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A GARCH Analysis of the Holiday Effect in the South African Equity Market

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Abstract: The holiday effect is one of the most noticeable seasonal anomalies in financial markets, and it appeals to technical traders who use past data from trading activities to devise profitable strategies. The purpose of this article is to assess the South African equity market's holiday anomaly. The financial data employed consists of market and sectorial indices of the Johannesburg Stock Exchange (JSE) spanning from 1995 to 2018. The holiday effect was modelled by Generalized Auto Regressive Conditional Heteroskedasticity Model (GARCH), exponential GARCH (EGARCH) and threshold GARCH (TGARCH) models. Negative pre-holiday effect was found in aggregate and sectorial indices for the variance equation. The mean and variance equations unveiled a post-holiday effect in market and sectorial indices. Basic materials should be avoided by investors since it increases their exposure. By investing in the Basic Materials sector, the pre-holiday trading strategy can help investors reduce their risk exposure. When it comes to post-holiday seasonal trading, investors should concentrate on the Telecommunications sector to generate higher profits. Investors can minimize losses by avoiding the Industrials sector, which increases risk exposure. In contrast to previous empirical research that focused on aggregate indices, our analysis delineates holiday anomaly for sectorial indices in South African equity.

Keywords: Seasonal Anomalies; GARCH; EGARCH; TGARCH; JSE

JEL Classification: C12; C23; D53; G12; G14

1 Introduction

Holiday anomaly is a global concept which dates back to 1930s and was found in financial markets around the world. The presence of holiday anomaly has

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been attributed to information asymmetry, investors' mood, superstition, cultural and religious reasons (Ariss *et al.*, 2011; Al-Khazali, 2014; Yang, 2016). Marett and Worthington (2009) investigated the Australian stock market to determine whether holidays had an impact on returns. The dissection of the overall market into various sectors that included banking, financials, energy, healthcare, insurance, materials, media, retail, telecoms and transport provided an interesting perspective of the holiday effect. A positive pre-holiday impact on equity returns was found in the overall market and in retail. Firms that were small produced a return that was at least 10 times as compared to other days (Marett & Worthington, 2009).

Moreover, Dodd and Gakhovich (2011) inspected the holiday anomaly in the equity markets of Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Serbia, Slovakia, Slovenia and Ukraine. The findings showed positive pre- and post-holiday effects on returns as well as negative post-holiday effects. The study confirmed the occurrence of a holiday anomaly in stock markets, and market inefficiency. However, the pre-holiday effects decreased with time. The authors explained that there was a sharp pre-holiday decline in liquidity.

Dumitriu *et al*. (2012a) analysed 28 stock exchanges from developed and emerging markets. The pre- and post-holiday dummy variables were used as the predictors of returns. Positive effects pre-holiday and post-holiday were exhibited in developed markets. Positive and negative pre-holiday as well as positive post-holiday effects were found in emerging markets. It was suggested that in times of crisis, investors in stock markets should be sensitive to turbulence during holidays. The financial crisis of 2008 was associated with the disappearance of the holiday anomaly. The declining holiday anomaly was explained by the lack of celebration by investors during a crisis, leading them to being sceptical and cashing in on their investments.

Casado *et al.* (2013) investigated the holiday anomaly in the Euro-zone, and in the equity markets in France, Germany, UK and Spain. The dependent variable was return whilst the predictors were US holiday, lagged return Europe and lagged return US. Holiday seasonality was included in the mean equation only. Findings revealed a positive US holiday effect on equity returns. The significant holiday anomaly was attributed to the levels of dealings on days coinciding with closure periods. The authors recommended that US holidays have a positive impact on returns for European equity markets and therefore investors can exploit the holiday anomaly to earn

abnormal returns.

Gama and Vieira (2013) examined the presence of holiday seasonality in the Portuguese equity market. A positive holiday effect on returns was observed. Observations indicated that the holiday anomaly affected firms of small magnitude most. Small-scale traders become more active as a follow-up to holidays. The holiday anomaly was explained by the happiness of the traders, which increased the desire to acquire stocks but lead to traders being sceptical to dispose. The study recommended that investors can benefit from holiday patterns and earn profits.

