

Exchange option value in stock financed takeover bids and arbitrage spread

Sudi Sudarsanam
Emeritus Professor of Finance & Corporate control
Cranfield School of Management
Cranfield MK43 0AL
Email: p.s.sudarsanam@cranfield.ac.uk

&
Ghulam Sorwar
Associate Professor of Finance
Nottingham Business School
Nottingham University
Nottingham NG8 1BB
Email: Ghulam.Sorwar@nottingham.ac.uk

13 January 2011 version

Corresponding author.

Please do not quote without the authors' written permission

Exchange option value in stock financed takeover bids and arbitrage spread

Abstract

Mergers and acquisitions are driven by the assumption that such activities increase share holder value. However, many empirical studies report value decline. Among the reasons for this is overpayment by acquirers. To investigate this, we decompose the observed takeover premium into undervaluation, synergy and transaction-related components. In share-exchange mergers, target shareholders hold an option to exchange their shares for those of the bidder at a specified exchange ratio. Using the Margrabe (1978) model, we value the exchange option and decompose the observed takeover premium into various components. To our knowledge, this is this first study that seeks to explain the observed takeover premium in stock for stock exchange offers using the exchange option framework. The observed target stock price is a combination of the exchange option plus the unobserved target stock value that reflects revaluation to correct for any undervaluation. Based on a sample of 236 UK share exchange takeover bids during 1990-2004, we find that both target revaluation and exchange option value account for significant proportions of the takeover premium. The exchange option value is driven by the probability of successful acquisition, nature of the bid and the length of the bid period. We find the exchange option value is driven by the arbitrage spread and the uncertainty during a takeover. Our results support theoretical predictions of a positive relationship between exchange options synergy and risk. We demonstrate the usefulness of option pricing models in capturing the impact of new information a takeover bid releases on the *stand alone* value of the target firm. Our option-based modelling of target valuation during a takeover bid provides a useful approach to assessing the reliability of observed target price as a predictor of bid outcome. This is likely to be of interest to risk arbitrageurs.

Determinants of Takeover Premium in Share-exchange Offers: An Exchange Option Pricing Approach

1. Introduction

According to the neoclassical model of the firm mergers and acquisitions are undertaken to enhance shareholder value. However, majority of acquirers seem to overpay *ex ante* or fail *ex post* to realise the expected synergies, leading to value gains for target shareholders but loss to acquiring shareholders (Bruner, 2004, ch.3 and Sudarsanam, 2010, ch.4). Overpayment by acquirers is consistent with managerial hubris as argued by Roll (1986). However, it may also be due to valuation errors made by the bidder. One way the bidder can minimise the valuation risk is to pay for the acquisition with a share exchange offer rather than cash. Thus the payment currency is a strategic tool to minimise valuation risk.

In the US, tender offers are governed by the Williams Act enforced by the Securities and Exchange Commission and tender offers, unlike mergers, are largely financed with cash (Datta et al, 2001). In the UK, with its most elaborate takeover regulatory regime in the world, payment currency choice is influenced by the rules of the City Takeover Code (the Code hereafter). For example, in mandatory bids, the offer has to be a cash offer or an exchange offer with a cash alternative (Sudarsanam, 2010, ch. 18). Thus the choice of payment currency is a result of the interaction of bidder's strategic consideration, need for risk mitigation and the constraints from the regulatory regime.

It is well documented that, in a takeover, a bidder generally pays a substantial acquisition premium. One reason for this is that the target is undervalued in the pre-bid period and the bid reveals the true higher value of the target firm. The premium may also be a share of incremental value from the potential synergies between the merging firms yielded to the target shareholders. Excessive acquisition premium may be paid by acquirers

suffering from hubris, overconfidence or similar behavioural infirmities (Roll, 1986; Malmendier and Tate, 2005; Sudarsanam and Gao, 2004). Some of the premium may be paid for tactical reasons during the bid period to persuade target shareholders to tender their shares in acceptance of the offer.

Several prior studies have sought to establish the sources of value in acquisitions and account for the takeover premium. Bhagat et al (1987) adopt an option-based approach to disentangling the sources of acquisition premium to target shareholders. In particular they model the targets' observed share price as the unobserved share price plus a put option offered by the bidder. In studies of cash tender offers in the US, they track the observed target stock price during the tender Offer period, estimate the underlying target's value that reflects new information released by the takeover bid about its intrinsic stand-alone value and the put option value. Bhagat et al explore whether the put value is overpayment or due to the regulatory cost of compliance with the tender offer rules under the Williams Act (WA) in the US.

In this study we adopt broadly a similar approach to disaggregating the observed target stock price but our sample is of exchange offers and the option pricing model is an exchange option model. We analyse the size and determinants of implicit exchange option values in takeovers involving share exchange offers.

In the risk arbitrage literature (Samuelson and Rosenthal, 1986) dealing with the predictability of bid outcome, the target stock price is regarded as a predictor of such outcome. Samuelson and Rosenthal argue that the target stock price during a takeover bid is a probability weighted average of the offer price if the bid succeeds and a fall back price if the bid fails. This relation is used by them to estimate the probability of bid success based on the observed target stock price on any day. To test whether target stock price is a reliable predictor of bid outcome, the authors calculate the forecast error called the Brier

score. The higher this score the lower is the predictive ability of the target stock price. The fall back price is a crucial input to this assessment.

Samuelson and Rosenthal (1986) use a number of proxies for the fall back stock price. In principle this should be the target value that incorporates the new information released by the bid i.e. the *stand alone* value of the target after bid announcement. We use the exchange option model to derive this value and use it as a proxy for the fall back value. We also test whether this measure is superior to the two proxies used by Samuelson and Rosenthal in capturing bid outcome uncertainty. We test whether exchange option value which also reflects such uncertainty is correlated with the Brier score.

For a sample of 236 share exchange takeover offers for UK listed target firms during 1990 to 2004, we estimate that the target firm revaluation accounts for a substantial part of the observed takeover premium and the exchange option value accounts for a significant proportion. The mean (median) observed three day premium to the target shareholders is about 8.6% (6.8%) whereas the intrinsic value change accounts for 10% (8%). The mean (median) exchange option value is 10.3% (5.2%). In exploring the bid characteristics that may account for the exchange option value we find that it is higher in hostile bids than in friendly ones. The longer the bid period the higher is the exchange option value. These findings suggest that a significant part of the observed bid premium reflects bid characteristics that are indicative of the uncertainty associated with the bid process or influence its outcome rather than the intrinsic value of the target. Our analysis also suggests that some of the wealth gains for targets are due to the bidding firm and target firm having unique synergies. We also find that our estimates of exchange option value are positively associated with the Brier score and this relation is stronger and more significant when the option-estimated underlying target value is used as the proxy for its fall back value.

Our paper contributes to a better understanding of the true determinants of takeover premium and demonstrates the usefulness of option pricing models in de-composing these determinants. To our knowledge, this is the first study that seeks to explain the observed takeover premium in stock for stock exchange offers using the exchange option framework and a large sample. Further, the study also provides a test of the usefulness of real options in understanding and measuring the impact of takeovers on firm risk and shareholder gains. We demonstrate the usefulness of option pricing models in capturing the impact of new information a takeover bid releases on the *stand alone* value of the target firm. Our option-based modelling of target valuation during a takeover bid provides a useful approach to assessing the reliability of observed target price as a predictor of bid outcome. This is likely to be of interest to risk arbitrageurs.

The paper is organised as follows. The next section discusses the various factors that may account for the acquisition premium. Section 3 describes the methodology and data. In this section we develop the exchange option pricing model that allows for breakdown of the acquisition premium into target revaluation and the exchange option value. We also describe our empirical models to explain the exchange option value in terms of the bidder/target and process characteristics. Results are presented and discussed in Section 4. Summary and conclusions follow in Section 5.

2. Theoretical framework

(i) What explains the acquisition premium to target shareholders?

There is well documented empirical evidence that target shareholders receive a substantial control premium from the bidders bidding for their shares. There is no clear cut explanation for the magnitude of these gains. Several alternative sources have been proposed in the literature. The gains may merely reflect the incremental value the bidder expects to generate through synergies between the bidder and target. These gains can only

arise after the merger of the two firms when they can exploit these synergies although the stock market may anticipate and value these synergies, which are then extracted by the target shareholders during the bid as premium. Another view is that the incremental value is due to the realisation by stock market investors that the target was previously undervalued and the announcement of the bid leads them to revalue the target as a *stand-alone* entity. This revaluation is *information-driven* rather than *synergy-driven*. A third perspective is that the bidder after the acquisition restructures the target as a separate operational entity although there may still be managerial, financial and strategic synergies between the two firms (see Sudarsanam, 2010, ch.4 and Bruner, 2004, ch. 3 for reviews of these studies). A fourth perspective is driven by behavioural explanations. According to this perspective bidder managers, suffering from hubris (Roll, 1986) or overconfidence (Sudarsanam & Gao, 2004; Malmendier and Tate, 2005), may overestimate the target value because of their misplaced self-confidence that they can ‘work miracles’. In this circumstance, the target gains are simply wealth transfers from bidders to target shareholders.

