 10.46 and 21.73 respectively and both are statistically significant. The coefficient for Mktt is 5.27 and insignificant. Bidding competition is significantly negatively correlated with deal success. The coefficients of target size and target resistance are not significant. For uncollared offers, target size, target resistance and bidding competition are the dominating factors, while the market returns all have positive but insignificant correlation with the success of a deal. Further, we compare the success or failure rates for collared or uncollared offers during up and down market. We use a dummy variable to represent market conditions: 1 if the market returns over the deal duration is positive; 0 otherwise. As shown in Table 7, for collared offers, 95.49% of the deals succeed in a rising market; and 86.89% of the deals succeed in a declining market. The difference between the two success rates is 8.6%. While for uncollared offers, 89.5% of the deals succeed in a rising market and 87.34% succeed in a declining market. The difference between the two success rates for uncollared offers is 2.16%, much lower than that for the collared offers. These results suggest that collar offers are more vulnerable to market downturns than are uncollared offers.

Table 6
Determinants of Deals' Outcome

Parameter	Expected Sign	Collared Offers	Uncollared Offers
Intercept		7.00	10.99***
TS	-	-2.30	-11.52***
Friendly	+	0.55	3.02***
Comp	-	-1.33*	-2.219***
Mkt_t	+	10.46*	3.26
Mkt_{t-1}	+	21.73***	1.50
Mkt_{t-2}	+	5.27	0.55

Notes: Table 6 presents the empirical results from estimating the following logistic regression.

$$Success = \frac{1}{1+\exp(\beta X)}$$

$$\beta X = \beta_0 + \beta_1 TS + \beta_2 Friendly + \beta_3 Comp + \beta_4 Mkt_t + \beta_5 Mkt_{t-1} + \beta_6 Mkt_{t-2}$$

Where success is 1 for successful offer, 0 for failed offer. TS is relative target size. Friendly is a dummy variable and equals 1 if the deal is a friendly offer, 0 if the deal is a hostile offer. Comp represents number of bidders for the target. Mkt_t is the monthly return of the value weighted CRSP index for the month that deal closes. Mkt_{t-1}, Mkt_{t-2} is the monthly return of value weighted CRSP index return one month, two months prior to deal closing respectively. ***, **,and * indicate statistical significance at the level of 0.01, 0.05 and 0.1, respectively.

Table 7
Impact of Market Returns on Deals' Outcome

	Rising Market	Declining Market
Panel A. Collared Offers		
Success	127 (95.49%)	53 (86.89%)
Failure	6 (4.51%)	8 (13.11%)
Panel B. Uncollared Offers		
Success	341 (89.50%)	138 (87.34%)
Failure	40 (10.50%)	20 (12.66%)

Note: This table compares deals' outcome vs. market conditions. Rising market refers to the cases where the market return for the deal duration is positive; declining market refers to the cases where the market return for the deal duration is negative.

7. Downside of Risk Arbitrage on Collared versus Uncollared Offers

To compare the downside of risk arbitrage for collared vs. uncollared offers, we followed the approach in Mitchell and Pulvino (2001). First, we constructed a risk arbitrage portfolio. Second, we calculated a time series of the portfolio returns by averaging the daily returns across all of the active deals on a calendar-time basis. Third, we regressed the time series returns of the risk arbitrage portfolio on the value weighted market index from CRSP using a piecewise linear regression, which allows the variation in the market coefficients conditional on the market returns.