Pantzalis and Ucar (2014) modelled US equity returns using independent variables religious holidays, negative announcements and positive announcements. The study findings revealed a negative Easter holiday effect, positive effect of positive announcements and negative effect for negative announcements. The results portrayed that there was deferment or lags in the dealing out and feedback of such news by the investors. The holiday may have been seen as a disturbance taking time and concentration off the investor's focus. This leads to market inefficiency of late and active managers can capitalise. The authors confirmed that a religious holiday affects equity returns and this is explained by the mood of investors.

Carchano and Pardo (2015) assessed the existence of pre- and post-holiday anomaly in the French, German and Spanish equity futures markets. Significant positive pre- and post-holiday effects were found. The study highlighted that there was an association between excess returns and positive pre- and post-holidays. Post-holiday volatility was higher than the pre-holiday, indicating that post-holidays carry a higher risk than pre-holidays. High returns were not in tandem with high risk. The findings proffer insight to investors regarding profitable trading days.

Beladi *et al.* (2016) researched the relationship between US equity returns and Christmas holidays, as well as the Halloween period. Findings displayed a positive Christmas holiday and Halloween effect on stock returns. The authors concluded that companies are most likely to declare bonuses towards year end and pay investors much cash in the period, resulting in the Christmas effect transmitting high demand for equities.

Dumitriu *et al.* (2012b) researched on the existence of the holiday anomaly in the Romanian Stock Exchange. Negative pre-holiday effects were found in indices representing the top 10 liquid companies and top 25 liquid companies.

For big companies and companies in the energy and utilities business, there was a positive pre-holiday impact on returns. A negative post-holiday effect on returns were found in the top 10 liquid companies, top 25 liquid companies, blue chip companies, and companies in the energy and utilities business. A significant positive post-holiday effect was present in the investment funds index. The findings demonstrated that different characteristics of stock are associated with the existence of pre- and post-holiday anomalies in the Romanian equity market. The study suggested that the investigation of holiday seasonality could be expanded to other equity markets. Therefore, this study examines the holiday anomaly in the South African equity market to establish if such opportunities exist in a developing financial market. The article is organised as follows: section 2 provides the literature review that pertains to holiday anomaly, section 3 describes the methodology, section 4 highlights the empirical findings and discussions and section 5 concludes the study and provide recommendations.

2. Literature Review

Al-Hajieh *et al*. (2011) examined the Ramadan holiday anomaly in Bahrain, Egypt, Jordan, Kuwait, Qatar, Saudi, Turkey and United Arab Emirates stock markets. The Runs test was employed on data in the 1992–2007 period to assess the existence of a random walk. Authors recommended that investors can make use of the Ramadan holiday through buying equities before the beginning and selling when the Ramadan holiday is about to end. Overwhelming evidence suggested that the Ramadan was associated with a positive mood of investors.

Coakley *et al*. (2012) tested the effect of the school holiday anomaly on stock returns in China, Japan, Hong Kong, Malaysia, the Philippines, Singapore, South Korea, Taiwan and Thailand equity markets. The fixed effect panel regression model estimated the returns as a function of school holiday and January independent variables for the years 1973–2006. The study results highlighted a negative and positive school holiday effect on returns, whilst January had a positive effect. The findings pointed out suppressed trading during vacations in terms of yields and levels of trade. The authors explained that investments were affected by time devoted to family issues, particularly during school holidays.

Bialkowski *et al*. (2013) employed the TGARCH model to assess the effect of the Ramadan holiday on Turkish equity returns for period 2000–2011. The stock returns were predicted by the Ramadan holiday, world return and lagged world return variables. The Ramadan holiday variable was also included in the volatility equation of the TGARCH. A positive Ramadan effect on returns and a negative effect on

volatility were observed. The fund managers portrayed changes in the exposure to various asset classifications during this period. These effects were attributed to the good mental atmosphere prevalent at Ramadan. Empirical findings demonstrated that investment managers have abnormal yields three-fold in the Ramadan period. Authors recommended that investors can time the equity market using the Ramadan holiday.

Siddiqui and Narula (2013) evaluated the holiday seasonality in the Indian stock market in the period 2000–2011. The holiday anomaly was assessed in the mean equation of the GARCH model. Determinants of the Indian equity returns were one day prior to a holiday, two days prior to a holiday, one day after a holiday and two days after a holiday. Negative and positive one day pre-holiday effects on returns were observed. One day post-holiday highlighted a positive effect on returns. The findings were explained by the mood of investors. Existence of the holiday anomaly confirm the weak-form inefficiency of the Indian equity market. The study recommended that investors must take into account a holiday anomaly in their investment strategies since they have the chance to enhance their returns and reduce losses around holidays.