(ii) Transactional explanations

US regulation of tender offers¹

Mergers and acquisitions may be subject to corporate law, securities law and antitrust law. The actual conduct of these transactions and the terms on which they are done may also be subject to regulation. In several countries, conduct of takeovers is regulated according to either law or a voluntary code administered by a self-regulatory body. In the US, tender offers made by bidders directly to target shareholders to tender their shares are regulated by the Williams Act (1968) enforced by the Securities and Exchange Commission (SEC). Tender offers can be paid for with cash or share exchange.

¹ On the US regulation see Weston et al (2004, ch. 2) and Kenyon-Slade (2004).

The tender offer rules regulate the period over which the initial or extended offer is kept open, whether the bidder can buy target shares during the tender period, the price to be offered for target shares, how the tenders will be notified etc. These rules are intended to allow target shareholders the time and information to decide whether to accept the offer and on what terms. Since a tender offer is made directly to target shareholders it circumvents the target management and may be perceived as hostile by the latter. In the US tender offers are mostly financed by cash, whereas in mergers, that are almost always friendly or non-hostile, stock exchange is the preferred payment currency². However, not all tender offers are hostile³.

UK regulation of takeovers⁴

In the UK, although corporate mergers can be carried out as schemes of arrangement under the Companies Act 1985 (now Companies Act 2006), in the case of publicly listed UK target firms this method is very infrequently employed. The vast majority of such mergers happen in the form of direct offers made to target shareholders under the aegis of the City Code on Takeovers and Mergers (the Code) administered and enforced by the City Panel on Takeovers and Mergers (The Panel). The Code is an elaborate set of rules covering various aspects of the bid process and takes into account transactions and activities of the bidder and target companies and their associates and concert parties well before the actual announcement of an offer. An offer under the Code is the UK equivalent of a tender offer under the WA⁵.

² In statutory mergers in the US, stock exchange has to account for between 50% and 100% of the consideration and, in all except the A type mergers, the buyer shareholders do not need to vote on the merger. Thus such mergers are essentially approved by target management (Bruner, 2004, ch.19).

³ A cash tender offer may be the first stage followed by a short form freeze-out merger to avoid the long delay in negotiated long form statutory mergers (Kenyon-Slade, 2004). This 2-stage merger is, however, based on a merger agreement between the bidder and its target.

⁴ On the UK takeover regulation and regulation in many continental European countries, see Sudarsanam (2010, ch.18).

⁵ In the UK Code the term 'tender offer' is used for open and direct offers made to target shareholders but only for minority voting rights. Thus it has a more restricted meaning in the UK than in the US.

In particular, the Code lays down a bid time table, imposes restrictions on share dealings that may create a false market in the bidder and target company shares, regulates the timing and content of information release by the firms, and stipulates the length of time the initial offer needs to be kept open and the length of time any extended offer is kept open⁶.

As regards the time table, in general, the bidder, within 28 days of announcement, has to mail the offer document to target shareholders and the target management. The time table starts on the day following the day of posting (Day 0). The target management has 14 days to respond to the offer and has to base its recommendation to its shareholders on independent advice. The initial offer is kept open for 21 days and may be extended but no new offers may be made after Day 46. The bid is closed on Day 60 whether it is successful or not. Day 39 is the last day for the target to release any new information. A bid can close after Day 21. A bid may be extended if there is a subsequent rival bid and the first bidder's time table now coincides with that of the rival bidder⁷. The Code lays down strict rules about the standard of information, such as earnings forecasts or expert opinion, released by both bidders and targets, and share dealing and conduct of bidders, targets and their advisers.

It is clear that the observed takeover premium during a takeover period is a result of bidder's and target shareholders' expectation of synergy and other efficiency gains, the behavioural biases of bidder managers leading to excessive premia and the takeover rules

⁶ An important characteristic of the UK Code, unlike the tender offer rules in the US, is the requirement for bidders to launch mandatory bids for the targets in which they have accumulated a certain percentage of shares (30% of voting shares) or have increased their holdings from the 30% or higher level reached through previous accumulation e.g. a failed mandatory bid (the creeping acquisition rule). Mandatory bid imposes several restrictions on bidders. They are deemed to have won the bid if they receive target shareholder acceptances resulting in over 50% control whereas in a voluntary bid they can set a higher minimum level of acceptances, say 90%. Another constraint is that bidders have to make a cash offer or attach a cash alternative to a stock exchange offer. This may influence both the level of acquisition premium and outcome of the bid.

⁷ The bid is terminated if the Office of Fair Trading refers the bid to the Competition Commission (or its predecessor the Monopolies and Mergers Commission) or the European Commission undertakes a Phase II inquiry. If the bid is cleared then the bidder can re-launch a new bid (See Sudarsanam, 2010, ch. 17).

that govern the offer. Where the premium is a tactical tool to win the bid, its size and effectiveness depend on the nature of the bid and target resistance e.g. whether friendly or hostile and the prospect/ incidence of rival bids. In this paper we seek to separate the premium components and relate them to the bid characteristics by using a sample of share exchange takeover offers for listed UK target firms.

(iii) Target value during a takeover offer

A share exchange offer involves one firm making a bid to the shareholders of another firm for some fraction or whole of the latter firm's shares in exchange for a fraction of its own shares. The period the offer is open for consideration and acceptance by target shareholders is the Offer period. It is the period between the announcement date of the offer and the date the offer is declared successful ('unconditional' in the parlance of the Code) or failed. During the Offer period the target shareholders not only own the stock but also an implied 'exchange' option to sell their stock to the bidder for a fraction of the bidder's share.

From the bidder's perspective, this exchange option represents the additional premium the bidder offers over and above the premium based on the true value of the target as a *stand-alone* business in comparison with its pre-bid price. The latter premium is a reflection of any pre-bid under-valuation of the target now corrected by the release of new information in the bid. The size of the exchange option value depends on the bidder's motivations for the bid and the constraints imposed by the regulatory rules. It may be viewed as part of the control premium that will be paid out of the additional synergies the takeover will generate.

The difference between the observed target stock price and its underlying true value is a measure of the exchange value. If the exchange option represents the synergy-related control premium then the bidder should suffer no value losses at the time of the offer. On

the other hand the exchange option may represent the extra premium the bidder has to pay in order to win the bid. If so, the exchange option value will be influenced by those bid characteristics that proxy for greater uncertainty or complexity in the bid process. For example, hostile bids and bids by multiple offerors (throughout this paper we use the term ‘multiple bids’ or ‘multiple bidders’ or ‘multiple offerors’ to mean bids from different bidders and not revisions of a bid by the same bidder or offeror) or protracted bids may call for higher valued, than friendly or single bidder, offers and bids that conclude quickly. We next describe our methodology to disentangle the ‘true’ underlying value of the target and the exchange option value during the Offer period. The target shareholders either ‘exercise’ the exchange option when they accept the offer or ‘abandon’ it when the offer fails at the offer expiry date.

3. Methodology and Data

(i) Methodology

Portfolio interpretation of target price behaviour during the Offer period

The wealth effect of a share exchange offer for target shareholders comprises two distinct components - re-estimated target stock value (hereafter ‘underlying target or stock value’) and the exchange option value of that stock. The underlying stock value is the observed price of the common stock minus the estimated exchange option value. This underlying value may change following an offer or offers that release new information concerning the target as a *stand-alone* firm.

We start our analysis by examining the characteristics of a portfolio comprising the target stock and the implied exchange option. Option pricing theory predicts that a portfolio of a stock and an exchange option should have different risk characteristics from the underlying stock by itself. Thus we expect that beta (the systematic risk) and standard

deviation of the portfolio returns will be substantially different during the Offer period from those in the Pre-offer period. Any observation consistent with this prediction will lend weight to the option perspective of target stock price during the Offer period.

Option valuation model

We use Margrabe's (1978) exchange option pricing model (OPM) to analyse in more depth the pricing of target's and acquirer's shares following a takeover offer. Although Margrabe illustrates his exchange option model in the takeover context, this model has not been employed so far to estimate empirically the exchange option value in a large sample of takeovers. We use numerical iteration to estimate (a) the value of the underlying target stock prices (b) the value of the exchange option held by the target shareholders, and (c) the standard deviation i.e. the implied volatility of the underlying target stock price. We employ the capital asset pricing model (CAPM) to estimate the beta during the Pre-offer period Offer period and the Offer period.

