

Analysing Mergers and Acquisitions in European Financial Services: An Application of Real Options

by
Christian L. Dunis* and Til Klein**
(Liverpool Business School and CIBEF***)

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Abstract

This paper applies real option pricing theory to the analysis of a sample of 15 recent mergers and acquisitions in the European Financial Services industry. Overall, it is found that those acquisitions were not on average overpaid. Nevertheless, further analysis, assuming the option premium equalled the takeover premium, shows that either the implicitly assumed volatility was too low, the assumed time to maturity was very short and/or the assumed subsequent market performance was too optimistic.

Keywords

Banking system, event studies, mergers and acquisitions, real options

1. Introduction

The European financial services industry has faced increasing consolidation and concentration in the last decade. In this paper, we apply *real option theory* to strategic investment analysis in the field of bank mergers and acquisitions. Traditional net present value analysis ignores flexibility. But managers can respond to changing circumstances by making new decisions and amending earlier ones. Flexibility shares characteristics of an option. There are various strategic and operational real options embedded in mergers and acquisitions. Real option analysis provides a technique for incorporating and valuing flexibility in mergers and acquisitions.

As merger benefits, measured as abnormal returns to shareholders, are possible, but not certain, they too share option characteristics.

The motivation and the originality of this research is to apply real option pricing theory to recent bank mergers in Europe to check if these were possibly overpaid. The option premium for a European call option on abnormal returns was calculated for 15 European bank mergers. On average, we find that the option premium exceeded the actual takeover premium suggesting that, from an option-pricing point of view, those acquisitions were not overpaid. Further analysis, assuming the option premium equalled the takeover premium, shows that either the implicitly assumed

* Christian Dunis is Girobank Professor of Banking and Finance at Liverpool Business School and Director of CIBEF (E-mail: cdunis@totalise.co.uk). The opinions expressed herein are not those of Girobank.

** Til Klein is an Associate with The Boston Consulting Group and an Associate Researcher with CIBEF (E-mail klein.til@bcg.com).

*** CIBEF – Centre for International Banking, Economics and Finance, JMU, John Foster Building, 98 Mount Pleasant, Liverpool L3 5UZ.

volatility was too low, the assumed time to maturity was very short and/or the assumed subsequent market performance was too optimistic.

The remainder of the paper is organised as follows. In section 2, we give a brief overview of consolidation patterns in the European Financial Service industry. In section 3, we review studies on the effects on market capitalisation of mergers and acquisitions. Section 4 provides an application of the real option theory to European bank mergers and section 5 concludes the paper.

2. Increasing Consolidation in the European Banking Industry

At the end of 1999 banking concentration was the highest in the smaller countries of the EU, except for Luxembourg, due to the large number of foreign banks there. With the exception of Germany, average concentration measured in controlled deposits by the top ten banks was higher in Europe than in the US. In Belgium, France, the Netherlands, Sweden and Switzerland, the 10 largest banks control over 80% of deposits¹. From 1995 to 1999 concentration increased in most countries. On average, the concentration in total assets of the five largest institutions increased by 28% from 1990 to 1999². The number of credit institutions in the European Union decreased in almost all member states in the 1990s, except for Greece, Ireland, Portugal and Sweden. On average, the number of credit institutions fell by 15.5%³.

Global mergers and acquisitions (henceforth M&A) activity in the financial services industry has steadily increased in the last two decades from 58.2 billion USD in 1985 to 393.5 billion USD in 1995. For the period from 1985 to 1995 the financial service industry accounted for 44% of global M&A transaction volume, i.e. 1.9 trillion USD. In Europe, the financial services industry was the most active industry in terms of buyers and sellers⁴. The number of mergers and acquisitions in the European financial service industry increased steadily over the past decade from 110 in 1990 to 311 in 1999. In the 1990s, Europe accounted for 34.9% and the US for 54.4% of financial sector M&As in G13⁵.

The total value of European financial M&As increased from 22,769.6million USD in 1990 to 147,025.6million USD in 1999. Europe accounted for 31% and the US for 58.7% of the total target value in G13 countries in the 1990s⁶. In the period from 1990 to 1999, the average target value in Europe (476.7million USD) was higher than in the US (334million USD) and in all G13 countries (383.2million USD). In Europe, average target value increased from 437.9million USD in 1990 to 948.6million USD in 1999. Whilst the total and average target value was particularly low in 1991 and 1994, the total and average deal value was highest in last three years of the decade⁷. In European domestic mergers in the 1990s, the average target value (520.6million USD) was higher than in European cross-border transactions (343.1million USD). The average target value was highest in

¹ Group of Ten (2001, 447).

² ECB (2000, 43).

³ ECB (2000, 45).

⁴ Smith/Walter (1998, 23).

⁵ Group of Ten (2001, 335, 347 and 351).

⁶ Group of Ten (2001, 347).

⁷ Group of Ten (2001, 347).

Switzerland (1,069.3million USD), Belgium (941.3million USD) and Germany (749.2million USD)⁸.

The average value of targets in the banking (630.7million USD) and insurance industry (629.7million USD) was much higher than the average target value of security firms and investment banks (152.0million USD). On average, the biggest acquirer was the insurance industry (673.3million USD) followed by banks (625.3million USD) and security forms (214.2million USD). The average target value was higher in intra-industry transactions (562.1million USD) than in inter-industry or in sector transactions (289million USD)⁹.

