RISK AND RETURN OF MERGER ARBITRAGE IN THE UK 2001 TO 2004

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ABSTRACT

This paper replicates the core underlying merger arbitrage strategy using daily data from the United Kingdom to generate three simulated merger arbitrage portfolio return series, for the period 2001 through to 2004. Past empirical evidence indicates that the merger arbitrage strategy generates large risk adjusted returns. More recent evidence indicates that the strategy has a return distribution equivalent to a short put option on a stock index. These prior studies have generally focused on monthly returns in the North American stock markets. For the UK market we find evidence that the merger arbitrage strategy exhibits little systematic risk and generates significant risk adjusted returns. Contrary to prior research we find no evidence of an increase in systematic risk in depreciating equity markets.

INTRODUCTION

Merger arbitrageurs generate returns by taking long and short positions in companies that are engaged in corporate mergers or acquisitions. Previous research has highlighted the positive risk, adjusted returns and asymmetric risks of the strategy. In this paper we create a simulated risk arbitrage portfolio, using UK data, and provide further evidence on the historical risk and return of the strategy.

Following the announcement of a merger there is typically a spread between the target company's share price and the deal price. The size of this spread reflects investor expectations of the corporate deal's success. Merger arbitrageurs attempt to profit by exploiting this spread. Deals can generally be classified into two main types: cash and share. With all share mergers, funds generally buy shares of the company being acquired and sell short the shares of the acquiring company in a proportion that reflects the proposed merger agreement. Whereas with cash mergers, the fund will buy the shares of the company being acquired below the agreed merger price and profit from the narrowing of the spread between the two when the deal is completed.

Though beyond the scope of this study, in practice arbitrageurs attempt to predict corporate takeover targets and there is a growing academic literature focusing on merger prediction. For example, Powell (1997) and Espahbodi and Espahbodi (2003) specify binary choice classification procedures to predict takeovers. However, the efficiency of merger prediction models is uncertain. Barnes (1998a) finds no evidence of merger predictability in the UK using statistical techniques, and Palepu (1986) demonstrates that the high predictive accuracy reported by early studies is due to statistical error.

The merger arbitrage strategy has attracted attention due to the large returns earned by hedge funds following the strategy. CSFB/Tremont, a hedge fund advisory company, provides historical data on the returns of merger arbitrage hedge funds. From January 1993 to March 2007 hedge funds following this strategy generated returns averaging 7.81 per cent per annum, with an annual standard deviation of 4.1 per cent. This equates to a Sharpe ratio of 0.93, comparing favourably with a Sharpe ratio of 0.48 for the Standard & Poor's 500 Index over the time period.[1]

Due to these high reported returns and evidence of biases in the hedge fund databases,[2] academic research on risk arbitrage has generally focused on replicating the strategy in the US market where the majority of merger activity takes place. Early studies supported the profitability of the strategy. This was reflected by Dukes, Frohlich and Ma (1992) in their study of 761 American tender offers between 1971 and 1985. The authors found 82 per cent of the transactions to be profitable with average abnormal returns of 24.6 per cent. Jindra and Walkling (2004) studied 362 cash tender offers between 1981 and 1995, reporting annual returns of 24 per cent. Branch and Wang (2005) concentrate their research on stock swap offers in the form of collars, studying 244 of these deal types between 1994 and 2003. Estimated annualised excess returns of 9.2 per cent are reported. Outside the US market, Karolyi and Shannon (1999) examined the profit potential of a risk arbitrage trading strategy operating in the Canadian mergers and acquisitions market. They studied 37 deals valued over CAD$50million which took place in 1997, reporting an annualised excess return of 33.9 per cent.

More recent research has highlighted three issues that may bias upwards prior merger arbitrage performance estimates: annualisation of returns, transaction costs and asymmetric risk. Returns achieved on merger activity are short-term in nature, i.e. one or two months from announcement to conclusion. Therefore it is inaccurate to assume these returns are sustainable for longer

periods, e.g. a year. It is this assumption upon which many of the exorbitant returns previously reported are based. The overestimation of excess returns is compounded by the exclusion of practical limitations such as transaction costs. Such limitations are influential in precluding ordinary individuals from achieving many of the extraordinary returns reported. Baker and Savasoglu (2002) analysed a diversified portfolio of risk arbitrage positions from 1981 to 1996. They constructed positions for 1,901 cash and stock mergers and acquisitions for the aforementioned period. The authors constrained the risk-bearing capacity, which accounted somewhat for the practical limitations inherent in a risk arbitrage trading strategy. Returns ranging from 0.6 per cent to 0.9 per cent per month were observed for the sample period (annual return 7.2 per cent to 10.8 per cent), with estimated positive abnormal returns of 3.6 per cent per annum. Mitchell and Pulvino (2001), based on a comprehensive sample of 4,750 deals spanning from 1963 to 1998, found that a risk arbitrage portfolio, controlling for transaction costs, generated abnormal returns of 4 per cent per annum. Mitchell and Pulvino (2001) also provided evidence that the returns from risk arbitrage are asymmetrically related to equity market risk factors, and are akin to writing put options on a stock index.

The existing literature has generally focused on the North American markets for merger arbitrage, providing little evidence of the performance of the strategy in other markets.[3] These studies have also focused on assessing performance of monthly data. This may overlook some interesting features of higher frequency data. Finally, in the sample periods previously considered the market returns have been positive.

In this paper we address the issue of merger arbitrage risk and performance analysis in three ways. First, we construct a simulated merger arbitrage portfolio using high frequency daily data in a manner ascribed to practitioners. Second, in order to provide incremental evidence to the existing literature, we focus only on United Kingdom-listed stocks in the sample period January 2001 to December 2004, in which the UK stock market declined by 19 per cent. Finally, we examine the data generating process of the merger arbitrage strategy to assess its risk.

