Long-run Volatility and Risk around Mergers and Acquisitions*

Sreedhar T. Bharath
University of Michigan

Guojun Wu
University of Michigan

This version: January 31, 2005†

*Sreedhar T. Bharath is at Ross School of Business, University of Michigan, Department of Finance, Ann Arbor, MI 48109, U.S.A. Phone: (734) 763-0485. e-mail: sbharath@umich.edu. Guojun Wu is at Ross School of Business, University of Michigan, Department of Finance, Ann Arbor, MI 48109, U.S.A. Phone: (734) 936-3248. e-mail: gjwu@umich.edu.

†We thank E. Han Kim and M.P. Narayanan for useful discussions, and seminar participants at University of Michigan for comments.

Long-run Volatility and Risk around Mergers and Acqusitions

Abstract

In this paper we study the changes in volatility and risk of acquirers around mergers and acquisitions and seek to understand the determinants of those changes. We find that there is a strong run-up in volatility and risk beginning four years before the merger. This pre-merger run-up is consistent with the hypothesis that M&As are a response to industry shocks. We find that for a period of about one year after the merger the cross-sectional average of the volatility measures continue to increase. Beyond that the systematic volatility and beta begin to decline. However, idiosyncratic volatility continues to increase for the next two years. The volatility patterns uncovered is also consistent with the risk of post-merger integration of the acquirer and the target firms that gets resolved slowly over time. Our findings may have important implications for understanding several issues, including the announcement effect of mergers, the diversification discount, and the long-run under-performance of acquirers in M&A transactions. The key insight is that as we understand the volatility and risk dynamics better, we will be able to compute risk-adjusted returns more accurately, potentially changing the conclusions of previous studies on these issues.

Keywords: Mergers and Acquisitions, Volatility, Risk, Diversification, Long-run underperformance
J.E.L. Classification Code: G12 G34.

1 Introduction

Corporate Mergers and Acquisitions (M&A) activity reached unprecedented levels in the late 1990s. In the year 2000, the dollar volume of worldwide M&A transactions reached approximately $3.2 trillion through over 3,000 transactions. Of these approximately half involved U.S. parties and U.S merger activity as a percentage of U.S. GNP was as high as 18% (Bruner 2004). In this paper we study the changes in long-run volatility and risk of acquirers around a merger and seek to understand the determinants of those changes.

A large body of empirical literature has studied the valuation effects of M&A announcements on targets and acquirers using event study methods [See Moeller, Schlingemann and Stulz (2003) for recent evidence]. The general consensus is that target firm shareholders enjoy significantly and materially positive abnormal returns while acquiring firms' shareholders experience significantly negative abnormal returns around the announcement dates. The evidence on long-run stock returns following M&A (over a 5-year period) provided by Loughran and Vijh (1997) suggests that acquirers have significantly negative returns.

While researchers have learned a lot about stock returns around an M&A transaction there has been very little study on long-run changes in volatility and risk of the acquiring firm around a merger event.[1] Studying volatility and risk changes may be important in understanding the announcement effect and the long-run returns following mergers.

Many of the existing explanations of negative announcement returns for acquirers focus on relative firm values or equity returns.[2] To the extent that acquisitions might increase the volatility of cash flows of the combined firm, the negative announcement effects documented in the literature might also be consistent with the view that markets recognize the increase in risk of the post merger firm. If the increase in volatility risk is priced, investors would demand higher expected returns from the acquirer. This can result in an immediate drop in the stock price. Similarly, changes in long-run returns might also be related to long-run changes in volatility and risk of the acquiring firm. In any case, it is worthwhile to investigate the changes

[1] Jayaraman, Mandelker and Shastri (1991) is a notable exception which studies the short-run changes in volatility (-160 +2 days) of targets around a merger using a small sample of 27 firms.

[2] For example, the hubris hypothesis of Roll (1986) suggests that managers of acquiring firms suffer from hubris, so they overpay. Jensen's (1986) free cash flow hypothesis argues that empire building management would rather make acquisitions than increase payouts to shareholders. Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2003) suggest that buying firms tend to acquire with stock when they believe the company's shares are overvalued. They find that merger activity, the use of stocks as form of payment, and who buys whom are driven by the relative valuations of the pairs of firms. Thus, the often observed post merger decline in stock price is argued to be not a reflection of the success or failure of the merger, but rather a correction in the market' valuation of the acquirer.

in volatility and risk of the acquirers around mergers and to understand the determinants of these changes.

We begin by studying the changes in volatility and risk of the equity of all U.S. acquiring firms that undertook a merger transaction between the fourth quarter of 1995 and the third quarter of 2002. One important innovation in our study is that rather than using volatility computed from realized returns, we use the implied volatility of 30-day at-the-money call options of the acquirers in event time (measured in quarters relative to the merger event).[3] The total volatility implied in an option's price is regarded as the option market's forecast of future return volatility over the remaining life of the relevant option. Implied volatility is interpreted as an efficient volatility forecast in a wide range of settings [See, for example, Day and Lewis (1988); Poterba and Summers (1986)]. As Christensen and Prabhala (1998) show, implied volatility outperforms past volatility computed using realized returns data in forecasting future volatility and subsumes the information content of past volatility. The availability of implied volatility data also dictates the choice of our sample period. We have over 6,000 firm acquisitions with implied volatility data on the event date.

Using the return beta for each acquirer relative to the market computed from the CRSP database, we decompose our total implied volatility (hereafter referred to as total volatility) into systematic and idiosyncratic components. We compute the systematic volatility each quarter as the product of beta and the average VIX index in that quarter. The VIX is the implied volatility on the S&P 100 (OEX) option traded on the Chicago Board Options Exchange (CBOE) and a popular measure of market risk. Idiosyncratic volatility is defined as the square root of the difference of the squared implied and the squared systematic volatility.

We find that there is a strong run-up in all three measures of volatility (total, systematic and idiosyncratic respectively) and risk (beta) leading up to the merger. In a four-year period leading up to the merger the run-up in the average total, systematic and idiosyncratic measures of volatility are about 13, 7 and 10 percentage points, respectively. The cross sectional average beta increases from 1.0 to 1.2 during the same period. There is a strong statistically and economically significant increase in all of these measures in the quarter after the merger as compared to the quarter before the merger.

For a period of one year after the merger, the cross-sectional averages of the volatility measures and beta continue to increase. However, both systematic volatility and beta begin to decline in the year after the merger. The decline from year one to year three following the merger for systematic volatility is about

[3]Qualitatively our results are not sensitive to choice of the maturity of the option. However using long maturity options such as a 365 day option introduces issues due to the relative lack of liquidity that must be addressed.

3 percentage points. The decline in beta for the corresponding period is about 0.16, from 1.24 to 1.08. Furthermore, idiosyncratic risk do not seem to decline for another two years. The total volatility declines slightly from one year after the merger.

In order to make sure this pattern is not due to a market-wide volatility pattern or the specific sample period, we construct volatility measures for two matched samples. The first matched sample uses the VIX measure. The second uses total volatility from firms NOT involved in any merger activities. Although there is some positive drift in volatility we do not find the same volatility patterns for the matched samples. Finally, to ensure that our results are not driven by outliers that influence cross-sectional averages, we compute year on year changes in medians of all these measures and confirm the statistical and economic significance of these patterns. The acquiring firm after the merger is really a portfolio of the target and the acquiring firm before the merger. For all targets with implied volatility data available we construct a portfolio volatility of the target and acquirer with their market value of equity as weights and the correlation between them estimated using return data in the CRSP database. The post-merger volatility is that of the acquirer. We find that this small sample produces broadly similar patterns found in the overall sample, confirming the robustness of our results.

We then turn to some interpretation of our results. The notion of industry shocks arising from unexpected changes in demand, technology, movements in capital markets and changes in entry barriers has been used to rationalize merger waves and the clustering of M&A activity within industries (Gort 1969). Mitchell and Mulherin (1996) find empirical support for this view using merger activity data in the 1980s. We construct a measure of industry shocks for each acquirer in event time following Mitchell and Mulherin (1996) and find a pattern of run-up in industry shocks similar to that of the run-up in volatility patterns uncovered above. The observed pattern of volatility is thus consistent with the theory of industry shocks. Greater industry shocks lead to greater levels of firm volatility. Increases in industry shocks are also reflected in increases in volatility measures leading up to the merger event, which may be considered as a response to industry shocks. The decline in systematic volatility and beta one year after the merger may reflect the success of merger as a response to industry shocks.

Mitchell and Mulherin (1996) argue that the poor performance of acquirers following an acquisition is often the signal of economic turbulence in the industry rather than the acquisition itself. These industry level shocks are likely to persist for some time so merger activities may predict subsequent higher volatility levels. Schumpeter (1948) argues that mergers and acquisitions are a process of creative destruction. Mergers are often followed by plant closings, change in the career of managers, and layoffs for employees. Through this

process, the economy renews itself and makes it more agile and resilient to macro shocks. Yet the process creates disruptions and uncertainties, hence it is associated with higher volatilities. Consistent with these views, we do find that total and idiosyncratic volatilities continue to be at the levels observed at the time of merger for up to three to four years after the merger.

In order to explain the observed pattern of systematic volatility and beta, we note that one of the most crucial aspects that determines the success or failure of the merger is the ability of acquirer management to unify both the target and acquirer into a single entity after the merger. Specific aspects of organizational integration include board, management, staff, programs, human resources, external communications and marketing, and systems (including finance, human resources, facilities, and information systems). The uncertainty generated by a merger creates the environment in which the post-merger integration strategy must be executed. Thus post-merger integration risk – the possibility that an M&A deal may fail to achieve the desired objectives in this process is an important issue that has to be factored in by the financial markets. This risk persists over the entire integration phase which can be as long as several years and declines with the successful integration of the acquirer and the target.

We hypothesize that firms with multiple acquisitions would face more post-merger integration risk. We divide the acquirers into quartiles based on the number of acquisitions made by the firms over the entire sample period. Frequent acquirers have higher market capitalization, profitability and leverage and lower R&D to sales when compared to infrequent acquirers. Consistent with the hypothesis, we find that frequent acquirers do not have a decline in total and idiosyncratic volatility measures following a merger. The post-merger systematic volatility also begins to decline later, after about 1.5 years post merger (compared to 0.5 years post merger for infrequent acquirers).

We then study the volatility patterns of firms that undertake non-diversifying versus diversifying mergers. Based on the principle of diversification, we expect inter-industry mergers to have declines in volatility after the merger. Surprisingly, we find that there is no difference in the patterns of volatility between the two groups. Both intra and inter industry mergers display a pre-merger four year run-up, followed by stable levels until three years after the merger for the total and idiosyncratic volatility measures. Systematic volatility and beta measures for both types of mergers are similar to the overall sample results described above. We also conduct a cross-sectional analysis of the determinants of the change in volatility between years 1 and 3 after the merger and find that (i) Cash deals decrease the total and idiosyncratic volatility compared to stock deals; (ii) Greater number of acquisitions increases the total and idiosyncratic volatility; and (iii) Increases in the market volatility are strongly related to increases in total and systematic volatility. However, a large

part of the change in total and idiosyncratic volatility between year one and three after the merger is still unexplained by deal and market characteristics.