With 26%, the UK accounted for most of European banking M&As in the 1990s, followed by Italy (14.5%) and Spain (7.4%)¹⁰. But in transaction value relative to GDP and average transaction value, Switzerland and Belgium were the countries with the most important M&A activities¹¹. With 76.7%, domestic targets were far more common than cross border transactions in Europe in the 1990s¹². The most sizeable acquisitions of foreign targets were undertaken in Belgium (49.5%), Switzerland (34.2%) and Spain (30.8%). In the US only 4.7% of the targets were foreign. Most cross border transactions took place in the insurance industry (39.1%), followed by security firms (20.2%)¹³.

Almost three quarter of the targets (73.4%) were in the same sector as the acquirer. Cross sector and industry acquisition targets accounted only for 26.6% of the transactions. About 23% of intra- and inter-industry mergers were international. With 33.6% of the targets, securities firms and investment banks undertook most cross sector and industry acquisitions¹⁴. The banking sector was the most active in the financial service industry. Banks accounted for 48.1% of the targets and 46.3% of the acquirer. Security firms and investment banks accounted for 32% of the targets and acquirers. Insurance companies accounted for 19.9% of the targets and 21.5% of the acquirers¹⁵.

3. Value enhancing and value destroying mergers

The assessment of the consequences of mergers and acquisitions in financial services is important with respect to two groups. Firstly, managers and shareholders are interested in potential benefits from mergers in order to improve the bank's competitive position and profitability. Secondly, regulators and policy makers are interested in how bank concentration affects the economy, i.e. competition, efficiency, stability of the financial system and the supply of banking services.

There are obvious potential benefits from mergers. Cost savings, revenue enhancement, risk diversification, market power and weak corporate control can motivate bank mergers and acquisitions. But these benefits can be reduced by merger costs. Diseconomies of mergers stemming from the difficulties in monitoring

⁸ Group of Ten (2001, 347, 367, 375 and 395).

⁹ Group of Ten (2001, 347).

¹⁰ Group of Ten (2001, 347).

¹¹ Group of Ten (2001, 367 and 395).

¹² Group of Ten (2001, 347).

¹³ Group of Ten (2001, 347, 351, 367, 387 and 395).

¹⁴ Group of Ten (2001, 347).

¹⁵ Group of Ten (2001, 347 and 349).

a larger firm, problems in integration of information technology or cultural conflicts can reduce or offset potential merger benefits.

There are various approaches that have been used in the literature to evaluate banking mergers. There are many studies on effects of mergers on efficiency, market power, risk or supply¹⁶. In this article, we focus on effects on shareholder value only. Traditionally the effect of a merger on shareholder value is measured by event studies. Event studies¹⁷ examine the stock market reaction to a merger announcement, i.e. whether investors believe it will create or destroy value. Event analysis assumes information-efficient markets. This means the market price is very sensitive to new information. New information like the announcement of a merger will be incorporated into the price immediately after it has been made public. The stock market reaction is then measured by abnormal returns. Abnormal returns are the difference between the expected price without the event and the actual price. The expected price is the price that would be expected without the event. This is calculated using the stock beta, i.e. the stock's historical behaviour relative to a market index. Without the event, abnormal returns should be zero. Abnormal returns or cumulative abnormal returns reflect the market's prediction of a merger's outcome. Positive abnormal returns reflect a positive view of the event while negative abnormal returns reflect a negative view.

Event studies are widely used to measure the effect of events, as they are very easy to compute¹⁸. Stock price data is easily available, the calculations are straightforward and do not rely on potentially misleading accounting data. But there are many problems with event studies. Firstly, the results depend highly on the length of the time window abnormal returns are computed for and the time base since the market often anticipates acquisitions long before the actual announcement day. The leakage of information prior to the announcement may also play a role here. Secondly, it is difficult to select a reasonable benchmark in a rapidly consolidating industry. Thirdly, this method assumes efficient markets that immediately incorporate new information and relies on the assumption that the market expectations are a good predictor of the long-term effects of an event. Zollo and Leshchinskii (2001) show for US bank mergers that in the long run the post-merger stock market performance is correlated with the way in which the acquired bank was integrated. They also show that financial markets anticipate the general integration approach and can only identify superior integration strategies in the long run. Cornett and Tehranian (1992) found positive correlation between accounting data and abnormal return suggesting that the market is able to identify successful mergers while Piloff (1996) found no correlation between post-merger operating performance and market reaction to merger announcements. Fourthly, the samples are usually small as this method is limited to publicly traded companies. Finally, it is impossible to differentiate between the specific value of consolidation and other wealth transfer effects associated with the transaction and to separate the effect of the merger from other company specific events. This is especially true in the case of multiple acquisitions or where new

¹⁶ For effects on efficiency, see e.g. Berger (1998), Thompson (1999) or Vander Venet (1996); for market power, see e.g. Berger *et al.* (1998a) or Bikker and Groeneveld (1998); for effects on risk, see e.g. Coates (1998) or Dermine (1999); for other aspects like retail supply, see e.g. Berger *et al.* (1998b), Jensen (1998), Lang *et al.* (1999), Sapienza (1998) or Udell (1998).

¹⁷ See e.g. Kean (1995, 235), Zhang (1997, 1421).

¹⁸ See Piloff and Santomero (1998, 63) for a discussion of advantages and disadvantages of event studies.

shares are issued to finance the acquisition. It is also difficult to distinguish if gains come from efficiency gains or market power.