Chia *et al*. (2015) investigated the pre- and post- impacts of holidays on the Hong Kong Exchange for period 1988–2012. The OLS, GARCH-M, EGARCH-M and TGARCH-M models were estimated. The one-day pre-holiday, two-day pre-holiday, one-day post-holiday, two-day post-holiday and January variables were used to predict returns. The mean equation results highlighted a positive one-day pre- and post-holiday, and positive two-day pre-holiday effects on returns. Findings from the volatility equation displayed negative one- and two days pre-holiday, positive one day post-holiday and negative two post-holiday effects on risk. The study confirmed the existence of pre- and post-holiday anomalies in the Hong Kong equity market, and that investors' behaviour in the equity market is affected by cultural orientation.

Lahav *et al*. (2016) modelled a subjective return in terms of gender, time, investment amount and feeling down. The study was centred on how Israeli students valued things prior to and post the holiday of Passover. Questionnaires were applied to collect opinions on the future views of the learners. The results confirmed a negative impact of investment amount on returns and a positive effect of a mood of feeling down on returns. The study concluded that jubilation leads investors to be more focused on the current time, not the future. This explains the well-defined holiday impacts. An optimistic view of the future was another factor leading to high stock yields in the days of holidays.

Sonjaya and Wayhudi (2016) studied the impact of Ramadan on returns in Bahrain, Indonesia, Jordan, Malaysia, Morocco, Kuwait, Oman, Qatar, Saudi Arabia and Tunisia's equity markets. OLS and GARCH was estimated on data covering the

years 1989–2013. The independent variables were Ramadan holiday and world return, whilst return was the dependent variable. Ramadan does not influence returns in the models. The conclusion obtained was that Ramadan affects the value of markets, but the effects disappeared with time. The authors indicated that the absence of a Ramadan effect emanated from improvement in the informational symmetry of the markets, leading to the holding of the EMH.

Casalin (2018) researched the presence of holiday seasonality in the Hong Kong and Chinese stock markets. The OLS, ARMA and GARCH were estimated on sample data covering the 2002–2017 period. The equity returns were modelled as a function of US return, gross domestic product and holiday. A positive holiday effect on returns was found. The observed holiday effect suggests inefficiency in these equity markets. The authors suggested that different institutional settings and behaviour affect the holiday anomaly. The study recommended that regulators correct market inefficiencies by removing holiday anomalies.

Al-Najaf *et al*. (2018) investigated the existence of a sacred holiday anomaly in the Iran and Iraq equity markets for the period 2012–2016. The autoregressive integrated moving average (ARIMA) model was utilised. The sacred holiday variables predicted the returns. A negative Dhu al-Qaʿdah holiday effect on returns was present in the studied stock markets. The authors suggested that investors should incorporate the sacred month when investing in Islamic nations. The findings in literature displays that equity returns responds differently to holidays and as such our study employ GARCH analysis to establish the effect of holidays on South African stock returns.

3. Data and Methodology

JSE financial data covers the period 1995 to 2018 and were sourced from IRESS database, a financial data firm. The indices consist of top 40 (J200), all shares (J203), basic materials (J510), industrials (J520), consumer goods (J530), health care (J540), consumer services (J550), telecommunications (J560), financials (J580) and technology (J590). Eviews 10 integrated with R software was used to analyse the data. The optimum order GARCH, EGARCH and TGARCH models were employed and interpreted though for specification purposes we use the order (1,1). To test for the pre-holiday and post-holiday effects this study adapted Gnanaseka and Rajesh (2016). However, we drop the constant term in the mean equation and replace it with a dummy variable for the pre-holiday. The GARCH specifications is retained but we extend the study to EGARCH and TGARCH by adding the dummy for the post-holiday and rest of the days.

$$R_t = \beta_0 D_{pre} + \beta_1 D_{post} + \beta_2 D_{rod} + \epsilon_t \quad (1)$$

$$h_t = a + b\epsilon_{t-1}^2 + ch_{t-1} + d_1 D_{post} + d_2 D_{rod} \quad (2)$$

β_0 is the pre-holiday effects coefficient.$\beta_1$and $\beta_2$the post-holiday and other week days coefficients respectively. D_{post} and D_{rod} are dummy variables for post-holiday and other week days respectively. $d_1$and d_2 are coefficients for post-holiday and other week days in the volatility model. $a$is the pre-holiday coefficient in the volatility model.