We explore the implications of our results in some detail for the diversification discount literature. Intra-industry M&As made by single segment firms convert them into diversified firms. During our sample period, we find that about one third of the firms in the yearly cross-sectional sample used by diversification discount studies had a merger the same year. Almost the entire sample of diversification discount studies consists of firms that have undertaken mergers and acquisitions in the previous 3-5 years. Since the change in risk and volatility for the acquirer lasts for several years after a merger, we ask if these findings affect the changes in diversification discount over time. We find that excess value measures computed based on asset multiples following Berger and Ofek (1995) are decreasing for the four-year period around the merger (-2,+2). However, during the same period the cash flows of these firms show a V-shaped pattern centered on the year of the merger, i.e., cash flows decline in the run-up to the merger and rebound sharply afterwards. Our findings of increased risk and volatility following a merger is consistent with the notion of higher expected returns for these firms, leading to a deepening of the diversification discount over time. Consistent with this view, Lamont and Polk (2001) show that diversified firms in general have higher expected returns than single segment firms. Further research is required to understand the relationship between changes in diversification discount and changes in risk and volatility of firms following a merger.

The paper is organized as follows. In section 2 we describe our sample, compute and document the patterns of risk and the three measures of volatility of acquiring firms around M&A announcement dates. In section 3 we provide interpretations of the findings. We study the determinants of changes in volatility and provide some evidence that industry shock and post-merger integration risk may be related to the observed volatility patterns. In section 4, we discuss the implications of our results for the diversification discount literature, abnormal returns in merger event studies and the literature on long-run under-performance following mergers. We conclude in section 5.

2 Sample Selection and Estimation of Volatility Measures

The sample of mergers and acquisitions is obtained from the Securities Data Company's (SDC) U.S. Mergers and Acquisitions Database. We select all mergers and acquisitions with announcement dates between the fourth quarter of 1995 and the third quarter of 2002. The choice of the sample period is dictated by the availability of data on the implied volatility of at-the-money call options on the acquirer. We also require

that all mergers i) have been completed, ii) a public or private U.S. firm or a non-public subsidiary of U.S. firm is acquired, and iii) the acquirer is a public firm included in the Center for Research in Security Prices (CRSP) database during the event window. We obtain the deal value which is defined by SDC as the total value of consideration paid by the acquirer, excluding fees and expenses. We also collect information on whether a transaction is a tender offer, a friendly or hostile acquisition, paid for fully by cash or stock, and whether the target and the acquirer are in the same Fama-French (1997) industry classification or not.

2.1 Summary Statistics

Our sample selection yields 8,139 successfully completed acquisitions during this period. Table 1 shows that both the number of deals as well as the deal value steadily increase from 1995 to 1999 before declining in the latter part the sample period. Table 1 also shows that about 3% of total deals are tender offers which is consistent with the low number of tender offers reported in other studies such as Loughran and Vijh (1997). About 31% of the deals are fully financed with cash and 14% with stock. The remaining deals use a mix of stock and cash as the method of payment. About 43% of the deals are inter-industry (i.e., diversifying) mergers.

2.2 Volatility and Risk Measures

We focus on implied volatilities of at-the-money call options on the equity of the acquirer in order to obtain a total measure of risk. The volatility implied in an option's price is widely regarded as the option market's forecast of future return volatility over the life of the option. Since we wish to study forward looking measures of volatility and risk, implied volatility is a natural and theoretically motivated choice. If option markets are efficient, implied volatility should be an efficient forecast of future volatility. Christensen and Prabhala (1998) find that implied volatility outperforms past realized volatility in forecasting future volatility and even subsumes the information content of past volatility in some cases.

We obtain the implied volatility of 30-day at-the-money call options from the IVY Database of Optionmetrics LLC. IVY is a comprehensive database of historical price, implied volatility and sensitivity information for the entire U.S. listed index and equity options market and contains approximately six years worth of historical data beginning in January 1996. The implied volatilities are calculated by Optionmetrics in accordance with the standard conventions used by participants in the equity option market using a Cox-Ross-Rubinstein binomial tree model which is iterated till convergence of the model price to the market

price of the option. We match the CUSIP numbers of the acquirer to the IVY database in order to obtain the time series of impled volatilities of each acquirer. While the number of acquirers for whom the implied volatility data is available changes through time, information is available for as many as 6,800 acquisitions on the event date.

We then proceed to break down the implied volatility which is a total volatility measure into systematic and idiosyncratic components. The CAPM implies that

$$R_{it} = \beta_{im} R_{mt} + \epsilon_{it}$$
$$\sigma_i^2 = \beta_{im}^2 \sigma_m^2 + \sigma_\epsilon^2$$

where R stands for the return, σ for the volatility and the subscript i and m stand for the firm i and the market respectively.

We use the average implied volatility of 30-day at-the-money call option each quarter as an estimate of σ_i for each firm in that quarter. For an estimate of σ_m we take the average VIX index in that quarter. VIX is a volatility index computed by the Chicago Board Options Exchange. It is calculated by taking a weighted average of the implied volatility from eight calls and puts on the S&P 100 index and is used widely as a measure of market volatility. We estimate the β of each stock using the returns data from the CRSP database for each quarter, relative to the event time using the Scholes and Williams (1979) correction for non-synchronous data. Idiosyncratic volatility is defined as the square root of the difference of the squared implied and squared systematic volatility, whenever the difference is greater than zero.[4]

We estimate the cross-sectional averages of the three volatility measures (total, systematic and idiosyncratic) and beta in event time where event time is estimated in quarters relative to the event date which is the announcement of the acquisition. We study a time period of 16 quarters (four years) before and after the acquisition. Table 2 and Figure 1 document the behavior of these measures in event time. The most striking feature of the three volatility measures and beta is the strong run-up leading up to the merger. In a four-year period leading up to the merger the run-up in the average total, systematic and idiosyncratic measures of volatility are about 13, 7 and 10 percentage points, respectively. The cross sectional average beta increases from 1.0 to 1.2 during the same period. There is a strong statistically and economically significant increase in all of these measures in the quarter after the merger as compared to the quarter before the merger.

[4]For a small fraction of implied volatilities, the difference is negative so idiosyncratic volatility is not defined. We drop those observations. Our results stay the same if we assume those idiosyncratic volatility to be zero.

For a period of one year after the merger, the cross-sectional averages of the volatility measures and beta continue to increase. However, both systematic volatility and beta begin to decline in the year after the merger. The decline from year one to year three following the merger for systematic volatility is about 3 percentage points. The decline in beta for the corresponding period is about 0.16, from 1.24 to 1.08. Furthermore, idiosyncratic risk do not seem to decline for another two years. The total volatility declines slightly from one year after the merger.

In order to make sure this pattern is not due to a market-wide volatility pattern or the specific sample period, we constructed volatility measures for two matched samples. The first matched sample uses the VIX measure. The second uses total volatility from firms NOT involved in any merger activities. This sample is constructed as follows. For each calendar quarter we obtain the total assets of all firms in the COMPUSTAT database but not in our merger sample for which the implied volatility data is available. We then classify each firm into deciles and obtain the median asset value break point for each decile. For each firm in the merger sample, we assign it to the decile that is the closest corresponding one in terms of asset value. We eliminate all matches where the difference in asset values between the merger firm and the corresponding median asset value of the matching decile is greater than 10%. We then obtain the cross sectional averages of the matched sample in event time for comparison with the merger sample. The medians of the two matched samples were plotted in the top two panels of Figure 1. Although there is some positive drift in volatility we do not find the same volatility patterns for the matched samples.

One may wonder if our results are driven by a few outlier firms that influence cross-sectional averages and the changing composition of the acquirer sample in event time. In order to address this issue we conduct a more stringent test. We compute the year on year change in all our measures for the ***same*** firm in event time. We then assess the statistical significance of these changes. These results are presented in Table 3. Panel A shows that acquirer total volatility change (implied volatility) for each year-on-year period from year four before the merger is positive and significant at the 1% level (both mean and median) and for up to one year after the merger, consistent with the findings in Figure 1 and Table 2. The results of year-on-year changes in systematic and idiosyncratic volatilities and beta also formally confirm the patterns uncovered in Table 2.

We now consider the short-run changes in volatility and risk measures of the acquirer around the merger. The row (-0.25,+0.25) in the different panels of Table 3 reports the changes in these measures as the difference between the value one quarter after the merger to the value one quarter before the merger. It is important to note that there is short-run increase in each of the four measures following a merger. The

increase over the two-quarter period is large in magnitude as compared to the year-on-year changes and is statistically significant at the 1% level . For example the mean (median) change in total volatility is 1.73 (1.64) in percentage points. Collectively the results in Table 3 indicate that there are significant short-run increases in risk and volatility around a merger event.

To the extent that these changes in risk are priced via an increase in expected return demanded by investors, we might have another channel for the value loss of acquirers due to announcements of M&A transactions. In addition to the cash flow effects identified by Jensen (1986) and Roll (1986) as discussed in the introduction, the increase in expected returns due to the increase in risk can also cause a decline in the value of the acquirer. This can help explain the negative announcement return effects found in earlier studies. If managers make appropriate risk return tradeoffs while choosing targets for M&A, the increase in expected returns might not have any effect on the value, offset by the expected increase in cash flows. Thus, the relative importance of these two effects (the cash flow and the discount rate effects) in explaining the negative announcement returns is an interesting research question beyond the scope of the current paper. One implication of our results, however is that announcement effects of M&A transactions will have to take the increase in risk of the acquirer into account when estimating abnormal returns in M&A transactions.

2.3 Combined Acquirer and Target Analysis

We have focussed our analysis on the acquirer before and after an M&A transaction. However, investors in capital markets have the ability prior to the merger to combine the target and acquirer shares in their own portfolios and achieve the same effect that the merger merely formalizes. In order to address this issue we examine the value-weighted portfolio (by market value weights) of the acquirer and the target before the merger and the acquirer itself after the merger. Portfolio theory suggests that the portfolio variance of the two stocks is given by

$$\sigma_{a,t}^2 = w^2\sigma_a^2 + (1-w)^2\sigma_t^2 + 2w(1-w)\rho_{a,t}\sigma_a\sigma_t$$

where a and t stand for the acquirer and the target respectively, and w is the relative size of the acquirer. If the relative size of the acquirer is very large (close to 1) examining the acquirer is almost the same as examining this portfolio. We estimate the correlation between the target and the acquirer $\rho_{a,t}$, using the daily return data each quarter for both firms from the CRSP database. Once we obtain the total volatility of the portfolio, we can estimate the systematic and idiosyncratic components as before.[5]

[5]The beta for the portfolio before the merger is the weighted average of the betas of the acquirer and the target.

Since this calculation requires that the implied volatility of at-the-money call options of both the acquirer and the target be available in event time, we lose a lot of observations in our sample. We are able to obtain about 144 merger events with volatility data as on the event date. Note that these targets are most likely to be bigger than an average target since they have options traded. As we argue above, the pre-merger portfolio volatilities are likely to be significantly different from those of the acquirers alone only when the targets are large. For smaller targets, acquirer volatility is a good proxy for the volatility of the portfolio of the acquirer and the target. The results based on acquirer-target portfolio volatility is presented in Table 4. As can be seen, all the three measures of volatility broadly follow patterns similar to that of Table 2 even though the number of observations decline rapidly in event time beyond year 3 after the merger. For example, both total and idiosyncratic measures of volatility feature a run-up in volatility prior to the merger, followed by an increase after the merger for up to 2 years and a decline thereafter.