Cybo-Ottone and Murgia (1996) found positive cumulative abnormal returns to the target shareholders and zero cumulative abnormal returns to the acquirer shareholders in the year following the announcement for a sample of 26 mergers of financial institutions in Europe.

In a sample of large US bank mergers from 1985 to 1996, Houston *et al.* (2001, 300) found that positive abnormal returns to the target set off the negative abnormal returns to the acquirer leaving a significant net increase in total market value. Kane (2000, 687) found significant positive abnormal returns to the target, negative abnormal returns to the acquirer and slightly positive net abnormal returns on announcement day for large US bank mergers in the period from 1991 to 1998. Lang *et al.* (1999) found small negative abnormal returns for acquirers and positive abnormal returns for the target for a sample of 101 US tender offers between 1968 and 1986. In a sample of 153 US bank mergers between 1985 and 1991, Houston and Ryngaert (1994) found negative abnormal returns to the acquirer shareholders four days before announcement, positive abnormal returns to the target shareholders but no change in aggregate shareholder wealth. Negative cumulative abnormal returns in the three years following a merger announcement to the acquirer shareholder were found by Madura and Wiant (1994) for US bank mergers between 1983 and 1987. In contrast to the majority of studies on abnormal returns from bank mergers Zhang (1997) found an increase in overall shareholder wealth for a sample of 107 US bank mergers between 1980 and 1990, whereby the gain to the target shareholders was significantly higher than to the acquirer shareholders.

Overall, the empirical evidence from event studies indicates that bank mergers do not create a statistically significant net increase in stock market value. Moreover, positive cumulative abnormal returns to the target shareholders and zero or negative cumulative abnormal returns to the acquirer shareholders suggest a wealth transfer from the acquirer to the target shareholders in bank mergers. Most event studies fail to show any significant net benefits from bank mergers. This would suggest that with mergers managers follow their own interest or that merger costs set off any benefits. To sum up, if the event study technique is very popular as it is very straightforward to compute, on the other hand, the conclusions that can be drawn from it seem rather limited.

Kane (2000) gives an alternative interpretation of event studies. Traditional event study interpretation benchmarks the stock market reaction on merger announcements against the expected stock market value of a stand-alone solution (assuming that stock price before announcement only represents the value of a stand alone solution). A positive market reaction, i.e. positive abnormal returns, shows that the market expects the value of the merged firm to be higher than the stand-alone firm. Contrary to this traditional view, Kane (2000) assumes that stock prices already include benefits from potential merger options. He therefore suggests benchmarking the stock market reaction to announcement against the best alternative deals, i.e. deal options that have been closed by the merger: the stock market reaction on announcement is not the deviation from the stand-alone solution but the deviation from the best alternative deal already included in the stock price. A positive stock market reaction to announcement can then be interpreted as the benefits from the actual deal exceeding the expected benefits from the best-assumed

potential deal. A negative stock market reaction to announcement can be interpreted as the benefits from the actual deal falling short of the benefits from a better potential deal.

4. Empirical Examination of Takeover Premia

4.1 Problem Review

Banks are usually acquired at a premium above their book or market value. The premium reflects potential efficiency gains and the value of intangibles such as franchise value, customer base and knowledge. On average the historical price to book value ratio is about 2.0, varying from 1.1 in 1990 to 2.8 in 1986¹⁹. Assuming efficient markets, the market value should reflect the target value. This means there must be an additional value from the merger in order to justify a takeover premium. As mentioned above, there are several potential benefits from banking mergers and acquisitions. But as they occur in the future these benefits are subject to uncertainty. As also mentioned above, empirical evidence shows that on average the realisation of such potential benefits is not likely. The realisation of these benefits requires active management and further investments, i.e. integration costs. Risk and flexibility must be taken into account when estimating potential merger benefits and determining the takeover premium paid by the acquirer. The real option approach is an alternative method for capturing uncertainty that, in contrast to traditional methods, takes flexibility into account²⁰. There is some work from researchers and practitioners on valuing a company using the real option approach²¹.

The idea behind the following examination is to view an acquisition as an option on potential benefits. Assuming semi-efficient capital markets, the market capitalisation reflects the market participants' view on the value of those benefits once the merger is announced. In the style of event studies, the share price is used as the basis for the option model. This can be seen as an option on abnormal returns. The combined market value of both target and acquirer is the share price of the option. The exercise price is the expected future market value of both companies without the merger. The option premium gives the value of this option and should be equivalent to the takeover premium. This call option is in the money if the market value of the merged entity exceeds the expected future market value of the two separate companies. In the following, we test this option model for historical European bank mergers and acquisitions and compare the calculated option value with the takeover premium actually paid.

4.2 Data and Methodology

There have been many bank mergers and acquisitions in Europe in the 1990s. Our population consists of European mergers and acquisitions since 1995. The Zephus Database²² and The Banker²³ were used to generate the statistical population.

¹⁹ Smith and Walter (1998, 34).

²⁰ For an introduction to real options, see e.g. Amram and Kutilaka (2000), Copeland and Antikarov (2001), Damodaran (2000) or Dixit and Pindyck (1998).

²¹ See e.g. Copeland and Antikarov (2001), Kellogg and Charnes (2000), Schwartz and Moon (2000) or Tomaszewski (2000); for a general analysis of options on merger benefits, see Raynor (2000).

