Effects of M&A in the Renewable Energy Sector: An Event Study Analysis

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Abstract

In this paper, we examine the effects of mergers and acquisitions (M&A) on the value of renewable energy companies, considering the types of M&A among the renewable energy, conventional energy, and other sectors. The event study methodology is used based on the ordinary least squares (OLS) and the general autoregressive conditional heteroscedasticity (GARCH) models, the latter of which allows for conditional variances. We classify the data into four groups by the type of M&A and test the significance of the cumulative abnormal return (CAR). The results show that the effect of M&A differs depending on the homogeneity of the involved firms' sectors and in the different industries within the renewable energy sector. Homogeneous M&A within the renewable energy sector has the most significant positive effect on firms in the renewable energy industries as well as on all firms. Consequently, the financial synergy and risk diversification effects have the most significant, positive impact in M&A in the renewable energy sector, regardless of the specific industry.

1. Introduction

Mergers and acquisitions (M&A) within the renewable energy sector has surged to over 70 percent(KPMG, 2011), showing that M&A has become a major management strategy of firms, not only in general, but also specifically in the renewable energy sector. Acquiring firms enable the acquirers to strengthen their competitiveness in the market. Especially in a rapidly changing sector as renewable energy, M&A play an important role in achieving sustainable growth and innovation (Choi and Kim, 2007). In the short term, seeking external growth and enhancing the firm's value through M&A affect the growth not only of the firms involved but also of the entire sector. Therefore, an in-depth study of the actual effects of M&A in the renewable energy sector is needed.

In the renewable energy sector, M&A are conducted in various ways according to the purpose of the firms involved. Some renewable companies focus only on one renewable energy resource such as either solar energy or wind energy, while others focus on several renewable energy resources, that is, on both solar and wind energies. This paper examines the different effects of M&A in the renewable energy, energy, and other sectors, assuming different purposes of M&A in each sector. Additionally, this paper examines cross-sector M&A, that is, the acquiring firm is not from the renewable energy sector but rather from the conventional

energy sector such as oil/gas or electricity/utility or other unrelated sectors such as investments or household goods.

In M&A within the renewable energy sector, synergy by economies of scale and scope or increased market power is expected. On the other hand, in cross-sector M&A, risk diversification in various aspects and green premiums for those who have no or few businesses in the green energy industry may occur. By analyzing the differences between the effects of M&A in the different energy sectors, we can develop M&A strategies for renewable energy companies and other firms interested in this sector.

There are numerous studies that have examined the effects of M&A, many of which used the event study method. Wårell (2007) analyzed a horizontal merger in the iron ore industry using a case of a merger between Rio Tinto and North Ltd. This paper describes in detail the process and background of a merger and compares its returns to a competitor's abnormal returns during the same period. The result shows that while the merger itself is significant, the returns are not significant when compared to those of the competitor's. Choi and Song (2007) examined the causes and effects of M&A in the upstream oil industry and found that the results did not support the common view in the stock market that "Mergers and acquisitions generally cause an increase in the stock price," as significant effects were only found in seven out of 13 cases. Even though M&A is a widely-used strategy, a large number of studies show it has no significant impact for the firms involved, prompting us to perform a more comprehensive analysis of the effects of M&A.

Meanwhile, Eisenbach et al. (2011) categorized M&A in the renewable energy sector that occurred between 2000 and 2009 by energy resource and size of the acquirer, finding significant effects in solar energy firms and smaller acquirers. There have been, however, no studies comparing the effects of the acquirer's sector in the renewable energy, conventional energy sectors, and other unrelated sectors. Given the significant adoption of M&A in the renewable energy and other energy sectors, this study aims to examine the effects of such a strategy.