3 Explanations of the Patterns

3.1 Pre-Merger Period: Industry Shocks

What could explain these patterns of volatility and risk around merger events? We hypothesize that the pre-merger run-up is related to the industry shocks firm experience. We show below that the patterns of industry shocks and volatility of profitability of merger firms are consistent with the patterns of volatility and risk. The pre-merger run-ups in volatility and risk are clearly big by any standards and suggests mergers and acquisitions as a possible mechanism used by managers to address the run-up in risk. Lambrecht (2002) studies the effect of industry shocks in the framework of real options. Firms have the option to acquire instead of growing organically. Industry shocks increase the uncertainty or volatility of the firms' asset values. Hence the value of the option to merge also increases. This induces a rise in merger activity as a response to industry shocks. According to Mitchell and Mulherin (1996) the industry level shocks are likely to persist for some time so merger activities may predict subsequent higher volatility levels. If the M&A is successful as a response to the industry shocks then we would eventually see less of an increase in volatility or even lower volatility levels.

Figure 2 shows the pattern of industry shocks. For our sample of merger events we plot the cross sectional mean of corresponding industry shocks (for the acquirer's industry) as computed by Mitchell and Mulherin (1996). Their measure gauges the shocks in an industry by computing the economic change experienced by the industrys members. To create a proxy for industry shocks, we compute abnormal industry sales growth

every year in our sample period. For each of the Fama-French (1997) industries in our merger sample, we use Compustat data to first compute industry year on year sales growth. For the measure of the industry sales shock, we then take the absolute value of the difference between a particular industrys sales growth and the average sales growth across all Fama-French (1997) industries. This measure corresponds to the idea of a shock, because it emphasizes that shocks can have both positive and negative effects on industry growth. The pattern is clearly upward sloping and remarkably similar to the run up in all the volatility measures observed before the merger.

Panel A of Table 5 provides the summary statistics of industry shocks (cross sectional averages) in event time for all acquirers. The shocks continually rise from a level of 5.56% in year -4 to 6.40% in the year of the merger. To formally examine the link between industry shocks and our volatility measures, we regress the change in volatility (Total, Systematic and Idiosyncratic) for each firm from year 3 to year 1 before the merger against the change in industry shocks over the same period. The choice of the period is to maximize the number of data observations while not being too close to the merger event. We expect a positive and significant coefficient on the industry shock variable, to be consistent with the theory. Panel B of Table 5 reports the regression results. We find the coefficient on changes in industry shocks to be positive and statistically significant (at the 1% level of significance) in the regression of changes in total and idiosyncratic volatilities. However, in the regression on the change is systematic volatility, we find the coefficient to be negative and marginally significant (at the 10% level of significance). This suggests that industry shocks mainly affect the total volatility through the change in idiosyncratic volatility. This is also consistent with the observation of Schumpeter (1950) that M&A activity is driven by turbulence at the level of the firms and the industry, not at the level of the economy. [6].

3.2 Post-Merger Period: Integration Risk

Furthermore we hypothesize that post-merger integrations of acquirer and target may be behind the patterns of volatility for the post-merger period. Consistent with this story we find that firms with multiple acquisitions tend to have less decline in volatility after the merger. Mergers between firms in different industries also tend to have less decline in volatility. One of the most crucial aspects that determines the success or failure of the merger is the ability of the acquirer management to unify both the target and the acquirer into a single entity after the merger. Termed Post Merger Integration (PMI), most companies have turned to integration managers – usually mid-to-upper level executives relieved of their customary duties – to help

[6]Industry shocks are likely to lead to higher volatility of profitability for firms in the industry (Pastor and Veronesi (2003)). We compute their measure in event time and find it to be similar to the pattern of industry shocks.

lead the task of integrating companies after an M&A (Shelton 2003). Specific aspects of organizational integration include board, management, staff, programs, human resources, external communications and marketing, and systems (including finance, human resources, facilities, and information systems). According to Bruner (2004), integration planning begins before the announcement of a definitive agreement and aims to conclude by the legal consummation of the deal. The goal is to create detailed implementation plans on the organizational issues complete with milestones for making the merger work as quickly as possible. The uncertainty generated by a merger creates the environment in which the post-merger integration strategy must be executed. The pace of execution must be quick. The adherence to the intent of a deal in the face of politicking and unexpected problems an integration effort summons up must be steadfast. Finally, the communication of the deal and the PMI strategy to various constituencies such as employees must be clear. Thus post-merger integration risk – the possibility that an M&A deal may fail to achieve the desired objectives in this process is an important issue that has to be factored in by the financial markets. This risk persists over the entire integration phase which can be as long as two years.[7]

3.2.1 Volatility Patterns of Multiple Acquirers

We hypothesize that acquirers that undertake multiple acquisitions in succession will have to face higher post-merger integration risk. With multiple targets the integration process will be longer and there will be more associated uncertainties. This suggests that multiple acquirers will face a period of sustained increase in volatility following an acquisition that will take longer to get resolved. Panel A of Table 6 shows that of the 1705 unique acquirer firms in our sample, the median firm undertook 3 deals over the sample period. The median time period between deals is about four months. This means that even as the post-merger integration risk of a deal is getting resolved, a new deal would contribute to increasing the risk of the acquiring firm. In Panel B we divide the firms into quartiles based on the number of acquisitions made during our sample period. Quartile 4 firms made the greatest number of acquisitions and Quartile 1 firms the least. We then tabulate the firm specific characteristics of these acquirers. Panel C shows that multiple acquirers are bigger (higher market capitalization), have lower growth opportunities (Q ratio), lower R&D to Sales, higher profitability and leverage as compared to the firms that make the least number of acquisitions. This is consistent with the profile of bigger mature firms with less growth opportunities seeking growth through acquisitions.

Figure 3 shows the total, systematic and idiosyncratic volatilities in event time for acquirers sorted into

[7]Bruner (2004) presents a case study of the merger of Union Bank of Switzerland and the Swiss Bank Corporation in which the integration phase was as long as two years since the announcement of the merger.

quartiles based on the number of acquisitions. It can be seen that the level of volatility (all the three measures) of the acquirers is monotonically decreasing in the number of acquisitions made (i.e. multiple acquirers have the lowest volatility levels). As the number of acquisitions increases, the decrease in volatility measures following the merger is shifted to the right (i.e., occurs at a later point in time). For the firms in Quartile 4, the decline in total volatility does not begin until four and a half years after a merger. In contrast, the volatilities of acquirers in Quartile 1 begin to decline one year after the merger. Therefore, the more acquisitions an acquirer has the later the decline in volatilities would occur. This is consistent with the view that the increase in volatility following a merger is at least in part due to post-merger integration risk, and the risk is greater and lasts longer for firms that make multiple acquisitions.

3.2.2 Role of Relative Size on Volatility Patterns of Multiple Acquirers

We examine the role of the relative size of the target to the acquirer on the increase in our measures of volatility following a merger. We expect that if the target is very small relative to the acquirer, the post-merger integration risk is likely to be lower and thus we do not expect to see a significant increase in our volatility measures. We define relative size as the ratio of the average market capitalization of the target to the sum of the average target and acquirer market capitalizations. The average is computed over the calendar year preceding the merger year. Due to data limitations, this produces about 962 cases. Firms are then sorted into two groups below and above the median relative size of the target: relative size small and relative size large, respectively. Similarly, the top two quartiles of the firms based on the number of acquisitions made are classified as frequent acquirers and the bottom two quartiles as infrequent acquirers. Each merger deal is then classified into one of the four groups based on the relatives size and the frequency of the acquisitions. Panel A of Table 7 reports the distribution of relative size and number of acquisitions (count) in these four groups.

Panel B of Table 7 reports the difference in total volatility for the same firm between quarter 1 and quarter 8 following the merger in event time. The choice of quarter 1 and 8 is to ensure that at least 30 data points are available in all the four groups for analysis. Figure 4 provides the time series of total volatility in event time for up to 16 quarters after the merger. From Figure 4, we see that amongst infrequent acquirers and a small target, there is a rapid decline in total volatility following the merger. It takes much longer for volatility to decline when the target is relatively large. Statistical tests of the mean suggest that the decline for small targets is about 14.1% and significant at the 1% level. However, for the relatively large targets the decline is indistinguishable from zero. These results suggest that it is difficult to integrate a large target as quickly as a small one.

The results among frequent acquirers and small/large targets, as shown in the bottom panel of Figure 4, is striking. Regardless of the relative size of the target, frequent acquirers are seen to have a steady increase in total volatility in the years following the merger. Statistical tests of the mean suggest that the increase in acquirer volatility for relatively large targets is about 4.6% and significant at the 1% level. However, the volatility change is slightly negative and indistinguishable from zero for the relatively small targets.[8] These results suggest that regardless of the size of the target, volatility does not decline (small targets) or continues to increase (large targets) amongst frequent acquirers. These results provide further support for the notion of post-merger integration risk that gets resolved over time. But the integration process lasts longer when the acquirer makes multiple acquisitions and the targets are relatively large.

3.2.3 Intra versus Inter Industry Mergers

Perhaps the strongest evidence in support of post-merger integration risk contributing to the increase in volatility following a merger can be obtained by looking at a sample of firms that diversified their industry operations by acquiring a firm outside their industry (Inter-Industry Mergers). The principle of diversification suggests that firms in different industries are more likely to have less correlated returns and cash flows. This would then lead to a lower volatility for the combined firm which is really a portfolio of the acquirer and the target. Thus from a portfolio diversification perspective we expect to see a greater decline in our volatility measures for inter industry mergers when compared to intra industry mergers (which are among firms in the same industry and hence more likely to be correlated).

A merger is classified as inter-industry if the acquirer and the target belong to different industries according to the 48-industry classification of Fama and French (1997) and intra-industry otherwise. Table 8 and Figure 5 present the results for the three volatility measures grouped according to the type of merger: Intra or Inter-Industry. Surprisingly, we find from Figure 5 that the behavior of both intra and inter industry mergers are similar for all the volatility and risk measures, even though we expected a greater decrease in these measures for inter-industry mergers as compared to intra-industry mergers. Contrary to the prediction of the portfolio theory, the figure shows that intra-industry mergers have a greater increase in volatility over time, i.e., volatilities start at lower levels compared to inter-industry mergers and end up at greater levels greater after the merger. Furthermore, the decrease in volatilities also are smaller and they happen later than for the intra-industry mergers. Table 8 reports the differences between the two groups' year-on-year

[8] This is possible even though the cross-sectional averages in event time are trending up slightly. We measure the decline or increase for the same firm in event time for our statistical tests.

changes for the three volatility measures. In all cases, the differences, as shown in the last two columns of the table, are either insignificant or of the wrong sign. Intra-industry mergers have higher increases in the run-up period and the years 1-3 post-merger period as compared to inter-industry mergers. This evidence lends considerable support for the view that post-merger integration risk is an important determinant of the volatility patterns observed after a merger.

3.2.4 Cross-Sectional Determinants of the Changes in Post Merger Volatility

We now examine the determinants of the changes in volatility after a merger using a multiple regression framework. Specifically, we study the changes in our volatility measures between years 1-3 following the patterns identified in earlier sections. We include changes in market specific volatility (the VIX index) and the deal characteristics as explanatory variables. We do not includes changes in firm specific measures in the regression as it is not clear what the direction of causality is between them and the volatility measures. The results of these regressions are presented in Table 9.