The EGARCH for holiday effects is extended as follows:

$$In(h_t) = a + cIn(h_{t-1}) + f_1 \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + f_2 \frac{|\epsilon_{t-1}|}{\sqrt{h_{t-1}}} + d_1 D_{post} + d_2 D_{rod} \quad (3)$$

Holiday effects specification extension for the TGARCH model:

$$h_t = a + b\epsilon_{t-1}^2 + ch_{t-1} + \gamma\epsilon_{t-1}^2 I_{t-1} + d_1 D_{post} + d_2 D_{rod} \quad (4)$$

4. Empirical Findings and Discussions

The EGARCH and TGARCH model results for holiday anomaly of JSE indices is illustrated and explained. The AIC, SC and LL for Student-*t* were found to be lower than the normal distribution errors and hence the EGARCH and TGARCH models with Student-*t* distributed errors were used for modelling holiday anomaly on the JSE (Harvey & Newbold, 2003). Only the Consumer goods sector had a TGARCH model specification, whilst the rest of the JSE indices were specified by the EGARCH models.

Firstly, there is an absence of pre-holiday effects in the mean equation for JSE indices in Table 1. The findings suggests that trading on a day prior to a holiday does not influence an investors' return, holding other things constant. Secondly, there are positively significant post-holiday effects, which are higher than the rest of the days in Table 1, for the Top 40, All Shares, Basic materials, Health care, Consumer services and Financials indices, except for Technology. The highest post-holiday effect is exhibited in the Telecommunications sector, with a coefficient of 0.003078. That indicates that an investment of a unit of capital on a trading day after the holiday increases the investors' return by 0.003078. The smallest effect is revealed in the Consumer services sector, with a coefficient of 0.001757. Thirdly, the rest of the days have a positive and significant effect on the returns for all JSE indices except for the Basic materials sector. The largest rest of the days effect is highlighted in the Consumer services sector, with a coefficient of 0.000941, which is the realised return for the investor when a unit of investment is made on rest of the days, assuming all things being constant. Fourthly, the results of the variance equation in Table 1 show

the presence of negative and significant pre-holiday effects for the JSE indices except for the Telecommunications and Technology sectors. Incorporating risk or current volatility reveals that a unit of investment on a trading day prior to a holiday will reduce volatility of stock returns for JSE indices, holding other things constant. The maximum reduction in volatility occurs in the Industrials sector. Fifthly, there is a significant and positive relationship between post-holiday returns and current volatility of returns on the JSE, with the exception of the Telecommunications and Technology sectors. Similarly, the rest of days resembles the same behaviour as the post-holiday effects. This implies that volatility increases when a unit of capital is invested either on a trading day after the holiday or on rest of the trading days, assuming all the other variable are held constant. Holding other things constant, the maximum volatility increases following a unit of investment by an investor on a post-holiday and rest of days is 0.834322 and 0.464327 respectively for the Industrials sector. The lowest volatility increases are 0.467297 and 0.223229 respectively for post-holiday and rest of day in the Consumer services sector when an investor commits a unit of capital on the associated trading days, holding other things constant. Sixthly, the asymmetry coefficients in the variance equation for Table 1 is negative and significant for all JSE indices. This indicates that negative news increases volatility more than positive news, a stylised fact in financial returns (Brooks, 2014). Looking at the f_2, the magnitude effect for previous period volatility is positively significant for JSE indices. The parameter f_3 reveals that the previous two trading days have a positive and significant size effect for the Top 40, All Shares, Basic materials and Financials indices, while it is negative for the Consumer services, Telecommunications and Technology sectors. Seventhly, combining c_1, c_2 and c_3 indicates an overall highly significant GARCH effect. This illustrates volatility persistence, and past news positively influences current volatility. Eighthly, there is weak evidence of parameter instability based on the Nyblom test, except for the Basic materials sector which is unstable for f_2. The sign bias is only significant for the Technology sector which entails a general absence of sign bias.

