Management of unexpected project risk events by the icss and dummy garch model

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Management of unexpected project risk events by the ICSS and dummy GARCH model

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Abstract

Unexpected project risk events are important for managers to evaluate and control large-scale projects. In the past, these issues are widely handled by event studies. However, event studies have been criticized for its irrational assumption, such as normal distribution and constant variance. In this paper, we consider a dummy GARCH model, which releases the assumption of the normal distribution, to deal with the impact of unexpected project risk events. In addition, the important events are detected automatically by using the ICSS, instead of determining by decision makers. From the result of our empirical studies, it can be seen that the flexibility of the proposed method is better than that of traditional event studies.

1. Introduction

Unexpected risk involves the threat of uncontrollable, unpredictable and unanticipated events, which are especially considered by the management of large-scale projects, since these unexpected risk events, such
as economic reversal and natural disasters, usually cause enormous cost overruns and huge market demand shortfalls (Flyvbjerg et al. 2002; 2005; 2006). In fact, about 45 percent cost overrun of the San Francisco BART system does not compare unfavorably with other rapid transit projects (Merewitz, 1973). Therefore, researchers, such as Arditi et al. (1985) analyzed cost overruns in Turkish public projects, Chan and Kumaraswamy (1997) analyzed delays in Hong Kong construction projects and Flyvbjerg et al. (2004) analyzed cost overrun in transportation infrastructure projects, have tried to determine the causes of and solutions to the common problem of project underperformance.

Since managing unexpected risk in large-scale projects is of importance, Miller and Lessard (2001) analyzed sixty large-scale engineering projects to outline six layers of managerial mechanisms to help control the outcomes of unanticipated risks. Then, Floricel and Miller (2001) and Miller and Floricel (2006) discussed how to design project structures in a proactive manner to govern “turbulences” triggered by unanticipated real dangers. However, the financial implications of evaluating large-scale projects by considering unexpected real events are less discussed in past studies. These events usually involve cash flows and financial risks so that investors may reassess the value and viability of a project.

Generally, the investment value of a project is determined by the expected value of cash flows of the project, e.g. Williams (1938). Therefore, many methods based on the net present value (NPV) are used for evaluating the project value. Trigeorgis (1991, 1993) propose the real option analysis (ROA), regarding the present value as the premium of real option holding. He characterizes the real option as several styles, including deferring, time-to-build, scale altering, abandon, switch, growth and multiple interacting. David (1996) propose a framework for linking the expected production costs of investors, the expected production costs of the host utility, and the degree of future uncertainty. The incorporated factor, uncertainty of future conditions, has an important bearing on the terms of contract. Chiara and Garvin (2008) propose a new family Markovian processes, including the Martingale variance model and the general variance model, for BOT risk models. These models incorporate the learning property and the increasing uncertainty property. Liao and Ho (2010) propose a fuzzy binomial approach for investment project valuation. Their paper exhibits the value of flexibilities embedded in the project, and present a method to compute the project’s adjusted NPV. The adjusted value, called fuzzy NPV, is characterized with right-skewed
possibilistic distribution due to the limited downside loss and upside potential profit.

Nevertheless, cash flows are usually uncertain in realistic project problems, since they continue changing with time. For example, the different lifecycle of a project should be reevaluated based on the renewed cash flow forecast. In addition, information risk will increase the rate of return required by investors (Zhang, 2006) and affect the related investment decisions. Finally, real risk events may cause a change of the composition of the board directors or project management team, a withdrawal of major partners, and a refinancing or debt restructuring (Miller and Floricel, 2006).

In contrast to the NPV methods, in finance and economics, event study is a standard and traditional method to investigate market responses to stock splits, earning announcements and restatements, accounting changes, regulatory changes, and world events. The introduction and state of the art of event study can refer to Rubinstein (2006), Brown and Warner (1980), Peterson (1989), McKinley (1997), and Binder (1998). Although event studies can capture the abnormal stock returns generated by new highly significant information of a project company (Huang and Sui, 2010), but it cannot well handle the stock return dynamics generated by unexpected project risk events. Many authors have identified the hazards of ignoring event-induced variance in event studies, yet event studies continue to ignore the problem (Seiler, 2000; Bittner, 2005).

