Sporting Performance and the Canadian Stock Market:
A study of hockey and its effect on the Canadian stock market through investor sentiment

Master thesis Department Finance

Peter Laureijs
572728
Master in Finance

Supervisor: Prof. Dr. R. G. P. Frehen
Second Reader: Prof. Dr. H. M. Prast

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Peter Laureijs

Tilburg University

ABSTRACT: Focusing on the relationship between sporting performance and national stock markets, this research takes a behavioral finance approach in an attempt to explain stock price movements. Motivated by Boyle and Walter (2003), who studied the New Zealand stock market and the All-Blacks Rugby team, a similar approach is used to capture any effect from Canadian National Hockey League team games – against U.S. teams – on the Canadian stock market through investor sentiment. The primary analysis finds no results statistically significant from zero, indicating that stock returns are independent from the performance of Canadian hockey teams. However, by performing the analysis on the day of the Canadian game results, statistically significant results are found, although they contradict theory.

Keywords: sporting performance, behavioral finance, investor sentiment, stock market

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Standard finance theory is backed by the Efficient Hypothesis Theory (Fama, 1991), which carries the belief that asset prices are rational. Stock market returns should, therefore, not be affected by any irrelevant, or economically neutral, information. Behavioral finance proponents attempt to disprove this theory by finding economically neutral, yet emotionally impactful events that have an effect on an investor's mood, and by extension their risk-tolerance.

Boyle and Walter (2003) attempted to use sporting events as an emotionally impactful variable in their study. While controlling for several economic indicators, they analyzed the effect of sporting performance of the New Zealand All-Blacks, an international rugby team, on the New Zealand stock market. After performing their regression, as well as several robustness checks, they concluded that there was no relationship between the game results and the stock market returns. However, they recommended that future research extend this model into other markets and sporting events.

Ice hockey has a rich history within Canada and is widely accepted as its national sport. Researchers have found evidence that the results of hockey games against international opponents could have an impact on the mood of Canadian investors (Robidoux, 2002; Sloan, 1989). The impact on the mood of investors could potentially be measurable within the country's stock market if it led to a change in investors' risk aversion towards their investments. These findings guide this paper into the study of whether there is an influence from non-economic events upon the Canadian stock market, leading to irrational – or non-intrinsic – prices, cultivated by

the irrational absorption of non-economic information into economic decisions by investors.

Following the model of Boyle and Walter (2003), this paper conducted several time-series regressions on a daily basis. A lag effect on the game results was used, which allowed a full day of trading to occur when the game outcome was known. The lag effect was also employed by Edmans, Garcia and Norli (2007), who found a significant relationship between soccer game losses and negative stock market returns.

This paper's sample consists of 1559 time-series observations, from July 2009 to July 2015. The primary analysis revealed the expected direction of the hockey game results effect, but was not statistically significantly different from zero. For example, a one unit increase in the game results will have a 2.36% increase in the probability of positive stock market returns. However, this result has a p-value of 0.66, and is therefore insignificant.

In performing additional tests, the loss effect is tested by using a dummy variable. This test revealed that when looking only at negative game result days, there is a negative, but insignificant, association on stock market returns. Next, the event-day effect was tested; that is, removing the lag effect on game results. Interestingly, when looking at the size of the impact on the stock market, there is a significant relationship found. For example, a one unit increase in Canadian game results leads to an increase in the Canadian stock market return by $0.0006. This result is perplexing when weighed with the knowledge that the Canadian stock market closes before the large majority of any hockey games take place. An

additional test is employed as an extension of the loss effect where each category is separated by whether the negative result day is positive, neutral or negative. When including the lag effect, the results are all statistically insignificant. However, when conducting the same study, and removing the lag effect on game day results, the size of the effect that game results have on the stock market are significant for both positive and negative game days. The movement of positive (negative) game day result, when Sentiment Persists, from 0 to 1 produces a 0.08 (-0.08) percent change to the stock market with 97% and 99% confidence levels, respectively. As expected, neutral games provided no results significantly different from zero. Finally, a last additional test includes lagged stock returns to provide stronger explanatory power to the model and to view the effect it will have on Canadian game results explanatory power. This test shows that by adding lagged stock returns, there is an economically small effect on CDN game results explanatory power.

In conclusion, this research presents findings regarding the relationship between sporting performance and the stock market. This expands upon current literature by exploring, to my knowledge, an untested market. In addition, it contributes to the growing body of behavioral finance literature, which attempts to disprove standard finance theory.