During the Offer period, the observed market price of a target firm's stock price is the sum of the underlying stock and a fractional exchange option based on that stock. The fraction of the exchange F may be any number between zero and one ($0 < F \leq 1$)⁸. F is the fraction of the target shares that the offeror seeks to acquire.

Estimating underlying target stock and exchange option values

The stock exchange offer from a bidding company gives the shareholders of the target company the right but not the obligation to exchange their shares for a certain number of those of the bidding company during the Offer period. The exchange ratio is chosen by the bidder. The option is European in that target shareholders will only exercise it by the end of the Offer period if it is profitable to do so. Hence when a stock bid is made, the

^{8 8} Note this fraction excludes, any shares already owned by the bidder prior to the offer. For the bid to be successful, the existing toehold plus the fraction F must exceed half.

shareholders of the target company not only own the shares but also an exchange option to exchange their stock for that of the bidding company. The observed target stock price, i.e. the market price, equals the unobserved stock value plus the unobserved exchange option value. The payoff pattern of an exchange option to change one stock for another is given by the following equation

$$\text{Payoff} = \max(0, V_T - U_T)$$

where U_T is the value of the asset given up by the target company shareholders at time T and V_T is the value of the asset received by target company in exchange at time T .

We use Margrabe's option pricing model and an iterative technique to estimate the underlying stock value, the implied standard deviation of target stock returns during the Offer period and the exchange value. Following Bhagat et al (1987) we assume that the observed stock price during the Offer period, P , is the price of the underlying target stock P_s , plus the value of a fractional exchange option FP_p where the fraction F , is the proportion of the target firm's common stock, not already owned by the bidder, sought in the tender offer and P_p is the exchange option value:

$$P = P_s + FP_p \tag{1}$$

We use Margrabe's equation to calculate the value of the exchange option:

$$P_p = V_0 N(d_1) - U_0 N(d_2)$$

with

$$d_1 = \frac{\ln(V_0/U_0) + (\hat{\sigma}^2/2)t}{\hat{\sigma}\sqrt{t}} \tag{2}$$

$$d_2 = d_1 - \hat{\sigma}\sqrt{t}$$

$$\hat{\sigma} = \sqrt{\sigma_U^2 + \sigma_V^2 - 2\rho\sigma_U\sigma_V} \tag{3}$$

where

t = days remaining to the end of Offer period,

U_0 = price of the asset given up by target company adjusted for dividends at time 0,

V_0 = price of the asset received by target company adjusted for dividends at time 0,

$\hat{\sigma}$ = joint standard deviation of the daily stock returns of the target and bidding companies, i.e. option volatility,

σ_U = standard deviation of the daily stock return of the target company

σ_V = standard deviation of the daily stock return of the bidding company

ρ = correlation between the daily returns of the target company the bidding company during the tender period. During the Offer period this correlation is based on the estimated target price return and the bidding company return

N = the cumulative normal density function

At bid announcement the bidding company offers a fraction of its share, say k for a target company share. k is the exchange ratio. Such that at the initial date $k V_0 = U_0$ ⁹. Thus at the start of the tender period the exchange option is an at-the-money option with no net cash flows between the bidding and the target firm.

In equations (1) and (2) both P_s and σ_U are unknown as both are unobservable; however, the combined stock and exchange option price, P , is observed. Thus we use an iterative technique to estimate P_s , and P_p for each day during the Offer period and standard deviation of the returns σ_U which is assumed to be constant over the Offer period.

For each firm in our sample, we start the procedure with day + 2 of the Offer period. As starting values for the unobserved stock price P_s we use the offer price, the stock price, or some other suitable value on the day before the offer announcement, depending on whichever facilitates faster convergence. For standard deviation σ , we use the standard

⁹ This assumes that k is based on relative share prices at the start of the Offer period.

deviations of the target and bidding companies and their joint correlation estimated from the Pre-offer period Offer period as a starting value. With these values we calculate the exchange option premium using equation (1). To solve for P_s we restate equation as:

$$P - P_s - FP_p = 0 \quad (4)$$

We minimise the square of the above function by adjusting P_s and σ_U subject to a suitable tolerance limit¹⁰. We repeat the procedure for each day during the Offer period. Once the process is completed for the entire Offer period, we have an estimated series of both the underlying stock and the exchange option values for each day of the Offer period. Using the estimated underlying stock values, we calculate the standard deviation of daily underlying target stock returns. If the standard Chi-square test fails to reject the null hypothesis that the estimated standard deviation and the starting values are the same at the 0.5 level of significance, we end the procedure and use the results as our estimates of P_s , and P_p and σ_U . If the hypothesis be rejected at the 0.5 level of significance, we start the entire procedure over again using as the starting value of σ_U , the estimated σ_U from our derived series. We continue this process until the Chi-square test does not reject the equality of starting and ending standard deviation at the 0.5 level.

Estimated exchange option value and bid characteristics

The estimated exchange option values and the true and observed takeover premia are then analysed to establish the impact of bid characteristics on these values. We divide our sample into sub-samples that reflect the bid characteristics and examine the difference in the estimated values between these sub-samples. We test for the significance of these differences using both parametric and non-parametric procedures. The characteristics we examine include the length of the Offer period, whether the bid is completed or aborted, and whether the bid is friendly or hostile. The bid process in different periods of overall

¹⁰ The tolerance limit is chosen such that the option premium is calculated to an accuracy of one pence. Our convergence procedure, that is solving equation (4) is different from that of Bhagat et-al (1987).

merger activity may be different because of pressure to conclude deals, competition for targets and pressure to match rival competitive strategies and so on¹¹. Our sample period is divided into different sub-periods to reflect overall M & A activity and we examine the implied exchange option values and test for any temporal differences that may be related to the M & A environment.

Exchange option value and target stock price as a predictor of bid outcome

The observed target price during a takeover bid has a signalling characteristic. It reflects the expected stock price in the event of bid success or bid failure as well as the associated probabilities of success or failure. Samuelson and Rosenthal (1986) develop a model in which the current target stock price on any day during a bid is a function of the offer price, the probability of success, a fall back price to which the target will fall in the event of bid failure and the probability of failure. Samuelson and Rosenthal (1986) argue that the probability (q) of a successful takeover as of day d is given by:

$$q = \frac{(1 + r_f)P_d - P_F}{P_T - P_F} \quad (5)$$

where

r_f = risk-free interest rate for the holding period until the end of the Offer period

P_d = Observed target share price during day d of the offer period

P_F = Fall back price of target share in the event of an unsuccessful takeover

P_T = Offer price for target shares

They then use the Brier score to measure the forecast performance. For only two outcomes, the Brier score is defined as:

$$B = \sum_{d=0}^I (q_{id} - s_i)^2 / I \quad (6)$$

¹¹ Aggregate M&A activity is known to exhibit waves (Sudarsanam, 2003, ch.2 and Bruner, 2004, ch. 4) and acquirers tend to pay excessive control premia around the peaks of these waves leading to massive value destruction (Moeller et al, 2005).

where q_{id} represents the probability of successful takeover for i^{th} company on day d and s_i is the offer's actual outcome, $s_i = 1$ for success and $s_i = 0$ for failure. I is the bid interval in days over which the score is calculated. In short the Brier score is a standardised measure of the mean-squared error associated with the forecast. Thus a lower Brier score implies a more accurate forecast. Given that the estimated exchange option value is also a measure of uncertainty surrounding the bid outcome, we expect that it will be positively related to the Brier score. Unlike Samuelson and Rosenthal, we propose using the estimated underlying target stock value as a proxy for the fall back value.

(ii) Data

The sample consists of 236 share exchange offers for publicly traded UK companies made during January 1990 to December 2004. Table 1 presents descriptive statistics for the sample by year as well as for three distinct sample periods. 203 of the sample bids succeed. 209 of the offers are friendly (including the solicited ones) but there are 27 hostile offers (including the unsolicited ones). In 19 of the sample cases there are multiple offers by two or more different offerors but we only examine the valuation effects of the first offer. The 1996-2000 period is the most active of the three periods.

[TABLE 1 APPROXIMATELY HERE]

Table 2 provides some descriptive statistics for the sample in terms of bid characteristics. The mean (median) Offer period for our sample of UK share exchange offers is 49 (36) days¹². The mean (median) deal value is £602m (£27m). Both the Offer period and the deal size vary by year and by period. In the early phase of the 1990s takeover wave, the mean (median) deal size is £181m (£16m) whereas during the boom it increases sharply to £889m (£41m) respectively. Both fall dramatically as the merger wave

¹² This contrasts with the mean (median) length of 15 (13) days reported by Bhagat et al (1987, fn 17) for the US. This is perhaps because the UK time table is longer than the US time table for tender offers (see Section 2 above).

recedes during 2001-04. In terms of the Offer period length, however, the median remains in a narrow range of 32 to 45 days.

