FINANCIAL PERFORMANCE OF TIMBER REAL ESTATE INVESTMENTS TRUSTS AFTER ANNOUNCEMENTS OF MAJOR STRUCTURAL CHANGES

by

WANJING HU

(Under the Direction of BIN MEI)

ABSTRACT

Several timber real estate investments trusts (REITs) had significant structural changes in the past two years. Weyerhaeuser (WY) and Rayonier (RYN) began spinning off their non-timberland assets and became more focused on timberland management. WY and Plum Creek (PCL) proposed to merge to create a $23 billion timber behemoth. In this study, the short-term financial performance of timber REITs after these major structural changes is assessed. Event study and generalized autoregressive conditional heteroscedasticity (GARCH) model are employed to evaluate event-induced abnormal returns, volatility, and volume dynamics. The divestiture announcements had no significant impact on returns, while the merger announcement generated abnormal returns. In most cases, these events also increased asset volatility. There exists a positive correlation between the conditional variance of stock returns and trading volumes for all firms, signaling that they are influenced by the same underlying information flow.

INDEX WORDS: Divestiture, Event study, Forest investments, Real estate, Volatility

# FINANCIAL PERFORMANCE OF TIMBER REAL ESTATE INVESTMENTS TRUSTS AFTER ANNOUNCEMENTS OF MAJOR STRUCTURAL CHANGES

by

WANJING HU

B.S., Shandong University, China, 2014

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2016

© 2016

Wanjing Hu

All Rights Reserved

# FINANCIAL PERFORMANCE OF TIMBER REAL ESTATE INVESTMENTS TRUSTS AFTER ANNOUNCEMENTS OF MAJOR STRUCTURAL CHANGES

by

WANJING HU

| | |
|---|---|
| Major Professor: | Bin Mei |
| Committee: | Puneet Dwivedi |
| | Craig Landry |

Electronic Version Approved:

Suzanne Barbour
Dean of the Graduate School
The University of Georgia
May 2016

DEDICATION

To my family, for their unconditional love and support.

ACKNOWLEDGEMENTS

I would first like to thank my parents for their support, sacrifice, and patience throughout this journey. Thanks to the Warnell School of Forestry and Natural Resources at the University of Georgia for giving me the background in forestry resources that is critical in my success in this program. A special thank goes to my advisor, Dr. Bin Mei for lending his wisdom and knowledge, and especially for advising me through this research, and my committee members, Dr. Puneet Dwivedi and Dr. Craig Landry, for their help and support.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS ..... v

LIST OF TABLES ..... viii

LIST OF FIGURES ..... ix

CHAPTER

1 INTRODUCTION ..... 1

2 LITERATURE REVIEW ..... 4

Event Study ..... 4

Corporate Divestitures ..... 5

Corporate Merger ..... 6

3 METHODOLOGIES ..... 8

Events and Data Sources ..... 8

Traditional Event Study ..... 9

Event Study with GARCH Modeling ..... 10

Event-induced Volatility ..... 11

GARCH Modeling of Return Volatility ..... 12

4 EMPIRICAL RESULTS ..... 14

Comparison of OLS and GARCH Results ..... 14

Results from the Event-induced Volatility ..... 15

Results from the GARCH Modeling of Return Volatility ..... 16

5 CONCLUSION.....18

REFERENCES .....21

LIST OF TABLES

Page

Table 1: A list of major structural changes of timber REITs between 2014 and 2015 ……...26

Table 2: Cumulative abnormal returns (CAR) and *t*-statistics (*t*-stat) during the event windows for divestiture announcements ……..……..……. 27

Table 3: Cumulative abnormal returns (CAR) and *t*-statistics (*t*-stat) during the event windows for merger announcements……....28

Table 4: Results from the GARCH models on return series without and with the adjusted trading volumes for divestiture announcements ……...29

Table 5: Results from the GARCH models on return series without and with the adjusted trading volumes for merger announcements...……..30

LIST OF FIGURES

Page

Figure 1: RYN's operating income by business segment from 2011 to 2013……...31

Figure 2: WY's operating income by business segment from 2011 to 2013…….....32

Figure 3: Abnormal volatility on individual dates over the event window for divestiture announcements.....33

Figure 4: Abnormal volatility on individual dates over the event window for merger announcements.....34

Figure 5: Daily returns and logarithmic volumes over the event window for divestiture announcements.....35

Figure 6: Abnormal volatility on individual dates over the event window for merger announcements.....36

# CHAPTER 1

# INTRODUCTION

Timberland is often seen as a good investment alternative with the ability to increase diversification to achieve a more efficient portfolio (Mendell, 2008). Timberland has provided several attractive features. It works as a hedging tool against inflation (Newell and Eves, 2009). Also, business cycles have no impact on biological growth (Mei and Clutter, 2010; Teeter, 1991). Moreover, timberland reduces the risk of returns as the low correlations between equities, bonds and real estate (Heikkinen and Kanto, 2000).

Over the past thirty years, there has been a major shift in industrial timberland ownership in the United States. Prior to the 1980s, most forestlands were owned and managed by vertically integrated forest product companies (Stein, 2011). Since the late 1980s, however, over 23 million acres of industrial timberlands changed hands, as traditional industrial owners started divesting their timberland assets (Clutter et al., 2005). For the new ownership, timber investment management organizations (TIMOs) and timber real estate investments trusts (REITs) are major players. TIMOs manage timber investments on behalf of large institutional investors such as pension funds, insurance companies, university endowments and wealthy families through separate accounts or comingled funds. TIMO assets are privately placed.

REITs are tax-efficient securities investing in real estate, such as shopping centers, apartments and timberlands. Timber REITs focus on investing in timber land and timber assets (Wang, 2011). Timber REITs own income-producing properties and produce raw timber for the forest products industry. The REIT structure requires more than 75% of firm's operating income

from real estate properties or interests on mortgages, less than 20% of its assets in non-real-estate-related areas such as manufacturing, and most importantly, more than 90% of its taxable income yield as dividends. Securitized timberlands have been over ten million acres in the United States in recent years (Sun, 2013). Today, there are five publicly-traded timber REITs[1] in the United States, including CatchMark (CTT), Plum Creek (PCL), Weyerhaeuser (WY), Rayonier (RYN) and Potlatch (PCH). A major advantage of a REIT is that it does not have to pay corporate income tax on earnings from land holdings. In addition, timber REITs provide investing opportunities to both retail and institutional investors and therefore are more liquid than private ownership. In the last two years, timber REITs were subjected to major structural changes (Table 1).

Timber REITs often have non-timber business segments, such as manufacturing and real estate. Recently, however, several timber REITs have been divesting their non-timber business. On May 27, 2014, RYN announced the separation of its performance fibers business called Rayonier Advanced Materials (RYAM) from its Forest Resources and Real Estate businesses, and distributed cash dividend of RYAM's common stock to RYN's shareholders (Rayonier, 2014). Figure 1 shows that the performance fibers segment took big account of RYN's total income. WY announced the divestment of its homebuilding and real estate's company on May 12, 2014 (Weyerhaeuser, 2014). Figure 2 displays that real estate business only hold small part in WY's total income. After divestments, both companies not only pursue their growth management strategies and executive priorities, but also improve their individual capital

[1] While there are many small, private timber REITs, most large ones are publicly traded. WY offered to acquire PCL in mid-2015 and both firms made a final agreement to the deal by the end of 2015. The completion time is set to be late first quarter or early second quarter in 2016.

structures and dividend policy for long-term benefit. In addition, both companies can secure significant tax benefits by concentrating on the development of timberland business.