The paper proceeds as follows: Section 1 presents the literature review, Section 2 discusses the research methodology, Section 3 illustrates the sample, Section 4 provides the empirical results, Section 5 displays the additional tests, and Section 6 contains the conclusion.

1. Literature Review

"Equity capital markets are unarguably the most visible and transparent part of the Canadian financial system. Together, the Toronto Stock Exchange (TSX) and the TSX Venture Exchange had a market capitalization of $1,215 billion at year-end 2003, representing 98 per cent of Gross Domestic Product" (Hendry and King, 2004). Such a behemoth of power and influence within the Canadian marketplace, with tentacles reaching foreign governments and investors around the globe; it would be comforting to know that the Canadian equity capital markets were efficient. Market inefficiencies have been seen numerous times across several different markets, dating back several centuries. In their major form, they come as bubbles, which can wreak havoc upon a region or, amplified by pronounced financial globalization, the world. "Bubbles always implode, since by definition they involve non-sustainable increases in the indebtedness of a group of borrowers or non-sustainable increases in the prices of stocks" (Kindleberger and Aliber, 2011).

Popular examples of speculative bubbles, and the ensuing crash of a market, include the Dutch Tulip Bulb bubble of the 1630s, the late 1920s stock price bubble, the Japanese property bubble of the 1980s, the crash of the dot-com bubble in 2000, and the United States housing bubble of 2008. "Manias – especially macro manias – are associated with economic euphoria; business firms become increasingly upbeat and investment spending surges because credit is plentiful" (Kindleberger and Aliber, 2011). It is observable across time that there can be a colossal and/or systemic negative effect caused by the mispricing of assets.

Individuals within a country dictate the prices of their equity capital market as a collective, whether working for a large institution that invests in equity markets or investing their own capital. When examining at this micro level, it becomes important whether or not the market is efficient and immune to economic – or non-economic – euphoria. Before delving deeper into the issue of non-economic events, and its potential effect on the equity capital market of Canada, it would be prudent to visit a background on the current theory and literature of finance.

There are currently two fields of finance theory that are competing to explain, and therefore predict, asset prices. Standard finance theory, which includes the Efficient Market Hypothesis, has long been acknowledged as the bible for finance theorists and professionals. The efficient market hypothesis carries the belief that asset prices are rational; that they properly reflect all information relevant to their future economic prospects (Fama, 1991). Asset prices should, therefore, not be affected by any irrelevant, or economically neutral, information. Thaler (1999) concisely summarizes this as follows:

> "Modern financial economic theory is based on the assumption that the "representative agent" in the economy is rational in two ways: The representative agent (1) makes decisions according to the axioms of expected utility theory and (2) makes unbiased forecasts about the future."

Its more recent contender, behavioral finance, argues "investors routinely and systematically make cognitive errors, thereby resulting in prices that deviate

from the pure rationality of an efficient market" (Boyle and Walter, 2003). Behavioral finance is a field that aims to merge behavioral and cognitive psychology theory with standard economics and finance to explain why individuals make irrational financial decisions.

Inspired by research in psychology on how certain events affect the emotions and mood of individuals**,** Saunders (1993) and Kamstra, Kramers and Levi (2000) provide evidence that stock market prices are indeed influenced by economically neutral events, such as the weather, through its psychological effect on investors' sentiment. Saunders (1993) found that daily returns on the AMEX and NYSE are negatively correlated with the cloud cover percentage for that day in New York. Kamstra, Kramers and Levi (2000) discovered that the days that follow the daylight savings change have significantly lower returns on the stock price indexes of four countries.

In the search for other economically neutral and emotionally significant events that may affect investor sentiment, several authors have performed analysis in the field of sporting performance and its effect on the stock market. Boidoa and Fasanob (2007) conducted a study on the Italian Stock Exchange and Italian football matches. They chose three Italian football teams, who were publicly listed on the stock exchange, and determined that the average price/return ratio following wins is higher than average price/returns following losses (Boidoa and Fasanob, 2007). Since these three football teams are listed on the stock exchange, their irrational price fluctuations could affect the Italian Stock Exchange as well, although the effect

would be very small since they would make up a small portion of the stock exchange.