7.1 Construction of the Risk Arbitrage Portfolio

A takeover attempt is included in the risk arbitrage portfolio starting two days after the offer announcement and removed when the deal is consummated or withdrawn. Daily returns are first calculated for each individual deal. The daily return for risk arbitrage is derived from three sources: the return on the target, the return from a short position in bidder's shares, and the risk free rate earned on the proceeds from the short sale. This return is calculated as follows (e.g., Baker and Savasoglu (2002)):

$$r_{it} = r_{Tit} - (r_{Bit} - r_{ft})\delta_t \frac{P_{Bit-1}}{P_{Tit-1}} \quad (3)$$

Where, r_{Tit} is return on the target on date t; r_{Bit} is return on the bidder on date t; r_{ft} is daily risk free rate on date t, obtained from DataStream; δ_t is number of shares of the bidder's stock that are sold short on date t. For collared offers, δ_t changes on a daily basis; for uncollared offers, δ_t is fixed over the duration of the deal; P_{Tit-1} is closing stock prices of the target on date t-1; P_{Bit-1} is closing stock prices of the bidder on date t-1. Then the daily individual returns are value weighted across all of the available active deals on day t to generate the daily portfolio return.

$$R_t = \frac{\sum_{i=1}^{N_t} V_i r_{it}}{\sum_{i=1}^{N_t} V_i} \quad (4)$$

Where, r_{it} is daily return per deal *i;* V_i is market capitalization for target *i;* N_t is the number of active deals on date *t;* R_t is the daily portfolio return for date *t*.

Finally, the monthly portfolio returns are obtained by compounding the daily portfolio returns.

$$R = \prod_{t=1}^{T}(1 + R_t) - 1 \quad (5)$$

Where, *T* is the last trading day in a month; *R* is the risk arbitrage portfolio's monthly return; R_t is daily portfolio return; Delta hedging on collared offers involves frequent rebalancing and may incur significant trading costs, therefore, we applied a \$0.04 per share commission cost for risk arbitrage on collared offers. For the purpose of comparison, we also imposed a \$0.04 commission cost for risk arbitrage on uncollared offers. All the empirical results reported are based on the post transaction cost case. For successful deals, the closing day is defined as the day on which the target is delisted. For failed deals, the closing day is the day after the failure of the deal is announced.

Table 8 reports means, standard deviations and Sharpe ratios for the risk arbitrage portfolio's monthly returns and the market portfolio's monthly returns. For our sample and time period, a risk arbitrage strategy based on all collared offers earns a mean monthly return of 1.28% and has a Sharpe ratio of 0.23. A risk arbitrage strategy based on all uncollared offers earns a mean monthly return of 1.18% and has a Sharpe ratio of 0.17. The market portfolio earns a mean return of 0.94%, and has a Sharpe ratio of 0.13. According to the Sharpe ratios, both risk arbitrage portfolios outperform the market.

Table 8
Monthly Portfolio Returns

	Mean (%)	SD (%)	Sharpe Ratio
Panel A: Risk Arbitrage Portfolios			
Collared Offers	1.28	4.14	0.23
UnCollared Offers	1.18	4.87	0.17
Panel B: Market Returns			
Market	0.94	4.70	0.13
T-bills	0.34	0.13	

7.2 Downside Risk of Risk Arbitrage Portfolio

To compare the downside risk of the risk arbitrage portfolios, we implemented a piecewise linear regression model (Mitchell and Pulvino 2001), which allows the variation in the market coefficients conditional on the market returns.

$$R_{Risk\ Arb} - r_f = \alpha + \beta_u (R_{Mkt} - r_f - threshold) \ \ if \ \ R_{Mkt} - r_f > threshold \quad (6)$$

$$R_{Risk\ Arb} - r_f = \alpha + \beta_{\mathrm{d}} (R_{Mkt} - r_f - threshold) \ \ if \ \ R_{Mkt} - r_f \leq threshold \quad (7)$$

Where, $R_{Risk\ Arb}$ is the monthly return to the risk arbitrage portfolio; R_{Mkt} is the return to the value-weighted market index from CRSP; R_f is the monthly risk free rate on three months Treasury bill, obtained from DataStream; β_u denotes the market coefficient in an up market; β_{d} denotes the market coefficient in a down market. An up (down) market refers to a market whose excess return is greater than (less than or equal to) the threshold. The threshold is estimated by minimizing the sum of squared residuals from the model through trial and error[7] for the overall sample.