To construct the simulated portfolio we take long positions in the target equity, combined with short positions in the acquirer's equity (in the case of all stock deals and stock/cash deals), creating merger arbitrage positions that capture deal spreads. We then combine the merger arbitrage positions into three portfolios: an equally weighted portfolio, a value-weighted portfolio and finally a real world portfolio that controls for transaction costs and capital constraints.

We focus on the UK over the period 2001 to 2004, as in this period the FTSE All Share Index declined by 19 per cent. No prior study has focused exclusively on a sample period with negative cumulative equity market returns. Examining the strategy in such unfavourable market conditions provides useful evidence of the true market neutrality of the strategy. Prior evidence (Mitchell and Pulvino, 2001) provides an expectation that merger arbitrage returns would be negative over this period.

Finally, by defining a set of asset classes that match an investment strategy's aims and returns, the portfolio's exposures to variations in the returns of the asset

classes can be identified. Multi-factor asset class models have been specified extensively in the hedge fund and mutual fund literature to assess risk and performance of investment funds. The multi-factor methodology provides evidence on the market neutrality of the strategy. Following the identification of exposures, the effectiveness of the strategy can be compared with that of a passive investment in the asset mixes.

The remainder of the paper is organised as follows. In the next section, to illustrate the strategy we describe two typical merger arbitrage transactions. In the third section we provide a thorough description of how our portfolio is constructed. A discussion of the statistical characteristics of the portfolios is given in the fourth section. The fifth section provides a discussion of the merger arbitrage risk factor models. In the sixth section we present results from estimating the risk factor models. The final section concludes the paper.

DESCRIPTION OF A TYPICAL MERGER ARBITRAGE POSITION

A greater understanding of the mechanics of a risk arbitrage investment may be gained from a closer look at two key transactions: a cash deal and a stock deal. The cash deal is the takeover of Anglo-Siberian Oil by Rosneft, and the stock deal is the bidding war for Oxford GlycoSciences (OGS) which arose in early 2003 between British biotech rivals Celltech and Cambridge Antibody Technology (CAT).

Anglo-Siberian Oil Co., an independent oil exploration and production company listed on the Alternative Investment Market (AIM), was first subject to risk arbitrage speculation following a bid by Rosneft Investments, announced on 4 April 2003. Rosneft Investments, a wholly owned Jersey subsidiary of the Russian state oil company Rosneft, offered STG£1 per Anglo-Siberian ordinary share, valuing the company at £46.3 million. Merger arbitrageurs would initiate a long position in Anglo-Siberian at the closing price (95.5p) and hold this position for the duration of the deal's active life (17 trading days). On 28 April the deal was declared wholly unconditional following valid acceptances received by Rosneft Investments with respect to 97.46 per cent of Anglo-Siberian's share capital. This constituted a successful conclusion to the deal and the relevant divestment was made by trading the initial investment for the offer price. The deal earned a 4.7 per cent total return on invested capital for the risk arbitrageur over a period of 17 days.

The bidding war for Oxford GlycoSciences (OGS) arose in early 2003 between British biotech rivals Celltech and Cambridge Antibody Technology (CAT). On 23 January 2003 CAT announced the agreed terms of a recommended merger with OGS. Under the terms of the deal OGS shareholders would receive 0.3620 new CAT shares for each share held. The offer represented a premium of 28.2 per cent and valued OGS at STG£109.6million, based on CAT's share price of 540p at the close of trade on 22 January (the last business day prior to the announcement).

Following announcement the risk arbitrageur made an investment in OGS using the share price at the close of trade on the announcement date (23 January 2003: £1.85). A short position using the 0.3620 share exchange ratio was also

initiated in the acquiring firm at the close of trade on the announcement date (23 January 2003: £5.30). These positions were initiated to capture the negative effects on acquirer returns and positive returns to targets, in the case of stock swap deals, documented in the literature (see for example Jensen and Ruback (1983), Roll (1986) and Barnes (1998b)).

The deal was concluded unsuccessfully on 11 April 2003 as a result of the board's withdrawal of its recommendation to proceed with the merger. The cause of the deal failure was twofold: (1) over the lifetime of the deal, CAT's share price reduced dramatically. This devalued the deal, until eventually on 10 April 2003 (the day preceding the deal's failure) CAT's share price was observed at a low of 349.5p, reducing the original offer by 35 per cent. (2) Celltech confirmed its interest in OGS when it announced a cash offer on 26 February 2003 of £1.82 per share, valuing the company at £101.4 million.

Deal failure requires the risk arbitrageur to repurchase CAT and sell OGS at the closing prices (CAT £3.48, OGS £1.82). Although the bid for OGS by CAT was unsuccessful it led to large profits for risk arbitrageurs. The fall in CAT's share price combined with a small fall in the OGS share price resulted in a return on invested capital of 20.8 per cent.

The competing bid entered by Celltech was treated as an entirely new deal. An investment was made in OGS, based on the share price (£1.90) at the close of trade on 26 February 2003 (the announcement date). Despite an initial rejection, the deadline was extended and the offer was declared wholly unconditional on 16 April 2003. The following day (17 April 2003) risk arbitrageurs realise their return. As the long position in OGS was purchased above the offer price, the successful conclusion of Celltech's bid for OGS leads to a negative return on invested capital of –4.2 per cent.

There are relative strengths and weaknesses of both cash and stock deals for the arbitrageur. Cash deals are more common (representing 79 per cent of the deals in our sample) and it is much simpler for the arbitrageur to capture return. As the strategy involves taking a single long position in the target stock there is less risk. If the deal fails the arbitrageur loses only on the long position in the target stock. With the stock deal there are greater risks to the arbitrageur. Rather than holding just a long position in one stock, the arbitrageur holds a long position in one stock and a short position in another. In the absence of a competing bid, following deal failure, it is expected that the arbitrageur will lose on both positions (Jensen and Ruback, 1983). The target stock will fall and the acquiring stock will increase. As a result of this increased risk the expected return is generally higher. For our sample the mean cumulative returns from cash deals is 2.2 per cent versus 2.6 per cent for stock deals.