This paper uses the event study methodology to analyze the effect of M&A on firm value, based on the acquirer's sector. We test two hypotheses; first, we hypothesize that the effect of M&A, in general, differs depending on the homogeneity of the involved firms' sectors. Second, we hypothesize that the effect of M&A also differs among the industries within the renewable energy sector depending on the homogeneity of the involved firms' sector. To test the second hypothesis, we classified the target firms into four groups by the

acquirer's sector. Furthermore, we apply the general autoregressive conditional heteroscedasticity (GARCH) model to the event study and compare the results with those from the OLS model. The GARCH model allows for conditional variance rather than constant variance, which is an assumption of traditional econometric models (Wang et al., 2002).

The remainder of this paper is organized as follows: Section 2 further examines the effect of M&A in the renewable energy industry and discusses the method of data analysis, event study. Section 3 describes the original data and hypothesis and presents the results. Section 4 discusses conclusions and significance of this study.

2. Method

2.1 M&A effect in the renewable energy sector

A merger is a transaction that combines two firms into one surviving firm, while an acquisition is the purchase of one firm, in whole or in part, by another firm(Cherian and Jarrow, 1995). M&A can play a constructive economic role depending on various factors surrounding the strategy such as transaction size, acquirer size, or deal type. In this paper, we compare the effects of M&A considering the involved firms' sectors. Prior to the empirical analysis, we present four theoretical M&A effects, in general and particularly in the renewable energy sector(Choi and Kim, 2007).

First, we expect a synergy effect, which arises when two companies are combined, producing an impact that is more than the sum of the firms' values. There are two types of synergies: operating synergy and financial synergy. Operating synergy occurs by achieving economies of scale (in production) or of scope (cost reduction by sharing common assets such as R&D budgets), which increases the resulting firm's efficiency. Meanwhile, financial synergy increases the firm's efficiency by reducing capital costs or increasing financing through consolidation. In M&A among homogenous firms within the renewable energy sector where both the acquirer and target firms belong to the same sector, we expect that operating and financial synergies would occur. In homogeneous M&A, operational synergy is expected as both firms share production processes or human resources. Since small renewable energy firms are relatively highly volatile, an M&A would reduce the high volatility of its cash flow and diversify its risks. In addition, financial synergy is also expected owing to the increase in the firm's size, which helps the resulting firm achieve economies of scale in financing, which in

turn reduces transaction or floatation costs. On the other hand, M&A between heterogeneous firms, where one of the firms involved does not belong to the renewable energy sector, but rather to the conventional energy sector (e.g., conventional oil/gas) or other unrelated sectors (e.g., investments), we infer that only financial synergy would occur.

Second, we expect increased market power through the expansion of the firm's scale or through securing exclusive profits by restricting competition. This effect is expected especially for homogeneous M&A where a firm's size or market share could significantly increase, enabling the acquirer to take an advantageous position in the competitive market. This increases the firm's market power, resulting in decreased competition and increased price, and ultimately, more profit. In the renewable energy sector, increased market power is best expected in homogeneous M&A; since the sector has very different industries, the firms' combined market share is not easily affected, that is, only M&A within the same industry can affect the resulting firm's market power.

Third, we expect risk diversification and the launch of new businesses from M&A. The renewable energy sector's significant potential has attracted significant interest and greatly increased the number of renewable energy firms(KPMG, 2011). Based on the efficient capital market assumption which states that capital moves from a declining industry to a growing industry, M&A in the renewable energy sector can expect the launch of new businesses or business diversification. M&A in this sector are also expected to achieve risk diversification or financial advantages. M&A reduces the risk inherent in highly volatile industries such as renewable energy, an effect called the diversified investment effect. Meanwhile, risk diversification is also expected in heterogeneous M&A. For instance, a renewable energy company in one industry may want to reduce its volatility by expanding into other renewable energy industries, thereby hedging its risks. On the other hand, given the decline in conventional energy resources such as oil, a conventional energy company can also pursue portfolio diversification as they expand into alternative energy resources. We also expect utility companies to use green energy resources as renewable portfolio standards (RPS) will soon be implemented. Companies not included in the first three cases we mentioned above (i.e., do not belong to the renewable energy or conventional energy sectors) may expect high returns from their diversification into this sector owing to its high growth rate.