[TABLE 2 APPROXIMATELY HERE]

In our further analysis reported in the next section, we use a subsample of 229 and 221 for table 3 and subsample of 214¹³ firms for the remaining tables meeting the following criteria (number of sample firms discarded for failing this test):

1. The Offer period must be at least six trading days long (1)
2. Stock price for both target and acquirer must be available (2)
3. Share price cannot be zero during the Offer period (3)
4. Share price must change during the Offer period (1)
5. Share price is less than one pence during the Offer period (1)
6. Problem of convergence in the option valuation procedure (8)
7. Total fraction of shares sought including initial toehold is less than 50% (6)

In total 16 firms were discarded and not included in the analysis. We excluded 8 firms that posed convergence problems with exchange option estimation. All the remaining sample firms were listed on the London Stock Exchange.

For the event study analysis of each offer, two estimation periods are used. The periods used are of identical length to that of Bhagat et-al (1987). The first is the 150-day pre-offer interval comprising trading day -170 to trading day -21 relative to the announcement date of the offer (day 0)¹⁴. The second is the Offer period, defined so as to exclude the announcement effects of the offer and its outcome effects of the bid. Thus the Offer period is from trading day + 2 through one day before the expiration date of the offer. Where there are multiple offers, the offer that expires first is used.

¹³ In Table 3, we estimate beta for 229 firms based on an original sample of 236 firms where we have completed data during the Pre-offer. This sample reduces to 221 during the Offer period. We use this sample of 221 firms to calculate the exchange option. However, imposing conditions 1-7 above further reduces the sample size to 214.

¹⁴ This is different from Day 0 for the purpose of the Code time table (see Section 2 above).

4 Results

(i) Does the target stock trade as a portfolio during Offer period?

Table 3 contains the mean and median betas and the mean and median standard deviations of the sample of firms estimated over the Pre-offer and Offer-periods. Betas are estimated using daily returns, the Financial Times All Share Index, and the Dimson model (1979). The Dimson model with two lags is used instead of the one-factor market model to adjust for the thin trading associated with small companies. Table 3 also contains the test statistics for testing hypotheses that the beta and standard deviation for the Offer period are equal to those for the Pre-offer period and the Post-offer period¹⁵. Two statistical tests are used, the paired *t*-test and the Fisher sign test.

[TABLE 3 APPROXIMATELY HERE]

Panel A contains the betas and standard deviation of the entire sample. However, panel B contains results for Pre-offer period beta greater than the Offer period beta and panel C contains results for Pre-offer period beta less than or equal to Offer period beta. Our intention behind the three panels is to test whether the exchange option is treated as a call option or a put option by the target company. At anytime during the Offer period, t , if the exchange option is exercised, payoff will be $kV_t - U_t$, or nothing if the option is not exercised. As pointed out by Margrabe (1978), this payoff implies that the exchange option is simultaneously a call option on a bidding company share at exercise price U_t , and a put option on target company share price with exercise price kV_t . If the target shareholders view the exchange option as a put option, then there should be a decrease in the risk measures between the Pre-offer period and the Offer period. Similarly there should be an increase in the risk measures if the exchange option is viewed as a call option.

¹⁵ Risk measures are calculated using stocks which were traded during each of the periods. If a stock was not traded during a particular period, i.e. there was no change in its price during a particular period, it was excluded from the calculations as it would lead to a beta and standard deviation of zero.

From panel A we see that mean (median) beta increases from 0.35 (0.26) to 0.41 (0.30) and the implied mean (median) standard deviation of the target increases from 0.03 (0.020) to 0.02 (0.02). The increase in beta indicates that target shareholders may view the exchange option as a call option, whereas decrease in standard deviation of returns indicates that target shareholders may view the exchange option as a put option. These conflicting results from the two risk measures may be due to an averaging effect due to the presence of both call and put options in the sample. It is possible that some target shareholders may be the exchange option as a call option whereas others would view it as a put option. We test this conjecture by splitting our sample into two subsamples.

In panel B, we analyse the target companies for which beta decreases between the pre-offer and the Offer period. The average (median) beta decreases from 0.55 (0.39) to -0.25 (-0.01). The change is statistically significant at the 1% level. Average (median) standard deviation increases from 0.03 (0.02) to 0.02 (0.02). Thus both risk measures confirm the presence of puts.

Panel C, contains target companies for which beta increases from the Pre-offer period to the Offer period. The average (median) beta increases from 0.20 (0.13) to 1.11 (0.78). The increase is significant at the 1% level. The mean (median) standard deviation decreases slightly from 0.03 (0.02) to 0.02 (0.02). We would have expected the standard deviation to increase slightly. The small decrease in the standard deviation may be due to outliers, which we have not been able to completely eliminate despite winsorizing at three standard deviations.

Based on the results of the three panels, we conclude that some target companies' shareholders view the exchange option as a call option (panel C), shareholders of other targets view it as a put option (panel B), and, overall, target shareholders view the exchange option as a call option (panel A).

(ii) Bid premium and exchange option value estimates

Table 4 contains the results of estimating the underlying stock value (or price) and exchange option value (*EOV*) during the Offer period. On average, the underlying stock price ($S_{t+2}^{estimated}$) for the day +2 of the Offer period is about 7 % higher than on the day before the announcement of the offer (pre-offer price (S_{t-1})). We refer to this as the True bid premium reflecting the way the target has been revalued on a *stand alone* basis. This may reflect a catch-up component of the observed bid premium i.e. a correction of the pre-bid undervaluation of the target. The mean Apparent bid premium i.e. the excess of observed target stock price (S_{t+2}) on day +2 over the day -1 price is 10% of the latter. Based on our definitions, we expect the following relation to hold

$$(S_{t+2}^{estimated} - S_{t-1}) + EOV \geq (S_{t+2} - S_{t-1})$$

True bid premium + implied exchange option value \geq Apparent bid premium

$S_{t+2}^{estimated}$ is estimated by disentangling the observed share price on day + 2 of the Offer period. *EOV* is based on the implied volatility of the estimated underlying stock values, obtained by disentangling the observed share price for every day of the Offer period. *EOV* incorporates the bid premium component over and above the true bid premium and the influence of expected synergy as well as the transactional uncertainty surrounding the takeover bid. This transactional uncertainty i.e. whether the bid will succeed or not depends in turn on a number of bid characteristics such as the length of the offer period, the relative size of the target to bidder etc. We discuss the expected impact of these characteristics on *EOV* below.

The equality in the above equation would hold if the true bid premium + exchange option premium = apparent bid premium if all the information about future activities was reflected by the offer price. However, in practice this is not going to be the case. A

takeover will lead to reactions from other market participants which will have an impact on the share price of the target company. In other words, it is possible that the standard deviations of the target company share price to increase during the Offer period to reflect the extra market activity due to the exchange offer. The level of this uncertainty is difficult to forecast and hence we would expect generally the inequality to hold.

Our results suggests that the market re-evaluates the underlying target stock upon announcement of the offer, taking into account the information revealed about the earnings potential of the *stand alone target* . On average, target shareholders are given a fractional exchange option valued at £0.19 per share. The mean Exchange option value is 11% of the pre-offer stock price and 10% of the underlying stock value. This may indicate unique synergies that allow the bidder to bid substantially more than the prevailing market price at the time of the offer and more than even the *stand alone* true target value, an overbid leading to wealth transfer from the bidding company to the target company or the influence of transactional characteristics.

[TABLE 4 APPROXIMATELY HERE]

(iii) Impact of bid outcome

We then consider the impact of offer failure on the estimated Apparent and True bid premia and exchange option values. For completed as well as withdrawn (also called ‘failed’) offers, Table 5 reports the bid premium and exchange option value estimates. The median True bid premium (both £ and as % of pre-offer target price) is significantly smaller in the case of failed offers. The median exchange option values are, however, significantly higher in the case of failed offers. More convincingly, the exchange option value as a proportion of Pre-offer target price is considerably higher in failed than in completed offers with differences highly significant. Thus takeover offers seem to fail in spite of the bidders offering a more valuable exchange option to target shareholders. It

appears that this inducement is not sufficient to win the target acceptance of the offer. Alternatively, the EOV reflects the higher uncertainty associated with bids that eventually fail.

[TABLE 5 APPROXIMATELY HERE]

(iv) Impact of bid hostility

Another bid characteristic, bid hostility, may have different implications for the exchange option value from those of friendly bids since the former are much more complex and uncertain and these may lead bidders to offer higher valued exchange options. These expectations are supported by our analysis in Table 6. The median True and Apparent bid premia and the median exchange option value (in both absolute £ and as a proportion of Pre-offer target price) are significantly higher in hostile than in friendly offers. The median exchange option value is £0.08 in hostile offers but only £0.04 in friendly ones. However, in percentage terms, the means are about 10% and 5% respectively. This is consistent with hostile bids more uncertain and complex than friendly bid.