PORTFOLIO CONSTRUCTION

In this section we describe how the risk arbitrage portfolios are constructed. Stock price and interest rate data come from DataStream and all data on the merger terms are from *Acquisitions Monthly*.[4]

The profitability of the strategy depends on the merger spread. Merger spreads are the platform upon which risk arbitrage returns are based:

> The speculation spread represents an immediately visible component of the total expected return endogenously determined through the actions of traders bidding in the post-announcement period (Jindra and Walkling, 2004, p. 498).

Spreads observed for cash deals on the date of announcement are calculated using equation (1).

$$[(P_i^{offer} - P_i^{announce})/P_i^{announce}] \quad (1)$$

Where P_i^{offer} is the tender price for the i^{th} offer and $P_i^{announce}$ is the price observed on the announcement date for the i^{th} offer. For successful deals the spread decreases consistently until the deal's conclusion, when it goes to zero. 79 per cent of the total deal population included in the sample utilise cash when bidding for a target company. Thus the spreads reported below are representative of the broader sample.

Table 1 also reports the deal duration. The duration is the length of time it takes a deal to complete from announcement to conclusion. The duration affects the risk arbitrageur through the opportunity cost of deals forgone when capital is tied up for prolonged periods. The average duration of all cash deals included in the sample is thirty-seven trading days.

TABLE 1: MONTHLY SPREADS

This table presents spreads for cash deals announced during the sample period spanning 1 January 2001 to 31 December 2004. The total deals announced column outlines the number of deals announced in a single month. The Average Duration is a measure of the average length of time it takes for deals announced in a single month to complete. The spreads were calculated using the formula

$$[(P_i^{offer} - P_i^{announce}) / P_i^{announce}]$$

where P_i^{offer} is the tender offer price for the i^{th} offer and $P_i^{announce}$ is the announcement date price for the i^{th} offer. Average spreads are calculated for individual deals announced in a single month.

Month	Total Deals Announced	Average Duration (Days)	Average Spread
2001			
January	2	74	1.70%
February	2	36	1.42%
March	5	35	4.20%
April	5	96	1.80%
May	2	22	3.22%
June	3	31	1.43%
July	1	9	0.52%
August	1	55	–4.78%

(*Continued*)

TABLE 1: *(CONTINUED)*

Month	Total Deals Announced	Average Duration (Days)	Average Spread
September	–	–	–
October	2	32	5.39%
November	–	–	–
December	1	32	0%
2002			
January	–	–	–
February	1	22	12.1%
March	2	37	1.53%
April	3	29	0.57%
May	5	26	2.80%
June	4	23	3.09%
July	–	–	–
August	1	17	0.46%
September	3	49	0.45%
October	1	39	1.11%
November	2	33	0.04%
December	2	42	–0.58%
2003			
January	–	–	–
February	3	36	–0.80%
March	1	40	–6.10%
April	5	35	0.14%
May	3	42	–0.52%
June	4	21	3.21%
July	4	25	0.97%
August	4	15	2.7%
September	2	30	0.26%
October	4	53	1.21%
November	2	19	2.53%
December	2	40	–1.10%
2004			
January	1	70	–0.33%
February	2	27	2.25%
March	–	–	–
April	3	48	10.2%
May	1	28	1.23%
June	2	30	0.16%
July	–	–	–
August	2	26	0.25%
September	1	19	0.58%
October	–	–	–
November	–	–	–
December	–	–	–

Merger spreads in the United Kingdom average 1.99 per cent for the sample period. This reflects the large volume of activity evident in the merger arbitrage sector, as a number of investment banks and specialist hedge funds, with broad capital bases, now practise risk arbitrage trading strategies. The increased number of risk arbitrageurs has had a negative effect on returns, as risk arbitrageurs compete away their rent (Cornelli and Li, 2002).

Risk arbitrageurs derive returns from two sources where cash is used by an acquiring firm to purchase a target company. Primarily a long position is taken in the target company's stock at the closing price following the deal's announcement and held until the deal is consummated.[5] The aim is to achieve a return on the spread observed on the announcement date. A second source of return is from dividends received on the long position in the target stock. A dividend payment can have a large effect on daily portfolio returns. For the purposes of this study daily returns are calculated for individual deals using equation (2).

$$R_{it} = \frac{P_{it}^{T} + D_{it}^{T} - P_{it-1}^{T}}{P_{it-1}^{T}} \tag{2}$$

Where R_{it} is the return for deal i on day t, P_{it}^{T} is the price of the target company i on day t, P_{it-1}^{T} is the price of target company i on day $t-1$ and D_{it}^{T} is the dividend receivable for target company i on day t. When a deal is completed successfully the risk arbitrageur exchanges the long position held for the cash offered by the acquirer. If an offer is unsuccessful the risk arbitrageur disposes of the long position at the prevailing market rate.