On November 8, 2015, WY and PCL announced a proposed merger to create a timberland behemoth with more than 13 million acres of productive timberland. PCL's stock was trading at around $46.77 with a 16% gain on the following day, while WY's shares was down by about 3% to $29.40. The WY-PCL merger will not only bring significant financial benefits, such as attractive dividend and strong balance sheet, but also build the combined company into the industry leader, capitalizing on the housing recovery, achieving higher and better use potential through the portfolio composition, and lowering the cost of manufacturing assets (Stone, 2015).

There are limited studies about the impact of timber REIT divestment and merger. The objective of this study is to fill this gap by applying event study and GARCH models on the divestiture and merger announcements of timber REITs. The null hypothesis is that there exist neither abnormal returns nor volatility variations after the announcements. This research not only sheds some light on the growing trend for timber REITs to divest their non-timber segments and the relation between timber and non-timber segments of timber REITs, but also help understand the financial performance of timber REITs merger.

# CHAPTER 2

# LITERATURE REVIEW

## *2.1. Event study*

An event study is commonly employed to examine the impact of an event on a stock's return. It has been widely used in the area of accounting, finance, and economics research, including earnings announcements, mergers, acquisitions and political economy questions (McWilliams, 1999). In forest economics, this technique has been used on diverse research topics. Sun et al. (2013) used event study to investigate how return and volatility of public forest firms react to different kinds of ownership changes and found that conversions to REITs generated positive abnormal returns while timberland sales and acquisitions had negative impacts on forest firms. Mei and Sun (2008) evaluated the market reactions to the mergers and acquisitions of forest firms and concluded that the mergers and acquisitions produced abnormal returns. Niquidet (2008) assessed the impact of forest policy reform in British Columbia, Canada, and reported negative market reactions to the announcement of the Forestry Revitalization Plan. Sun and Zhang (2011) found positive impacts of industrial timberland sales on forest products firms. In last few years, increasing papers placed great emphasis on the time series properties of financial data, specifically, the event-induced volatility of stock returns (Dutta, 2014; Sun et al., 2013). These literatures showed the feasibility of using event study to evaluate the financial performance of timber REITs after major structure changes. In this study,

short-term event study that incorporates time-varying heteroscedasticity in financial time series data is used to assess the changing structural effects of timber REITs.

### *2.2. Corporate divestitures*

A sizeable amount of research has been conducted on the topic of corporate divestitures. Goolsbee and Maydew (2002) simulated the effect of timber REIT spin-offs and found increased cash flow to compensate the revenue losses in the aggregate level. Prezas and Simonyan (2015) analyzed the determinants of divestitures. The announcement effects of spin-offs were found to be positive, and the undervalued firms had higher possibility to spin off their assets during periods of investor optimism. Brauer and Wiersema (2012) found the lowest returns at the peak of divestiture wave as there existed a U-shape pattern between divestiture position and stock market returns. Moschieri (2011) suggested that divestiture was optimal if the parent firm granted the spin-off unit self-actualization and increased returns to compensate the risks of divestments. Nguyen (2013) evaluated the extent and sources of value related to the divestitures of French firms and found that investors realized the profit of divestiture and reevaluated the seller accordingly for high-leverage firms. Kolev (2016) employed meta-analysis to synthesize the impact of various antecedents to divestitures and found that most divestitures resulted from previous divestment experience, corporate governance and unprofitable unit. Xia and Li (2013) found that the dependence between firms and their subunits and the rising strength of the subunits would reduce the risk of divesting the subunits. Gadad et al. (2009) evaluated the effect of changes in operating performance on the divestitures and found that the divestitures increased the real economic gains. Madura and Murdock (2012) evaluated the impact of corporate divestitures on the parent firm’s shareholder risk and found that the shift in risk on the parent

firm was based on the types of assets divested and the liability structure. While few studies investigate the impacts of timber REITs' divestitures, this study examines the abnormal returns and volume volatilities of timber REITs after the divestiture announcements.

*2.3. Corporate merger*

Merger is regarded as a prevailing strategy in developing distribution ways, or addressing new markets. Mergers often strengthen businesses by making their operations more synergetic. Shaheen (2006) assessed the impact of acquisition announcements and found that the acquisition announcement generated negative impact on the target firms. Gopalaswamy et al. (2008) evaluated the differnet market reactions between target and acquiring companies and suggested that acquiring companies had higher returns than those for the target companies around the announcement period. Allen et al. (2014) estimated the mergers' distributional impact and found that merger would be profitable in the interim of the distribution of transaction price. Savor and Lu (2009) examined how overvalued firms benefited their long-term shareholders and found that successful stock bidders performed much better than unsuccessful ones. Kumar et al. (2015) tested the relationship between the stock market's reaction to the previous and the subsequent acquisition and found that the increased abnormal returns would strengthen acquirers to buy target firms. Gaur et al. (2013) evaluated how the market reacted to the competitors of the acquiring firms after the acquisition announcement as the market reagarded the announcements as catalyst for future development. Jansen and Stuart (2014) evaluated the impact of the merger and acquisition announcements and found that the market reactions to the acquisitions announced by small firms were much more positive than those announced by larger firms. Sheen (2014) found that the price of the acquirers' products would decline if they got into a new

product market. This study examines the effect of WY-PCL merger on each party's financial performance.

# CHAPTER 3

# METHODOLOGIES

## *3.1. Events and data sources*

This study uses traditional short-term event study estimated with the ordinary least square (OLS) to assess abnormal returns and employs the generalized autoregressive conditional heteroskedasticity (GARCH) procedure to consider time-varying volatility. The results of abnormal returns across timber REITs and over time are compared between OLS and GARCH models. Then, both timber REITs evaluated their event-induced volatility to assess how the events change the volatility. These events are announcements by RYN and WY to divest non-timber segments in May 2014 and by WY and PCL to merger with each other in November 2015. The investigation time period for all firms is 259 trading days before and 5 trading days after the hypothetical event day '0'. The first 254 days in this period (- 281, - 28) are designated as the 'estimation window', and the following 11 days (- 5, + 5) designated as the 'event window'. All stock data are obtained from the Center for Research in Security Prices (CRSP, 2014).

*3.2. Traditional event study*

Investors may change their attitude towards the market when an event occurs, leading to a shift in the firm's return producing process. The market model is widely applied on estimating the stock returns on a firm.

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

where $R_{it}$ and $R_{mt}$ represent the stock return and the overall market return on day $t$, and the parameters $\alpha$, $\beta$ show a linear market model. The abnormal return equals the observed event date return $R_{id}$ subtracting the conditional expected return.

$$AR_{id} = R_{id} - (\hat{\alpha}_i + \hat{\beta}_i R_{md}) \quad (2)$$

The increasing or decreasing firm-specific uncertainty could be seen from the abnormal return $AR_{id}$. The market model in equation (1) identifies $\varepsilon_{it}$ for an event date.

The abnormal returns of individual firms on particular days can be added up over time. This is used to calculate aggregate abnormal returns.

$$CAR_{d_1,d_2} = \sum_{d=d_1}^{d_2} AR_d \quad (3)$$

where $CAR_{d_1,d_2}$ is the cumulative abnormal returns from $d_1$ to $d_2$ in the event window.

The variances of the abnormal return and the cumulative abnormal returns are:

$$Var(AR_d) = \sigma_{\varepsilon_i}^2 \quad (4)$$

$$Var(\mathrm{CAR}_{d_1,d_2}) = (d_2 - d_1 + 1)\sigma_{\varepsilon_i}^2 \quad (5)$$

where *Var(.)* indicates variance. The variance of the abnormal returns are approximately equal to the variance of the error term from the estimation model (MacKinlay, 1997).