In this paper, we proposed a dummy GARCH model with ICSS to consider the impact of unexpected project risk events. The advantages of the proposed method are that it can consider structural change and volatility clustering. In addition, it can fit return series with the $t$ distribution and normal distribution. Two BOT projects, Eurotunnel and Taiwan High-Speed Rail (THSR) Company, are used here to justify the proposed method. The empirical findings indicate that unexpected project risk will significantly affect the stock return and should be well evaluated before possible decisions.

The rest of this paper is organized as follows. First, this article presents the proposed method and examines the statistical properties of related abnormal performance measures. Secondly, the THSRC risk events are identified and classified, and the sources and properties of the stock price data discussed. Thirdly, the results of the THSRC case studies are presented. Fourthly, the research findings are summarized, and their practical implications discussed. Finally, this article is concluded, and the future research direction stated.
2. Reviews of event study

According to Ball and Brown (1968) and Fama et al. (1969), event studies investigate whether or not a real event produces a significant impact on the performance of an underlying security. Event studies can be divided into four classifications: market effect studies, information content studies, metric explanation studies and methodology studies (Bownan, 1983; Henderson, 1990). Usually, there are three kinds of event study, namely market adjusted model, market model and CAPM model, are widely used for estimating the abnormal return. We briefly describe the above models as follows:

(1) Market-adjusted model. The abnormal return of the market-adjusted model can be represented as:

\[ AR_{i,t} = R_{i,t} - R_{m,t}, \quad R_{m,t} = \ln(M_t/M_{t-1}) \]  

(1)

where \( AR_{i,t} \) denotes the abnormal return of the \( i \)th security at the time \( t \), \( R_{i,t} \) is the actual return at the time \( t \) and \( R_{m,t} \) is the market return at the time \( t \), and \( R_{m,t} \) denote the market index at the time \( t \) and \( t-1 \), respectively.

(2) Market model. The market model is also called one-factor market model which means the return of the specific security is only related with the market factor. Therefore, the information of the specific security will reflect to the error term of the model. The market model can be presented as

\[ R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t}, \quad E(\epsilon_{i,t}) = 0, \quad Cov(\epsilon_{i,t}, \epsilon_{j,t}) = 0, \]

for \( i \neq j \), \( Cov(R_{m,t}, \epsilon_{i,t}) = 0 \),

where \( \alpha_i \) is the intercept term, \( \beta_i \) denotes the market risk faced by the security, \( R_{i,t} \) is the actual return at the time \( t \) and \( R_{m,t} \) is the market return at the time \( t \). Usually, \( \alpha_i \) and \( \beta_i \) can be estimated by the ordinary least squares (OLS) method. Then, the abnormal return on an event announcement at the time \( t \) can be given by

\[ AR_{i,t} = R_{i,t} - \hat{\alpha}_t - \hat{\beta}_t R_{m,t} \]  

(3)

where \( \hat{\alpha}_t \) and \( \hat{\beta}_t \) are estimated by OLS.
(3) CAMP model. The CAPM model considers the factor of the risk-free interest in the model and can be described as:

\[ R_{i,t} - R_{f,t} = \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_{i,t}, \]

\[ E(\varepsilon_{i,t}) = 0, \text{Cov}(\varepsilon_{i,t}, \varepsilon_{j,t}) = 0 \text{ for } i \neq j, \text{Cov}(R_{m,t}, \varepsilon_{i,t}) = 0, \]

(4)

where \( R_{f,t} \) denotes the risk-free interest at the time \( t \). Similar to the market model, the parameter \( \beta_i \) can be estimated by OLS and, then, calculate the abnormal return as

\[ AR_{i,t} = R_{i,t} - R_{f,t} - \hat{\beta}_i (R_{m,t} - R_{f,t}) \]

(5)

Although event study is widely used in understanding the impacts of specific events, it suffers the following shortcomings. First, unexpected project risk events can produce abnormal returns, and the abnormal returns, in turn, can generate large stock price changes subsequently. This common phenomenon is referred as “volatility clustering” in the financial literature and cannot be account for by event study. Secondly, the expected return is postulated to be a normal distribution in the model. However, empirical evidences indicate that financial assets, such as stock price and foreign rate, clearly violate the characteristic of the normal distribution and approximate the characteristic of the \( t \) distribution, i.e., heavy tail. In addition, event study does not consider the situation of structural change and may simplify the results of event study models.