We report regression results for the change in all our three volatility measures between year 3 and year 1. We find that change in market volatility is an important determinant of change in total and systematic volatility. A 1% increase in the VIX index produces a 0.3% increase in total volatility and 1.42% increase in systematic volatility over the 2 year period. Both the total and idiosyncratic volatility regressions have a positive and significant intercept, suggesting that there is a lot of unexplained increase in volatility. Both measures are strongly and positively related to the number of acquisitions made by the firm. An increase in the number of acquisitions from the 25th to the 75th percentile increases both measures in year 3 by 0.5% over the year 1 levels. However, the number of acquisitions does not seem to affect systematic risks. This is consistent with the hypothesis that the increase in volatility during the period is due to integration risk which is likely to to be firm-specific and not systematic. The systematic risk is basically only significantly affected on by the VIX. Amongst deal characteristics we find that cash deals decrease the total and idiosyncratic volatility. Finally, we find that inter-industry mergers are not different from intra-industry mergers in their total and idiosyncratic volatility changes, as the coefficient is largely insignificant. However, contrary to expectation, systematic volatility increases for inter-industry mergers (by about 1.7% with a significance level of 10%), and increases more for firms making greater number of acquisitions.

4 Implications of the Results

We now discuss the implications of these results for the following effects well studied in the literature: the announcement effect, the diversification discount, and long-run under-performance of acquirers following a merger.

4.1 Acquirer Announcement Effect

A large literature over the last twenty five years has examined the returns to acquirer shareholders on the announcement of an acquisition. Bruner (2004) summarizes the findings of these studies. There are 22 studies that report negative returns with 14 of the 22 being significantly negative. The significantly negative returns vary between 1% and 4%. There are 32 studies that report positive returns with 23 of them reporting significantly positive returns. Overall 26% of the studies show value destruction (significant negative returns); 31% show value conservation (insignificantly different from zero); and 43% show value creation (positively significant returns).

Our results of significant increase in total and systematic measures of volatility around the merger event has implications for the results of these studies. All of these studies typically use a benchmark model of returns (say the market model) estimated from past return data of the acquirers before the merger to compute the abnormal returns due to the event. To the extent that mergers raise the risks of these acquirer firms that are priced by an asset pricing model, the expected returns on these firms go up around the merger. Taking this into account in computing the abnormal returns could change the conclusions of these studies. In particular, the studies that report positive abnormal returns would over-estimate the gains due to acquisitions without considering the commensurate increase in risk around the event.

4.2 The Diversification Discount

A large literature following Berger and Ofek (1995) compares the market value of firms that operate multiple lines of business to the value of a portfolio of stand-alone firms operating in the same industries. They find that U.S. conglomerates are priced at a mean discount of 15% (the diversification discount). The presence of such a discount is of considerable debate in the literature and has been challenged and attributed to selection bias by Graham, Lemmon and Wolf (2002).

Since many firms become diversified by the process of M&A, it is of considerable interest to study the behavior of the discount over time around merger events. Using the same criteria applied by Berger and Ofek (1995) and other studies, we construct a sample of diversified firms each calendar year. We find that out of this sample about 30% of the firms undertook an M&A transaction the **same** year as reported in Table 10. Given our results that changes in volatility around an M&A transaction for an acquirer are over a long period of 3-6 years, it is likely that almost the entire diversification discount sample would be consisting of acquirers experiencing changes in volatility and risk around mergers. Thus it would be of considerable interest to study the changes in diversification discount around a merger.

Table 10 and Figure 6 present the results of the changes in diversification discount over time. We calculate the excess value measures following Berger and Ofek (1995) using asset multipliers in event time. We separate the firm into premium firms (excess value > 0) and discount firms (excess value < 0). From both Table 10 and Figure 6 it is clear that that the excess value measures are steadily declining for the two-year period around the merger. The decrease is statistically indistinguishable from zero for discount firms and strongly significant for premium firms. At the same time, the cash flows from operations (scaled by total assets) is V-shaped in event time for both discount firms and premium firms. That is, there is a sharp rebound in actual cash flows following a merger. The difference between year +2 and year 0 cash flows is strongly statistically significant at the 1% level of significance for both the mean and the median. The value of any firm depends mechanically on the firm's future cash flows and future expected returns. Thus, even with an increase in actual cash flows following a merger (which is a good proxy for future cash flows) the excess values continue to decline. This suggests that expected returns would have to increase for these firms around the same time period. Given our results of increase in risk and volatility measures following a merger, this is plausible. Thus our results suggest that changes in diversification discount of firms over time might be related to changes in risks of these firms over time (especially due to M&A transactions). However, further research is required to understand the relationship between the changes in risk around M&A and the changes in diversification discount over time.

4.3 Long-run Under-performance following Mergers

Loughran and Vijh (1997) show that acquirers earn an abnormal return of -6.5% over a five year period following the merger compared to a sample of matching firms. Cash financed mergers have an abnormal return of +18.5% while stock financed mergers have an abnormal return of -24.2%. The matching of the firms is in the spirit of Fama and French (1992) in that it adjusts for size and book-to-market effects. Specif-

ically, all firms are ranked according to their yearly required returns on equity (i.e., F=b0 + b1*Size + b2*Book-to-market). Firms are then ranked on this F-value and matched with the acquirer firms. Then the five-year buy-and-hold returns are computed for the acquirer and the control firm. However, to the extent that the acquirer volatility and risk change over the four-year period after the merger (increases for the first year and then decreases), the matching firm has to mimic the changes of the acquirer firm over the four years in order to draw inferences on long-run under-performance. For example, if the increase in volatility and risk (that is priced) of the acquirer over the first year is not taken into account while constructing the matching firm, the under-performance is understated. Similarly over the next three years, if the decrease in risk is not taken into account while constructing the matching firm, the under-performance is overstated. The net effect of this over the five year-period is a matter of empirical determination and has implications for the conclusion about long-run under-performance following mergers.

5 Conclusion

In this paper we study the changes in volatility and risk of acquirers around mergers and acquisitions and seek to understand the determinants of those changes. We find that there is a strong run-up in volatility and risk beginning four years before the merger. This pre-merger run-up is consistent with the hypothesis that M&As are a response to industry shocks. We find that for a period of about one year after the merger the cross-sectional average of the volatility measures continue to increase. Beyond that the systematic volatility and beta begin to decline. However, idiosyncratic volatility continues to increase for the next two years. The volatility patterns uncovered is also consistent with the risk of post-merger integration of the acquirer and the target firms that gets resolved slowly over time.

Our findings may have important implications for understanding several issues, including the announcement effect of mergers, the diversification discount, and the long-run under-performance of acquirers in M&A transactions. The key insight is that as we understand the volatility and risk dynamics better, we will be able to compute risk-adjusted returns more accurately, potentially changing the conclusions of previous studies on these issues.

References

[1] Andrade, Gregor, Mark Mitchell, and Erik Stafford, 2001, "New Evidence and Perspectives on Mergers," *Journal of Economic Perspectives* 15, 103-120.

[2] Berger, P., and E. Ofek, 1995, "Diversification's effect on firm value," *Journal of Financial Economics* 37, 39-65.

[3] Bruner, R.,2004, *Applied Mergers and Acqusitions*, John Wiley and Sons Inc.

[4] Campbell, John Y., Martin Lettau, Burton G. Malkiel, and Yexiao Xu, 2001, "Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk," *Journal of Finance* 56, 1-43.

[5] Christensen,B. J., and N. R. Prabhala, 1998, "The Relation Between Implied and Realized Volatility," *Journal of Financial Economics* 50, 125-150.

[6] Day, T. E., Lewis, C. M., 1988, "The Behavior of the Volatility Implicit in the Prices of Stock Index Options," *Journal of Financial Economics* 22, 103-122.

[7] Fama, E. and French K., 1992, "The Cross Section of Expected Returns," *Journal of Finance* 47, 427-465.

[8] Fama, E. and French K., 1997, "Industry Costs of Equity," *Journal of Financial Economics* 43, 153-193.

[9] Gort, M., 1969, "An Economic Disturbance Theory of Mergers," *Quarterly Journal of Economics* 83, 624-642.

[10] Graham, J. R., M. Lemmon, and J. Wolf, 2002, "Does Corporate Diversification Destroy Value?" *Journal of Finance* 57, 695-720.

[11] Jayaraman, N., G., Mandelker, and K., Shastri, 1991, "Market Anticipation of Merger Activities: An Empirical Test," *Managerial and Decision Economics* 12, 439-448.

[12] Jensen, M. C., 1986, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review* 76, 323-329.

[13] Lambrecht, Bart M., 2002, "The Timing of Takeovers under Uncertainty: A Real Options Approach," Working paper, Cambridge University.

[14] Lamont, O., and C. Polk, 2001, "The Diversification Discount: Cash Flows Versus Returns," *Journal of Finance* 56, 1693-1721.

[15] Loughran, T., A. Vijh, 1997, "Do Long-term Shareholders Benefit from Corporate Acquisitions?" *Journal of Finance* 52, 1765-1790.

[16] Mitchell, Mark L, and J. Harold Mulherin, 1996, "The Impact of Industry Shocks on Takeover and Restructuring Activity," *Journal of Financial Economics* 41, 193-229.

[17] Moeller, Sara B., Frederik P. Schlingemann, and Rene M. Stulz, 2003, "Firm Size and the Gains from Acquisitions," *Journal of Financial Economics* forthcoming.

[18] Pastor, Lubos, and Pietro Veronesi, 2003, "Stock Valuation and Learning about Profitability" *Journal of Finance* 58, 1749-1790.

[19] Poterba, James M., and Lawrence H. Summers, 1986 "The Persistence of Volatility and Stock Market Fluctuations," *American Economic Review* 76, 1142-51.

[20] Rhodes-Kropf, Matthew, and S. Viswanathan, 2003"Market Value and Merger Waves," *Journal of Finance* forthcoming.

[21] Roll, R., 1986, "The Hubris Hypothesis of Corporate Takeovers," *Journal of Business* 59, 197-216.

[22] Scholes, M. and Williams J.,1977, "Estimating Betas from Nonsynchronous Data," *Journal of Financial Economics* 5, 309-327.

[23] Shelton M. J., 2003, "Managing Your Integration Manager," *Mckinsey on Finance* Summer, 12-15.

[24] Shleifer, Andrei, and Robert W. Vishny, 2003, "Stock Market Driven Acquisitions," *Journal of Financial Economics* 70, 295-311.

Table 1: Number of Mergers, Mode of Deal, and Form of Payment

This table reports the number of mergers, mode of deal, and form of payment over the sample period by COMPUSTAT calendar year and quarter. Deal Value is in billions of dollars. All other values are as percentage of the number of deals in each quarter. Cash and Stock represent deals that are 100% financed by cash and stock respectively. Inter Ind. is a merger where the acquirer and the target belong to different industries. Industry classification follows the 48-industry groupings by Fama and French (1997). The sample consists of all deals reported in SDC Platinum database and for which implied volatility of at-the-money call options (30 day maturity) is available for the acquirer in the Option Metrics database. The sample period is 1995.Q4 to 2002.Q3.