Last, we expect green premiums from M&A in the renewable energy sector(Chan, 2009). Chan's (2009)

examination of the initial public offerings (IPOs) and seasoned equity offerings (SEOs) of environmental-oriented companies showed that they are less vulnerable to corporate social crises and environmental disasters, thus, giving them a "premium" over non-green firms. In this study, renewable energy companies are considered representative of green companies and those outside the green business have incentives to pursue the green premium.

Table 1. Effects of M&A in the renewable energy industry

		Homogeneous M&A	Heterogeneous M&A
Synergy	Operating synergy	O	
	Financial synergy	O	O
Increased market power		O	
Risk diversification			O
Green premium			O (in energy and other sectors)

2.2 Event study methodology

Event study is an econometric method that evaluates changes in the expectations of corporate earnings from unexpected events. This method has broad applications. For instance, in accounting and finance, event studies have been applied to a variety of events from firm-specific events to those affecting the entire economy(McKenzie et al., 2004; Wårell, 2007). In the fields of law and economics, event studies have been applied in legal liability cases to assess damages. M&A are one of the events that have been significantly studied(MacKinlay, 1997).

Although most traditional event study methods assume a constant variance in both the pre- and post-event periods, some, such as that by Brown and Warner (1985), noted that if the variance is underestimated, the test statistic will lead to a rejection of the null hypothesis more frequently than it should(Brockett et al., 1994). Recently, many studies focused on explaining the conditionally heteroscedastic effect in event studies(Leggio and Lien, 2000; Murthy and Rao, 2009; Weston et al., 1999; Xu et al., 2003) and found that since the autoregressive conditional heteroscedasticity (ARCH) effect has been shown to be significant in many financial series, it would be safer to take this into consideration in an event study.

To generalize the assumption of a constant variance required in traditional econometric models, Engle (1982) developed a model describing a new class of stochastic processes called ARCH. The ARCH model

specification has been generalized to the GARCH model by Bollerslev (1986) and Baillie and Bollerslev (1990) to allow for past conditional variances in the current conditional variance equation(Wang et al., 2002). The GARCH model consists of a mean equation and a conditional variance equation. The advantage of this approach is that it models the level of the returns, as does the basic market model, and also allows for time-varying volatility.

In this paper, the event study is carried out through the following six steps:

1) **Event definition:** First, the event is defined and the period of interest or event window is identified based on the defined event. In general, the period of interest is expanded to multiple days before and after the event. In this paper, the event is M&A in the renewable energy sector and the event window starts from 10 days before the event to 15 days after the event.
2) **Sample selection criteria:** Second, the target firms and their stock returns during the event period are determined. Stock returns are the daily returns and firm i's rate of return at t days, shown below P_t is the closing price at day t and P_{t-1} is the closing price at day t-1:

$$R_{it} = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

3) **Measure normal returns**: Normal return is the expected stock return under normal circumstances, that is, when the event does not occur. Abnormal return is the difference between the true stock return and the normal return. Since the value of an abnormal return depends on a model for forecasting normal returns, we use two models, OLS (using the market model) and GARCH, then compare them to obtain a more accurate and impartial interpretation.

A. Normal return of the OLS model

The normal return of the OLS model is defined as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (2)$$

where R_{it} is the stock return of firm i at day t and R_{mt} is the stock return of the market at day t. The stock return of a market is an appropriate market index and we use the representative of each of the market index to which the firm belongs. ε_{it} is an error term for the changes that cannot be explained by the changes of the whole and whose distribution is iid N (0, σ_i^2). The estimation period is defined by the parameters α and n, which represent 150 days before and 30 days after the event, respectively. Based on

these estimated parameters, we calculate the normal returns.

B. Normal return of the GARCH model

The normal return of the GARCH model is presented below. It is specified using additional parameters in the mean equation and the addition of a variance equation.