An arbitrageur's approach to a stock swap is more complex. Primarily the arbitrageur seeks to maximise returns on the spread observed between the acquirer's share price and the target's share price using closing prices following the deal's announcement. Thus the risk arbitrageur also engages in short selling of the acquirer's stock. The number of shares sold short by the risk arbitrageur is determined by the deal's share exchange ratio. Where applicable, dividends receivable from the long position are offset against dividends payable on the short position. Returns are calculated at the end of each day. Large, well established risk arbitrageurs receive interest on the proceeds of a short sale (generally at the risk free rate). Position returns in this study incorporate the return on the spread, the return on the proceeds of the short sale and any dividends receivable or payable and are calculated using equation (3).

$$R_{it} = \frac{P_{it}^{T} + D_{it}^{T} - P_{it-1}^{T} - \Delta\left(P_{it}^{A} + D_{it}^{A} - P_{it-1}^{A} - rfP_{i1}^{A}\right)}{\text{Position Value } t-1} \tag{3}$$

Where R_{it} is the return for deal i on day t, P_{it}^{T} is the price of the target company i on day t, P_{it-1}^{T} is the price of target company i on day $t-1$, D_{it}^{T} is the dividend receivable for target company i on day t, P_{it}^{A} is the price of the acquiring company i on day t, P_{it-1}^{A} is the price of acquiring company i on day $t-1$, D_{it}^{A}

is the dividend payable on the short position in acquiring company i on day t, rf represents the risk free rate, P_{i1}^{A} is the price of the acquiring company on the first day the deal is announced, Δ symbolises the share exchange ratio and the Position Value $t-1$ represents the value of the overall position on the previous day and is calculated as $P_{it-1}^{T} + \Delta P_{it-1}^{A}$.

On successful conclusion of a deal, the risk arbitrageur repays the shareholder from whom the acquirer's stock was originally borrowed, with the shares in the newly merged entity, originally purchased in the target firm.

If a deal concludes unsuccessfully the risk arbitrageur covers the short position in the acquirer's stock at the prevailing market rate. The long position held in the target firm must also be sold at the prevailing market rate. This creates the potential for downside risk.

We construct equally weighted (EWRA), value-weighted (VWRA) and real world (RWRA) risk arbitrage portfolios. The first two portfolios, EWRA and VWRA, are simplified measures of risk arbitrage performance. The returns generated by these two portfolios highlight the limitations of much of the previous literature. The third portfolio (RWRA) is established to reflect a fairer representation of risk arbitrage performance, and analyses how an actual arbitrageur may have fared over the same period.

The EWRA portfolio is calculated as the average return on each day for the entire sample of merger activity included in the study. Returns are calculated for cash, stock and mixed mergers for all active deals. Where active deals are absent, it is assumed that the risk-free rate of return is achievable. It is expected that the returns of this portfolio are upward biased, as it fails to account for transaction costs and the limited ability of risk arbitrageurs, due to capital constraints, to exploit all merger activity.

The VWRA portfolio invests more capital in larger deals. Value weightings are created for daily returns on active deals, according to the market capitalisation of the target company. The market capitalisations of target firms for active deals are totalled each day and weights are allocated. The daily return for individual deals are multiplied by their respective weighting factors and summed across all active deals. As with the EWRA portfolio, it is assumed that the risk free rate of return can be achieved on days where no active deals exist. The VWRA portfolio again fails to account for practical limitations such as transaction costs and assumes the arbitrageur is invested in every deal.

In practice, arbitrageurs do not have unlimited capital to invest and this is crucial in determining their strategy (Shleifer and Vishny, 1997). The final RWRA portfolio is seeded with £1 million on 1 January 2001 and, if possible, an investment is made in each deal announced subsequent to that date. Only one restriction is placed upon investments made in the real world portfolio. No single investment can exceed 10 per cent of the portfolio's total value on the date of announcement. This is a risk management safeguard practised widely amongst risk arbitrageurs, limiting the effect on portfolio performance of unsuccessful mergers. Eight deals are excluded from the real world portfolio due to inadequate availability of capital. The returns on active deals are summed at the close of trade each day. This allows the total value of the portfolio inclusive of all open

TABLE 2: TRANSACTION COSTS

This table presents the transaction costs encountered by risk arbitrageurs and included in the RWRA portfolio. Stamp duty is levied by the government on each investment made in the UK stock market at a constant rate. Trading costs are included and were calculated by averaging six online trading websites that allowed unlimited trading for a fixed cost per trade. A constant charge is levied on all trades in the UK stock exchange greater than £10,000 by the Panel on Takeovers and Mergers (PTM) and is included in the table below.

Type of Charge	Cost
Government Stamp Duty	0.5% (charged on each investment)
Online Trading Costs	£11.50 per trade
PTM	£1 (charged on investments over £10,000)

TABLE 3: ANNUAL RETURNS

This table presents annual return data for each of the risk arbitrage portfolios, the market represented by the FTSE All Share Index and the risk-free rate. The first series (EWRA) is an equally weighted portfolio ignoring the practical limitations of arbitrage and averaged across daily returns. The second series (VWRA) is similar to the EWRA except the target firm's market capitalisation figure is employed as a weighting factor. The third return series (RWRA) is comparative to an actively managed risk arbitrage portfolio and accounts for the practical limitations faced by risk arbitrageurs. CAR is the compounded annual rate of return.

Date	Total Deals Announced	EWRA Returns (%)	VWRA Returns (%)	RWRA Returns (%)	FTSE Returns (%)	Rf (%)
2001	28	13.12	12.42	7.51	−15.41	5.21
2002	32	17.66	6.79	9.30	−24.97	4.11
2003	42	10.23	0.39	4.41	16.56	3.82
2004	19	10.52	0.15	6.30	9.21	4.77
% CAR		62.15	20.71	30.40	−19.21	19.15