Table 2 shows no pre-holiday effects, and reports that the post-holiday and rest of the days is positive and significant for the Consumer goods sector, with the post-holiday exhibiting stronger effects in the mean equation. Based on the findings, an investor who invests a unit of investment on a trading day after the holiday earns 0.001769 units, holding other things constant. The variance equation shows significant negative and positive pre-holiday and post-holiday effects respectively. The pre-holiday coefficient is affected by structural changes whereas the post-holiday is unaffected. Holding other things constant, the pre-holiday trading of a unit of capital reduces volatility, while the post-holiday increases volatility. There is no sign bias in the TGARCH model. However, results reveal that there is a leverage effect, since the γ parameter value is positive; this emphasises that bad news increases volatility more than good news of the same magnitude. Past information

from a previous period has a positive impact on volatility while information for the past 3 days decreases volatility, as highlighted by parameters b_1 and b_3 respectively. There is volatility persistence for the Consumer goods sector, and past volatility news has a positive impact on current volatility as indicated by c_1 and c_3 (Brooks, 2014).

A pre-holiday effect is irrelevant to JSE investors, though internationally there is support for it (Chancharat *et al*., 2018; Seif *et al*., 2017). The post-holiday anomaly is consistent with Chancharat *et al*. (2018), who showed a positive effect for Thailand, Seif *et al*. (2017) for Brazil, Czech Republic, Hungary, Malaysia, and Poland. Qadan and Kliger (2016) study on the Israel equity market is in sync with the positive post-holiday effect found in this study. Asian evidence reinforces the positive post-holiday findings for the JSE (Chia *et al*., 2015; Yuan & Gupta, 2014).

EGARCH and TGARCH models show no pre-holiday effects in the mean equation, a position inconsistent with Alagidede's (2013) regression results, which showed the presence of a pre-holiday anomaly. However, Coutts and Sheikh (2002) support the no pre-holiday effect for the ordinary least squares model. The negative pre-holiday effect exists after considering the risk through volatility equations for the JSE, unlike previous studies which focused on mean equations; this is in sync with Yuan and Gupta's (2014) findings on the Japanese and South Korean equity markets. Additionally, positive post-holiday effects are present in both mean and variance equations for the JSE indices. The different positive post-holiday effects in the variance equation reflects investors' attitude to risk, with the lowest being in the Consumer goods sector, which suggests that investors are optimistic, and the highest in the Industrials sector, illustrating that investors are pessimistic (Qadan & Kliger, 2016). The positive post-holiday in the mean equations may mean that information is not comprehended fully by JSE investors, which provides an opportunity for abnormal returns (Yuan et al., 2015). The findings nullify the EMH and demonstrate the existence of a holiday anomaly in the JSE. Therefore, investors can make use of the post-holiday effect in its trading strategies, because transacting a day after the holiday results in excess returns.