On the other hand, in econometrics and financial engineering the GARCH model has been widely used to explain the phenomenon of volatility clustering and evaluate unexpected risk. For example, Duan and Wei (2005) evaluated the risk composition of the incentive effect of executive stock options to help CEOs take the balanced level of systematic risk. Hammoudeh et al. (2010) also used the GARCH model for the asymmetric shocks in the equity market. Therefore, it may be useful to consider the GARCH model to understand the impact of events, instead of using event studies. Although the conventional GARCH model can include the leverage effect, it cannot consider the impact of structural change or specific events. However, these issues may be important for evaluating and managing the unexpected risk in large projects.

In this paper, we developed a dummy GARCH model to replace the traditional event studies for the following reasons. First, the proposed models can consider the leverage effect and volatility clustering which are
not considered in event studies. Secondly, the proposed model used the $t$ distribution, instead of the normal distribution, to fit the expect return. Finally, the proposed model can consider the possible impact of structural change to increase the accuracy of understanding the project risk.

3. ICSS and the dummy GARCH model

In the following, we will introduce the ICSS algorithm and dummy GARCH. The ICSS algorithm is widely used to detect unknown multiple break-points recently, and GARCH is another popular model for capturing the phenomenon of volatility clustering in the time series. Here, two methods are integrated to account for the unexpected risk of large-scale projects.

3.1. Iterated cumulative sum of squared (ICSS)

ICSS was proposed by Inclan and Tiao (1994) to detect multiple change points of variance form a given time series. With respect to Chow test (1960) and Quandt test (1960), ICSS can detect more than one unknown change point. It uses the concept of binary segmentation (Vostrikova, 1981) to test the entire series first, split at a detected change point and repeat until no change points are found. The procedures of ICSS can be described as follows:

Step 1. Using the cumulative sums of squares (CSS) to estimate the number of the change points.

$$CSS_k = \sum_{t=1}^{k} \varepsilon_t^2, k = 1, 2, \ldots, T, \quad (6)$$

where $\varepsilon_t^2$ is a series of uncorrelated random variables with mean 0 and variance .

Step 2. Defining the centered cumulative sums of squares (CCSS) as

$$CCSS_k = \frac{CSS_k}{CSS_T} - \frac{K}{T}, k = 1, 2, \ldots, T, \quad (7)$$

where $CCSS_0 = CCSS_T = 0$.

Step 3. Determining change points. If there are no change point in volatility, CCSS will oscillate around zero. However, if ICSS significantly departures from zero, whether a negative or positive value, a change point can be derived.
The reasons that we employ ICSS to detect jumps of the series are follows. First, jumps reflect good or bad news events, and affect the conditional or unconditional skewness of the return distribution through the magnitude and the sign of the mean of the jump size distribution. Secondly, jumps may cause the leverage effect (Cho and Engle, 2000; Maheu and McCurdy, 2003) and, then, result in the volatility feedback (Brown et al. 1988; French et al. 1987; Haugen et al. 1991) that reduces stock prices. Note that the leverage effect indicate that when bad cash flow news (negative event) lower stock prices, the equity becomes more highly leveraged, causing an increase in volatility, and volatility feedback means that an increase in volatility will increase the required rate of return on stock, and thus reduce stock prices (Campbell and Hentschel, 1992).

3.2. Dummy GARCH

The general autoregressive conditional heteroscedasticity (GARCH) model was proposed by Bollerslev (1986) to generalize the autoregressive conditional heteroscedasticity (ARCH) model (Engle, 1982), which modifies traditional ARIMA models (Box and Jenkins, 1965) to consider the time-varying variance in the model. Afterward the GARCH model is widely used in fitting various financial data, because it can account for the empirical phenomena of the volatility-clustering and heavy tail of financial assets.

In addition, the leverage effect (Black, 1976), which corresponds to a negative correlation between past returns and future volatility, is another important characteristic of financial assets and considered by GARCH. That is, the leverage effect indicates that stock market volatility tends to rise in response to bad news and responses reverse to good news. In spite of these issues are important, they cannot be considered by traditional event study. Thus, the GARCH model is used here to account for the above considerations.