Year	Qtr	No.	Deal Value	Tender offer	Friendly	Cash	Stock	Inter Ind.
1995	4	90	16.2	3.33	100.00	28.89	14.44	37.78
1996	1	218	40.4	3.67	97.71	32.11	12.39	39.45
1996	2	211	19.2	1.90	97.63	28.91	13.74	45.50
1996	3	256	36.6	1.56	94.14	28.13	16.41	39.84
1996	4	224	52.2	4.46	96.88	29.91	13.39	37.50
1997	1	253	28.5	2.37	98.42	25.69	13.04	43.08
1997	2	264	29.9	2.65	98.11	31.82	11.36	37.12
1997	3	262	39.5	1.91	99.62	30.92	16.41	44.66
1997	4	322	54.0	4.04	98.45	33.85	10.87	42.24
1998	1	287	48.2	3.14	98.95	26.83	19.16	40.77
1998	2	368	191.9	2.45	96.74	26.63	12.23	41.85
1998	3	380	79.0	2.37	97.11	28.95	13.42	42.37
1998	4	319	89.0	3.13	97.81	30.72	13.48	38.24
1999	1	377	136.9	2.92	97.88	33.16	11.41	43.24
1999	2	427	177.7	4.22	99.30	34.19	17.80	43.79
1999	3	388	158.6	3.09	97.94	24.74	20.10	40.98
1999	4	425	192.3	2.59	97.18	30.12	20.71	44.94
2000	1	421	176.9	2.61	97.15	27.79	21.62	44.42
2000	2	388	216.1	4.38	98.45	27.58	19.33	47.94
2000	3	356	111.1	5.06	98.60	32.30	18.82	46.63
2000	4	283	76.4	2.83	98.59	32.16	13.07	50.18
2001	1	274	51.8	2.19	98.91	33.21	10.58	44.53
2001	2	279	144.4	3.94	98.21	34.05	14.34	42.65
2001	3	234	63.8	4.70	98.29	29.06	6.41	42.31
2001	4	221	41.0	2.71	98.64	30.77	10.41	43.89
2002	1	202	30.6	3.96	98.02	35.64	7.43	43.56
2002	2	216	26.1	4.17	98.61	41.67	4.17	41.67
2002	3	194	7.3	1.03	100.00	36.08	3.61	50.00
All Qtrs		8139	2335.5	3.15	98.03	30.68	14.36	43.11

Table 2: Volatilities and Beta Summary Statistics

This table provides the summary statistics of implied volatility of at-the-money call options (30 day maturity), beta, systematic volatility and idiosyncratic volatility for acquirer by event time measured in quarters relative to the merger announcement date. Betas are computed using daily return data within each quarter. Systematic volatility is computed by multiplying beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. The sample period is from 1995.Q4 to 2002.Q3.

Panel A: Acquirer Implied Volatility in %

				Quantiles				
Event time	n	Mean	S.D.	Max	Q3	Mdn	Q1	Min
-16	1987	47.49	19.10	169.03	59.21	43.08	32.74	11.27
-12	3088	50.70	21.82	328.38	62.55	45.93	34.82	14.54
-8	4225	54.31	23.37	243.77	67.51	48.63	37.08	13.15
-4	5476	57.22	24.66	336.82	69.86	51.29	39.38	4.35
-1	6642	59.40	25.58	342.41	73.44	53.13	40.80	4.34
1	6765	61.13	26.66	266.57	75.86	54.77	41.52	3.89
4	6404	62.90	26.67	445.57	78.70	57.26	42.68	3.74
8	5412	62.61	24.16	195.46	77.17	58.12	44.08	3.23
12	4050	62.04	22.89	209.77	75.65	58.07	44.48	9.28
16	2720	61.37	22.31	224.14	74.09	57.25	44.36	5.64

Panel B: Acquirer Beta

				Quantiles				
Event time	n	Mean	S.D.	Max	Q3	Mdn	Q1	Min
-16	1987	1.02	0.86	6.26	1.39	0.93	0.53	-4.91
-12	3088	1.04	0.91	7.68	1.41	0.89	0.51	-2.19
-8	4225	1.07	0.94	8.42	1.49	0.90	0.49	-4.51
-4	5476	1.13	1.01	6.67	1.58	0.95	0.50	-3.61
-1	6642	1.18	1.03	7.26	1.63	0.97	0.53	-2.52
1	6765	1.23	1.06	8.42	1.71	1.02	0.54	-2.15
4	6404	1.24	1.11	9.12	1.76	1.03	0.54	-3.28
8	5412	1.16	1.02	9.80	1.63	0.99	0.51	-3.00
12	4050	1.08	1.01	7.18	1.55	0.90	0.44	-2.44
16	2720	1.06	0.96	9.66	1.51	0.88	0.43	-2.02

Table 2 (continued): Implied Volatility Summary Statistics

Panel C - Acquirer Systematic Volatility in %

				Quantiles				
Event time	n	Mean	S.D.	Max	Q3	Mdn	Q1	Min
-16	1987	23.18	17.88	139.54	30.66	18.62	10.68	0.05
-12	3088	24.22	19.98	150.08	31.97	18.83	10.84	0.00
-8	4225	25.95	21.54	219.50	34.70	20.63	10.86	0.03
-4	5476	28.50	23.99	174.90	37.66	22.25	11.59	0.02
-1	6642	29.61	24.07	206.08	39.87	23.09	12.53	0.01
1	6765	30.99	25.37	194.52	41.49	24.44	12.89	0.02
4	6404	32.25	26.55	222.58	43.39	24.99	13.41	0.01
8	5412	30.94	24.80	302.34	42.23	24.55	13.24	0.02
12	4050	29.17	24.65	213.14	39.51	22.29	11.63	0.02
16	2720	28.34	24.00	297.25	38.79	22.06	11.39	0.01

Panel D: Acquirer Idiosyncratic Volatility in %

				Quantiles				
Event time	n	Mean	S.D.	Max	Q3	Mdn	Q1	Min
-16	1820	40.82	19.37	163.07	51.43	37.52	26.34	1.89
-12	2845	43.64	21.91	327.76	55.15	39.34	28.42	0.84
-8	3876	46.86	23.14	241.02	59.47	42.21	30.30	3.11
-4	5032	48.49	23.21	336.12	60.43	44.13	32.57	0.66
-1	6164	50.13	23.88	341.40	62.69	45.51	33.43	1.17
1	6247	51.40	24.84	266.23	64.53	46.59	33.98	1.19
4	5854	53.01	24.75	445.23	66.84	48.56	35.52	2.09
8	4955	53.37	23.73	195.46	67.00	49.71	36.05	2.12
12	3708	53.72	22.83	203.26	66.95	50.09	37.61	2.72
16	2497	53.40	22.44	224.11	65.86	50.14	38.07	1.66

Table 3: Changes in Volatilities and Beta

This table provides the univariate tests of changes in implied volatility of at-the-money call options (30 day maturity), beta, systematic volatility and idiosyncratic volatility for acquirer each year measured relative to the merger announcement date. Mean and Median for the period (i,j) denotes the change in each measure between year j and year i, where i and j are measured relative to the merger announcement date. The t-Test (Wilcoxon test) statistic tests the hypothesis that Mean (Median) each year is zero. Betas are computed using daily return data within each quarter. Systematic volatility is computed by multiplying beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. The sample period is from 1995.Q4 - 2002.Q3. ***,**,* indicates significance at 1%, 5% and 10% level respectively.

	Mean	t-test	Median	Wilcoxon	Mean	t-test	Median	Wilcoxon
Period	Panel A : Total Volatility				Panel B : Systematic Volatility			
(-4,-3)	3.21	5.36***	2.85	4.86***	1.05	1.90*	0.21	0.72
(-3,-2)	3.61	6.72***	2.70	6.39***	1.72	3.48***	1.80	3.15***
(-2,-1)	2.91	5.90***	2.66	6.20***	2.55	5.42***	1.62	4.32***
(-0.25,+0.25)	1.73	3.83***	1.64	3.52***	1.38	3.22***	1.35	2.80***
(+0.25,1)	1.77	3.81***	2.49	4.49***	1.26	2.79***	0.55	2.28**
(1,2)	-0.29	-0.62	0.86	1.45	-1.31	-2.75***	-0.44	-1.67*
(2,3)	-0.57	-1.16	-0.05	-0.29	-1.77	-3.45***	-2.26	-4.51***
(3,4)	-0.67	-1.19	-0.82	-1.07	-0.83	-1.38	-0.23	-1.17
	Panel C : Beta				Panel D: Idiosyncratic Volatility			
(-4,-3)	0.02	0.68	-0.04	-0.93	2.82	4.48***	1.82	4.12***
(-3,-2)	0.03	1.54	0.01	1.54	3.22	5.76***	2.87	5.57***
(-2,-1)	0.07	3.22***	0.05	2.14***	1.63	3.3***	1.92	4.12***
(-0.25,+0.25)	0.05	2.66***	0.05	2.36***	1.27	2.9***	1.08	2.61***
(+0.25,1)	0.02	0.90	0.01	0.46	1.61	3.56***	1.97	4.51***
(1,2)	-0.08	-4.07***	-0.04	-2.97***	0.36	0.77	1.15	1.49
(2,3)	-0.08	-3.83***	-0.09	-4.66***	0.35	0.69	0.38	1.37
(3,4)	-0.02	-0.74	-0.02	-0.48	-0.32	-0.55	0.05	0.38

Table 4: Portfolio Analysis of Acquirer and Target

This table provides the portfolio implied volatility of at-the-money call options (30 day maturity), systematic volatility and idiosyncratic volatility for each merger deal measured relative to the merger announcement date. The portfolio is the market value weighted combination of acquirer and target before the merger and the combined entity (acquirer) after the merger. Portfolio volatility before the merger is obtained using the portfolio variance formula on the acquirer and the target. Portfolio volatility after the merger is the volatility of the combined entity (acquirer). Correlation between the acquirer and the target each quarter is computed using daily return data within the quarter. Betas are computed using daily return data within each quarter. Beta before the merger is the market value weighted average of the acquirer and the target. Beta after the merger is the beta of the combined entity (acquirer). Systematic volatility is computed by multiplying the portfolio beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. The sample period is from 1995.Q4 - 2002.Q3.

	Total Volatility			Systematic Volatility		Idiosyncratic Volatility		
Quarter	N	Mean	Median	Mean	Median	N	Mean	Median
-16	45	38.57	37.37	22.32	17.71	39	31.87	31.17
-12	60	41.26	36.41	29.53	27.32	46	31.21	26.77
-8	80	47.74	43.29	30.70	28.42	68	36.88	35.31
-4	119	54.25	48.57	27.37	21.39	111	45.44	44.09
-1	128	56.58	50.29	31.21	25.59	121	43.34	41.07
1	144	59.58	52.67	32.87	26.51	128	49.22	45.44
4	113	54.89	48.39	31.59	24.65	102	43.70	41.76
8	65	55.88	48.61	36.78	34.68	52	43.96	37.96
12	27	49.23	42.94	26.09	22.77	25	40.76	36.40
16	15	48.76	43.03	32.82	25.49	13	34.61	31.83

Table 5: Industry Shocks of Acquiring Firms

This table provides the behavior of industry shocks of acquiring firms in percent around the merger event by event time measured in years relative to the merger announcement date. Industry Shock is defined as the shock to sales and is computed following the method in Mitchell and Mulherin (1996). The cross sectional average of this measure and its distribution is presented in Panel A. Panel B provides the regression analysis of the change in volatility (total, systematic and idiosyncratic) between year -3 and year -1 for the same firm before the merger announcement date. ΔVIX is the change in the VIX index for the corresponding period before the merger. Industry classification follows the 48-industry groupings by Fama and French (1997). The sample period is from 1995.Q4 - 2002.Q3. ***,**,* indicates significance at 1%, 5% and 10% level respectively.