²² Zephus (www.zephus.com) is a M&A database starting 1998. Only the free of charge data are used.

²³ The Banker publishes major bank mergers on an annual basis.

From this population, European banking mergers and acquisitions were selected according to the following five criteria. Firstly, both target and acquirer were publicly traded before the merger and so was the merged company after the merger. Secondly, we only considered the acquisition of a controlling stake, i.e. at least 50 percent. Thirdly, there was no major deal, defined as exceeding ten percent of the acquirer market value in the year following the examined transaction. Fourthly, in order to calculate a one-year option on historical data, the announcement had to take place before 31st July, 2000. Fifthly, all relevant data on each chosen deal had to be available. On the basis of these five selection criteria, fifteen transactions were finally retained²⁴ as listed in Table 1 in the Appendix.

The option on potential merger benefits to the shareholders is a European call option on the market value of the merged company with the expected future stand-alone market value defined as the exercise price. The dividend adjusted Black and Scholes model is used to value the option²⁵. The option premium was calculated using a simple Excel spreadsheet²⁶.

The share price equivalent of the option is the cumulated market value²⁷ of target and acquirer prior to the announcement of the deal terms²⁸. The announcement day is taken from the Financial Times using the McCarthy database and confirmed by local newspapers or the Internet. To avoid effects from early information leakage the previous four-week average of share prices excluding the week of announcement was used.

The exercise price is the hypothetical future market value without the merger. To predict the future market values the beta for each stock was calculated by regressing the weekly market value on the national market index over the previous two-year period. The regression result was used to forecast the market value for up to two years after the merger. The exercise price is the combined hypothetical future market value after one year. All stock and index related data were taken from the Thomson Financial DataStream databank.

The standard deviation is the annualised standard deviation of weekly returns after the merger. Assuming semi-efficient markets that incorporate publicly available new information promptly, the calculation of the standard deviation of the acquirer stock price return was started the week after the announcement.

The dividend yield is the average dividend yield of the merged company one year after the merger taken from the Thomson Financial DataStream databank.

For the risk free rate, the domestic three-month rate of the acquirer's country at announcement day was taken from DataStream. For time to maturity a one-year period was assumed. This was due to data availability and the assumption that efficient markets should have well anticipated potential long-term merger gains

²⁴ The population was by no means complete and the selection criteria were more a guidance than a strict systematical selection.

²⁵ To model the option as an American call option with a stochastic exercise price would have been reasonable too. For demonstration purposes the examination here is limited to a one-year European call option.

²⁶ We follow Copeland and Antikarov (2001) who give practical instructions to create option pricing spreadsheets in Excel.

²⁷ All stock price related data are taken from Thomson Financial DataStream.

²⁸ The announcement day is always the announcement of the deal terms, i.e. the stock exchange ratio or cash offer.

within this time period even if accounting data might not reflect any benefits in this short period due to integration costs. The British pound was chosen as the reference currency and consequently all currency data were converted into British pounds.

DATA AND METHODOLOGY
BANK MERGERS ARE MODELLED AS A EUROPEAN CALL OPTION

Option Variable	Data	Source
Share Price	Cumulated market value of target and acquirer prior to announcement (four-week average)⁽¹⁾	Thomson Financial DataStream McCarthy Database
Excercise Price	Hypothetical future market value of the separated entities forecast by the beta	Thomson Financial Datastream Own calculations
Standard Deviation	Annualised standard deviation of weekly returns after the merger	Own calculations
Dividend Yield	Average dividend yield in the year after the merger	Thomson Financial Datastream
Risk Free Rate	Domestic three month rate to the acquirer	Thomson Financial Datastream
Time to Maturity	One Year	

The dividend-adjusted Black-Scholes Formula is used to calculate the option premium

(1) Announcement of deal terms; excluding the week of announcement
 Note: All calculations are carried out in British Pounds

4.3 Empirical Results

In this section, we report our results and conduct some further sensitivity analysis. Firstly, the option result is reported and benchmarked with the actual takeover premium. Secondly, an attempt is made to analyse possible deviations of the option result from the actual takeover premium by analysing implicit assumptions. Thirdly, the sensitivity of the option result to changes in some of the underlying assumptions is examined.

Table 2 shows that for all 15 mergers and acquisitions an average takeover premium of 15.6% on top of the average stock price four weeks prior to the announcement of the deal terms was paid with a standard deviation of 12.5%. The takeover premium ranged from 0.74% (BBV-Argentaria) to 38.4% (Santander-BCH). Takeover premia tend to be higher in domestic deals.

The average option premium for all 15 cases is 99.6% with a standard deviation of 162%. The option premium ranges from 2.5% (Vereinsbank-Hypotheckenbank) to 580.8% (DAB-Self Trade) of the average market value four weeks prior to announcement. For international cases, the option premium tended to be higher. Extremely high values occurred for the more recent cases (Bipop-Entrium, DAB-Self Trade, HVB-Bank Austria). Due to subsequent bearish stockmarket conditions, these recent deals had lower market capitalisation one year after the merger than on announcement day. In option terms, at announcement the option was in the money since the stock price was above the exercise price (i.e. the expected future market

value)²⁹. Taking these three cases from the sample (to give what we call our 'subsample' in Table 2), the average option premium is 31.5% with a standard deviation of 27.7%.