Table 9 presents the empirical results for analyzing the risk and return characteristics of risk arbitrage on collared vs. uncollared offers. The estimated threshold is -2.7%. Similar to Mitchell and Pulvino (2001), we find a significant nonlinear risk return profile for the risk arbitrage portfolio for collared offers: a significantly positive correlation (β of 0.92) with the market in a declining market (market excess return less than–2.7%) and an insignificant correlation in a rising market. For uncollared offers, piecewise regression indicates a positive correlation with the market (β of 0.48) in a declining market, significant at the level of 0.2 and insignificant beta in a rising market. These results also indicate that risk arbitrage applied to stock swap offers with collars has had greater downside risk compared to risk arbitrage on stock swap offers without collars: 0.92 versus 0.48; significant at the level of 0.05 versus significant at the level of 0.2. These findings are consistent with

[7] This method is also used in Mitchell and Pulvino 2001.

the empirical results from the section 6. Stock swap offers with collars are more vulnerable to market condition than uncollared offers and risk arbitrage on collared offers has higher systematic risk in market downturns than that of uncollared offers. Figures V. and VI. illustrate the fitted piecewise regression for the collared and uncollared offer samples.

Table 9
Downside Risk: Risk Arbitrage for Collared Stock Swap Offers versus Uncollared Stock Swap Offers

	α	β_d	β_u	Threshold	Adj -R^2
Collared Offers	0.024***	0.92***	-0.1800	-0.027	16.13%
Uncollared Offers	0.014**	0.48#	0.0041	-0.027	3.68%

Note: Table 7 represents results from the piecewise regression model.

$$R_{Risk\ Arb} - r_f = \alpha + \beta_u (R_{Mkt} - r_f - threshold) \ \ if \ \ R_{Mkt} - r_f > threshold$$

$$R_{Risk\ Arb} - r_f = \alpha + \beta_d (R_{Mkt} - r_f - threshold) \ \ if \ \ R_{Mkt} - r_f \leq threshold$$

Where $R_{riskarb}$ is the monthly return on the value weighted risk arbitrage index. R_{mkt} is the value weighted CRSP index. *** Indicates statistical significance at the 0.01 level.** Indicates statistical significance at the 0.05 level. # Indicates statistical significance at the 0.2 level.