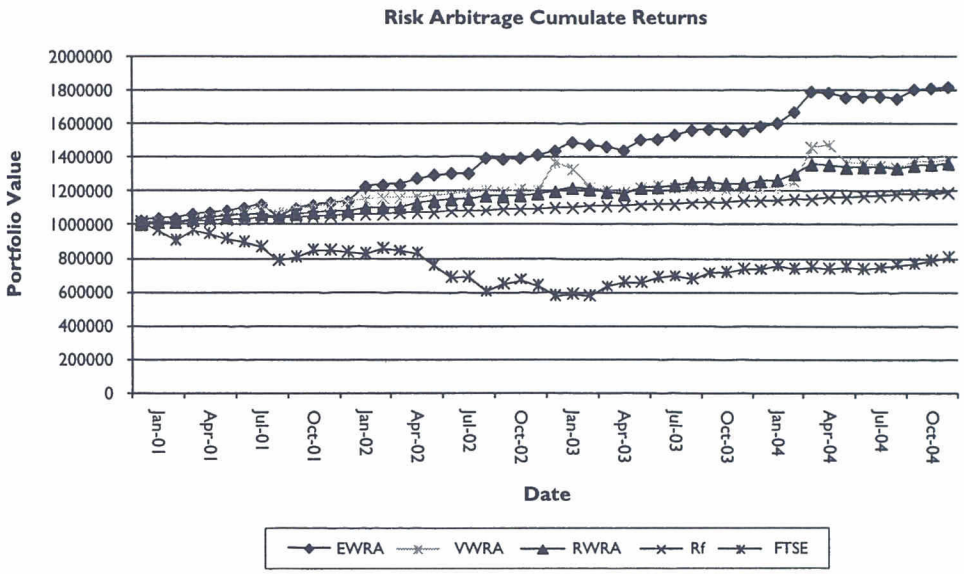
positions, for each of the 1,045 trading days, to be observed. The real world portfolio includes transaction costs, replicating the practicalities faced by active risk arbitrageurs. The transaction costs are reported in Table 2.[6]

Online share trading is utilised for investment and divestment purposes using an average price of £11.50 per unlimited trade.[7] In the United Kingdom the Panel on Takeovers and Mergers also imposes a £1 levy on all trades larger than £10,000. The vast majority of transaction costs are incurred from government stamp duty imposed on investments made on the London Stock Exchange at a rate of 0.5 per cent. Considering the average investment is £70,904, the total stamp duty accrued over the four-year period is sizeable (£42,543). Adhering to the realistic nature of this portfolio, the idle capital is assumed to earn the risk-free rate each day.

The annual returns of the three portfolios are reported in Table 3 and the cumulative portfolio values are plotted in Figure 1. All portfolios produced

FIGURE 1: CUMULATIVE RETURNS

This graph plots the value of £1 million invested in each of the portfolios on 1 January 2001 and divested on 31 December 2004. The first portfolio (EWRA) is an equally weighted portfolio ignoring the practical limitations of arbitrage and averaged across daily returns. The second portfolio is similar to the EWRA except for the target firm's market capital being employed as a weighting factor. The third portfolio (RWRA) is comparative to an actively managed risk arbitrage portfolio. Rf is the risk free rate. FTSE represents the FTSE All Share Index.



positive returns in each year from 2001 to 2004, despite the FTSE All Share producing negative returns in 2001 and 2002. Contrary to expectations from previous literature (Mitchell and Pulvino, 2001) the portfolios produced their largest returns when the general market was weakest. The equally weighted portfolio produces the highest cumulative returns (60 per cent) and the value-weighted portfolio produces the lowest returns (30.4 per cent). In the next section we will more closely examine the statistical properties of the portfolios.

PORTOFOLIO STATISTICAL CHARACTERISTICS

This section of the study analyses the properties of the excess return series generated by three risk arbitrage portfolios for the sample period spanning 1 January 2001 to 31 December 2004. Descriptive statistics for the excess returns on the VWRA portfolio (VWRA-Rf), the EWRA portfolio (EWRA-Rf) and the RWRA portfolio (RWRA-Rf) are reported in Table 4, Panel A.

TABLE 4: DESCRIPTIVE STATISTICS

Panel A presents descriptive statistics for the daily excess returns of the series. Three different time series of risk arbitrage returns are analysed spanning the 4-year period from 1 January 2001 to 31 December 2004. The first series (RWRA-Rf) is comparative to an actively managed risk arbitrage portfolio. The second (EWRA-Rf) is an equally weighted portfolio ignoring the practical limitations of arbitrage and averaged across daily returns. The third series (VWRA-Rf) is similar to the EWRA except for the target firm's market capitalisation being employed as a weighting factor. The return series generated by the market (R_{MKT}-Rf) for the sample period and the size (*SMB*) and book to market (*HML*) factors are also analysed. Panel B presents the correlation coefficients between the 3 explanatory factors.

Panel A: Descriptive Statistics Portfolios

	Mean	Variance	Skew	Kurt	Q Stat	Q Signif
EWRA-Rf	0.04	0.38	0.52	62.53	33.57	0.00
VWRA-Rf	0.02	0.45	9.25	205.00	32.51	0.00
RWRA-Rf	0.01	0.09	2.02	37.01	12.46	0.26

Panel B: Descriptive Statistics Explanatory Factors

R_M	(0.02)	1.41	(0.13)	2.68	46.49	0.00
SMB	0.00	1.12	(0.49)	3.62	40.42	0.00
HML	(0.02)	0.19	(0.21)	2.57	18.82	0.04

Panel C: Cross Correlations Explanatory Factors

	R_M	*SMB*	*HML*
R_M	1.00	(0.82)	0.05
SMB	(0.82)	1.00	(0.13)
HML	0.05	(0.13)	1.00

The RWRA portfolio generates a positive daily excess return of 0.009 per cent for the sample period. The EWRA portfolio performs better, earning an excess daily return of 0.04 per cent. The VWRA portfolio generates an excess return of just 0.002 per cent, despite ignoring many of the practical limitations encountered by risk arbitrageurs. The excess returns for the RWRA portfolio display the lowest level of volatility for the sample period (variance 0.09). The evidence of positive skew across all three risk arbitrage portfolios highlights an asymmetric tail of returns protruding towards positive values. The positive skew observed from the RWRA return distribution, combined with the large kurtosis figure, indicate a portfolio exhibiting a number of extreme excess returns generally observed on profit-making days. Table 4 also reports Ljung-Box Q-Statistics testing for autocorrelation up to ten lags in each of the portfolios. Both the VWRA-Rf and EWRA-Rf series exhibit serial correlation.