The mean equation in the GARCH (p,q) model is defined as:

$$R_{it} = \alpha_i + \beta R_{mt} + \sum_{h=0}^{H} \lambda_h r_{i-t} + \varepsilon_{it} \quad (3)$$

The conditional variance equation in the subdued GARCH (p,q) model is defined as:

$$\varepsilon_{it}|\Omega_{it} \sim N(0, h_{it}) = \varphi_{i0} + \sum_{k=0}^{q} \varphi_{ik}\, \varepsilon_{i,t-k}^2 + \sum_{j=1}^{p} \varphi_{ij}\, h_{i,t-j} \quad (4)$$

To estimate the GARCH model, the ARCH term, p, and GARCH term,q, must be in the appropriate order. Many studies have shown that the volatility of financial variables last for a long time and that a simple GARCH (1,1) model holds well (Lamoureux and Lastrapes, 1993). In addition, Batchelor and Orakcioglu (2003); McKenzie et al. (2004); Wang et al. (2002) also chose GARCH (1,1) models in their event studies. We take these findings into consideration in our model by applying GARCH (1,1) to the error term. In the estimation stage, we use the maximum likelihood estimator.

4) **Abnormal return**: Abnormal return is defined as follows:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt} + \varepsilon_{it}) \quad (5)$$

Based on this equation, the abnormal return is the difference between the true stock return (R_{it}) and the normal return($\alpha_{it} + \beta_i R_{mt} + \varepsilon_{it}$).

5) **Aggregation of abnormal return:** The estimated effect of the event throughout the entire event window is determined by adding each t day's abnormal return separated over time. Prior to this process, the representative value of each group must take the average abnormal return of the firms in each group:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \quad (6)$$

$$CAR_i(t_1, t_2) = \sum_{t_1 \sim t_2} AAR_{it} \quad (7)$$

where t_1 is the starting date, t_2 is the ending date, and N is the number of firms.

6) **Null hypothesis test**: The hypotheses are defined and the t statistics for testing statistical significance are calculated. The t statistics used in this paper are defined as:

$$t = \frac{CAR(t_1,t_2)}{[Var(CAR(t_1,t_2))]^{1/2}} \quad (8)$$

3. Estimation results

3.1 Data description

In this section, we describe the data used to estimate and test our hypotheses. The sample consists of firms that announced a M&A with those in the renewable energy sector in the last five years. M&A information were obtained from Bloomberg, Marketline, M&A reports from accounting firms, and stock data from the Datastream data service. To filter out unhelpful information on individual firms, the following criteria were applied: (1) the companies are presented in Marketline; (2) the firm's stock data before or after the event are available at Datastream; (3) the stock data 150 days before and 30 days after the event period are available; and (4) the normal rate of return (ROR) model is statistically significant. After filtering the data using these criteria, 29 M&A cases were used in the analysis.

Table 2. Sample description and transaction characteristics

Characteristics					
Deal type	Number	Acquirer Sector	Number	Acquirer Country	Number
Homogeneous	8	Solar	4	North America	10
		Wind	2	*US*	*9*
Heterogeneous (renewable energy)	4	Bio	3	Asia	7
		Other renewable	3	*China*	*2*
Heterogeneous (energy)	11	Oil/gas	7	EU	10
		Utility	3	*Italy*	*4*
				Germany	*3*
Heterogeneous (other)	6	Other	7	Other	2
Total	29	Total	29	Total	29

a. Source: Marketline, Bloomberg, and Datastream

Table 2 presents the original data by deal type, acquirer sector, and acquirer country. From the table, it is clear that the energy industry has the most number of M&A in our data and that solar energy has the most acquirers among the renewable energy industries. Conventional oil and gas companies represent the most number of acquirers, evidencing their active involvement in M&A with renewable energy firms. Asia is also a major participant in renewable energy M&A, along with North America and the EU, evidencing the globalization of M&A in the renewable energy sector.

3.2. Empirical results

In this section, we confirm whether the effect of M&A differs based on the homogeneity of the involved firms' sectors and in the different industries within the renewable energy sector. Table 3 presents the empirical results for the first hypothesis, showing that the effect of M&A differs based on the homogeneity of the involved firms' sectors. The event period are divided into four cases to verify the long term and short-term effects. The sign of the cumulative abnormal return (CAR) indicates whether a firm's value is increasing (+) or decreasing (−).