The statistical significance is tested as follows.

$$t_d = AR_d (Var(AR_d))^{-0.5} \sim N(0,1) \quad (6)$$

$$t_{d_1,d_2} = CAR_{d_1,d_2} (Var(\mathrm{CAR}_{d_1,d_2}))^{-0.5} \sim N(0,1) \quad (7)$$

where both statistics $t_d$ and $t_{d_1,d_2}$ follow a standard normal distribution.

*3.3. Event study with GARCH modeling*

The event-induced variances are assumed constant in the traditional OLS models, while event-induced volatilities are allowed to vary over time (Devaney, 2012).

The market model incorporated the GARCH (1, 1) effect is showed as:

$$R_{it} = \alpha + \beta_i R_{mt} + \xi_{it}, \xi_{it} \left| \Omega_{t-1} \sim N(0, \sigma^2_{\xi_{it}} = h_{it}) \right. \quad (8)$$

$$h_{i,t} = \omega_i + \gamma_i h_{i,t-1} + \varphi_i \xi^2_{i,t-1} \quad (9)$$

where $\xi_{it}$ denotes the error term with mean zero and conditional variance $h_{it}$; and $\Omega_{t-1}$ refers to the information set at time *t*-1.

When considering GARCH effect, the abnormal return $AR_{id}$ and cumulative abnormal returns $CAR_{\mathrm{d1;d2}}$ can be obtained as in OLS.

In this study, same statistics are used to assess abnormal returns with the GARCH effect as in Hilliard and Savickas (2002). In order to construct the estimates, abnormal returns are modified by the time-varying volatility as follows.

$$SR_{id} = AR_{id} (\hat{h}_{id})^{-0.5} \quad (10)$$

$$\hat{h}_{id} = \omega_i \sum_{j=0}^{d-1} (\hat{\gamma}_i + \hat{\varphi})^j + (\hat{\gamma}_i + \hat{\varphi})^{d-1} \gamma_i h_{i,t^*} + (\hat{\gamma}_i + \hat{\varphi})^{d-1} \hat{\varphi}_i \hat{\xi}^2_{i,t^*} \quad (11)$$

where $SR_{id}$ is the standardized abnormal return of firm *i* on day *d* during the event window. When the information set is available, the volatility forecast of the event window is conditional, where $t^*$ represents the final day of the estimation window (Białkowski et al., 2008; Corrado, 2011)

In the same way, the standardized culmulative abnormal returns are obtained by adding up the standardized abnormal returns for a period of time.

$$SCAR_{i,d_1,d_2} = (\sum_{d=d_1}^{d_2} AR_{id})(\sum_{d=d_1}^{d_2} \hat{h}_{id})^{-0.5} \quad (12)$$

where $SCAR_{i,d_1,d_2}$ denotes the standardized cumulative abnormal returns of firm *i* between days $d_1$ and $d_2$.

To assess if $SR_{id}$ and $SCAR_{d_1,d_2}$ are statistically significant, $T_d$ and $T_{d_1,d_2}$ are described as:

$$T_d = SR_{id} \sim t_{N-1} \quad (13)$$

$$T_{d_1,d_2} = SCAR_{d_1,d_2}(d_2 - d_1 + 1)^{-0.5} \sim t_{N-1} \quad (14)$$

where statistics $T_d$ and $T_{d_1,d_2}$ have a student *t*-distribution with *N*-1 degree of freedom.

*3.4. Event-induced volatility*

The event-induced volatility is employed to evaluate how unsystematic volatility changes along with the events (Hilliard and Savickas, 2002). To examine the scale of changes, a multiplicative abnormal volatility parameter $\pi$ is used

$$\lambda = Var(AR_d)^{-0.5} \hat{h}_{id} \quad (15)$$

where the parameter $\lambda$ can be calculated from any day over the event window. The parameter $\lambda_d = 1$ implies that the unsystematic volatility is not affected by the event, and $\lambda_d \succ 1$ indicates the event increases the volatility.

*3.5. GARCH modeling of return volatility*

To examine what effect the trading volume has on the stock return volatility, we use GARCH models with mean specification in line with Engle et al. (1987).

$$R_t = \mu + \varphi R_{t-1} + \varepsilon_t \tag{16}$$

where $R_t$ represents the original daily return of a firm on day *t*; $\mu$ and $\varphi$ are the coefficients; and $\varepsilon_t$ is the disturbance term.

Based on Nelson (1991), the exponential GARCH model is given as follows.

$$\log \sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \gamma(|\varepsilon_{t-1}| + E(|\varepsilon_{t-1}|)) + \beta \ln \sigma_{t-1}^2 \tag{17}$$

where $\omega$, $\alpha$, $\gamma$, and $\beta$ are the coefficients. This equation indicates the volatility is affected by the sign and magnitude of the term $|\varepsilon_{t-1}|$.

The mixture-of-distributions hypothesis supposes that trading volume and price volatility are driven by the same underlying information flow (Luu and Martens, 2003). According to Lamoureux and Lastrapes (1990), the following GARCH model included the adjusted trading volume data:

$$\log \sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \gamma(|\varepsilon_{t-1}| + E(|\varepsilon_{t-1}|)) + \beta \ln \sigma_{t-1}^2 + \phi \hat{V}_t \tag{18}$$

where $\hat{V}_t$ denotes the adjusted trading volumes with coefficient $\phi$.

Akaike Information Criterion (AIC) and log-likelihood ratio test are used to compare the goodness of fit of the conditional variance equation. Parameter $\phi$ will be significant and

positive when price volatility and trading volume are affected by the same information set. If the trading volume represents a reasonable factor for the serially correlated information set, the GARCH coefficient $\beta$ should be reduce.

# CHAPTER 4

# EMPIRICAL RESULTS

## *4.1. Comparison of OLS and GARCH results*

Both event groups use event study based on OLS and GARCH models. Outcomes of abnormal returns over time and across firms are compared between the two procedures. Table 2 displays the CARs and the associated *t*-statistics of divestiture announcements for seven sub-stages within the event window of eleven days. The CARs of RYN are between 1.96% and 6.23% with the OLS estimation, and between 0.90% and 3.52% with the GARCH estimation. For WY, the CARs are between -1.07% and 2.34% under the OLS model, and between -1.27% and 2.66% under the GARCH model. The CARs are all positive for the OLS model. The *t*-statistics of CAR for both timber REITs are not significant for all stages in the event window. The estimates of different sub-stages for the GARCH model are also insignificant. Thus, the divestiture announcements have no impact on the timber REITs.

In contrast, the group of merger announcements, as shown in Table 3, have different results than the divestiture announcements and generate strong abnormal returns. The CARs of PCL are between 13.59% and 18.11% with the OLS estimation. The CAR estimates for all seven sub-periods are positive and significant. In particular, the CAR is 13.59% for (-1, 1), with corresponding estimate of 9.650. For period of ($d_1$, $d_2$) = (0, 1), the CAR is 15.48% and the estimate is 13.467. The CARs are between 15.79% and 21.02% with the GARCH estimation. All of the estimates for sub-periods are significant. For WY, the CARs are between -5.23% and

448% under the OLS model. The abnormal returns are negative and significant for three sub-periods: -3.236 for (-1, 1), -3.251 for (-1, 0), -2.365 for (0, 1). The CARs are between -5.43% and 3.34% under the GARCH model. The estimates are significant for (-1, 1), (-1, 0), (0, 1), with corresponding values of -3.136, -3.176 and -2.289. In sum, merger announcement has positive effect on the returns of PCL and negative effect on the returns of WY.