The above results also suggest that hostile bidders expect to exploit synergies and not merely correct for the pre-bid undervaluation of the targets. Thus it appears that such bids are not merely disciplinary to correct managerial failure.

[TABLE 6 APPROXIMATELY HERE]

(v) Target valuation during the offer

As the bid period unwinds and the bid evolves through new information from bidder and target companies and other participants like analysts, fund managers, media commentators and other stakeholders like trade unions, the underlying stock value as well as the exchange option value change. At close of the Offer period the exchange option is

exercised if the bid succeeds or abandoned if the bid fails. Following this evolution, we expect to see the underlying stock value converge to the closing observed stock price in the case of completed offers. In these cases the closing observed price is also likely to converge on the offer price. In the case of withdrawn bids, the underlying target value may reflect the new information released by the bid about its true *stand alone* value but the additional premium due to anticipated synergies may fail to materialise. Thus the closing price may be higher than the underlying value and it is also likely to be higher than the offer price. The closing price reflects the market's expectation of the underlying value plus the additional synergies that a bidder may extract from the target acquisition. Where the offer price falls below this market expectation, the bid is likely to fail.

In Table 7 we report the difference between the underlying value (V_u) at the end of the Offer period and the observed closing stock price as well as the difference between the closing price (V_c) and the offer price (V_o) for completed and failed offers. For the Entire sample in Panel A, we find that the final closing price is on average only 10% away from the underlying stock value. The median difference is smaller (5%). Further the closing price is 6% different from the offer price (median -1.5%). This points to an effective convergence process in the full sample. Panel B contains the analysis for the entire sample whilst excluding the multiple offers. Overall conclusions are the same as in Panel A.

[TABLE 7 APPROXIMATELY HERE]

We examine the Completed and Withdrawn offers separately in Panel C and Panel D including and excluding multiple offers respectively. In Panel C we find that the underlying value converges on the closing price (the mean difference being 7.5% and the median only 3.6%) but there is still a large gap between the two in the case of failed bids. The closing price is still about 25% (12%) higher than the underlying value in terms of the mean (median). Thus in the case of failed bids, the target share price at the expiry of the

bid stays well above the underlying value. We find that the closing price and underlying value are similar for completed bids but for failed bids the closing price is well above the underlying value. These results are broadly similar, but statistically weaker, when multiple bids are excluded from the sample perhaps due to the very small sample of failed bids (see Panel D of Table 7).

In Panels C and D, we also find that the closing price converges on the offer price in both completed and failed bids and the gaps between the two prices are broadly similar. While such convergence accords with our expectation in the case of completed bids, it is inconsistent with our expectation for the failed bids. It appears that although the offer price is not different from the closing price the bid fails for non-price reasons.

(vi) Joint impact of bid characteristics and exchange value

As the exchange option is a means of combating uncertainty in the valuation of the target from both the bidder and target shareholder perspectives, its value is shown above to be associated with bid characteristics that reflect the complexity and uncertainty of the bid process.

To estimate the Brier score (equation 6 above), we need to estimate q and to estimate q we need to estimate or assume the fallback price P_F . First we assume fallback price P_F is the observed target price 30 days prior to the offer. Second we use the estimated day + 2 share price based on the Margrabe model. Third we estimate P_F as suggested by Samuelson and Rosenthal (1986) who estimate the following regression based on the unsuccessful offers.

$$P_F = aP_I + (1 - a)P_T + \varepsilon \quad (7)$$

Following Samuelson and Rosenthal (1986) P_I is three-day average target stock price two weeks prior to the offer and P_F is the three-day average target stock price during the second week following the failure of the offer.

Our original sample of 214 estimated options price reduces to 30 when all the successful offers are excluded. Based on this sample we obtain the following regression:

$$P_F = 0.3P_I + 0.7P_T$$

(7.14) (16.76)

t -ratios are in parentheses.

Our univariate results concerning bid outcome and bid hostility discussed above provide supporting evidence. We now run a multiple regression to evaluate the joint impact of these and other characteristics. In addition to the completion and hostility variables, we include the length of the bid period and the sampling period to capture the impact of M & A activity in the UK. We estimate the following OLS model:

$$\begin{aligned} Exchangevalue = & \alpha_0 + \alpha_1 Length + \alpha_2 1996 - 00 + \alpha_3 2001 - 04 + \alpha_4 Complete \\ & + \alpha_5 Agreed + \alpha_6 Multiple + \alpha_7 Brier + \varepsilon \end{aligned} \quad (8)$$

where *Exchangevalue* is the estimated exchange option value, *Length* is the length of the Offer period as a fraction of a year. Our sample period covers episodes of hot and cold M & A markets which are likely characterised by differences in synergy expectations and deal completion uncertainties. For example in hot markets there may be higher expectations of value creation but also higher uncertainty about deal completion because of harder bargaining by targets or the emergence of multiple bidders The subperiod 1996-00 may be regarded as a hot period being the ascendant half of the 1990s merger wave. The subperiods 1990-1995 and 2001-2004 are cold periods representing the subsidence of the

1980s merger wave and the 1990s merger wave¹⁶. Our expectation is that the exchange option value is likely to be higher in hot than in cold M & A markets.

In our regression model, *1996-00* is a dummy with a value of 1 for that period 1996-00 and 0 for the other two periods, *2001-04* is a dummy with a value 1 for that period and 0 for the other two periods, *Complete* is a dummy with a value of 1 for completed and 0 for failed offers, *Agreed* is a dummy variable with a value of 1 for friendly bids and 0 for hostile ones, and *Multiple* is a dummy variable with a value of 1 for multiple offers and 0 otherwise. *Brier* represents the Brier score estimated using three different fallback prices. Specifically *BMBRIER* uses the observed target share price 30 days before the offer, *ESBRIER* uses the estimated day + 2 share price based on the Margrabe model as the fall back price and *RBRIER* uses the regression approach of Samuelson and Rosenthal to estimate the fallback price. Both the exchange option premium and the brier score are measures of uncertainty in that a higher exchange option premium is due to higher uncertainty and higher Brier score is due to a less accurate forecast. We would thus expect there to be a positive and significant relationship between the two.

We expect that *Exchangevalue* is a positive function of Length and 1996-00 (the boom time in UK M & A activity) and a negative coefficient of Agreed. We find the length to be a significant parameter at the 1% level. We find that Agreed coefficient is significant at the 10% level. If we repeat this regression whilst excluding the multiple offers we find that only Length is significant. If we introduce the Brier variable into the regression we find that the coefficients are always positive. However, only in the case where the fall back price is based on the day + 2 estimated target share price based on the Margrabe model is the coefficient both positive and significant at the 10% level. This is consistent with the univariate results in Table 6 where we find that EOV is significantly

¹⁶ On merger waves in the UK during the 1990s and 2000s see Sudarsanam (2010, ch.2)

smaller in agreed bids than in hostile bids. Thus to conclude, we find that the exchange option premium is driven by the length of the offer period and the level of uncertainty.

(vii) Real options-based modelling

Impact of relative size of bidder to target, business risk and synergy on bid premium

Lambrecht (2004) attempts to explain possible reasons behind the great merger waves of the last century. He proposes a real options-based model in which firms have incentives to merge during periods of economic expansion. In the model, takeover-related returns to acquirers are dependent on hysteresis, size of merging firms and the synergy between them. Lambrecht predicts that in a takeover the bid premium should be higher when the bidder is larger relative to its target, product market uncertainty greater and the synergies created in the takeover are larger.

To test Lambrecht's predictions and to further test if the takeover premium is a measure of uncertainty we perform the regression below adding:

$$\text{Takeoverpremium} = \text{CONST} + \alpha_1 \text{BUSRISK} + \alpha_2 \text{RELSIZE} + \alpha_3 \text{SYNERGY} + \alpha_4 \text{Brier} + \varepsilon$$

(9)

We proxy *Takeoverpremium* due to economic expansion by the *Exchangevalue*. *CONST* is the intercept. *BUSRISK* is business risk representing product market uncertainty and is represented by the product of the target stock return volatility (standard deviation) estimated over 1 year prior (250 trading days) to bid announcement and one minus the target leverage ratio¹⁷. The target leverage ratio is defined as the ratio of book value of debt of target to book value of total assets of target from the most recent accounting statement prior to bid announcement. *RELSIZE* is the logarithm ratio of acquirer market capitalisation to target market capitalisation, both 4 weeks prior to announcement.

¹⁷ We adjust the observed equity volatility for leverage to derive the asset (business) volatility.