PERFORMANCE MEASUREMENT MODELS

In this section of the paper we evaluate the risk-adjusted performance of the risk arbitrage portfolios over the sample period with two asset pricing models, the

market model derived from the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965), and a three factor model incorporating market, size and value factors (Fama and French, 1992, 1993).

The market model is a single index model which assumes that all of a stock's systematic risk can be captured by one market factor. The equation to estimate this is (4).

$$R_{pt} = \alpha + \beta_1 R_{M\,t} + \varepsilon_t, \quad R_{M\,t}, \varepsilon_t \sim \text{IID} \tag{4}$$

Where R_{pt} is the return on the merger arbitrage portfolio at time t in excess of the risk free rate, $R_{M\,t}$ is the excess return on the FTSE All Share for month t and ε_t is the error term.[8] α and β are the intercept and the slope of the regression, respectively. The model assumes that portfolios of assets with the same beta will offer the same return. Any positive deviation indicates superior performance. Although the market model is commonly used in the evaluation of securities, it has been applied extensively in the performance measurement literature (e.g. Jensen, 1968; Carhart, 1997; Capocci and Hübner, 2004).

The three factor stock model extends the market model through the inclusion of two factors that take the size and book-to-market ratio of firms into account. It is estimated from equation (5).

$$R_{pt} = \alpha + \beta_1 R_{Mt} + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t, \quad R_{M\,t}, SMB_t, HML_t, \varepsilon_t \sim \text{IID} \tag{5}$$

Where SMB_t is the factor mimicking portfolio for size (Small Minus Big) and HML_t is the factor mimicking portfolio for book-to-market ratio (High Minus Low). We construct SMB as the return on the FTSE UK Small Companies Index – the return on the FTSE100 UK Index. HML is constructed as the return on the FTSE Value Index – the return on the FTSE Growth Index. All of the indices are value weighted. Fama and French (1992, 1993) employ a similar model to explain the cross section of stock returns. Including these factors in our analysis allows us to control for risk and, as such, our analysis is based on abnormal (i.e. risk-adjusted) returns.

To formally test the portfolios for abnormal performance we examine the estimated intercept, α, of the market and three factor models. The intercept of the equation is commonly referred to as Jensen's alpha (Jensen, 1968) and is interpreted as a measure of out- or under-performance. To assess performance we examine the intercepts, sign and significance. The magnitude of the estimated alpha depends on the magnitude of the portfolio returns and the proportion of those returns unrelated to the market risk of the portfolio. A significantly positive alpha is evidence that the portfolio generates positive risk-adjusted abnormal returns. A significantly negative alpha is evidence that the portfolio generates negative risk-adjusted abnormal returns over the sample period, while an alpha insignificant from zero is evidence that after adjusting for risk, the portfolio generates no abnormal returns.

Descriptive statistics of the three risk factors and cross correlations are reported in Table 4, Panels B and C respectively. The risk factors have mean returns that are zero or negative over the sample period. It is also notable that the

variance of the risk factors is considerably higher than the variance of the risk arbitrage portfolios. These factors also exhibit negative skewness and positive excess kurtosis. Q-Stats indicate the presence of serial correlation in each of the risk factor series. In Panel C there is high negative correlation between *SMB* and R_M. This is due to the FTSE100 representing a large proportion of the market capitalisation of the FTSE All Share index.

RESULTS

In this section of the paper results are reported from estimating the models discussed in the previous section for the three simulated merger arbitrage portfolios.

Table 5 reports results from ordinary least squares (OLS) estimation of the risk factor models discussed above for the *EWRA, VWRA and RWRA portfolios.* Although the conditional heteroskedasticity and autocorrelation are not formally treated in the OLS estimate of the parameters, the test statistics are heteroskedasticity and autocorrelation consistent due to Newey and West (1987).

None of the coefficients are significantly different from zero and the explanatory power of the estimated models is close to zero. Given the low variance of the EWRA and RWRA portfolios and the lack of covariance with the risk factors, both

TABLE 5: OLS REGRESSION ESTIMATES – CONTEMPORANEOUS MODEL

This table presents the results of estimating the following model of merger arbitrage portfolio excess returns

$$y_t = \alpha + \beta_0 R_M + \beta_1 SMB + \beta_2 HML + \varepsilon$$

Where y_t is the excess return on the portfolio at time *t*, R_M is the excess return on the FTSE ALL Share index at time *t*, *SMB* is the factor mimicking for size constructed as the return on the FTSE Smaller Companies Index minus the return on the FTSE100 index and *HML* is the return on the FTSE Value Index minus the return on the FTSE Growth index. Figures in parentheses are *P*-Values from the test of $\alpha = 0$ and $\beta = 0$ for *Rm-Rf*, *SMB* and *HML*.

y	α	β_{RM}	β_{SMB}	β_{HML}	Adj R^2
EWRA-Rf	0.04	0.02			0.07%
	(0.01)	(0.43)			
EWRA-Rf	0.05	0.10	0.11	0.10	1.30%
	(0.01)	(0.26)	(0.25)	(0.17)	
VWRA-Rf	0.02	0.00			–0.10%
	(0.40)	(0.90)			
VWRA-Rf	0.02	0.03	0.04	–0.05	0.00%
	(0.40)	(0.33)	(0.30)	(0.31)	
RWRA-Rf	0.01	0.00			–0.10%
	(0.11)	(0.94)			
RWRA-Rf	0.01	0.02	0.03	0.03	0.20%
	(0.08)	(0.45)	(0.33)	(0.29)	

t-statistics (unreported) are heteroskedasticity and autocorrelation-consistent, due to Newey and West (1987).

portfolios exhibit significantly positive α, indicating abnormal performance of four basis points per trading day for the EWRA portfolio and one basis point per day for the RWRA portfolio. This is equivalent to 10 per cent per annum and 2.5 per cent per annum abnormal returns respectively. Due to the larger variance and lower mean return, the VWRA α, though positive, is not significantly different from zero.