The threshold dummy GARCH-in-mean (TdGARCHim) model with the $t$ distribution used in this paper can be formulated as:

$$y_t = x'_t b + \delta \sqrt{h_t} + \epsilon_t,$$

$$\epsilon_t \mid \Omega_{t-1} \sim N(0, h_t),$$
\[ h_t = \alpha_0 + \sum_{i=1}^{q} (\alpha_i + 1_{\varepsilon_{t-i} < 0})\varepsilon_{t-i}^2 + \eta_i D_{i1} + \sum_{j=1}^{p} \beta_j h_{t-j}, h_t \sim T(t), \]

(10)

where \( \alpha_0 > 0, \alpha_i \geq 0, \beta_j \geq 0, \forall i, j, y_t \) is an exogenous variable, \( \Omega_{t-1} \) denotes all available information at the time \( t-1 \), \( x_t b \) is the conditional mean of \( y_t \), \( h_t \) is the conditional variance of \( y_t \), \( 1 \) is the indicator function such that \( 1_{\varepsilon_{t-i} < 0} = 1 \) if \( \varepsilon_t < 0 \); otherwise, zero, and \( D_{i1} \) denotes the \( i \)th dummy variable which represents the event in this paper.

The advantages of the proposed method, which integrates the ICCC algorithm and dummy GARCH-in-mean model, can be described as follows. First, the proposed method can separate idiosyncratic shocks from market shocks and identify structural breaks of stock returns caused by idiosyncratic shocks so that we can determine if the idiosyncratic shocks are related to unexpected project risk events. Secondly, from the results of the proposed method, we can determine the leverage and volatility feedback effects of the unexpected project risk events.

4. Empirical Studies

In this paper, two empirical studies, namely, Eurotunnel and Taiwan High Speed Rail (THSR), are discussed and demonstrated by the proposed method.

Case 1: Eurotunnel

The Channel Tunnel has the longest undersea portion of any tunnel in the world. The 51.5km “Chunnel tunnel” connects Folkstone, Kent in England to Coquelles near Calais in northern France an undersea railroad.

Eurotunnel was formed on 13 August 1986 and consisted of two banks and five construction companies, building and operating the Channel Tunnel between Great Britain and France. The company operates the car shuttle services and earns revenue on other trains and passenger service by Eurostar passing through the tunnel. Stock of the Eurotunnel was issued on the London Stock Exchange and Euronext Paris.
Channel Tunnel began construction officially on 1 December 1987. The tunnel cost around £9.5bn to build, about double its original estimate of £4.7bn. The tunnel, which was financed partly from investment by shareholders and partly from £8bn of debt, was officially opened on 6 May 1994 by HM Queen Elizabeth II and President François Mitterrand. Eurostar, which was freight and passenger trains, commenced operation on 14 November 1994. In its first year of operation the Company lost £925m because of disappointing revenues from passengers and freight together with heavy interest charges on its £8bn of debt.

Because the huge construction cost, Eurotunnel had heavy debt. In 2007 a new restructuring plan was approved by shareholders where Deutsche Bank, Goldman Sachs and Citigroup agreed to provide £2.8bn of long-term funding, the balance of the debt was exchanged for equity. Then new group “GROUPE EUROTUNNEL” was formed and replaced Eurotunnel to operate the Channel Tunnel.

The basic data of Case 1 (Eurotunnel) in this study are collected from the Datastream to support the test of structural changes. And the sample period is from December 9, 1987 to July 7, 2007.

The first step of the proposed method is to determine the significant point of the structural break of Eurotunnel by the ICSS algorithm. In addition, we should also eliminate the impacts of the system risk. Therefore, we calculate the structural break points of the return series of FEST and Eurotunnel, respectively, and remove the influence of FEST. Finally, the structural break points of Eurotunnel derived by the ICSS algorithm can be depicted as shown in Figure 1.