SYNERGY¹⁸ is the pre-offer correlation during the Pre-offer period Offer period between the target and bidding company stock returns. It measures the similarity (or relatedness) of the product and market characteristics of bidders and targets. Synergy is expected to be greater in related than in unrelated acquisitions¹⁹. *Brier* represents the Brier score. As the *Takeoverpremium* measures uncertainty there should be a positive relationship between it and the Brier score as a higher Brier score indicates larger forecasting error.

Our initial sample is based on 188 observations. Based on our regressions we find that both BUSRISK and SYNERGY are significant and RELSIZE is insignificant. However, the coefficient of RELSIZE is almost zero for all combinations. In the final three regression in the table we therefore regress *Takeoverpremium* against BUSRISK, SYNERGY and the Brier score. We find BUSRISK and SYNERGY coefficients are always positive and significant. Further the Brier score coefficient is also positive, however it is only significant at the 10% level when the estimated day +2 based on the Margrabe model is used as the fallback price. Thus for our sample, the main drivers are SYNERGY and BUSRISK and the Brier score. The regressions presented in Table 9 broadly support Lambrecht's predictions. Further consistent with Table 8 they also support the view that *Takeoverpremium* is driven by uncertainty. The exchange option thus has some economic rationale and is not merely an overpayment due to behavioural biases of acquirer managers or bid-related tactics.

[TABLE 9 APPROXIMATELY HERE]

¹⁸ We find the pre-offer period correlation is the only robust measure of synergy. We used SDC codes, however, the results were not robust.

¹⁹ There is much evidence for the superior value creating performance of related acquisitions compared to unrelated or conglomerate acquisitions. This conclusion has, however, been challenged on methodological grounds in recent studies. See Sudarsanam (2003, ch. 8) for a review of the relevant studies.

5. Summary and conclusions

In this paper, we examine the pricing of the common stock of target firms during stock exchange takeover offers. During the Offer period, target shareholders hold an exchange option on the shares of the target, such that the observed target stock price reflects the combined value of the portfolio of underlying target stock and the implied exchange option offered by the bidder. We use option pricing theory, in particular Margrabe's exchange option pricing model, to estimate the value of the individual components of this portfolio.

As would be expected from option pricing theory, we observe a change in both beta and standard deviation of the common stock of targets during the Offer period. The change in standard deviation supports the option view of the target stock during the Offer period. Furthermore, we estimate the unobservable values of the underlying target stock and exchange option during the Offer period using the Margrabe model. We find that the underlying stock value just after the announcement is, on average, 9% higher than the preannouncement stock price. The exchange option value is, on average, about 10% of the preannouncement price. This indicates that the bidder and the target have unique synergies, which allow the bidder to make a bid that is substantially higher than the underlying target value that reflects correction for any pre-bid undervaluation.

We examine the rationale for this exchange option from a variety of theoretical perspectives and identify some of its determinants. In particular we investigate the impact of bid characteristics on the exchange option value. As expected, longer Offer periods and hostile offers require higher valued exchange option from the bidder because of increased complexity and uncertainty. We also find that offers may fail in spite of higher valued exchange option than in completed offers. Thus, the exchange option, while allowing

bidders and targets to cope with the uncertainty of a takeover offer, is not enough to guarantee a successful bid outcome for the bidder.

We also explore the dynamics of the systematic risk of bidders and targets within the framework of recently expounded real options-based models of takeovers. We find that the exchange option value is highly correlated with the relative riskiness of bidders and targets, consistent with Lambrecht's (2004) model. Thus, the exchange option has an economic rationale and is not merely due to behavioral biases such as hubris and resultant overpayment. We further examine the relationship between the exchange option value and the uncertainty surrounding a takeover. We find that the exchange option premium is directly proportional to the future uncertainty i.e. less accurate future forecasts in terms of the Brier score and the uncertainty surrounding a takeover in terms of the arbitrage spread. Our paper contributes to a better understanding of the true determinants of takeover premium and demonstrates the usefulness of option pricing models in de-composing these determinants. Further, the study provides a preliminary test using UK data of the usefulness of real options in understanding and measuring the impact of takeovers on firm risk and shareholder gains. We demonstrate the usefulness of option pricing models in capturing the impact of new information a takeover bid releases on the *stand alone* value of the target firm. Our option-based modelling of target valuation during takeover bids provides a useful approach to assessing the reliability of observed target price as a predictor of bid outcome. This is likely to be of interest to risk arbitrageurs.

References

- Bhagat, S., Brickley, J.A., Lowenstein, U., 1987. The pricing effects of interfirm cash tender offers. *Journal of Finance* 42, 965-986.
- Bradley, M., Desai, A., Kim. E.H., 1988). Synergistic gains from corporate acquisitions and their division between the stockholders of target and acquiring firms. *Journal of Financial Economics* 21, 3-40.
- Bruner, R., 2004. *Applied Mergers and Acquisitions*, Wiley.
- Draper, P., Paudyal, K., 1999. Corporate takeovers, mode of payment, returns and trading activity. *Journal of Business Finance & Accounting* 26, 521-558.
- Franks, J., Harris, R., Mayer, C., 1988. Means of payment in takeovers: Results from the UK and the US, in A J Auerbach (ed), *Corporate takeovers: Causes and Consequences* (Chicago: University of Chicago Press).
- Franks, J., Harris, R., 1989. Shareholder wealth effects of corporate takeovers: The UK experience. *Journal of Financial Economics* 23, 225-249.
- Goergen, M., Renneboog, L., 2004. Shareholder wealth effects of European domestic and cross-border takeover bids. *European Financial Management* 10, 9-45.
- Gregory, A., 1997. An examination of long-run performance of UK acquiring firms. *Journal of Business Finance & Accounting*, 24, 971-1002.
- Higson, C., Elliott, J., 1998. Post-takeover returns: The UK evidence, *Journal of Empirical Finance* 5, 27-46.
- Huang, Y., Walkling, R., 1987. Target abnormal returns associated with acquisition announcements, payment method, acquisition form and managerial resistance, *Journal of Financial Economics* 19, 329-349.
- Jensen, M., Ruback, R., 1983. The market for corporate control: The scientific evidence, *Journal of Financial Economics* 11, 5-50.
- Jarrell, G.A., Poulsen, A., 1989. The returns to acquiring firms in tender offers: Evidence from three decades, *Financial Management*, autumn, 12-19.
- Lambrecht, B.M., 2004. The Timing and Terms of Mergers Motivated by Economies of Scales Stock Returns in Mergers and Acquisitions. *Journal of Financial Economics* 72, 41-62.
- Loughran, T., Vijh, A., 1997. Do long term shareholders benefit from corporate acquisitions?, *Journal of Finance* 52 , 1765-1790
- Margrabe, W., 1978. The Value of an Option to Exchange One Asset for Another. *Journal of Finance* 33, 177-186.

- Malmendier, U., Tate, G., 2005. CEO overconfidence and corporate investment. *Journal of Finance* 60, 2661-2700.
- Moeller, S., Schlingemann, F.P., Stulz, R.M., 2005. Value destruction on a massive scale? A study of acquiring-firm returns in the recent merger wave. *Journal of Finance* 60, 757-782.
- Rau, R., Vermaelen T., 1998. Glamour, value and the post-acquisition performance of acquiring firms. *Journal of Financial Economics* 49, 223-253.
- Roll, R., 1986. The hubris hypothesis of corporate takeovers. *Journal of Business* 59, 197-216.
- Samuelson, W., Rosenthal L., 1986. Price movements as indicators of Tender Offer Success. *Journal of Finance* 41, 481-499.
- Schwert, W., 1996. Markup pricing in mergers and acquisitions. *Journal of Financial Economics* 41, 153-192.
- Stapleton, R., 1982. Mergers, Debt Capacity, and the Valuation of Corporate Loans, in M. Keenan and L. White, eds., *Mergers and Acquisitions*, Lexington Press: Lexington, MA
- Sudarsanam, S., 2010. *Creating value from mergers and acquisitions, The challenges 2nd edition* (Harlow, UK: FT Prentice Hall).
- Sudarsanam, S., Mahate A., 2003. Glamour acquirers, method of payment and post-acquisition performance: The UK evidence. *Journal of Business Finance & Accounting* 30, 299-342.
- Sudarsanam, S., Gao, L., 2004. Value creation in UK high technology acquisitions, Financial Management Association (USA) Annual Meeting, New Orleans.
- Travlos, N., 1987. Corporate takeover bids, methods of payment and bidding firms' stock returns. *Journal of Finance* 42, 943-963.
- Weston, F., Mitchell, M., Mulherin, H., 2004. *Takeovers, restructuring and corporate governance*, Prentice Hall.