Table 3. Cumulative abnormal rates of return by M&A type

Event windows	Homogeneous		Heterogeneous (renewable energy)		Heterogeneous (energy)		Heterogeneous (other)	
	OLS	GARCH	OLS	GARCH	OLS	GARCH	OLS	GARCH
[-10;+15]	2.685*** (5.3630)	2.748*** (8.9412)	9.973*** (6.7498)	10.887*** (7.2349)	−5.102*** (−9.8883)	−3.077*** (−9.2027)	1.490 (0.7001)	−0.589 (−1.0507)
[-5;+5]	6.798 (1.1619)	4.284** (2.9670)	5.745** (5.3531)	6.205** (5.8302)	−3.462*** (−10.0454)	−2.670*** (−10.7041)	2.011* (2.0845)	1.721 (1.6285)
[-1;+1]	1.069 (2.7919)	1.966** (4.4151)	−0.117 (−0.0378)	0.218* (3.2399)	−2.010* (−3.2694)	−1.813* (−3.2542)	−2.332 (−1.664)	−2.422 (−1.7101)
[0]	−1.039 (−0.3578)	−13.074 (−1.6002)	0.188 (0.2728)	1.005 (1.5939)	−0.938 (−0.5082)	−11.572** (−6.5684)	−1.860 (−0.551)	−10.865** (−3.3712)

a. *, **, and *** represent rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively.
b. ( ) represent t-statistics.

The result shows that heterogeneous M&A within the renewable energy sector has the most significant, positive effect on firm value, followed by homogeneous M&A. Based on the GARCH model for the event period 10 days before to 15 days after the event, the CAR of heterogeneous M&A is 10.887, significantly larger than that of homogenous M&A, 2.748. The difference between the CAR is reduced in the period 5 days before to 5 days after the event, to 4.284 for homogenous M&A and 6.205 for heterogeneous M&A, based on the GARCH normal return. Consequently, the financial synergy and risk diversification effects have the most positive effect on M&A in the renewable energy sector.

On the other hand, heterogeneous M&A in the energy sector shows a negative effect in both the OLS and GARCH models. The CAR for the event period 10 days before to 15 days after the event is −3.077, significant based on the GARCH normal return. This implies that M&A in the energy sector are driven by other reasons,

including pressures for carbon hydrate reduction. Thus, even though M&A with renewable firms pose a negative effect on energy firms, they still pursue this strategy to meet carbon emission requirements.

In terms of the event periods, the CAR in the period 10 days before to 15 days after the event show the most significance in many cases. The CAR in the event days are insignificant in most cases except in heterogeneous M&A in the energy and other sectors, evidencing the long-term rather than short-term effects of M&A. In terms of the methodology of normal returns, the OLS tended to reject the null hypothesis more than the GARCH model. If we do not consider the serial correlation of variance, we would underestimate the effect of M&A. These results parallel those of Wang et al. (2002).

Table 4 presents the differences in the effects among the renewable energy subsectors, showing the CAR of solar, wind, and bio energies in homogeneous groups. M&A has a positive effect on firm value in the solar and wind energy industries, but a negative effect in the bio energy industry in the period 10 days before to 15 days after the event. Since the absolute value of the CAR is the difference between the subsectors, the higher CAR in solar energy (13.221) and lower CAR in wind energy (4.58) means that M&A has a more positive effect in the solar energy sector, in which parallels the findings of Eisenbach et al. (2011). This prompted us to further examine which effects can be applied to all industries through our second hypothesis.