Robustness tests indicate that the results reported in Table 5 are not sensitive to (i) the choice of market index (we also estimated performance relative to the MSCI and DataStream UK indices with no difference in findings); (ii) the use of returns rather than excess returns; (iii) the use of monthly rather than daily data; and (iv) the assumption of no multicollinearity (we also estimate the model with the return on the FTSE Small Companies Index in place of *SMB* with no change in findings). To correct for the potential downward bias in beta estimation when using daily data, two lags of the daily return on each of the risk factors are specified in addition to the contemporaneous return when estimating equations (3) and (4). This downward bias is caused by non-synchronous trading between the illiquid stocks and the more liquid asset class factors.[9]

Results from OLS estimation of models (4) and (5), incorporating lags of the risk factors, are reported in Table 6. Although the magnitude of the coefficients is larger, none are significantly different from zero and the models again have almost zero explanatory power. Estimated α are larger for the EWRA (five basis points) and RWRA portfolios (two basis points) for the non-synchronous model. This equates to annualised abnormal returns of 12.5 per cent and 5 per cent per annum respectively.

TABLE 6: OLS REGRESSION ESTIMATES – LAGGED MODEL

This table presents the results of estimating the following model of merger arbitrage portfolio excess returns

$$y_t = \alpha + \beta_0' R_M + \beta_1' SMB + \beta_2' HML + \varepsilon$$

Where y_t is the excess return on the portfolio at time t, $R_M = (R_{M\,t}, R_{M\,t-1}, R_{M\,t-2})$, $SMB = (SMB_t, SMB_{t-1}, SMB_{t-2})$ and $HML = (HML_t, HML_{t-1}$ and $HML_{t-2})$. The β coefficient is the sum of the contemporaneous β and lagged β s. Figures in parentheses are *P*-Values from the joint test of $\beta_{jt} + \beta_{jt-1} + \beta_{jt-2} = 0$ for R_M, *SMB* and *HML*

y	α	$\beta_{RM\,(t0\ to\ t-2)}$	$\beta_{SMB(t0\ to\ t-2)}$	$\beta_{HML(t0\ to\ t-2)}$	Adj R^2
EWRA-Rf	0.05	0.07			0.26%
	(0.01)	(0.68)			
EWRA-Rf	0.06	0.14	0.16	0.21	1.35%
	(0.00)	(0.34)	(0.30)	(0.21)	
VWRA-Rf	0.02	–0.01			–0.24%
	(0.40)	(0.78)			
VWRA-Rf	0.02	0.02	0.09	0.08	–0.06%
	(0.33)	(0.61)	(0.31)	(0.30)	
RWRA-Rf	0.02	0.01			–0.06%
	(0.08)	(0.64)			
RWRA-Rf	0.02	0.04	0.05	0.08	0.12%
	(0.04)	(0.46)	(0.34)	(0.20)	

t-statistics (unreported) are heteroskedasticity and autocorrelation-consistent, due to Newey and West (1987).

TABLE 7: OLS REGRESSION SUB-SAMPLE ESTIMATES – LAGGED MODEL

This table presents the results of estimating the following model of merger arbitrage portfolio excess returns

$$y_t = \alpha + \beta_0' R_M + \beta_1' SMB + \beta_2' HML + \varepsilon$$

Where y_t is the excess return on the portfolio at time t, $R_M = (R_{M\,t}, R_{M\,t-1}, R_{M\,t-2})$, $SMB = (SMB_t, SMB_{t-1}, SMB_{t-2})$ and $HML = (HML_t, HML_{t-1}$ and $HML_{t-2})$. The β coefficient is the sum of the contemporaneous β and lagged β s. Figures in parentheses are *P*-Values from the joint test of $\beta_{jt} + \beta_{jt-1} + \beta_{jt-2} = 0$ for R_M, *SMB* and *HML*. Panel A presents results from limiting estimating the model from January 2001 to December 2002. Panel B presents results from estimating the model in a sample period from January 2003 to December 2004.

Panel A: Sample Period Jan 2001 to Dec 2002

y	α	$\beta_{RM\,(t0\ to\ t-2)}$	$\beta_{SMB(t0\ to\ t-2)}$	$\beta_{HML(t0\ to\ t-2)}$	Adj R^2
EWRA-Rf	0.06	0.10		1.04%	
	(0.02)	(0.50)			
EWRA-Rf	0.08	0.20	0.22	0.19	3.34%
	(0.00)	(0.15)	(0.14)	(0.18)	
VWRA-Rf	0.02	0.02			4.22%
	(0.11)	(0.00)			
VWRA-Rf	0.03	0.07	0.11	0.00	6.30%
	(0.02)	(0.02)	(0.07)	(0.24)	
RWRA-Rf	0.02	0.02			0.47%
	(0.06)	(0.49)			
RWRA-Rf	0.02	0.06	0.07	0.04	2.02%
	(0.02)	(0.27)	(0.26)	(0.24)	

Panel B: Sample Period Jan 2003 to Dec 2004

y	α	$\beta_{RMRF(t0\ to\ t-2)}$	$\beta_{SMB(t0\ to\ t-2)}$	$\beta_{HML(t0\ to\ t-2)}$	Adj R^2
EWRA-Rf	0.04	0.01			1.26%
	(0.09)	(0.24)			
EWRA-Rf	0.05	0.00	0.00	0.26	2.24%
	(0.06)	(0.55)	(0.89)	(0.08)	
VWRA-Rf	0.02	–0.06			1.28%
	(0.61)	(0.64)			
VWRA-Rf	0.03	–0.08	0.01	0.26	3.91%
	(0.53)	(0.78)	(0.89)	(0.25)	
RWRA-Rf	0.02	0.00			1.51%
	(0.26)	(0.44)			
RWRA-Rf	0.02	–0.01	0.00	0.16	1.90%
	(0.18)	(0.61)	(0.84)	(0.11)	

t-statistics (unreported) are heteroskedasticity and autocorrelation-consistent, due to Newey and West (1987).