On average, the option premium was 1.7 times or 170% of the takeover premium for the subsample with an average takeover premium of 18.5% and an average option premium of 31.5%. But there was a great dispersion within the sample. The result ranged from an option premium of 12.8% of the takeover premium (Vereinbank-Hypobank) with an option premium of 2.5% and a takeover premium of 19.6%) to an option premium of 3,809.4% of the takeover premium (Swedbanken-Föreningsbanken with an option premium of 60.9% and a takeover premium of 1.6%).

Using the option premium as a benchmark for the twelve cases in the subsample, five targets were "overpaid", i.e. the takeover premium exceeded the option premium, and seven cases were "underpaid", i.e. the takeover premium was smaller than the option premium. All "overpaid" cases were domestic mergers and the consideration was made, with one exception, in shares.

To examine why the option premium on average and for the majority of the transactions was higher than the takeover premium, a further analysis was carried out. Assuming the acquirer would have used option pricing analysis to determine the takeover premium, what would have been the implicit assumptions? What are the implicit assumptions to end up with the option premium equal to the actual takeover premium³⁰?

Table 3 shows that, on average, the actual volatility of 41.5% in the year following the announcement was above the assumed volatility of 28% on average. Considering the subsample, the actual volatility was 1.33 times the assumed volatility in the year following the merger announcement. This increase in volatility in the year following the merger cannot be explained only by an increase in market volatility. Most "wrong" estimations of the volatility occurred in domestic mergers. Interestingly, the assumed volatility, 28.1% on average, is close to the average volatility of the acquirer in the year prior to merger announcement of 29.9%. But this average result does not hold for single cases. The correlation between the targets' volatility in the year prior to announcement and the assumed volatility is only 0.13. Only in five out of twelve cases is the difference less than 50%.

So far, the option premium for a period of one year following the merger announcement was calculated. Assuming the acquirer would have used option pricing analysis to determine the takeover premium, what would have been their assumption on time to maturity? Table 4 documents the time to maturity to end up with an option premium equal to the takeover premium actually paid. On average, 1.25 year to maturity had been assumed in the subsample. But again, there is a great dispersion within the subsample. Only in four out of twelve cases was a longer period assumed. In cases with very low takeover premia, less than 3.2%, the time to maturity is less than one month. As the option price increases with time to maturity, we end up with an average option price above the takeover premium. Yet a

²⁹ These cases were considered as 'outliers' and taken out of the sample for further analysis.

³⁰ This was done using Excel "Goal Seek" setting the option premium equal to the takeover premium actually paid.

conclusion that managers had assumed a very short period of time to realise merger benefits must be taken cautiously.

Looking at Table 5, on average, the market value of the merged firm increased by 23.5% in the year following the announcement while the market increased by an average of 19%. This average result suggests that the merged firms outperformed the market but this varies highly from case to case. Only half of the merged companies actually outperformed the market. As the call option price decreases with higher exercise prices, to end up with an option premium equal to the takeover premium an increase in market value of 59.6% on average would have been necessary. We can thus conclude that, on average, a much better performance was implicitly assumed. This is true for two thirds of the cases under review.

To further demonstrate the sensitivity of the option premium to changes in the input parameter, sensitivity analyses were carried out. The change in option premium to certain changes in volatility and time to maturity were thus calculated.

Table 6 shows the change in the option premium for different volatility assumptions. Of course, the premium increases as the volatility increases. But there is a great dispersion within the sample. For a 10% volatility, the premium ranges from zero to 8.1%. For a 75% volatility, the premium ranges from 25.4% to 233.3%. Similarly, the option premium increases with time to maturity. Our base scenario option above was calculated for one year and Table 7 shows the change in the option premium for longer time periods.

5. Conclusion

Due to the small sample, restrictive assumptions and simplifications, the possibility for drawing general conclusions from our study of recent mergers and acquisitions in European financial services is limited. There are big differences within the sample, i.e. a bigger sample might give less ambiguous results. Still, even if one takes these limitations into account, some interesting findings were made.

From an option theory point of view, the results suggest that the takeover premia paid were not too high. On average, an option premium of almost double the takeover premium actually paid was found.

Furthermore, some interesting facts concerning the implicit assumptions behind the takeover premium paid were discovered using the real option pricing approach. Firstly, the actual volatility was much higher than the implicitly assumed one. The implicitly assumed volatility felt short of the actual volatility after the merger but was relatively close to the acquirer's volatility in the year prior to the merger, suggesting that a change in volatility was not considered likely. Secondly, implicitly, a much better performance in the year following the merger was assumed, as the necessary performance to equal option and takeover price was more than double the actual change in performance.

As shown in the sensitivity analysis, the option premium is highly sensitive to the input data, i.e. small changes in the assumptions can have significant effects on the premium. The quality of the results depends on the accuracy of estimating the input parameters. Our analysis of recent European bank mergers was conducted with the benefit of hindsight as a historical analysis, it was not carried out in a prospective context: the realism of the retained assumptions is definitely the weakest point of

using option theory to evaluate mergers and acquisitions beforehand, in a forward-looking context.

Compared to the actual takeover premium, very high option premia for the option on abnormal returns were found. The option price rises with uncertainty. This suggests that in most cases uncertainty was underestimated. According to our findings, acquirers were too optimistic concerning post-merger volatility, time to maturity and/or stock price performance. Apart from the limitations due to the small sample size, the results raise some further questions. Firstly, one could question if option pricing is appropriate to value flexibility and uncertainty in mergers and acquisitions. Of course the value of flexibility must be positive, but flexibility does not always improve value. It could be argued that managerial activities sometimes destroy rather than create additional value. Secondly, an abnormal return based examination assumes semi-efficient markets and this is yet another debatable issue, but one that is well beyond the scope of this article.