The *t*-statistics for the GARCH model are a little smaller than those from the OLS model. This difference is caused by the different assumptions underlying the models. The GARCH model incorporates the time-varying volatility into the estimates, increasing the standard errors and decreasing the significance of abnormal returns.

*4.2. Results of the event-induced volatility*

The estimates of the abnormal volatility are presented for the event window (-5, 5) in Figure 3 and Figure 4. For the group of divestiture announcement, the event-induced volatilities for RYN's event are larger than 1 on 8 days (-2, -1, 0, 1, 2, 3, 4, 5). It indicates that divestiture of RYN led to a larger volatility of the firm. The maximum of abnormal volatility is 1.73 at Day 5. While the event-induced abnormal volatility for WY's announcement ranges between 0.72 and 0.73 over the event window, all values are less than one. The divestiture of WY decreases the volatility. Thus, only the volatility of RYN has gradually increased magnitudes over the event window. In contrast, the event-induced volatility of WY and PCL as a result of their merger announcement are larger than one on 11 days. The maximum volatility is 1.062 on Day -5 for PCL and is 1.026 on Day 5 for WY. Therefore, the event-induced volatility were affected by event for both WY and PCL.

*4.3. Results of the GARCH modeling of return volatility*

Table 4 and Table 5 report the GARCH specification. When considering the adjusted trading volumes in the model, the AIC value is less than that without the trading volume. For example, according to Table 3, RYN's AIC value decreased from 5.979 to 3.147 after considering the adjusted trading volume. In Table 4, the AIC value of WY is 3.683 for the model without adjusted trading volumes and larger than the model adding the trading volumes. The likelihood ratio tests refuses the null hypothesis that models with and without trading volumes are the same at the 1% significance level. Therefore, it is adequate to incorporate trading volumes into the GARCH procedure.

Results from the GARCH model considering the adjusted trading volume variable is compared to the results without the adjusted trading volume. The model is thought to be appropriate as most of the estimates are significant. For example, for the group of divestiture announcements, the ARCH coefficient $\alpha$ and GARCH coefficient $\beta$ are positive and significant for both firms. The sum of $\alpha$ and $\beta$ is bigger than 0.7, implying conditional volatility lasts long. When the trading volume is incorporated into the volatility equation, the coefficients of contemporaneous trading volume ($\phi$'s) for all firms are positive and highly significant. Therefore, the trading volume is positive contemporaneous correlated with return volatility.

Figure 5 shows the daily returns and logarithmic volumes over the event window for divestiture announcements. For WY, the trading volumes are positively correlated to stock returns as the trading volume increases when the stock return increases. For RYN, the positive correlation between the trading volumes and stock returns is more apparent than WY. Figure 6 shows the daily returns and logarithmic volumes over the event window for merger announcements. The trading volumes are positively correlated to stock returns for either WY or

PCL. The positive relationship between trading volumes and stock returns is more obvious for PCL than WY.

# CHAPTER 5

# CONCLUSION

This study investigates the impact of timber REITs' major structural changes with 1-11 day event windows. Event studies with OLS and GARCH models produce close estimates of abnormal returns for the group of divestiture announcements and the group of merger announcements. For the group of divesting non-timber segments, the abnormal returns of RYN and WY are statistically insignificant over the event windows. In addition, returns on RYN's stocks show increased volatility for most days over the event window, while WY's stock returns show decreased volatility over the event window. For the group of merger announcements, the abnormal returns of PCL are significantly positive, while PCL-WY merger resulted in negative impact for WY. Besides, the event-induced volatility increased gradually for both firms. Overall, the divestiture announcements had little impact on stock returns and increased RYN's security volatility while the PCL-WY merger decision generated abnormal returns and increased both firm's security volatility. Using the GARCH model to investigate the relationship between price variation and volume, a positive correlation are found for all timber REITs. This phenomenon suggests that returns and volumes are influenced by the same underlying information flow.

The insignificant results of the divestiture announcements contrast with the findings of Tucker (2013), where a positive market reaction was found, as the market typically views internal divestment positively. The former may be attributed to either the market's lack of appreciation of the synergies, or the difficulty to quantify such benefits at the outset, as investors

sometimes hold too strongly to their own information, and discount public signals. Another plausible explanation is that the market may respond differently in the long run as the long-term strategies play an important role in the motivation of many divestitures, especially when the spin-offs are themselves big businesses (Frazzini, 2006). Future studies are necessary to examine whether these divestitures are beneficial to timber REITs in the long run.

The outcomes from the merger announcement reveals that abnormal returns of the target firm are significantly different from acquiring firm. The target firm, PCL, experiences positive abnormal returns. The acquiring firm, WY, experiences negative abnormal returns. These findings may be due to the different estimates of investors towards the future profitability of participating firms. Investors may treat merger announcements as a sign that PCL's stock is undervalued and prefer to buy more stock of it, leading to a positive market reaction. Whereas the investors are likely to view merger announcements as a sign that WY's stock is overvalued and decrease their demand for it. Thus, it is reasonable to expect WY to produce negative abnormal returns (Shaheen, 2006).

The merger announcement led to trading of 13.58 million shares for PCL on the event day, about ten times over the average, and a 17% price increase. The trading volume of WY was 41.32 million shares on the event day, about four times as big as the average, while the price fell by 3%. The abnormal large trading volume could be attributed to the different evaluations of investors toward the potential risk and reward profile of the stocks when they received new messages. The phenomenon indicates some kind of evidence of a lack of market efficiency as there exists abnormal returns after the public announcements (Reilly and Brown, 2006). For the group of divestiture announcements, the trading volume for RYN was 56.23 million shares on the event day, approximately equal to the average, accompanied by 1% price increase. The

trading volume of WY was 22.57 million shares on the event day, about two and a half times lower than the average, while the price almost remained unchanged. The lack of significant reaction to the divestiture announcements shows the evidence that there exists market efficiency since investors were unlikely to experience abnormal returns after the information was released.

The findings of this study can clarify the mechanisms of market dynamics and stock volatility under the divestiture announcements of non-timber segments, the relationship between timber REITs and their non-timber segments, and the merger announcements of timber REITs. This study also provides valuable guidance for other timber REITs when comes to structural changes like divestiture or merger. Additionally, the research results will provide suggestions for investors who seek to make profits with timberland.

## REFERENCES


Allen, J., Clark, R., Houde, J.-F., 2014. The effect of mergers in search markets: Evidence from the Canadian mortgage industry. American Economic Review 104, 3365-3396.

Białkowski, J., Gottschalk, K., Wisniewski, T.P., 2008. Stock market volatility around national elections. Journal of Banking and Finance 32, 1941-1953.

Brauer, M.F., Wiersema, M.F., 2012. Industry divestiture waves: How a firm's position influences investor returns. Academy of Management Journal 55, 1472-1492.

Clutter, M., Mendell, B., Newman, D., Wear, D., Greis, J., 2005. Strategic factors driving timberland ownership changes in the US South, www.srs.fs.usda.gov/econ/pubs/southernmarkets/strategic-factors-and-ownership-v1.pdf

Corrado, C.J., 2011. Event studies: A methodology review. Accounting and Finance 51, 207-234.

CRSP, 2014. The Database of the Center for Research in Security Prices. University of Chicago Booth School of Business, IL.

Devaney, M., 2012. Financial crisis, REIT short-sell restrictions and event induced volatility. The Quarterly Review of Economics and Finance 52, 219-226.

Dutta, A., 2014. Parametric and nonparametric event study tests: A review. International Business Research 7, 136-142.