Finally, to investigate if the risk arbitrage portfolios are linearly related to equity market risk factors, we estimate the non-synchronous trading models in two sub-sample periods: January 2001 to December 2002 and January 2003 to December 2004. Results from OLS estimation in the two sub-samples for the three portfolios are presented in Table 7.

Panel A presents the results for the sample period January 2001 to December 2002, a period when the FTSE All Share Index declined by 40 per cent. Over this period only the VWRA portfolio exhibits a significantly positive coefficient on any of the equity market factors (R_M and SMB). Again the intercepts for EWRA and RWRA are significantly positive. In Panel B none of the risk factor coefficients are significantly different from zero. In this period, January 2003 to December 2004, when the FTSE All Share increased in value by 26 per cent, only the EWRA portfolio generates statistically significant abnormal returns.

CONCLUSIONS

The returns to merger arbitrage in the UK have received little academic attention. The literature is dominated by studies focusing on North American markets. In this paper we address this gap in the literature by simulating portfolios, in the manner ascribed to merger arbitrageurs, focusing exclusively on the UK market.

Over the sample period 2001 to 2004, when the FTSE Index returns were negative, this strategy produced consistently positive returns with a low variance. To ensure these results are robust to real world limitations, we construct one series with transaction costs and limitations on investing capital. We find evidence that the merger arbitrage portfolios exhibit abnormal returns and almost no significant relationship with equity market risk factors over the sample period. Contrary to prior evidence, we also find no increase in systematic risk in depreciating equity markets.

We construct three portfolios: equally weighted, value-weighted and real world. The equally weighted and value-weighted portfolios have fewer constraints, and unsurprisingly the equally weighted portfolio generates the largest returns. Suggesting that larger deals may be more efficiently priced the value-weighted portfolio exhibits the lowest returns. Finally the real world portfolio, which controls for transaction costs and capital constraints, while producing lower returns than a portfolio equally weighted amongst transactions, still generates abnormal risk-adjusted returns of at least 2.5 per cent per annum.

To assess the risk of the portfolios, we specify two asset-pricing models – the market model and a UK three factor model – incorporating size and value risk factors. Results from estimating contemporaneous and lagged models indicate that, contrary to the findings of prior literature, our portfolios exhibit almost no significant relationship with commonly specified equity risk factors.

In addition this finding is not dependent on the level of returns. We subdivide the sample into two time periods: a negative return stock market period from January 2001 to December 2002 and a positive return stock market period from January 2003 to December 2004. Contrary to the findings of Mitchell and Pulvino

(2001), over the initial period of the sample equity returns were negative and in this period the merger arbitrage portfolios produced their largest returns.

The results of our study highlight two opportunities for future research. Further analysis could focus on why merger arbitrage returns in the UK exhibit less systematic risk than those documented for the US. Another fruitful avenue for researchers would be to incorporate merger prediction into future studies of merger arbitrage performance. As this is a key feature of the strategy in practice, incorporating it in future studies will lead to a fuller picture of the risks and returns of the strategy.

Overall, our finding of abnormal returns from following the strategy, consistent with prior research, is encouraging news for investors in hedge funds and proprietary trading desks which follow the strategy. Perhaps more interesting is our finding of no significant systematic risk from following the strategy from 2001 to 2004, a period characterised by large stock market declines. This warrants further investigation. Perhaps the portfolio exhibits luck and there were fewer deal failures over our sample period or, alternatively, we cannot discount the possibility of an as yet unidentified characteristic of the UK market for corporate control which leads to these results.

NOTES

1 See <http://www.hedgeindex.com> for details on the CSFB Tremont Indices.

2 Hedge fund databases exhibit several biases including survivor bias, lookback bias and selection bias. For details of these biases see, for example, Fung and Hsieh (1997).

3 There are some studies examining merger arbitrage outside North America. For example, Hutson and Kearney (2005) model the interaction between bidder and target stock prices during takeover bids on the Australian stock market.

4 Published monthly by Thomson Financial, *Acquisitions Monthly* has in-depth analysis of mergers and acquisitions transactions across every industry sector worldwide.

5 For both cash and stock deals, if the deal is announced during market trading hours, we initiate positions using that day's closing price(s). If the deal is announced after the market close we use the following day's closing price. In practice, to maximise returns, arbitrageurs will attempt to act in advance of the takeover. This will result in potentially higher returns as arbitrageurs capture the announcement effect. However, positions will also last longer than the deal's duration.

6 In addition to the direct transaction costs listed here arbitrageurs also face indirect transaction costs such as bid-ask spreads and the price impact of large trades. We thank both referees for highlighting these costs.

7 £11.50 is the average share trading cost from a sample of six UK online stockbrokers.

8 We specify the one-month money market rate as the risk free rate.

9 Scholes and Williams (1977) and Dimson (1979) amongst others show that betas of securities that trade less (more) frequently than the index, used as the market proxy, are downward (upward) biased. Results are not sensitive to the choice of lags. We repeat the analysis with four to ten lags of the explanatory factors with no change in findings.

ACKNOWLEDGEMENT

The financial support of the Irish Research Council for the Humanities and Social Sciences (IRCHSS) is gratefully acknowledged.

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