Overall, bank mergers and acquisitions are not yet fully understood. Particularly in Europe there is still room for further research to catch up with the US. Future research should focus on the determinants of merger effects in order to give managers, shareholders and policy makers a better information on which to base decisions. We hope to have shown that real option analysis can be an interesting way to look at bank mergers and acquisitions. But real option based research in this field is still in its infancy and, in this context, it would be interesting to carry out a real option based analysis using accounting data and not only stock prices as was the case in this paper.

APPENDIX

Table 1: European Bank Mergers & Acquisition in the Sample

Acquirer	Target	Date ¹⁾	Consideration	Comment
Allianz (Germany)	AGF (France)	Nov 1997	cash or shares	hostile bid from Generali in Oct 1997
Banco Bilbao Vizcaya (Spain)	Argentaria (Spain)	Oct 1999	shares	merger 70:30
Bipop (Italy)	Entrium (Germany)	Jun 2000	shares	majority in private transaction
BNP (France)	Paribas (France)	July 1999	shares	hostile first bid in March 1999
DAB (Germany)	Self Trade (France)	Dec 2000	shares	time to maturity only 47 weeks
Dresdner (Germany)	Kleinwort Benson (UK)	Jun 1995	cash	full integration
HVB (Germany)	Bank Austria (Austria)	Jul 2000	shares	
ING Group (NL)	Banque Bruxelles Lambert (Belg.)	Nov 1997	shares + cash	
Lloyds (UK)	TSB (UK)	Oct 1995	share + cash	merger of equals
Royal Bank of Scotland (UK)	National Westminster Bank (UK)	Jan 2000	share + cash	hostile bid second improved bid
San Paolo SpA (Italy)	IMI (Italy)	Nov 1997	shares	
Banco Santander (Spain)	Banco Central Hispano (Spain)	Jan 1999	shares	merger of equals
Swedbanken (Sweden)	Föreningsbanken (Sweden)	Feb 1997	shares + cash	government involved
Union Bank of Switzerland (CH)	Swiss Bank Corporation (CH)	Dec 1997	shares	formally SBC took over UBS
Bayr. Vereinsbank (Germany)	Hypotheken- und Wechselb. (Ger)	Jul 1997	shares + cash	partly paid by shares in Allianz

¹⁾ Announcement Day

Table 2: Takeover vs. Option Premium

Acquirer	Target	Option ¹⁾ Premium million £	Option ²⁾ Premium %	Takeover Premium million £ ³⁾	Takeover Premium % ⁴⁾	Option Premium Subsample	Takeover Premium Subsample
Allianz (Germany)	AGF (France)	288.025,00	67,30%	230,68	5,39%	67,30%	5,39%
BBV (Spain)	Argentaria (Spain)	1.687,24	25,01%	49,79	0,74%	25,01%	0,74%
Bipop (Italy)	Entrium (Germany)	4.279,50	356,02%	311,45	25,91%	-	-
BNP (France)	Paribas (France)	465,20	3,99%	959,39	8,23%	3,99%	8,23%
DAB (Germany)	Self Trade (France)	1.983,26	580,80%	96,71	28,32%	-	-
Dresdner (Germany)	Kleinwort Benson (UK)	115,11	12,29%	39,00	4,16%	12,29%	4,16%
HVB (Germany)	Bank Austria (Austria)	5.151,41	178,28%	910,47	31,51%	-	-
ING (NL)	BBL (Belgium)	2.296,14	74,95%	97,70	3,19%	74,95%	3,19%
Lloyds (UK)	TSB (UK)	617,14	14,82%	872,68	20,96%	14,82%	20,96%
RBoS (UK)	NatWest (UK)	2.284,40	10,98%	1.664,98	8,00%	10,98%	8,00%
San Paolo (Italy)	IMI (Italy)	3.642,89	63,98%	1.605,67	28,20%	63,98%	28,20%
Santander (Spain)	BCH (Spain)	513,11	6,58%	2.991,67	38,39%	6,58%	38,39%
Swedbanken (Sweden)	Förenings (Sweden)	344,66	60,95%	9,39	1,60%	60,95%	1,60%
UBS (Switzerland)	SBC (Switzerland)	5.542,82	35,06%	1.566,01	9,90%	35,06%	9,90%
Vereinsbank (Germany)	Hypobank (Germany)	118,53	2,50%	929,75	19,60%	2,50%	19,60%
Average			99,57%		15,61%	31,53%	18,47%
Standard Deviation			162,02%		12,52%	27,69%	20,81%

¹⁾ Option premium in million British Pounds ²⁾ Option premium as percentage of the average target stock price 4 weeks prior to announcement ³⁾ Actual takeover premium in million British Pounds paid to the target shareholders ⁴⁾ Actual takeover premium as percentage of the average target stock price 4 weeks prior to announcement
Source: own calculations