Panel A: Summary Statistics of Industry Shocks

Event time	n	Mean	S.D.
-4	8731	5.56	4.58
-3	8731	5.90	4.96
-2	8731	6.24	5.60
-1	8731	6.45	6.06
0	8731	6.73	6.40
1	7853	6.66	6.41
2	6750	6.79	6.77
3	5130	7.00	7.35
4	3460	6.81	6.83

Panel B : Regression Analysis

	ΔTotalvol	ΔSysvol	ΔIdiovol
	(1)	(2)	(3)
Const.	5.59***	0.17	4.21***
	(0.37)	(0.48)	(0.45)
ΔVIX	0.11**	1.14***	
	(0.05)	(0.06)	
ΔIndShock	0.26***	-0.11*	0.28***
	(0.05)	(0.06)	(0.06)
Obs.	2998	2998	2557
R^2(%)	1.09	10.25	0.80

Table 6: Summary Information on Deal Activity and Firm Characteristics of Acquirers

This table provides the distribution of number of merger deals and days between deals for acquirers in the sample (Panel A). It also provides the mean and median firm characteristics one year before the merger date sorted into quartiles (Panel B). Acquiring firms are grouped into quartiles based on the total number of mergers undertaken within the sample period. Quartile 1 consists of firms with the least number of mergers and Quartile 4 the most. Inter Ind. is a dummy variable that assumes the value 1 for a merger where the acquirer and the target belong to different industries. Industry classification follows the 48-industry groupings by Fama and French (1997). Firm Characteristics are obtained from COMPUSTAT Quarterly data files. Market Cap is the product of price and number of shares outstanding (Data14*Data61). Q Ratio is the ratio of market value of assets to book value of assets ((Data44-Data60+Data14*Data61)/Data44). R and D to Sales is the ratio of R and D expenses to sales (Data4/Data2). Tangibility is the ratio of property, plant and equipment to total assets (Data42/Data44). Profitability is the ratio of operating income before depreciation to total assets (Data21/Data44); Leverage is the ratio of long term debt to total assets (Data51/Data44). The t-Test (Wilcoxon test) statistic tests the hypothesis that Mean (Median) of the difference between quartile 4 and quartile 1 is zero (Panel C). The sample period is from 1995.Q4 - 2002.Q3. ***,**,* indicates significance at 1%, 5% and 10% level respectively.

Panel A

Variable	Obs	Mean	Median	Std Dev	Min	25th	75th	Max
No. of deals	1705	4.82	3	5.65	1	1	6	68
Days b/w deals	6514	225.32	116	293.02	1	41	289	2314

Panel B

	Quartile 1		Quartile 2		Quartile 3		Quartile 4	
Variable	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Diversify	43.4%	0	40.4%	0	44.1%	0	43.2%	0
Market Cap	2690.27	527.79	2614.77	632.65	4015.04	829.21	14221.63	1952.85
Q Ratio	3.84	2.26	3.72	2.20	2.90	2.00	3.17	2.18
Tangibility	26.5%	19.5%	26.8%	19.4%	27.7%	20.7%	24.1%	18.3%
R and D to Sales	84.6%	15.4%	145.7%	12.3%	99.9%	9.7%	17.6%	9.1%
Profitability	-0.3%	3.4%	1.8%	3.6%	3.1%	4.0%	4.5%	4.3%
Leverage	14.8%	5.4%	16.0%	8.7%	18.3%	11.2%	20.1%	15.2%

Panel C

Variable	t-test (Q4-Q1)	Wilcoxon (Q4-Q1)
Diversify	-0.08	-0.08
Market Cap	4.92^{***}	11.33^{***}
Q Ratio	-2.89^{***}	-1.33
Tangibility	-2.13^{**}	-0.73
R and D to Sales	-8.12^{***}	-6.78^{***}
Profitability	4.67^{***}	5.46^{***}
Leverage	4.09^{***}	6.25^{***}

Table 7: Summary Information on Relative Size of Acquirer and Target

This table provides the distribution of the relative size of the acquirer and the target. Firms are first sorted into two groups, below and above the median number of acquisitions in the sample period (infrequent and frequent acquirers respectively). Firms are further sorted into two groups below and above the median relative size of the target to the acquirer (relative size small and relative size large respectively). Relative size is defined as the ratio of the average market capitalization of the target to the sum of the average market capitalizations of the target and acquirer. The average is computed over the calender year preceding the merger year. Total volatility is measured using the implied volatility of at-the-money call options (30 day maturity). Panel A provides the distribution of the relative size in the four groups described above. Panel B provides the differences in mean total volatility between quarter 1 and quarter 8 after the merger for infrequent and frequent acquirers respectively. The t-test statistic tests the hypothesis that difference of the mean total volatility is zero. The sample period is from 1995.Q4 - 2002.Q3. ***,**,* indicates significance at 1%, 5% and 10% level respectively.

Panel A: Relative Size and Count Summary Statistics

No. of Acq	Rel - Size	Variable	Obs	Mean	Median	Std Dev	Min	25th	75th	Max
Infrequent	Small	Relsize	40	3.0%	3.3%	2.0%	0.05%	0.8%	4.5%	6.7%
		Count	40	1.7	2	0.5	1	1	2	2
Infrequent	Large	Relsize	70	28.6%	22.5%	19.8%	7.2%	12.8%	36.5%	82.3%
		Count	70	1.6	2	0.5	1	1	2	2
Frequent	Small	Relsize	464	2.2%	1.5%	2.1%	0.01%	0.4%	3.6%	7.0%
		Count	464	17.4	13	16.4	3	7	20	68
Frequent	Large	Relsize	388	25.2%	20.7%	17.3%	7.1%	12.3%	32.0%	96.4%
		Count	388	9.2	7	7.2	3	4	11	68

Panel B: Difference in Mean Total Volatility between Quarter 1 and Quarter 8

No. of Acq	Rel - Size	Mean	t-stat
Infrequent	Small	-14.1	-2.84***
Infrequent	Large	-5.5	-1.42
Frequent	Small	-0.4	-0.33
Frequent	Large	4.6	2.92***

Table 8: Changes in Volatilities by Intra/Inter Industry Mergers

This table provides the univariate tests of differences of changes in implied volatility of at-the-money call options (30 day maturity), systematic volatility and idiosyncratic volatility between intra industry acquirers and inter industry acquirers for each year measured relative to the merger announcement date. Inter Ind. is a dummy variable that assumes the value 1 for a merger where the acquirer and the target belong to different industries. Industry classification follows the 48-industry groupings by Fama and French (1997). Mean and Median for the period (i,j) denotes the change in each measure between year j and year i, where i and j are measured relative to the merger announcement date. The t-Test (Wilcoxon test) statistic tests the hypothesis that Mean (Median) difference of the change in volatility between intra and inter industry mergers each year is zero. Betas are computed using daily return data within each quarter. Systematic volatility is computed by multiplying beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. The sample period is from 1995.Q4 - 2002.Q3. ***,**,* indicates significance at 1%, 5% and 10% level respectively.

Panel A: Acquirer Implied Volatility Change in %

	Intra Industry				Inter Industry				Intra-Inter	
Period	N	Mean	Std.Dev	Median	N	Mean	Std.Dev	Median	t-test	Wilcoxon
(-4,-3)	1023	3.29	16.53	2.62	962	2.48	13.15	2.27	1.19	1.23
(-3,-2)	1625	2.83	16.74	2.58	1428	3.49	14.82	3.56	-1.15	-2.28
(-2,-1)	2245	1.82	18.51	1.73	1918	1.82	16.17	2.62	0.02	-1.30
(1,2)	2820	1.63	20.10	2.32	2187	1.09	20.93	1.73	0.93	0.85
(2,3)	2206	0.52	20.61	0.81	1628	1.58	20.63	2.18	-1.57	-1.88
(3,4)	1475	-1.73	19.48	-1.99	1087	-0.05	21.41	-0.05	-2.07	-2.35

Panel B: Acquirer Systematic Volatility Change in %

	Intra Industry				Inter Industry				Intra-Inter	
Period	N	Mean	Std.Dev	Median	N	Mean	Std.Dev	Median	t-test	Wilcoxon
(-4,-3)	1023	2.47	24.00	2.20	962	3.43	22.17	2.37	-0.92	-0.46
(-3,-2)	1625	2.67	23.83	2.38	1428	2.49	23.23	2.96	0.21	-0.37
(-2,-1)	2245	2.64	24.61	2.21	1918	2.28	24.27	1.31	0.48	0.99
(1,2)	2820	0.90	25.88	0.93	2187	1.97	27.10	2.06	-1.42	-1.63
(2,3)	2206	1.72	26.38	1.19	1628	1.40	25.04	1.34	0.38	0.23
(3,4)	1475	2.76	23.66	2.19	1087	3.49	25.32	2.63	-0.75	-0.95

Panel C: Acquirer Idiosyncratic Volatility Change in %

	Intra Industry				Inter Industry				Intra-Inter	
Period	N	Mean	Std.Dev	Median	N	Mean	Std.Dev	Median	t-test	Wilcoxon
(-4,-3)	864	2.70	22.18	1.62	757	1.88	17.79	1.22	0.82	0.64
(-3,-2)	1399	1.93	21.25	1.07	1129	2.95	19.50	2.67	-1.24	-1.89
(-2,-1)	1921	0.87	23.32	0.62	1565	0.59	19.97	1.32	0.37	-0.63
(1,2)	2444	1.52	22.95	1.44	1821	0.84	22.91	0.51	0.95	0.96
(2,3)	1938	0.71	23.26	-0.05	1387	0.81	24.28	0.66	-0.13	-0.74
(3,4)	1312	-2.98	21.82	-3.37	953	-1.47	23.64	-2.04	-1.58	-1.70

Table 9: Regression Analysis of Change in Acquirer Volatility after Merger

The table reports the regression results of the change in volatility (total, systematic and idiosyncratic) between year 3 and year 1 for the same firm after the merger announcement date. ΔVIX is the change in the VIX index for the corresponding period after the merger. Cash is a dummy variable that assumes the value 1 for deals that are 100% financed by cash and 0 otherwise. Tender offer is a dummy variable that assumes the value 1 for deals that are tender offers and 0 otherwise. Friendly is a dummy variable that assumes the value 1 for deals that are coded as friendly in the SDC database and 0 otherwise. No. Acquisitions is the total number of acquisitions made by the firm over the sample period. Inter Ind. is a dummy variable that assumes the value 1 for a merger where the acquirer and the target belong to different industries. Industry classification follows the 48-industry groupings by Fama and French (1997). The sample period is from 1995.Q4 - 2002.Q3. ***,**,* indicates significance at 1%, 5% and 10% level respectively.