Figure V
Risk and Return Profile for Risk Arbitrage Portfolio—Collared Offers

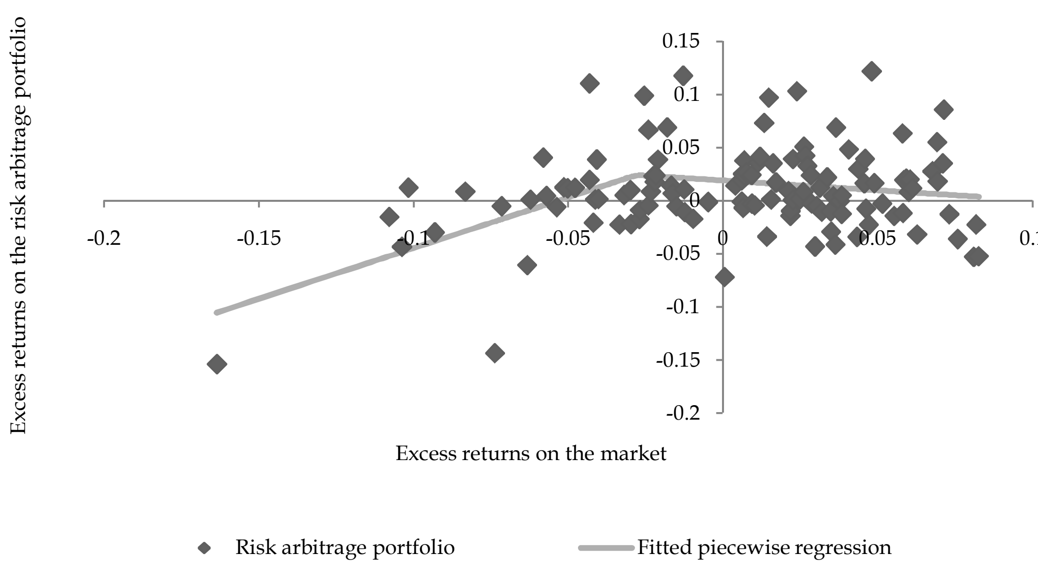
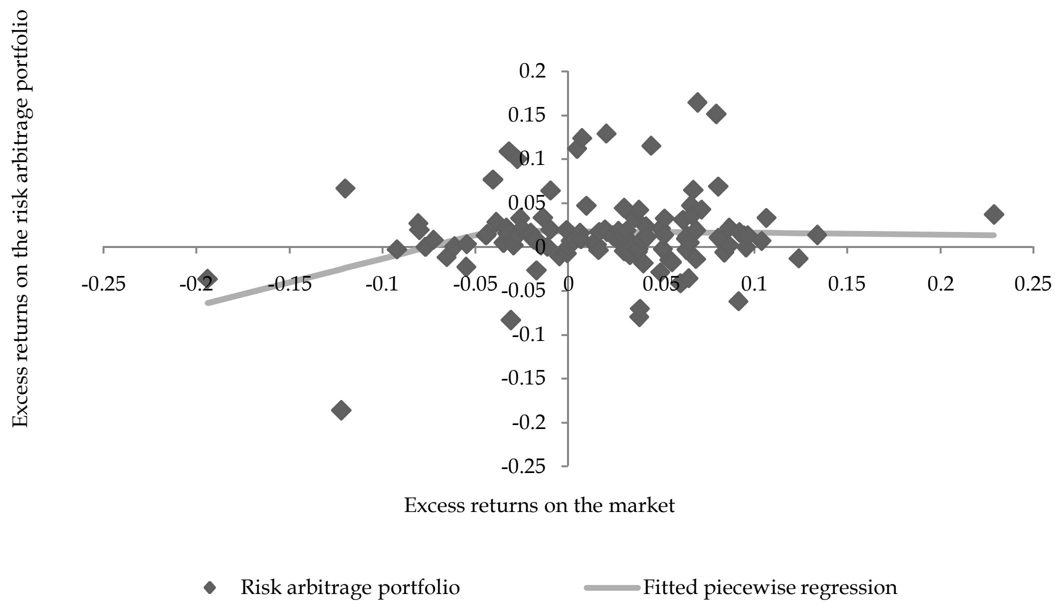


Figure VI
Risk and Return Profile for Risk Arbitrage Portfolio—Uncollared Offers



Figures V. and VI. plot the excess returns for the risk arbitrage portfolio against the excess returns for the market for all collared offers and uncollared offers respectively. Fitted line from a piecewise linear regression is also shown.

8. Conclusion

Herein we first explore the influence of deal specific factors and market uncertainty on the use of collars in a stock swap offer finding that their use is positively correlated with expected market uncertainty, bidder's and target's market related risk exposure, and bidding competition; and negatively correlated with relative target size. Can the structure of collars overcome the adverse selection impact and make risk arbitrage on collared offers market neutral? We then analyze the impact of market returns on the deal's outcome for collared versus uncollared offers. We find that the failure rates in a down market are higher for collared offers than for uncollared offers. Our results suggest that although collared offers are more flexible and are intended to protect both the bidders and the targets against dramatic price changes, the deal completion risk of collared offers is still greater in a down market. Third, we compare the risk and return characteristics of risk arbitrage on collared offers versus that of uncollared offers. We find that the return of the value weighted risk arbitrage portfolio on collared offers exhibits a stronger non-linear relationship with the market index compared to that on uncollared offers. The downside beta is around 0.9 for collar offers and significant at the statistical level of 0.05, while the downside beta is around 0.48 for uncollared offers and only significant at the statistical level of 0.2. Our results imply that the adverse selection factor dominates the flexibility of collars and expose risk arbitrage on collared offers to greater downside risk than risk arbitrage on uncollared offers.

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