Engle, R.F., Lilien, D.M., Robins, R.P., 1987. Estimating time varying risk premia in the term structure: The Arch-M model. Econometrica 55, 391-407.

Frazzini, A., 2006. The disposition effect and underreaction to news. Journal of Finance 61, 2017-2046.

Gadad, A.-M., Stark, A.W., Thomas, H.M., 2009. Divestitures: Wealth transfers or real economic gains? Applied Financial Economics 19, 1073-1081.

Gaur, A.S., Malhotra, S., Zhu, P., 2013. Acquisition announcements and stock market valuations of acquiring firms' rivals: A test of the growth probability hypothesis in China. Strategic Management Journal 34, 215-232.

Goolsbee, A., Maydew, E., 2002. Taxes and organizational form: The case of REIT spin-offs. National Tax Journal 55, 441-456.

Gopalaswamy, A.K., Acharya, D., Malik, J., 2008. Stock price reaction to merger announcements: An empirical note on Indian markets. Investment Management and Financial Innovations 5, 95-103.

Heikkinen, V., Kanto, A., 2000. Market model with longrun effects - Empirical evidence from Finnish forestry returns. Silva Fennica 34, 61-69.

Hilliard, J.E., Savickas, R., 2002. On the statistical significance of event effects on unsystematic volatility. Journal of Financial Research 25, 447-462.

Jansen, I.P., Stuart, N.V., 2014. How to predict the market's reaction when you announce an acquisition. Journal of Corporate Accounting & Finance 25, 43-49.

Kolev, K., 2016. To divest or not to divest: A meta‐analysis of the antecedents of corporate divestitures. British Journal of Management 27, 179-196.

Kumar, M.V.S., Dixit, J., Francis, B., 2015. The impact of prior stock market reactions on risk taking in acquisitions. Strategic Management Journal 36, 2111-2121.

Lamoureux, C.G., Lastrapes, W.D., 1990. Heteroskedasticity in stock return data: Volume versus GARCH effects. Journal of Finance 45, 221-229.

Luu, J.C., Martens, M., 2003. Testing the mixture-of-distributions hypothesis using 'realized' volatility. Journal of Futures Markets 23, 661-679.

MacKinlay, A.C., 1997. Event studies in economics and finance. Journal of Economic Literature 35, 13-39.

Madura, J., Murdock, M., 2012. How and why corporate divestitures affect risk. Applied Financial Economics 22, 1919-1929.

McWilliams, A., 1999. Issues in the use of the event study methodology: A critical analysis of corporate social responsibility studies. Organizational Research Methods 2, 340-365.

Mei, B., Clutter, M.L., 2010. Evaluating the financial performance of timberland investments in the United States. Forest Science 56, 421-428.

Mei, B., Sun, C., 2008. Event analysis of the impact of mergers and acquisitions on the financial performance of the U.S. forest products industry. Forest Policy and Economics 10, 286-294.

Mendell, B., 2008. Investor responses to timberlands structured as real estate investment trusts. Journal of Forestry 106, 277-280.

Moschieri, C., 2011. The implementation and structuring of divestitures: The unit's perspective. Strategic Management Journal 32, 368-401.

Nelson, D.B., 1991. Conditional heteroskedasticity in asset returns: A new approach. Econometrica 59, 347-370.

Newell, G., Eves, C., 2009. The role of U.S. timberland in real estate portfolios. Journal of Real Estate Portfolio Management 15, 95-106.

Nguyen, P., 2013. The role of firm performance in the market reaction to divestiture announcements. Economics Bulletin 33, 1723-1728.

Niquidet, K., 2008. Revitalized? An event study of forest policy reform in British Columbia. Journal of Forest Economics 14, 227-241.

Prezas, A.P., Simonyan, K., 2015. Corporate divestitures: Spin-offs vs. sell-offs. Journal of Corporate Finance 34, 83-107.

Rayonier, 2014. Rayonier board of directors approves separation of Rayonier Advanced Materials, http://www.businesswire.com/news/home/20140616005704/en/Separation-Rayonier-Advanced-Materials-Expected-Close-June.

Reilly, F.K., Brown, K.C., 2006. Investment analysis and portfolio management. Leonardo da Vinci programme project.

Savor, P.G., Lu, Q.I., 2009. Do stock mergers create value for acquirers? Journal of Finance 64, 1061-1097.

Shaheen, I., 2006. Stock market reaction to acquisition announcements using an event study approach, Undergraduate Thesis, Department of Economics. Franklin and Marshall College, p. 50.

Sheen, A., 2014. The real product market impact of mergers. Journal of Finance 69, 2651-2688.

Stein, P.R., 2011. Trends in forestland. Forest History Today 17, 83-86.

Stone, A., 2015. Plum Creek and Weyerhaeuser merge, forming timber giant, http://blogs.barrons.com/incomeinvesting/2015/11/09/plum-creek-and-weyerhaeuser-merge-forming-timber-giant/.

Sun, C., 2013. On the market risk of securitized timberlands. Journal of Forest Economics 19, 110-127.

Sun, C., Rahman, M.M., Munn, I.A., 2013. Adjustment of stock prices and volatility to changes in industrial timberland ownership. Forest Policy and Economics 26, 91-101.

Sun, X., Zhang, D., 2011. An event analysis of industrial timberland sales on shareholder values of major U.S. forest products firms. Forest Policy and Economics 13, 396-401.

Teeter, L.D., 1991. Stand density management strategies under risk: effects of stochastic prices. Canadian Journal of Forest Research 21, 1373-1379.

Tucker, J., Guermat, C., Prasert, S., 2013. Short-run reaction to news announcements: UK evidence, Unpublished Manuscript, Retrieved from http://connection.ebscohost.com/c/articles/90073989.

Wang, L., 2011. Timber REITs and taxation, http://www.timbertax.org/developments/Timber%20REIT%20Taxation%20Briefing.pdf.

Weyerhaeuser, 2014. Weyerhaeuser (WY) to split-off Weyerhaeuser real estate company, http://www.streetinsider.com/Corporate+News/Weyerhaeuser+(WY)+to+Split-Off+Weyerhaeuser+Real+Estate+Company/9474188.html.

Xia, J., Li, S., 2013. The divestiture of acquired subunits: A resource dependence approach. Strategic Management Journal 34, 131-148.

Table 1. Announcements of major structural changes of timber REITs between 2014 and 2015

| | Company | Ticker | Date | Event information |
|---|---|---|---|---|
| REIT divestiture | | | | |
| 1 | Rayonier | RYN | 2014-05-27 | Divestiture of performance fibers |
| 2 | Weyerhaeuser | WY | 2014-05-12 | Divestiture of real estate segment |
| | | | | |
| REIT merger | | | | |
| 1 | Plum Creek | PCL | 2015-11-08 | Target |
| 2 | Weyerhaeuser | WY | 2015-11-08 | Acquirer |

Table 2. Cumulative abnormal returns (CAR) and *t*-statistics (*t*-stat) during the event windows for divestiture announcements

| | OLS | | | | GARCH | | | |
|---|---|---|---|---|---|---|---|---|
| | RYN | | WY | | RYN | | WY | |
| Event window | CAR | *t*-stat | CAR | *t*-stat | CAR | *t*-stat | CAR | *t*-stat |
| (-5,5) | 6.23 | 1.241 | 2.34 | 0.626 | 3.52 | 1.060 | 2.66 | 0.803 |
| (-3,3) | 3.97 | 0.992 | 0.52 | 0.172 | 1.40 | 0.530 | 0.52 | 0.196 |
| (-2,2) | 3.49 | 1.030 | -0.01 | -0.004 | 1.61 | 0.718 | -0.05 | -0.023 |
| (-1,1) | 3.78 | 1.441 | -0.74 | -0.376 | 1.83 | 1.058 | -0.86 | -0.497 |
| (-1,0) | 1.96 | 0.918 | -0.61 | -0.381 | 0.90 | 0.638 | -0.69 | -0.489 |
| (0,1) | 2.58 | 1.204 | -1.07 | -0.674 | 1.23 | 0.870 | -1.27 | -0.897 |
| (0,5) | 5.16 | 1.393 | -0.19 | -0.067 | 2.33 | 0.953 | -0.30 | -0.123 |

*Note*: CARs are in percentage form.