Table 4. Cumulative abnormal rates of return by resource in homogeneous group

Event windows	Solar		Wind		Bio	
	OLS	GARCH	OLS	GARCH	OLS	GARCH
[-10;+15]	12. 908*** (8. 6539)	13. 221*** (8. 3141)	4. 947** (4. 5149)	4. 586** (4. 3432)	−10. 134 (1. 0933)	−3. 032*** (5. 3884)
[-5;+5]	9. 021*** (9. 8164)	9. 295*** (9. 4264)	3. 105** (2. 5957)	3. 048** (2. 5565)	−10. 763** (−4. 2105)	−7. 693** (−3. 2700)
[-1;+1]	−0. 099 (−0. 3662)	0. 339 (0. 5802)	−0. 472 (−1. 4187)	−0. 510 (−1. 8557)	−0. 109 (1. 1176)	0. 732 (1. 8623)
[0]	6. 961** (2. 7142)	8. 589 (1. 5805)	1. 048 (0. 7378)	2. 210 (2. 1456)	−5. 108** (−3. 2895)	−22. 382** (−3. 6047)

a. *, **, and *** represent rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively.
b. ( ) represent t-statistics.

Table 5 presents the results for the second hypothesis, which proposes that the effect of M&A also differs among the different industries within the renewable energy sector depending on the homogeneity of the involved firms' sectors. Results show that heterogeneous M&A has the most significant, positive impact in the wind energy industry; that homogeneous M&A has the most significant, negative impact in other sectors; and

that heterogeneous M&A in other sectors shows the second greatest significant, positive impact. Consequently, the financial synergy and risk diversification effects are greatest in M&A in the renewable energy industries, although we cannot say with certainty whether the other effects have the same impact on firm value.

Table 5. Cumulative abnormal rates of return by M&A deal type in wind energy industry

Event windows	Homogeneous		Heterogeneous (in renewable)		Heterogeneous (in energy)		Heterogeneous (in the other)	
	OLS	GARCH	OLS	GARCH	OLS	GARCH	OLS	GARCH
[-10;+15]	−0. 957** (−4. 7564)	−2. 083*** (−5. 6805)	12. 943*** (6. 7142)	13. 229*** (6. 9686)	0. 122 (−0. 8157)	0. 335 (0. 5702)	15. 243** (3. 9466)	13. 394** (3. 5012)
[-5;+5]	−4. 184*** (−8. 5728)	−4. 167*** (−9. 0368)	8. 001** (3. 8160)	7. 915** (4. 0552)	0. 555** (2. 6516)	0. 709** (2. 5790)	15. 540** (3. 8962)	14. 758** (3. 7539)
[-1;+1]	0. 122 (2. 011)	0. 193 (2. 0378)	−1. 372** (−9. 0279)	−1. 359** (−8. 6939)	1. 284** (18. 9844)	1. 200** (16. 9370)	−5. 133* (−3. 8362)	−5. 346* (−3. 9063)
[0]	−3. 228 (−1. 6264)	1. 435 (1. 4380)	3. 875** (1. 9262)	−0. 313 (−0. 5437)	1. 051 (1. 3184)	−0. 579 (−0. 4956)	2. 496 (0. 5668)	1. 668 (0. 5621)

a. *, **, and *** represent rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively.
b. ( ) represent t-statistics.

4. Discussions and Conclusions

Using the event study method, this paper proves that the effect of M&A differs depending on the homogeneity of the involved firms' sectors and among the different industries within the renewable energy sector. Heterogeneous M&A within the renewable energy sector has the most significant, positive effect on firms in the renewable energy industries and on all firms, in general. Consequently, the financial synergy and risk diversification effects pose the greatest positive impact in M&A in the renewable energy sector, regardless of the industry. However, we cannot say with certainty whether the other effects have the same impact on firm value.

Our study used the GARCH model to enhance the confidence of analysis. In many cases, CARs based on OLS accept the hypothesis that the CAR is zero, which could mean that the M&A has no effect, and consequently, that the stock data of renewable energy firms show conditional rather than constant variance.

Our study examines M&A in the context of the renewable energy sector and its different effects among the renewable energy, conventional energy, and other unrelated sectors. Future studies may confirm our findings by replicating our methodology using more detailed firm information. Further examination of the industries in the value chain of the renewable energy sector is an interesting avenue for future research.

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