From the result of the ICSS algorithm, we can obtain five structural break points for significantly affecting the variance of the return series of Eurotunnel. Then, we set up four basic DTGARCH models with the t distribution, which are usually used in GARCH models, and compare the performance of the fitness criteria, as shown in Table 1. Then, we use the criterion of BIC to determine the optimal parameters of the lags as DTGARCH (1,1) and to calculate the corresponding parameters of the model as shown in Table 2. Note that usually BIC and AIC are widely used to determine the preferred model and BIC is better than AIC when considering the principle of the parsimony.
From Table 2, it can be seen that the return series of Eurotunnel has the GARCH effect, since and are significant (p-values are 0.0152 and < 0.0001, respectively) though the risk premium is not significant (p-value of DELTA is larger than 0.05). In addition, the events, 1, 3, 4, and 5, show significant change of the conditional variance of the model. We can check the event lists to indentify the unexpected risks of Eurotunnel include the operational risk and financial risk roughly. For example, Section III (between Event 2 and Event 3) shows more good news.
Section IV (between Event 4 and Event 5) reveals more financial crises of Eurotunnel. In addition, since the open day of Eurotunnel (i.e., 1994/11/14) is significant, it indicates the risk before the operation and the risk after the operation of Eurotunnel are quite different. Furthermore, the empirical result indicates that the return series of Eurotunnel is appropriately fitted by the t distribute, since the p-value of TDF is significant.

### Case 2: Taiwan High Speed Rail (THSR)

The Taiwan High Speed Rail is the first public construction in Taiwan and the most massive in the world which is constructed and operated by private sectors, transferred to the government after the concession operation period. The total cost of construction is about 460 billion NT dollars (about 14.5 billion US dollars).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Standard error</th>
<th>t–value</th>
<th>p–value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.004859</td>
<td>0.004645</td>
<td>-1.05</td>
<td>0.2954</td>
</tr>
<tr>
<td>$\alpha_0$</td>
<td>0.0000307</td>
<td>0.0000104</td>
<td>2.95</td>
<td>0.0032</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>0.1839</td>
<td>0.0758</td>
<td>2.43</td>
<td>0.0152</td>
</tr>
<tr>
<td>$\psi_1$</td>
<td>0.0684</td>
<td>0.0962</td>
<td>0.71</td>
<td>0.4768</td>
</tr>
<tr>
<td>$\beta_1$</td>
<td>0.5839</td>
<td>0.0960</td>
<td>6.08</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>DELTA</td>
<td>-0.000456</td>
<td>0.000523</td>
<td>-0.87</td>
<td>0.3830</td>
</tr>
<tr>
<td>TDF</td>
<td>0.2932</td>
<td>0.035</td>
<td>8.36</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Dummy 1 (1994/11/14)</td>
<td>0.0000326</td>
<td>0.0000151</td>
<td>2.16</td>
<td>0.0311</td>
</tr>
<tr>
<td>Dummy 2 (1999/04/21)</td>
<td>3.49E–23</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Dummy 3 (2001/07/18)</td>
<td>0.0000639</td>
<td>0.0000315</td>
<td>2.03</td>
<td>0.0427</td>
</tr>
<tr>
<td>Dummy 4 (2003/04/30)</td>
<td>0.000194</td>
<td>0.0000732</td>
<td>2.66</td>
<td>0.0079</td>
</tr>
<tr>
<td>Dummy 5 (2007/07/11)</td>
<td>0.000528</td>
<td>0.000224</td>
<td>2.35</td>
<td>0.0186</td>
</tr>
<tr>
<td>Dummy 6 (2009/09/11)</td>
<td>0.000170</td>
<td>0.000104</td>
<td>1.64</td>
<td>0.1012</td>
</tr>
</tbody>
</table>
The Taiwan High Speed Rail is constructed and is operated in the concession operation period by Taiwan High Speed Rail Corporation (THSR). The concession operation period started from 1998 which is last for 35 years, and the business development lands is last for 50 years. After that period, the operation rights return to the government.

The government agency who manages the high speed rail project is the Bureau of High Speed Rail, Ministry of Transportation and Communications (BOSHR, MOTC). BOSHR is also the one who did the preliminary planning, and they are in charge of construction, operation supervision and the construction plans of the rapid transit system linking the external region in station area.