Table 3. Cumulative abnormal returns (CAR) and *t*-statistics (*t*-stat) during the event windows for merger announcements

| | OLS | | | | GARCH | | | |
|---|---|---|---|---|---|---|---|---|
| | PCL | | WY | | PCL | | WY | |
| Event window | CAR | *t*-stat | CAR | *t*-stat | CAR | *t*-stat | CAR | *t*-stat |
| (-5,5) | 16.49 | 6.116 | 4.48 | 1.448 | 19.16 | 5.778 | 3.34 | 1.007 |
| (-3,3) | 15.12 | 7.033 | -2.79 | -1.132 | 17.65 | 6.672 | -2.82 | -1.066 |
| (-2,2) | 15.41 | 8.479 | -2.34 | -1.119 | 18.00 | 8.050 | -2.40 | -1.074 |
| (-1,1) | 13.59 | 9.650 | -5.23 | -3.236 | 15.79 | 9.117 | -5.43 | -3.136 |
| (-1,0) | 15.90 | 13.830 | -4.29 | -3.251 | 18.46 | 13.056 | -4.49 | -3.176 |
| (0,1) | 15.48 | 13.467 | -3.12 | -2.365 | 18.00 | 12.726 | -3.24 | -2.289 |
| (0,5) | 18.11 | 9.098 | 1.20 | 0.523 | 21.02 | 8.582 | 1.25 | 0.511 |

*Note*: CARs are in percentage form.

Table 4. Results from the GARCH models on return series without and with the adjusted trading volumes for divestiture announcements

| | RYN | | WY | |
|---|---|---|---|---|
| | A. Without volumes | B. With volumes | A. Without volumes | B. With volumes |
| $\mu$ | -0.153 | -0.686 | 0.093 | 0.078 |
| | [0.000] | [0.000] | [0.237] | [0.020] |
| $\varphi$ | 0.294 | 0.522 | -0.066 | -0.079 |
| | [0.000] | [0.000] | [0.456] | [0.028] |
| $\omega$ | -0.744 | 0.113 | -0.072 | -0.506 |
| | [0.000] | [0.000] | [0.354] | [0.009] |
| $\alpha$ | 0.061 | -0.509 | 0.053 | -0.069 |
| | [0.000] | [0.000] | [0.578] | [0.505] |
| $\beta$ | 0.903 | 0.911 | 0.672 | -0.525 |
| | [0.000] | [0.000] | [0.014] | [0.006] |
| $\gamma$ | 7.006 | -0.447 | 0.099 | -0.200 |
| | [0.000] | [0.000] | [0.649] | [0.328] |
| *Shape* | 2.227 | 3.385 | 23.208 | 99.357 |
| | [0.000] | [0.000] | [0.638] | [0.548] |
| ø | | 0.041 | | 0.988 |
| | | [0.000] | | [0.000] |
| *AIC* | 5.979 | 3.147 | 2.721 | 2.627 |
| *LR* test | 375.50 | | 11.86 | |
| | [0.000] | | [0.001] | |

*Note*: A and B refer to the specifications in the conditional variance equation. The *LR* test is the log-likelihood ratio test. The numbers in the brackets are *p*-values. The *shape* values are from the Student's *t*-distribution of the innovations.

Table 5. Results from the GARCH models on return series without and with the adjusted trading volumes for merger announcements

| | PCL | | WY | |
|---|---|---|---|---|
| | A. Without volumes | B. With volumes | A. Without volumes | B. With volumes |
| $\mu$ | -0.094 | -0.130 | -0.099 | -0.050 |
| | [0.324] | [0.000] | [0.514] | [0.652] |
| $\varphi$ | -0.049 | -0.117 | 0.131 | 0.064 |
| | [0.611] | [0.000] | [0.091] | [0.355] |
| $\omega$ | 0.601 | 0.455 | 0.185 | 0.629 |
| | [0.192] | [0.000] | [0.051] | [0.002] |
| $\alpha$ | -0.965 | -0.984 | -0.358 | 0.121 |
| | [0.149] | [0.000] | [0.009] | [0.447] |
| $\beta$ | 0.811 | 0.780 | 0.815 | -0.456 |
| | [0.000] | [0.000] | [0.000] | [0.014] |
| $\gamma$ | 1.367 | -0.748 | -0.024 | -0.347 |
| | [0.153] | [0.000] | [0.895] | [0.135] |
| *Shape* | 2.100 | 2.232 | 4.565 | 100.000 |
| | [0.000] | [0.000] | [0.046] | [0.545] |
| ø | | 0.595 | | 2.853 |
| | | [0.000] | | [0.000] |
| *AIC* | 3.492 | 3.391 | 3.683 | 3.402 |
| *LR* test | 9.26 | | 28.71 | |
| | [0.002] | | [0.000] | |

*Note*: A and B refer to the specifications in the conditional variance equation. The *LR* test is the log-likelihood ratio test. The numbers in the brackets are *p*-values. The *shape* values are from the Student's *t*-distribution of the innovations.

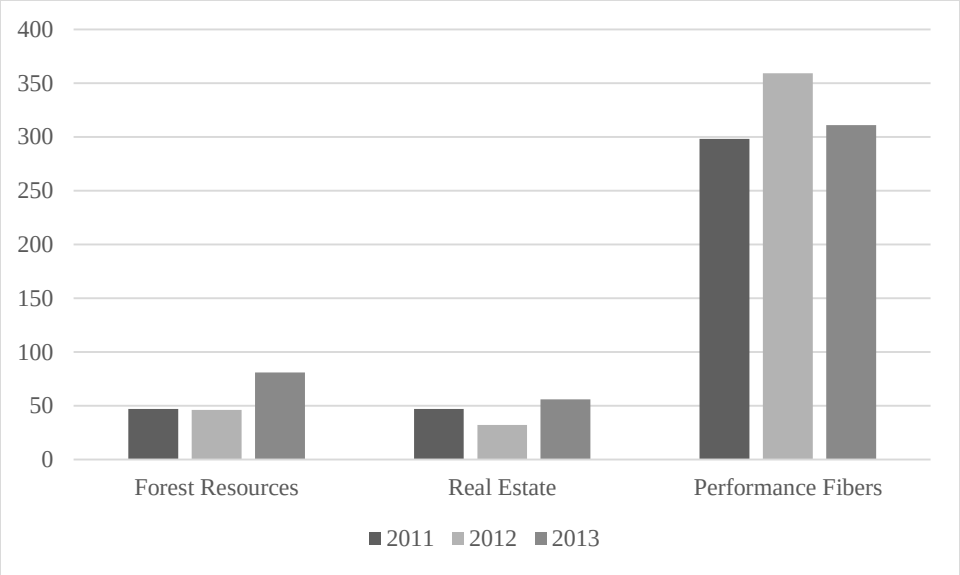


Fig. 1. RYN's operating income by business segment from 2011 to 2013
*Note*: The values are in millions of dollars. The data are obtained from RYN's 10-K reports.