Table 1: Sample Distribution of UK Share Exchange Takeover Offers during 1990-2004

The sample consists of share exchange takeover offers made to London Stock Exchange (LSE) listed companies. It includes 19 multiple bids i.e. with two offers for the same target. We analyse the effects of only the first of these bids. Hostile bids are those resisted by target management when the first offer is made and include offers unsolicited by that management. Agreed bids include those solicited by the target management and offers that are recommended by it.

Panel A: Sample distribution by year				
Year	Sample Offers	Number of Successful bids	Number of Agreed bids	Number of Hostile Bids
1990	10	9	8	2
1991	18	14	16	2
1992	8	8	8	0
1993	10	9	8	2
1994	9	8	8	1
1995	19	17	16	3
1996	21	18	18	3
1997	20	18	18	2
1998	23	19	21	2
1999	24	17	18	6
2000	27	24	25	2
2001	17	16	17	0
2002	6	6	5	1
2003	15	11	14	1
2004	9	9	9	0
	236	203	209	27
Panel B: Sample distribution by period				
1990-1995	74	65	64	10
1996-2000	115	96	100	15
2001-2004	47	42	45	2
1990-2004	236	203	209	27

Table 2: Descriptive statistics for the sample offers

Offer period is the time in days between the date of announcement of an offer and the date of expiry of that offer. Target value is the deal value that may include the value of target equity as well as any target debt to be assumed by the bidder if the bid is successful. Offers are based on a sample of 236 UK target firms. The mean (median) exchange ratio for the sample is 0.95 (1.00).

	Offer period		Target value (£m)	
	Mean	Median	Mean	Median
Panel A				
Entire period averages and medians				
	49.16	36.00	601.95	27.38
Sub-period averages and medians				
1990-1995	40.49	32.50	181.10	16.43
1996-2000	52.18	40.00	889.29	40.56
2001-2004	55.34	45.00	548.68	18.40
Panel B: Yearly averages and medians				
Year				
1990	36.90	37.00	19.21	9.74
1991	44.44	35.50	17.63	12.10
1992	63.13	32.50	24.09	16.30
1993	35.60	32.50	38.39	13.15
1994	31.56	28.00	202.60	27.80
1995	35.89	30.00	553.23	23.98
1996	40.76	34.00	240.85	42.55
1997	43.20	29.00	41.23	32.11
1998	48.70	35.00	633.64	29.12
1999	61.79	49.00	557.52	41.08
2000	62.15	50.00	2534.53	86.95
2001	46.94	39.00	625.23	12.60
2002	72.17	56.00	1239.09	208.30
2003	56.80	57.00	448.49	38.82
2004	57.56	35.00	110.79	11.30

NOTE: The average (median) for 2002 was higher than for 1997. This is despite the fact that 1997 was boom year for M & A activities and 2002 was the bottom of it. During 1997, there were 20 bids and for 2002 there were only 6 bids. However, the bids in 2002 were substantially bigger than in 1997. The largest bid in 2002 was £6483. This figure is almost 8 times as big as the combined values of all bid offers during 1997.

Table 3: Changes in Risk of Targets surrounding the Share Exchange Offer

The sample consists of 236 UK share exchange takeover offers. Two period samples include only offers for targets for which data are available throughout the pre-offer and the Offer period. Market index used is the FTSE All Shares index. The Pre-offer period consists of 150 trading days beginning from day -170 to day -21 from the date of offer announcement (denoted as day 0). The Offer period runs from day +2 through one day before expiry of the offer. During this period, observed target stock price reflects the value of a portfolio of the stock and an exchange option on that stock held by the target shareholder. The estimated sample betas (Beta) and the daily standard deviations (Std Dev) for this portfolio are reported below. The Pre-offer period standard deviation is based on the observed target share price during that period. The Offer period standard deviation is the implied standard deviation obtained from the implied target prices based on the Margrabe model. Test statistics for difference in means (Student t-test) and in medians (Fisher sign test) of the risk parameters between Pre-offer and Offer periods are reported. The numbers in brackets contain the p values. All outliers are winsorized at three standard deviations.

Panel A: Entire sample	Pre-Offer period		Offer period		<i>t</i> - stat	<i>Sign</i> - stat
	229 ¹ observations		221 ² observations			
	Mean	Median	Mean	Median		
Beta	0.35	0.26	0.47	0.30	-1.27 (0.20)	1.42 (0.16)
Std Dev	0.03	0.02	0.02	0.02	3.85 (0.00)	-4.10 (0.00)
Panel B: Pre-offer period beta greater than Offer period beta: 106 observations						
Beta	0.55	0.39	-0.25	-0.01	5.90 (0.00)	-6.60 (0.00)
Std Dev	0.03	0.02	0.02	0.02	2.30 (0.02)	-2.33 (0.02)
Panel C: Pre-offer period beta less than or equal to Offer period beta: 115 observations						
Beta	0.20	0.13	1.11	0.78	-7.34 (0.00)	7.74 (0.00)
Std Dev	0.03	0.02	0.02	0.02	-1.85 (0.06)	-2.89 (0.00)

NOTE 1: During the Pre-offer period 229 companies had complete data available.

NOTE 2: During the Offer period 221 companies had complete data available and a convergent value of beta. If we reduce the sample size from 229 to 221 during the pre-offer period, mean (median) standard deviation and beta are 0.03 (0.02) and 0.37 (0.26) respectively. Panel C and Panel D analysis are based on continuous sample of 221. This ensures same company's are compared during each period.

Table 4: Bid Premium and Exchange option Value during Offer period

We have 214 estimated option prices available from an original sample of 236²⁰ from 1990 to 2004 with target share price available both in the pre-offer and Offer periods. True bid premium is the difference between the underlying stock value at day +2 and pre-offer target share price on day -1. Apparent premium is the difference between the stock value at day + 2 and the pre-offer target value on day -1. Exchange option value is the estimated exchange option value using the Margrabe model on day + 2 of the Offer period. For Apparent premium % and True bid premium % the denominator is day – 1 target stock price. Outliers are winsorized at three standard deviations.

	Entire sample	
	214 observations	
	Mean	Median
Underlying target value (£)	1.70	0.90
True bid premium (£)	0.12	0.04
Apparent premium (£)	0.15	0.06
Exchange option value (£)	0.19	0.04
True bid premium %	7.41	5.25
Apparent premium %	9.80	7.87
Exchange option value/Pre-Offer price (%)	11.11	5.83
Exchange option value/ Underlying stock value (%)	10.59	5.45

²⁰ For the remaining, we were either unable to achieve convergence or data was incomplete.

Table 5: Underlying Target Value and Exchange option Value in Completed and Withdrawn Offers

214 total offers are separated into completed takeovers and withdrawn offers. For variable definitions and on estimation of exchange option value see note to Table 4. *t*-stat is test statistic for the paired *t*-test of difference in means between the two samples. *Sign* stat is the test statistic for the Fisher sign test of difference in medians between the two samples. *p* values are in brackets. Outliers are winsorized at three standard deviations.

Entire sample (sample size 214)						
	Completed offers 184 observations		Withdrawn offers 30 observations		<i>t</i> - stat	<i>Sign</i> - stat
	Mean	Median	Mean	Median		
True bid premium (£)	0.13	0.05	0.10	0.00	0.30 (0.77)	3.39 (0.00)
Apparent premium (£)	0.15	0.06	0.15	0.02	0.56 (0.57)	2.88 (0.00)
Exchange option Value (£)	0.18	0.04	0.23	0.07	-0.59 (0.56)	-5.01 (0.00)
True bid premium (%)	8.62	6.79	-0.05	-0.34	1.71 (0.09)	5.31 (0.00)
Apparent premium (%)	9.97	8.12	8.78	6.86	0.35 (0.72)	1.47 (0.14)
Exchange option Value/ Pre-Offer price (%)	10.28	5.23	16.17	9.88	-1.79 (0.08)	-6.78 (0.00)
Exchange option Value/ Underlying stock value(%)	9.51	4.77	17.22	9.66	-2.64 (0.00)	-6.34 (0.00)

Table 6: Underlying Target Value and Exchange option Value in Agreed and Hostile Offers

214 total offers are separated into agreed and hostile offers. For variable definitions and on estimation of exchange option value see note to Table 4. *t*-stat is test statistic for the paired *t*-test of difference in means between the two samples. *Sign* stat is the test statistic for the Fisher sign test of difference in medians between the two samples. *p* values are in brackets. Outliers are winsorized at three standard deviations.