The construction began at March 26, 1999. Originally, the completion of construction is scheduled for October 31, 2005. But the project was significantly behind the schedule, the schedule of opening is postponed to 2006. On December 24, 2006, the Ministry of Transportation and Communications (MOTC) approved the transport services to be opened to the public. The operation test began on January 5, 2007, and the tickets started to sale on January 2. The official operation began on February 1, 2007.

4.1. Sample Selection

The basic data of case 2 (THSR) in this study are collected from the Central Bank and the Gre Tai Securities Market (GTSM) to support the test of structural changes. And the sample period is from September 8, 2003 to April 21, 2010. The procedures of Case 2 are similar to that of Case 1 and first to determine the possible structural break points of THSR by ICSS, as shown in Figure 2.

The result of ICSS indicated that there are four structural change points which affect the conditional variance of the return series of THSR. Then, we incorporate these four dummy variables into the proposed models to derive the parameters of DTGARCH. Note that in Case 2 we do not consider the operational date as another dummy variable because the second dummy variable, i.e., 2006/11/03, is close to the open date of THSR, i.e., 2007/01/05. Finally, we consider several possible models and compare the performance of the criteria, as shown in Table 3. According to the criterion of BIC, we consider DTGARCH (1,1) as the final model and
calculate the corresponding parameters as shown in Table 4. Note that the major difference of the models between Case 1 and Case 2 is that Case 2 employees the normal distribution and Case 1 considers the $t$ distribution to fit the return series.

The result of Case 2 indicated that the phenomenon of the risk premium of THSR is not significant (p-value of DELTA is larger than 0.05), even though the coefficient of DELTA is positive. On the other hand, the leverage effect is significant since the coefficient of is negative and signifi-
The arch effect of the return series of THSR is also significant since the p-value of is significant. In addition, the p-values of Event 1 is less than the significant level (i.e., 0.05) indicate that the risks of THSR before and after operational date are different, since the date of Event 1 happens prior to the open day of THSR. Finally, from the event report of THSR, we can also conclude that the risks of THSR include the operational risk and financial risk.

5. Discussion

Large-scale infrastructure projects are generally exposed to unexpected risk events, but the financial impacts of these events are not well understood. Although traditional event studies have been widely used to resolve the impact of events, rigid assumptions of event studies make it hard to explain realistic problems. This article proposes a dummy-based GARCH model to connect the stock market responses to a series of unexpected risk events of a project company. The market responses were measured by abnormal stock returnsthat represent investor evaluation of real event impacts.

In addition, traditional event studies propose subject events by a researcher and then to test the significance of these events. Therefore, the
work of an event study is unstable and dependent on the experience or insight of a researcher. On the other hand, the proposed method adopts ICSS to detect possible significant events automatically. Then, these events can be justified by the GARCH model. The proposed method is relatively objective and useful, since researchers do not need to be familiar with the specific company or to subjectively determine the possible events.

Furthermore, compared with event studies, the proposed method has the following advantages. First, instead of only considering the normal distribution, both the normal and $t$ distributions can be considered in our model, since many empirical studies indicate that the $t$ distribution is more suitable for explaining the phenomena of financial series. Second, the proposed methods can objectively determine the possible important events, instead of assigning by a researcher. Third, the proposed method can be used to further possible applications, such as forecasting or risk evaluation.

The empirical results of two cases indicates that the return series of Eurotunnel and THSR have the phenomenon of the volatility clustering, i.e., the arch effect. However, the risk premium of both projects is not significant. Therefore, the higher risk of the large-scale projects does not imply the higher expected return. This situation also indicates the importance of evaluating the large-scale projects. In addition, from the event reports, it can be concluded that the results of the abnormal returns of Eurotunnel and THSR are mainly caused by the financial risk and operational risk.

In addition, the results of the parameter estimation show the unexpected events founded by ICSS result in structural change of the stock return, i.e., the variances are different with respect to different blocks. This information also indicates that traditional event studies treat ever series as a single system may be inappropriate. That is, large-scale project risk should be not treated as a constant, but a variable varied from time to time.

6. Conclusion

In this paper, we develop a dummy GARCH model, instead of traditional event studies, to consider the impact of unexpected project risk in large-scale projects. From the empirical results of Eurotunnel and THSR, it can be seen that the proposed method can provide more information and insights about the unexpected risks and release the assumption of traditional event studies.
References


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