	ΔTotalvol	ΔTotalvol	ΔSysvol	ΔSysvol	ΔIdiovol	ΔIdiovol
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	6.27**	6.47**	-.14	.49	8.53**	8.25**
	(2.71)	(2.72)	(2.86)	(2.9)	(3.69)	(3.72)
ΔVIX	.31***	.31***	1.42***	1.42***		
	(.06)	(.06)	(.07)	(.07)		
Cash	-1.44*	-1.45*	1.82*	1.79*	-1.86*	-1.84*
	(.79)	(.79)	(.96)	(.96)	(1.04)	(1.04)
Tender Offer	2.32	2.31	-.97	-.99	2.04	2.05
	(1.53)	(1.53)	(2.23)	(2.23)	(2.23)	(2.23)
Friendly	-3.04	-3.03	-.03	0	-5.08	-5.07
	(2.65)	(2.65)	(2.69)	(2.7)	(3.6)	(3.6)
No. Acquisitions	.1***	.09***	.04	0	.1***	.12**
	(.02)	(.03)	(.03)	(.04)	(.03)	(.05)
Inter-Industry	1.01	.6	1.7*	.39	-.21	.34
	(.74)	(1.01)	(.88)	(1.21)	(.96)	(1.33)
Inter-Ind.*No.Acq.		.03		.1*		-.03
		(.04)		(.05)		(.07)
Obs.	3586	3586	3586	3586	3011	3011
R^2	.01	.01	.1	.1	.004	.004

Table 10: Diversification Discount, Cash Flow and Volatility Patterns Around Mergers

This table shows the number of firms used in the diversification discount studies that have a merger transaction in the same year. This table also shows the behavior of the the mean diversification discount (premium), the mean ratio of cashflow to total assets of acquiring firms, and the mean systematic volatility around the merger event by event time measured in years relative to the merger announcement date. Diversification discount (premium) is computed as the excess value measure based on asset multipliers following Berger and Ofek (1995). Cashflow is defined as the cash flow from operations taken from COMPUSTAT's statement of cashflows (annual COMPUSTAT data item 308-annual COMPUSTAT data item 124). Total assets is measured as the book value of total assets (DATA6) minus the book value of equity (DATA60) plus the market value of equity. Market value of equity is obtained from CRSP database as the product of shares outstanding and the closing stock price. The t-test (Wilcoxon) statistic tests the hypothesis that difference between the means (median) in years 0 and 2 is zero. ***,**,* indicates significance at 1%, 5% and 10% level respectively. The sample period is from 1990 to 2002.

Year	Total Firms	Merger Firms	%	Year	Total Firms	Merger Firms	%
1996	1353	361	26.7%	2000	4536	1297	28.6%
1997	1479	429	29.0%	2001	4014	988	24.6%
1998	4229	1277	30.2%	2002	2168	593	27.4%
1999	4576	1378	30.1%	Overall	11637	3445	29.6%

	t	-2	-1	0	1	2	Difference (0,+2)	
Discount Firms							t-stat	Wilcoxon
Discount								
	Mean	-0.360	-0.389	-0.385	-0.399	-0.399	-1.25	
	Median	-0.271	-0.287	-0.291	-0.318	-0.315		-1.69*
	N	800	1194	1971	2149	1963		
Cash Flow								
	Mean	6.06	5.06	2.50	3.15	4.54	4.68***	
	Median	5.85	5.50	4.34	4.85	5.50		6.19***
	N	876	1402	2532	2715	2579		
Premium Firms								
Premium								
	Mean	0.555	0.599	0.539	0.517	0.502	-2.60***	
	Median	0.355	0.440	0.393	0.384	0.367		-2.90***
	N	972	1806	2433	2320	2088		
Cash Flow								
	Mean	3.53	3.43	3.22	2.92	4.17	4.46***	
	Median	4.24	3.92	3.92	4.00	4.53		5.51***
	N	967	1800	2425	2311	2082		

Figure 1: Volatility of Acquiring Firms around the Merger Event

This figure shows the behavior of the average total volatility, beta, systematic volatility and idiosyncratic volatility of acquiring firms around the merger event by event time measured in quarters relative to the merger announcement date. Total volatility is measured using the implied volatility of at-the-money call options (30-day maturity). Betas are computed using daily return data within each quarter. Systematic volatility is computed by multiplying beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. We also graph the median of total volatility from a matched sample with no merger activity in the total volatility figure, and the median of the VIX index in the systematic volatility figure. Time period 0 is simply the average value of observations right before and after the merger event and provided only as a visual aid. The sample period is from 1995.Q4 to 2002.Q3.

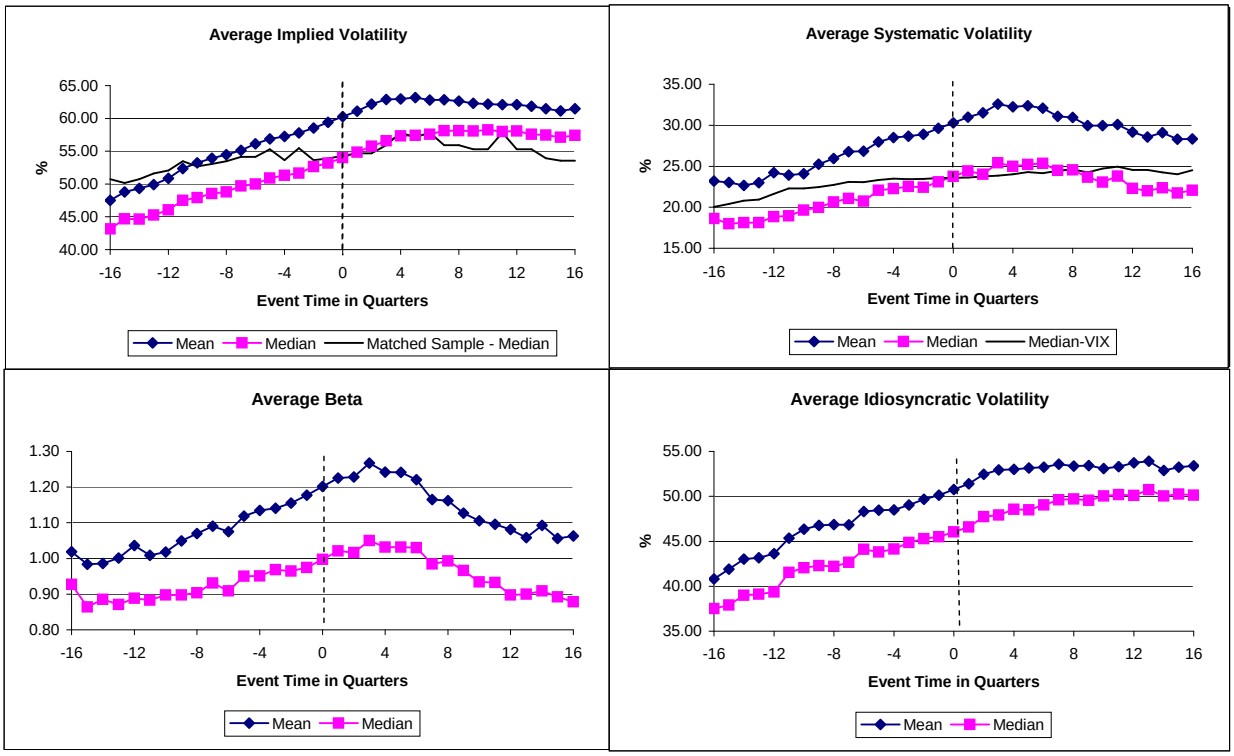

Figure 2: Industry Shocks of Acquiring Firms

This figure shows the behavior of industry shocks of acquiring firms around the merger event by event time measured in years relative to the merger announcement date. Industry Shock is defined as the shock to sales and is computed following the method in Mitchell and Mulherin (1996). The cross sectional average of this measure is presented. The sample period is from 1995.Q4 to 2002.Q3.

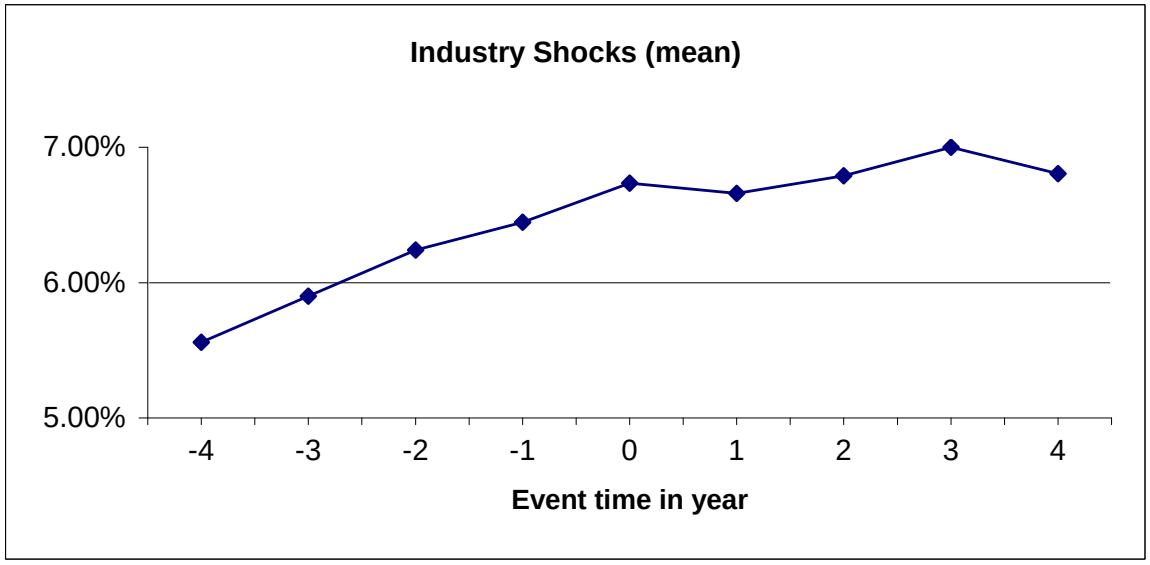

Figure 3: Volatility of Acquiring Firms Grouped by Merger Activity Levels

This figure shows the behavior of the average total volatility, systematic volatility and idiosyncratic volatility of acquiring firms around the merger event by event time measured in quarters relative to the merger announcement date. Firms are grouped in quartiles based on the number of acquisitions made in the sample period. Q1 is the set of firms with the least number of acquisitions and Q4 the most. Total volatility is measured using the implied volatility of at-the-money call options (30-day maturity). Betas are computed using daily return data within each quarter. Systematic volatility is computed by multiplying beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. Time period 0 value is simply the average value of observations right before and after the merger event and provided only as a visual aid. The sample period is from 1995.Q4 to 2002.Q3.