Table 3: Implicitly Assumed Volatility

Acquirer	Target	Volatility ¹⁾	Volatility ²⁾	Volatility ³⁾	Volatility ⁴⁾	Volatility ⁵⁾	Volatility ⁶⁾
		All t + 1Y	Subsample t + 1Y	Assumed t + 1Y	Acquirer t - 1Y	Market t - 1Y	Market t + 1Y
Allianz (Germany)	AGF (France)	42,12%	42,12%	16,93%	30,87%	20,79%	27,62%
BBV (Spain)	Argentaria (Spain)	29,02%	29,02%	7,37%	36,30%	21,96%	23,58%
Bipop (Italy)	Entrium (Germany)	44,00%	-	-	-	-	-
BNP (France)	Paribas (France)	27,63%	27,63%	35,44%	36,12%	25,46%	23,97%
DAB (Germany)	Self Trade (France)	88,96%	-	-	-	-	-
Dresdner (Germany)	Kleinwort Benson (UK)	12,70%	12,70%	9,00%	16,38%	15,76%	10,37%
HVB (Germany)	Bank Austria (Austria)	41,29%	-	-	-	-	-
ING (NL)	BBL (Belgium)	36,95%	36,95%	10,01%	29,96%	21,46%	23,87%
Lloyds (UK)	TSB (UK)	31,23%	31,23%	40,41%	22,44%	10,26%	8,79%
RBoS (UK)	NatWest (UK)	38,75%	38,75%	32,99%	35,86%	12,84%	13,77%
San Paolo (Italy)	IMI (Italy)	75,96%	75,96%	33,24%	39,99%	20,50%	30,32%
Santander (Spain)	BCH (Spain)	21,10%	21,10%	53,22%	33,75%	32,56%	16,69%
Swedbanken (Sweden)	Förenings (Sweden)	35,78%	35,78%	6,54%	24,89%	16,45%	25,03%
UBS (Switzerland)	SBC (Switzerland)	59,34%	59,34%	23,97%	27,30%	20,61%	27,43%
Vereinsbank (Germany)	Hypobank (Germany)	37,98%	37,98%	67,65%	25,60%	14,17%	22,39%
Average		41,52%	37,38%	28,06%	29,96%	19,40%	21,15%
Standard Deviation		19,89%	16,72%	19,49%	6,89%	6,04%	7,05%

¹⁾ and ²⁾ Actual annualised volatility of the merged company in the year after announcement ³⁾ Assumed volatility if option premium is set equal to actual takeover premium ⁴⁾ Annualised volatility of acquirer weekly stock return in the year prior to announcement ⁵⁾ Annualised volatility of the acquirer's domestic market index in the year prior to announcement ⁶⁾ Annualised volatility of the acquirer's domestic market index in the year following the announcement
Source: own calculations

Table 4: Implicitly Assumed Time to Maturity

Acquirer	Target	Option Premium Subsample	Takeover Premium Subsample	Time to Maturity Assumed (in years)
Allianz (Germany)	AGF (France)	67,30%	5,39%	0,16
BBV (Spain)	Argentaria (Spain)	25,01%	0,74%	0,07
Bipop (Italy)	Entrium (Germany)	-	-	-
BNP (France)	Paribas (France)	3,99%	8,23%	1,71
DAB (Germany)	Self Trade (France)	-	-	-
Dresdner (Germany)	Kleinwort Benson (UK)	12,29%	4,16%	0,53
HVB (Germany)	Bank Austria (Austria)	-	-	-
ING (NL)	BBL (Belgium)	74,95%	3,19%	0,08
Lloyds (UK)	TSB (UK)	14,82%	20,96%	2,00
RBoS (UK)	NatWest (UK)	10,98%	8,00%	0,75
San Paolo (Italy)	IMI (Italy)	63,98%	28,20%	0,22
Santander (Spain)	BCH (Spain)	6,58%	38,39%	6,21
Swedbanken (Sweden)	Förenings (Sweden)	60,95%	1,60%	0,04
UBS (Switzerland)	SBC (Switzerland)	35,06%	9,90%	0,16
Vereinsbank (Germany)	Hypobank (Germany)	2,50%	19,60%	3,05
Average		31,53%	12,36%	1,25
Standard Deviation		27,69%	11,86%	1,84

Source: own calculations

Table 5: Implicitly Assumed Exercise Price

Acquirer	Target	Combined Market Value t = 0	Actual Value t + 1 Y	Assumed Value t + 1 Y	% Change Value	% Change Ass Value	% Change Market Value
Allianz (Germany)	AGF (France)	£ 35.992,80	£45.863,01	£ 80.649,76	27,42%	124,07%	31,55%
BBV (Spain)	Argentaria (Spain)	£ 24.053,16	£27.277,34	£ 45.697,11	13,40%	89,98%	0,29%
Bipop (Italy)	Entrium (Germany)	-	-	-	-	-	-
BNP (France)	Paribas (France)	£ 23.408,08	£31.788,85	£ 28.289,11	35,80%	20,85%	39,52%
DAB (Germany)	Self Trade (France)	-	-	-	-	-	-
Dresdner (Germany)	Kleinwort (UK)	£ 8.956,69	£10.159,06	£ 10.891,12	13,42%	21,60%	23,04%
HVB (Germany)	Bank Austria (Aus)	-	-	-	-	-	-
ING (NL)	BBL (Belgium)	£ 25.069,22	£29.304,90	£ 54.289,51	16,90%	116,56%	16,16%
Lloyds (UK)	TSB (UK)	£ 7.316,51	£ 8.175,92	£ 7.462,61	11,75%	2,00%	12,90%
RBoS (UK)	NatWest (UK)	£ 30.244,10	£38.678,62	£ 42.020,59	27,89%	38,94%	7,09%
San Paolo (Italy)	IMI (Italy)	£ 12.610,11	£13.105,52	£ 22.791,17	3,93%	80,74%	7,41%
Santander (Spain)	BCH (Spain)	£ 21.232,32	£25.755,04	£ 19.173,68	21,30%	-9,70%	16,54%
Swedbanken (Swed)	Förenings (Sweden)	£ 3.309,23	£ 3.639,56	£ 7.199,41	9,98%	117,56%	13,47%
UBS (Switzerland)	SBC (Switzerland)	£ 28.961,86	£32.126,35	£ 55.521,71	10,93%	91,71%	10,70%
Vereinsbank (Ger)	Hypobank (Ger)	£ 10.823,21	£20.438,57	£ 13.088,42	88,84%	20,93%	49,15%
Average					23,46%	59,60%	18,99%
Standard Deviation					22,50%	48,76%	14,40%