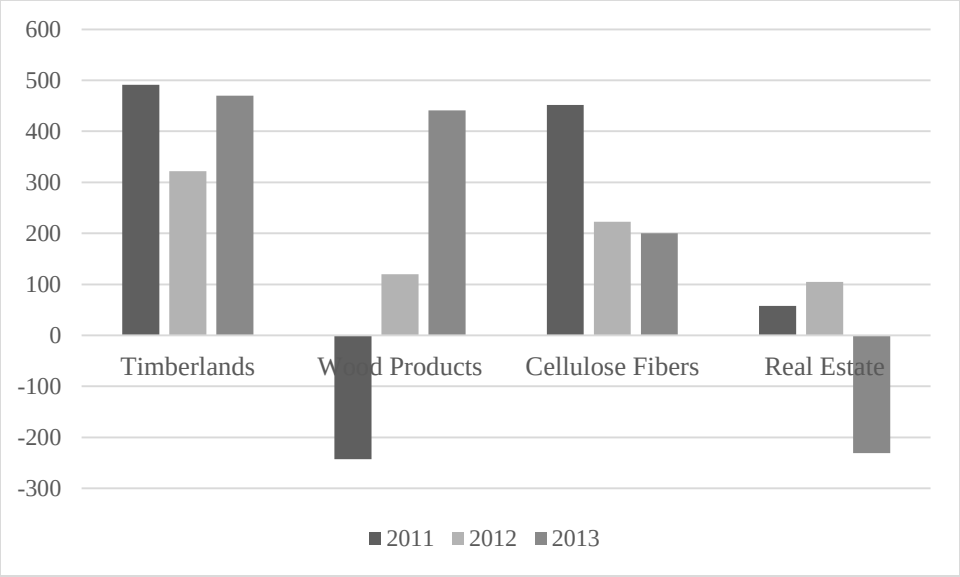


Fig. 2. WY's operating income by business segment from 2011 to 2013
*Note*: The values are in millions of dollars. The data are obtained from WY's 10-K reports.

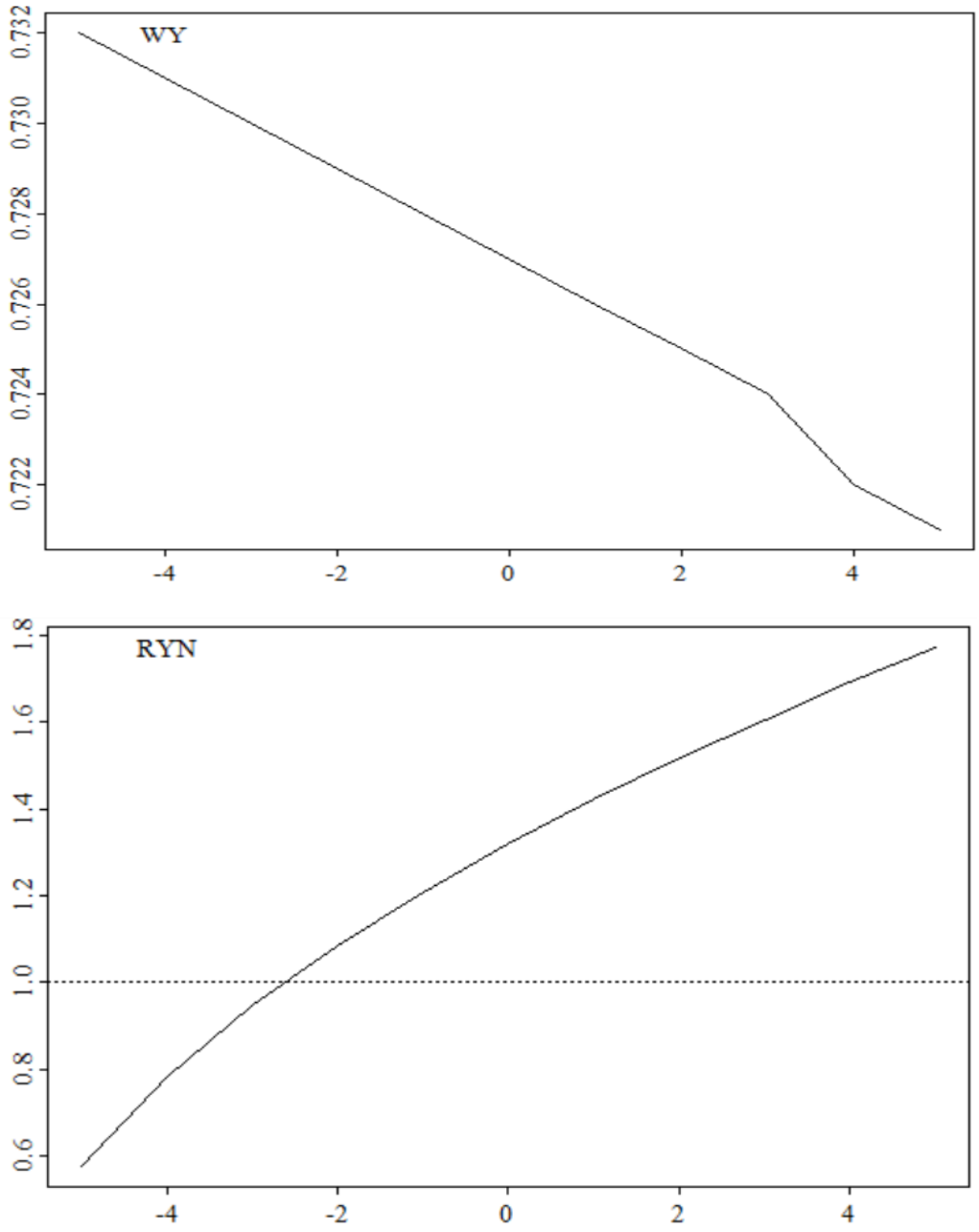


Fig. 3. Abnormal volatility on individual dates over the event window for divestiture announcements.
*Note*: A value of one indicates no change in volatility.