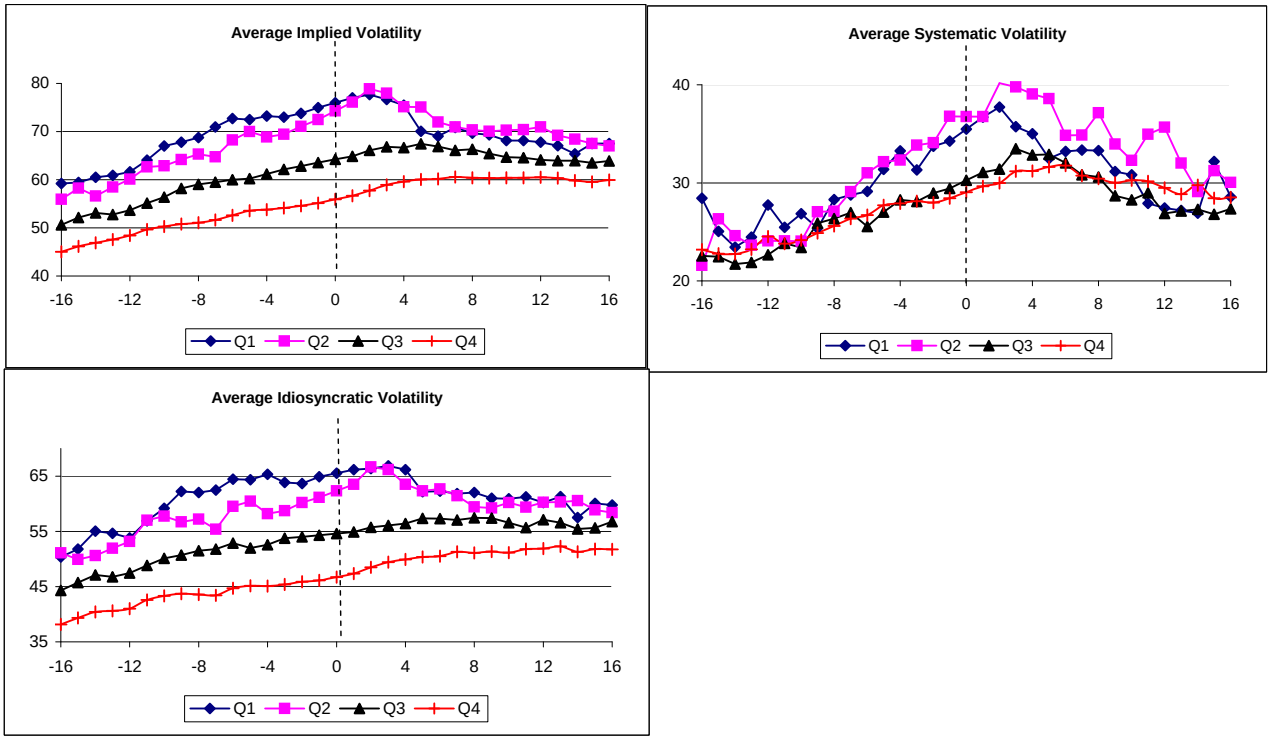

Figure 4: Volatility of Acquiring Firms Grouped by Merger Activity Levels and Relative Size
This figure shows the behavior of the average total volatility of acquiring firms around the merger event by event time measured in quarters relative to the merger announcement date. Firms are sorted in two groups based on the relative size of the target to the acquirer. Relative size is defined as the ratio of the average market capitalization of the target to the sum of the average market capitalizations of the target and acquirer. The average is computed over the calender year preceding the merger year. The top panel consists of acquirers with the number of acquisitions made in the sample period below the median number of acquisitions for all acquirers. The bottom panel consists of acquirers with the number of acquisitions made in the sample period above the median number of acquisitions for all acquirers. Total volatility is measured using the implied volatility of at-the-money call options (30-day maturity) and is the one year moving average. Time period 0 value is simply the average value of observations right before and after the merger event and provided only as a visual aid. The sample period is from 1995.Q4 to 2002.Q3.

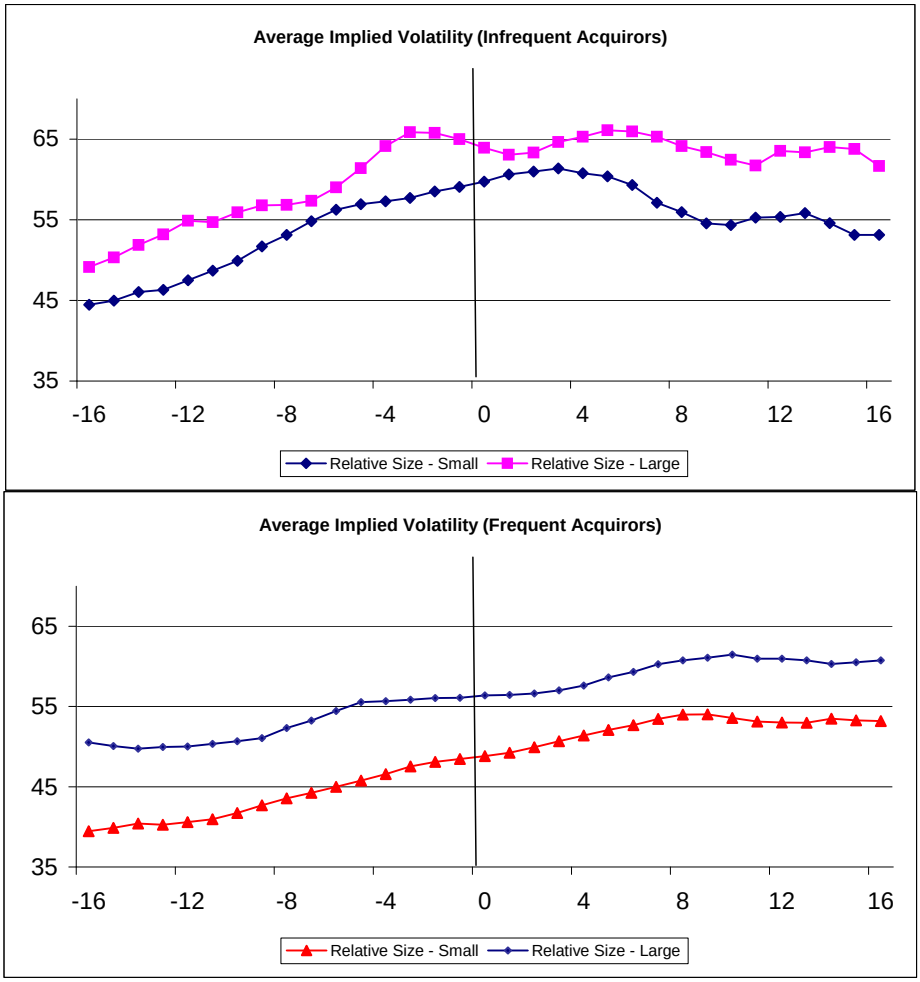

Figure 5: Volatility of Intra/Inter Industry Mergers

This figure shows the behavior of the average total volatility, beta, systematic volatility and idiosyncratic volatility of acquiring firms around the merger event by event time measured in quarters relative to the merger announcement date. Inter industry merger is a merger where the acquirer and target belong to different industries. Intra industry merger is a merger where the acquirer and target belong to the same industry. Industry classification follows the 48 industry groupings by Fama and French (1997). Total volatility is measured using the implied volatility of at-the-money call options (30-day maturity). Betas are computed using daily return data within each quarter. Systematic volatility is computed by multiplying beta and the average VIX index for each quarter. The VIX index data are obtained from the CBOE. Idiosyncratic volatility is computed as the square root of the difference between the total variance and the systematic variance. Time period 0 value is simply the average value of observations right before and after the merger event and provided only as a visual aid. The sample period is from 1995.Q4 to 2002.Q3.

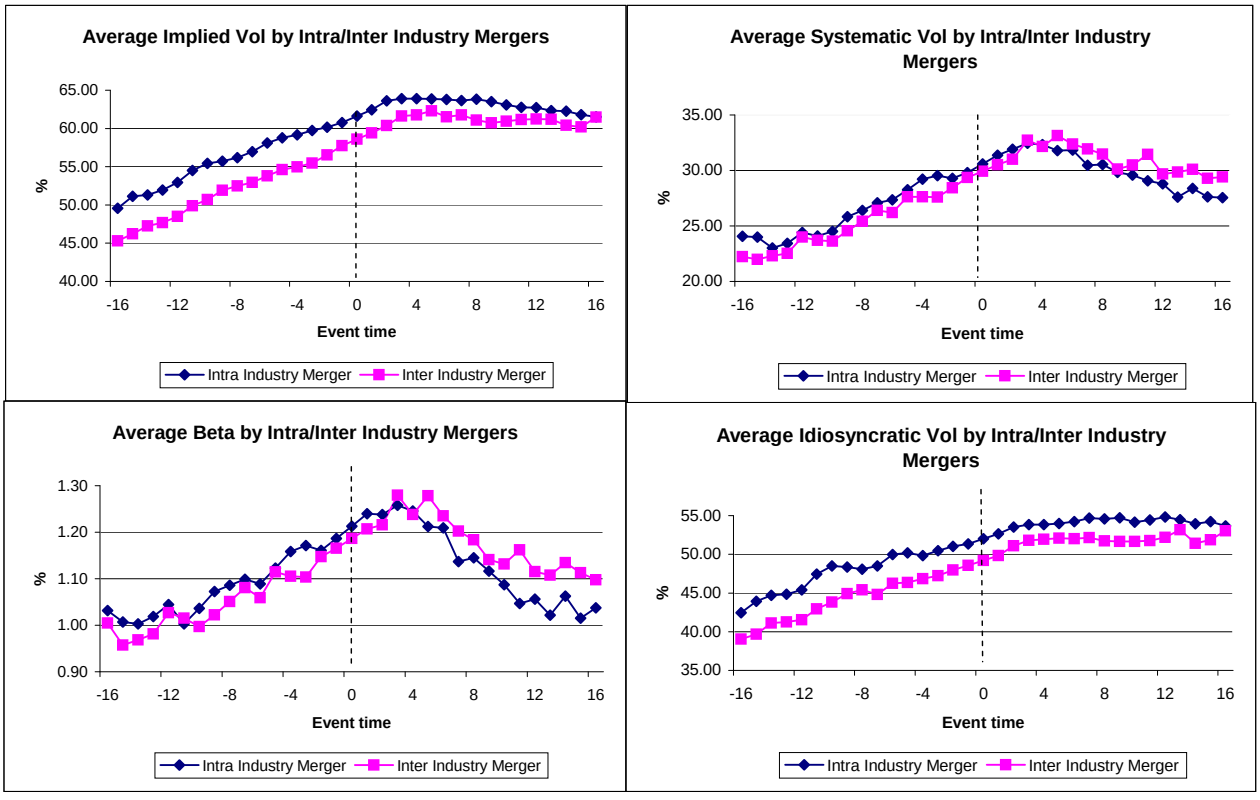

Figure 6: Diversification Discount and Cash Flow Patterns Around Mergers

This figure shows the behavior of the the mean diversification discount (premium), and the mean ratio of cashflow to total assets of acquiring firms around the merger event by event time measured in years relative to the merger announcement date. Diversification discount (premium) is computed as the excess value measure based on asset multipliers following Berger and Ofek (1995). Cashflow is defined as the cash flow from operations taken from COMPUSTAT's statement of cashflows (annual COMPUSTAT data item 308- annual COMPUSTAT data item 124). Total assets is measured as the book value of total assets (DATA6) minus the book value of equity (DATA60) plus the market value of equity. Market value of equity is obtained from CRSP database as the product of shares outstanding and the closing stock price. The sample period is from 1990 to 2002.