Source: own calculations

Table 6: Volatility Sensitivity

Acquirer	Target	Volatility t + 1Y	Premium with actual Volatility	Premium with 10 % Volatility	Premium with 25 % Volatility	Premium with 50 % Volatility	Premium with 75 % Volatility
Allianz (Germany)	AGF (France)	42,12%	67,30%	0,24%	20,34%	91,71%	172,15%
BBV (Spain)	Argentaria (Spain)	29,02%	25,01%	2,39%	19,63%	54,07%	88,61%
Bipop (Italy)	Entrium (Germany)	-	-	-	-	-	-
BNP (France)	Paribas (France)	27,63%	3,99%	0,01%	2,83%	18,01%	36,93%
DAB (Germany)	Self Trade (France)	-	-	-	-	-	-
Dresdner (Germany)	Kleinwort Benson (UK)	12,70%	12,29%	6,04%	51,19%	142,08%	233,34%
HVB (Germany)	Bank Austria (Austria)	-	-	-	-	-	-
ING (NL)	BBL (Belgium)	36,95%	74,95%	3,17%	38,56%	116,38%	195,81%
Lloyds (UK)	TSB (UK)	31,23%	14,82%	1,77%	10,72%	27,38%	43,88%
RBoS (UK)	NatWest (UK)	38,75%	10,98%	0,09%	4,24%	17,10%	31,18%
San Paolo (Italy)	IMI (Italy)	75,96%	63,98%	8,10%	21,10%	42,48%	63,20%
Santander (Spain)	BCH (Spain)	21,10%	6,58%	0,39%	9,88%	34,98%	61,54%
Swedbanken (Sweden)	Förenings (Sweden)	35,78%	60,95%	6,31%	36,79%	93,13%	148,85%
UBS (Switzerland)	SBC (Switzerland)	59,34%	35,06%	1,46%	10,61%	28,38%	46,11%
Vereinsbank (Germany)	Hypobank (Germany)	37,98%	2,50%	0,00%	0,17%	7,81%	25,39%
Average		37,38%	31,53%	2,50%	18,84%	56,13%	95,58%
Standard Deviation		16,72%	27,69%	2,83%	15,95%	43,90%	72,37%

Source: own calculations

Table 7: Time Sensitivity

Acquirer	Target	Assumed Takeover		1 Year Option	2 Years Option	3 Years Option	4 Years Option	5 Years Option
		Time	Premium					
Allianz (Germany)	AGF (France)	0,16	5,39%	67,30%	118,36%	154,92%	182,57%	204,00%
BBV (Spain)	Argentaria (Spain)	0,07	0,74%	25,01%	42,34%	55,48%	66,13%	75,05%
Bipop (Italy)	Entrium (Germany)	-	-	-	-	-	-	-
BNP (France)	Paribas (France)	1,71	8,23%	3,99%	9,85%	14,72%	18,70%	21,97%
DAB (Germany)	Self Trade (France)	-	-	-	-	-	-	-
Dresdner (Germany)	Kleinwort Benson (UK)	0,53	4,16%	12,29%	29,25%	43,84%	56,28%	66,97%
HVB (Germany)	Bank Austria (Austria)	-	-	-	-	-	-	-
ING (NL)	BBL (Belgium)	0,08	3,19%	74,95%	125,41%	162,93%	192,77%	217,27%
Lloyds (UK)	TSB (UK)	2,00	20,96%	14,82%	23,72%	29,95%	34,59%	38,11%
RBoS (UK)	NatWest (UK)	0,75	8,00%	10,98%	20,65%	28,10%	34,08%	38,99%
San Paolo (Italy)	IMI (Italy)	0,22	28,20%	63,98%	89,19%	106,13%	118,47%	127,75%
Santander (Spain)	BCH (Spain)	6,21	38,39%	6,58%	14,83%	21,81%	27,78%	32,96%
Swedbanken (Sweden)	Förenings (Sweden)	0,04	1,60%	60,95%	93,34%	116,15%	133,50%	147,14%
UBS (Switzerland)	SBC (Switzerland)	0,16	9,90%	35,06%	51,32%	62,62%	71,19%	77,95%
Vereinsbank (Germany)	Hypobank (Germany)	3,05	19,60%	2,50%	10,40%	19,19%	27,62%	35,43%
Average		1,25	12,36%	31,53%	52,39%	67,99%	80,31%	90,30%
Standard Deviation		1,84	11,86%	27,69%	42,82%	53,52%	61,65%	68,05%

Source: own calculations

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