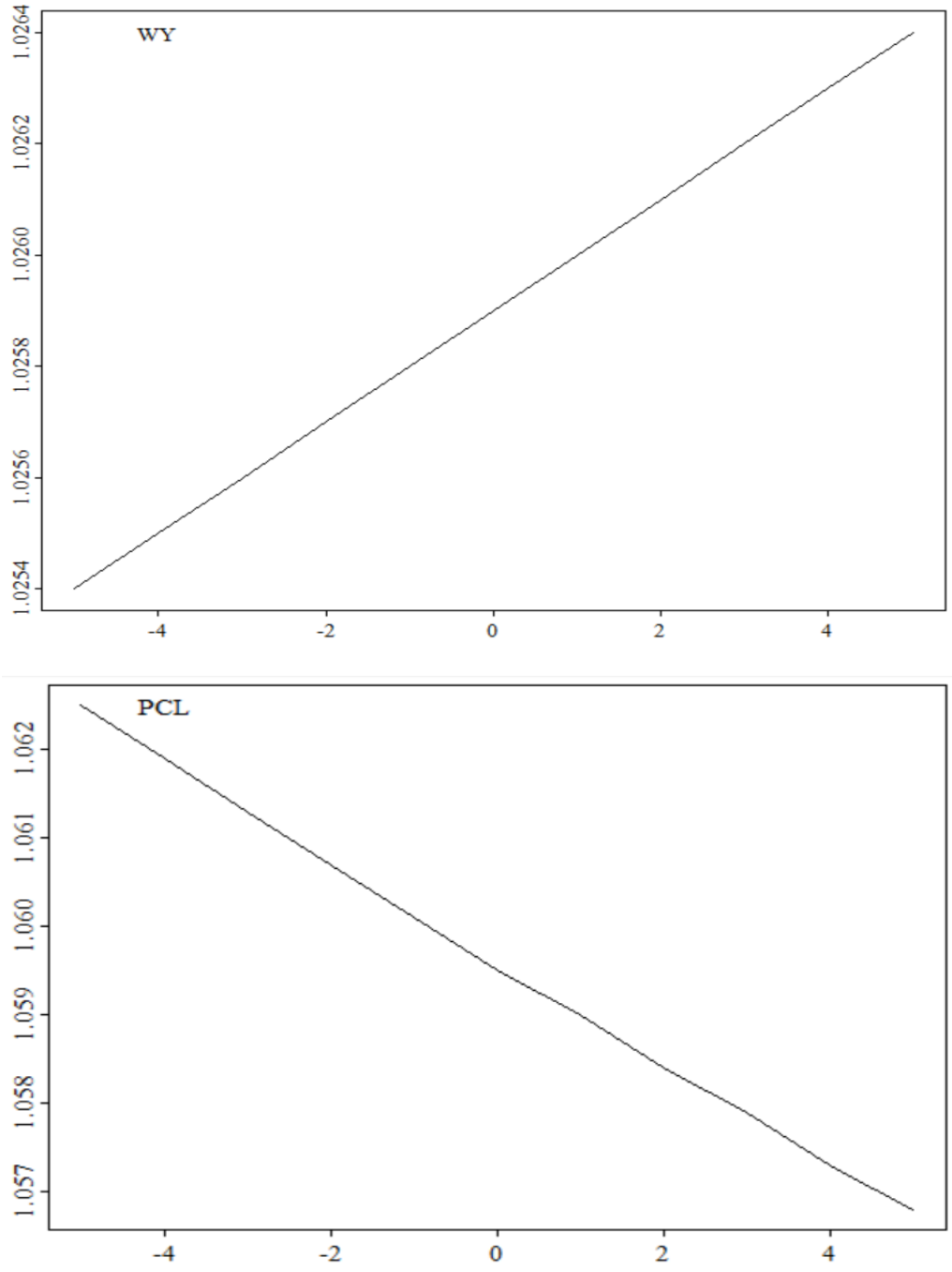


Fig. 4. Abnormal volatility on individual dates over the event window for merger announcements.
*Note*: A value of one indicates no change in volatility.

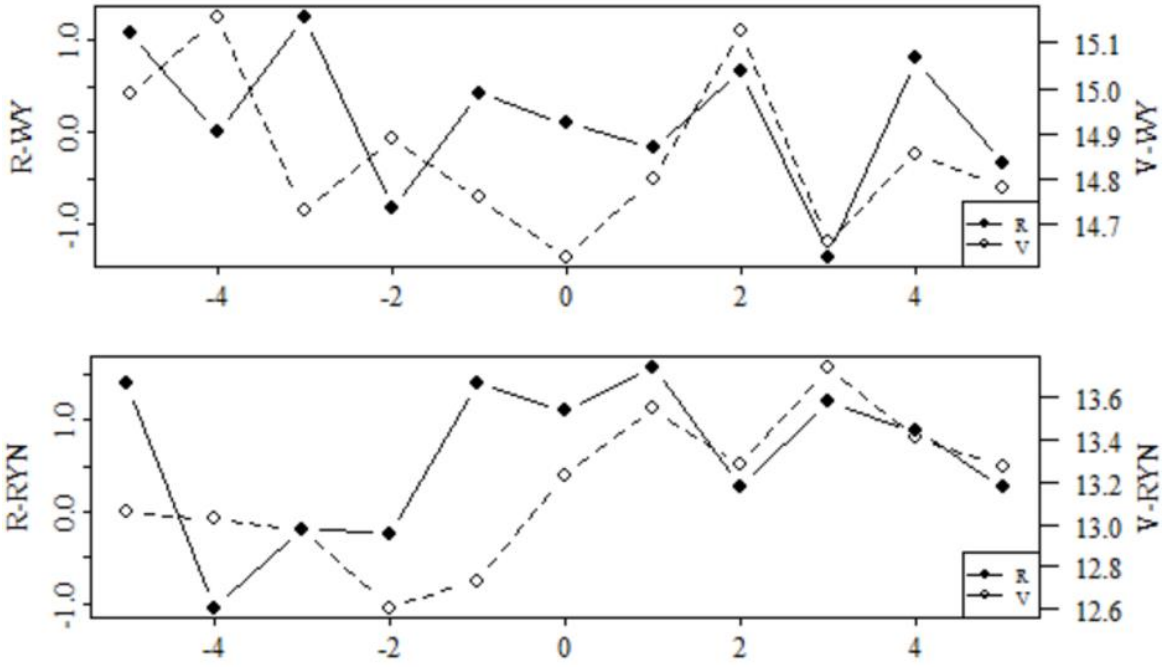


Fig. 5. Daily returns and logarithmic volumes over the event window for divestiture announceme nts.

*Note*: R represents daily returns (%), and V represents the logarithmic volumes.

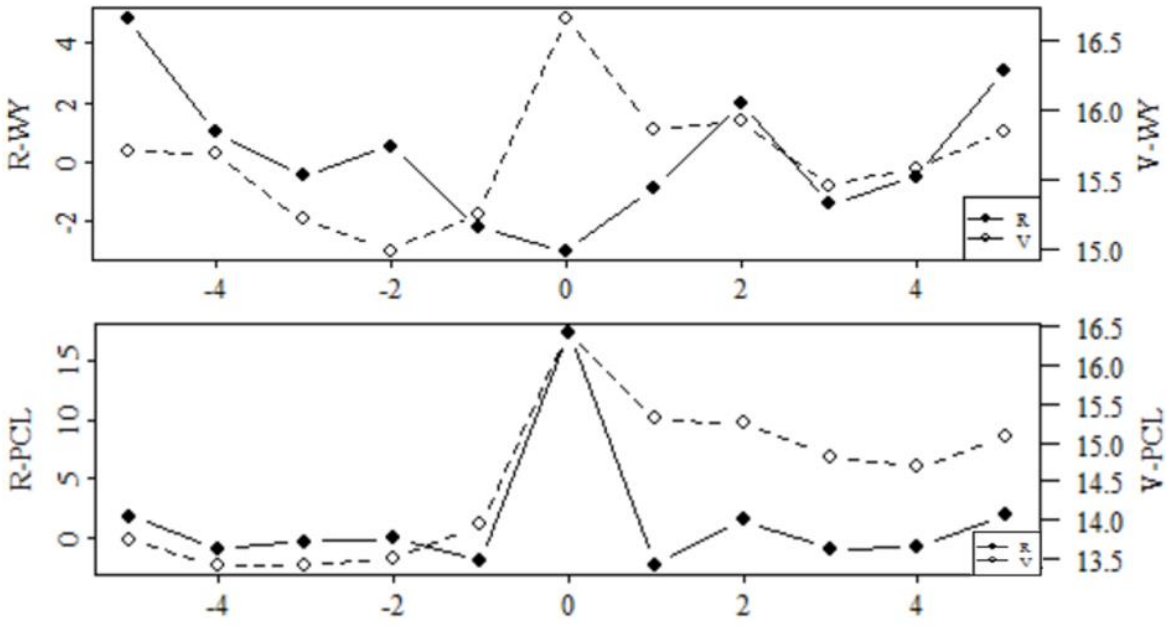


Fig. 6. Daily returns and logarithmic volumes over the event window for merger announcements. *Note*: R represents daily returns (%), and V represents the logarithmic volumes.