Panel: Entire sample (214 observations)						
	Agreed takeovers 189 observations		Hostile takeovers 25 observations		<i>t</i> - stat	<i>sign</i> - stat
	Mean	Median	Mean	Median		
True bid premium (£)	0.10	0.03	0.28	0.08	-1.91 (0.06)	-3.21 (0.00)
Apparent premium (£)	0.14	0.04	0.22	0.09	-1.04 (0.30)??	-2.63 (0.00)
Exchange option Value (£)	0.17	0.04	0.32	0.08	-1.73 (0.08)	-6.18 (0.00)
True bid premium (%)	6.50	4.73	14.28	14.91	-1.42 (0.16)	-6.33 (0.00)
Apparent premium (%)	9.14	7.39	14.80	12.28	-1.59 (0.11)	-4.15 (0.00)
Exchange option Value/ Pre-Offer price (%)	10.40	5.46	16.48	9.72	-1.71 (0.09)	-6.47 (0.00)
Exchange option Value/ Underlying stock value(%)	10.10	5.13	14.29	8.87	-1.31 (0.19)	-5.60 (0.00)

Table 7: Comparison of Target Stock Value, Offer Price and Observed Closing Price

$CONV_{u-c} = (V_u - V_c) / V_u$ (%) measures convergence of underlying target stock value, V_u , towards the closing observed target stock price, V_c on the final day of the Offer period. $CONV_{c-o} = (V_c - V_o) / V_o$ (%) measures the convergence of closing stock price, V_c , to the offer price, V_o . In Panel B and D, we exclude all multiple bids. t -stat and $Sign$ stat are as defined in Table 3. p values are in brackets. 18 of the offers involve multiple (two) offerors. Outliers are winsorized at three standard deviations.

Panel A: Entire sample (214 observations) (Targets subject to multiple offers included)						
	Mean	Median	t -stat	$sign$ -stat		
$CONV_{u-c}$	-9.95	-4.97	-0.65 (0.52)	-1.09 (0.28)		
$CONV_{c-o}$	6.28	-1.49	-0.01 (0.99)	-0.27 (0.78)		
Panel B: Entire sample (196 observations) (Targets subject to multiple offers excluded)						
	Mean	Median	t -stat	$sign$ -stat		
$CONV_{u-c}$	-7.93	-3.96	0.44 (0.66)	-1.00 (0.32)		
$CONV_{c-o}$	4.89	-1.68	-0.08 (0.93)	-0.14 (0.88)		
Panel C: Completed and withdrawn offers (Targets subject to multiple offers included)						
	Completed 184 observations		Withdrawn 30 observations		t -stat	$sign$ -stat
	Mean	Median	Mean	Median		
$CONV_{u-c}$	-7.47	-3.57	-25.13	-12.16	3.93 (0.00)	5.31 (0.00)
$CONV_{c-o}$	6.50	-1.68	4.91	-0.10	0.15 (0.88)	-0.89 (0.38)
Panel D: Completed and withdrawn offers (Targets subject to multiple offers excluded)						
	Completed 179 observations		Withdrawn 17 observations		t -stat	$sign$ -stat
	Mean	Median	Mean	Median		
$CONV_{u-c}$	-7.87	-4.55	-17.22	-5.13	1.67 (0.10)	0.67 (0.50)
$CONV_{c-o}$	6.91	-1.53	6.03	-0.94	0.06 (0.95)	-0.52 (0.60)

Table 8: Regression of estimated exchange option value on deal characteristics

Exchange option value (*Exchangevalue*) estimated by Margrabe's model. *Length* is the Offer period in years. *1996-00* is a period dummy variable for 1996 to 2000 and equates to 1 for 1996 to 2000 and zero otherwise. *2001-04* is the dummy variable for 2001 to 2004 and equates to 1 for 2001 to 2004 and zero otherwise. The first period, 1990 to 1995, is captured by the intercept. *Complete* is a dummy variable (=1) for completed and (=0) for withdrawn offers. *Agreed* is a dummy variable (=1) for agreed and (=0) for hostile offers. *Multiple* is a dummy variable (=1) for multiple bidders and (=0) for single bidder. *Brier* represents the Brier score estimated using three different fallback prices; *BMBRIER* (share price 30 days before the Offer), *ESBRIER* (estimated day + 2 share price) and *RBRIER* (regression). The robust p values are for one tailed test since the hypothesised impact of each of these variables is unidirectional. Outliers are winsorized at three standard deviations

$$Exchangevalue = \alpha_0 + \alpha_1 Length + \alpha_2 1996 - 00 + \alpha_3 2001 - 04 + \alpha_4 Complete + \alpha_5 Agreed + \alpha_6 Multiple + \alpha_7 Brier + \varepsilon$$

Variable	Exchange Option Value				
	Multiple offers		Excluding multiple offers		
<i>Intercept</i>	0.02 (0.44)	0.02 (0.43)	-0.01 (0.42)	-0.04 (0.43)	-0.01 (0.49)
<i>Length</i>	1.18 (0.00)	1.22 (0.00)	1.52 (0.00)	1.59 (0.00)	1.53 (0.00)
<i>1996-00</i>	0.05 (0.16)	0.02 (0.32)	0.10 (0.14)	0.10 (0.15)	0.10 (0.13)
<i>01-04</i>	0.04 (0.25)	0.03 (0.32)	-0.01 (0.45)	-0.01 (0.46)	-0.01 (0.46)
<i>Complete</i>	0.08 (0.20)	0.02 (0.44)	-0.03 (0.42)	0.03 (0.41)	0.03 (0.42)
<i>Agreed</i>	-0.13 (0.09)	-0.06 (0.31)	-0.05 (0.36)	-0.06 (0.33)	-0.05 (0.37)
<i>Multiple</i>	0.04 (0.33)				
<i>BMBRIER</i>			0.02 (0.45)		
<i>ESBRIER</i>				0.15 (0.06)	
<i>RBRIER</i>					-0.01 (0.48)
<i>Adjusted R²</i>	0.17	0.17	0.08	0.09	0.08
<i>VIF²</i>	1.23	1.23	1.10	1.10	1.10
<i>F Statistic</i>	4.66 (0.00)	5.71 (0.00)	4.49 (0.00)	4.58 (0.00)	4.40 (0.00)
Observation	214	196	196	196	1.96

Note: 1. These are targets subject to bids by more than one offeror. We include the first among multiple offers to succeed.

Note: 2. VIF (variance inflation factor) is well below the conventional threshold of 10 and hence multicollinearity is not a serious problem.

Table 9: Determinants of takeover premium in share exchange takeovers

Takeoverpremium is the estimated exchange option value using the Margrabe model on day + 2 of the Offer period. *CONST* is intercept. *BUSRISK* proxies for product market uncertainty and is measured as product of one year stock return standard deviation and one minus the target leverage ratio, debt/total assets. *RELSIZE* is the logarithm ratio of acquirer market capitalisation to target market capitalisation, both 4 weeks prior to announcement date, day 0. *SYNERGY* is proxied by the Pre-offer period correlation between the target and bidding stock price returns. Brier represents the Brier score estimated using three different fallback prices; BMBRIER (share price 30 days before the Offer), ESBRIER (estimated day + 2 share price) and RBRIER (regression).

Numbers in parentheses are *p* values based on robust standard errors and are for one tailed tests.

$$Takeoverpremium = CONST + \alpha_1 BUSRISK + \alpha_2 RELSIZE + \alpha_3 SYNERGY + \alpha_4 Brier + \varepsilon$$

<i>CONST</i>	0.08 (0.01)	0.18 (0.00)	0.12 (0.00)	0.12 (0.00)	0.03 (0.14)	0.12 (0.00)	0.07 (0.00)	0.01 (0.36)	-0.03 (0.30)	0.00 (0.48)
<i>BUSRISK</i>	0.32 (0.00)			0.19 (0.07)	0.30 (0.00)		0.19 (0.07)	0.31 (0.01)	0.34 (0.00)	0.32 (0.01)
<i>RELSIZE</i>		-0.01 (0.33)		-0.01 (0.33)		-0.01 (0.47)	-0.01 (0.47)			
<i>SYNERGY</i>			0.49 (0.00)		0.47 (0.00)	0.48 (0.01)	0.47 (0.00)	0.51 (0.00)	0.52 (0.00)	0.51 (0.00)
<i>BMBRIER</i>								0.05 (0.25)		
<i>ESBRIER</i>									0.08 (0.10)	
<i>RBRIER</i>										0.04 (0.24)
<i>Adjusted R²</i>	0.06	0.00	0.07	0.02	0.12	0.05	0.07	0.15	0.15	0.14
<i>VIF¹</i>	1.07	1.00	1.08	1.03	1.15	1.06	1.08	1.19	1.20	1.19
<i>F statistic</i>	6.67 (0.01)	0.19 (0.66)	8.78 (0.00)	1.16 (0.31)	8.85 (0.00)	2.94 (0.06)	2.57 (0.06)	6.45 (0.00)	6.76 (0.00)	6.45 (0.00)
Observations	188	152	188	152	188	152	152	172	172	172

1. VIF is well below the conventional threshold of 10 and hence multicollinearity is not a serious problem.