Table 1. EGARCH models results for holiday

R_t	J200	J203	J510	J520	J540	J550	J560	J580	J590
Mean equation									
β_0	-0.000521	-0.000219	-0.000152	0.000273	-2.94E-08	0.000584	-3.50E-05	4.21E-05	9.52E-05
β_1	0.002311**	0.002212**	0.002024*	0.001944**	0.001943**	0.001757**	0.003078**	0.002111**	0.000906
β_2	0.000459**	0.000532**	0.000246	0.000561**	0.000543**	0.000941**	0.000558**	0.000501**	0.000673**
Variance equation									
A	-0.76394**	-0.766932**	-0.628927**	-1.039242**	-0.733727**	-0.484839**	-0.072642	-0.899579**	-0.021
f_1	-0.119634**	-0.116195**	-0.074248**	-0.080574**	-0.049312**	-0.043699**	-0.009371*	-0.112649**	-0.008075*
f_2	0.154497**	0.15315**	0.160909**+	0.204094**	0.253291**	0.268618**	0.297577**	0.231351**	0.417573**
f_3	0.10213**	0.105933**	0.13337**	0.0695		-0.114796**	-0.243331**	0.113545*	-0.430782**
f_4									0.05317
c_1	0.437807**	0.421399**	0.23594	0.480306**	0.619732**	0.98422**	1.593191**	0.315988*	1.591878**
c_2	0.534189**	0.551059**	0.330525*	0.479227**	-0.001054		-0.597673**	0.368001**	-0.594188**
c_3			0.412741**		0.352518**			0.278407**	
d_1	0.649304**	0.645936**	0.512481**	0.834322**	0.575253**	0.467297*	-0.025535	0.580248**	-0.058172
d_2	0.310104**	0.309968**	0.227249*	0.464327**	0.287417**	0.223229*	-0.00359	0.293189**	-0.026485
AIC	-6.14842	-6.344398	-5.615528	-6.236552	-6.042382	-6.158172	-5.257314	-6.264972	-5.610223
SC	-6.134708	-6.330685	-5.600673	-6.222839	-6.02867	-6.145602	-5.243601	-6.250116	-5.595368
LL	17962.31	18534.47	16407.54	18219.61	17652.74	17989.78	15360.73	18303.58	16392.05
SB	1.1658	0.8660	0.006325	1.0833	1.3472	0.388414	0.4941	1.2062	1.967*
NEGSB	0.8576	0.9167	0.045403	1.5239	1.4563	0.784088	1.7762	1.6280	1.381
POSSB	1.5630	1.3659	0.524302	0.2738	0.1959	0.008251	0.7860	0.1235	1.281
JE	3.1871	2.8790	0.450701	2.4704	3.2598	1.846210	4.9688	2.9305	4.509

+ indicates significant Nyblom test at 5% level. * and ** indicates significance at 5% and 1% level respectively.
n* denote that normal distributed error is assumed in the model.

Table 2. TGARCH models results for holiday

$\mathbf{R_t}$	J530
Mean equation	
β_0	0.000655
β_1	0.001769**
β_2	0.000457**
Variance equation	
a	-3.35E-05**+
b_1	0.058687**
γ	0.09553**
b_2	0.036512
b_3	-0.033027*
c_1	0.315938*
c_2	0.564289**
c_3	
d_1	6.08E-05**
d_2	3.74E-05**+
AIC	-5.792354

SC	-5.777499
LL	16923.78
SB	0.1308
NEGSB	0.1115
POSSB	0.4090
JE	0.2127

+ indicates significant Nyblom test at 5% level. * and ** indicates significance at 5% and 1% level respectively. n* denote that normal distributed error is assumed in the model.

5. Conclusion and Recommendations

Holiday effects were assessed in two aspects, namely the pre-holiday and post-holiday effects. The EGARCH model specification with Student-*t* error innovations was applied to 9 JSE indices that included Top 40, All shares, Basic materials, Industrials, Health care, Consumer services, Telecommunications, Financials, and Technology, whereas the TGARCH was applied to the Consumer goods sector in order to model seasonality in holidays. No pre-holiday effect was found in both the aggregate and sectoral indices of the mean equation. For the aggregate indices, that is, the Top 40 and All Shares of the JSE, a positive post-holiday effect was observed in the mean equation. The Basic materials, Industrials, Consumer goods, Health care, Consumer services, Telecommunications, Financials, and Technology sectors illustrated a positive post-holiday effect. The highest post-holiday effect was observed in the Telecommunications sector.

The variance equation showed a negative pre-holiday effect for the aggregate indices, namely the Top 40 and All Shares. A negative pre-holiday effect was exhibited in the Basic materials, Industrials, Consumer goods, Health care, Consumer services, Telecommunications, Financials, and Technology sectors. The lowest pre-holiday effect was found in the Industrials sector. A positive post-holiday effect is observed in the Top 40 and All Shares, which represent aggregate indices. For the sectoral indices, a positive post-holiday effect is indicated in Basic materials, Industrials, Consumer goods, Health care, Consumer services, and Financials. The Industrials sector has the highest positive post-holiday effect in the variance equation. A strategy based on the pre-holiday effect will not improve returns for the aggregate and sectoral indices, and hence such a trading technique is valueless to investors. However, the pre-holiday trading strategy will be useful in reducing investors' risk exposure by investing in the Basic materials sector. When it comes to post-holiday seasonal trading, it is recommended that investors focus on the Telecommunications sector to earn excess returns. Investors can avoid making losses by ignoring the Industrials sector since it has the effect of increasing risk exposure.

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