Edmans, Garcia, and Norli (2007), motivated by psychological evidence of a strong link between soccer results and mood, did a study on international soccer results and its effect on the stock market. They found a significant market decline after soccer losses. Unlike Boidoa and Fasanob (2007), their study did not rely on any teams being publicly listed on the stock market. They also documented a statistically significant loss effect, although smaller, after international cricket, rugby, and basketball games. Ice hockey games were studied on an international scale, but the results were not consistent with Edmans, Garcia and Norli (2007) analysis. Edmans, Garcia, and Norli (2007) acknowledged that this is likely because these sports are second in importance, relative to soccer, in most European countries. Having included 8 countries – Canada, Russia, and six European countries – it is likely that their results were hampered by the 'secondary' nature of the sport in the six European countries.

Similarly, Boyle and Walter (2003) study the impact of sporting success on the stock market using the New Zealand All-Blacks rugby team and the New Zealand stock market. The use of sporting performance as the economically neutral event was partly motivated by Hirt et al (1992), who found that "individuals' estimates of their own future abilities and performances are positively correlated with sporting team success" (Boyle and Walter, 2003).

Searching for a sport that may have a significant impact on the Canadian Stock Market, the national sport of Canada, seems an obvious candidate. Hockey has

a rich history as the national sport of Canada. Robidoux (2002) wrote "…there has been one expression of nationalism that has remained constant since confederation, that being the game of ice hockey". Sloan (1989) wrote "When Team Canada lost to Russia's national hockey team in 1972 the consequences were described as a "national castration". The reverse occurred when the U.S. Olympic Hockey team defeated the heavily favored Russian Team in 1980."

It can be suggested that the performance of Canadian hockey teams could affect the mood of Canadian fans, either positively through a sporting success or negatively through a sporting loss. An extension of this would be to suggest that Canadian fans' mood could be measurable within the country's stock market if it led to them being more or less risk averse in their investments. However, Boyle and Walter (2003) recognized that the winning team's positive psychological impact could be offset by the losing team's negative psychological impact, which could result in no change to market prices. Boyle and Walter (2003) addressed the issue by choosing a sporting event where the majority of market participants share the same desire for the sporting team's performance, such as an international event.

The National Hockey League (NHL), the most popular professional hockey league in North America, has undergone massive development in the United States of America. This resulted in the majority of NHL teams to be located south of the Canadian border. The fact that there are significantly more NHL teams located in the United States than in Canada can be seen as a benefit to a study that requires an international nature. This is because the majority of hockey games that a Canadian NHL team will play will be against a team from the United States. To illustrate, 7 of

the 30 NHL franchisees are located in Canada, while the remaining 23 are within the United States. This means that 76.67% of the teams in the National Hockey League are U.S. teams. To further exemplify, the Montreal Canadiens' played 162 regular season games from 2013 to 2015. Of the 162 games, 130 of these were against teams from the United States, amounting to 79.27% of hockey games. This high percentage of international games allows for fewer games being excluded from the sample. When gauging the psychological impact created from a match between two Canadian teams, it is possible that the two effects, positive and negative, would negate each other. However, when looking purely at Canadian versus U.S. games, this offsetting effect should be overcome. Although fans would generally prefer only their own team to win, and not any other Canadian team, this paper assumes that fans only focus their attention on the matches of their own team. Therefore, they should not be emotionally impacted and there should not be an offsetting factor by the fans of the other Canadian teams.

The purpose of this paper is to determine whether there is an influence from non-economic events upon the Canadian stock market. This paper examines whether Canadian investors irrationally include non-economic information into their economic decisions, which could lead to non-intrinsic prices in the Canadian stock market. Based on empirical findings in Boyle and Walter (2003) and Edmans, Garcia and Norli (2007), this research acts as an extension to existing literature on the relationship of sporting performance and the stock market. It will test a different market and sport in an attempt to provide more robust evidence in the area of study.

2. Research Methodology and Preliminary Results

To test the hypothesis that Canadian NHL team game results against American teams have an effect on the Canadian equity market, a similar model to that of Boyle and Walter (2003) is employed.

$$CEM_t = \beta_1 + \beta_2 * CDN\_R_{t-1} + \sum_{j=1,J} \beta_j * CV\ (j) + \varepsilon_t$$

CEM_t = Canadian Equity Market returns at time t

CDN_R_{t-1} = Canadian Game Results at time t-1

CV (j) = Control Variables, as illustrated below

2.1. Dependent Variable

To determine whether there is a relationship between the Canadian game results and the CDN stock market, and if this relationship is significant, daily data are used from July 2009 to July 2015. The indicator of the Canadian stock market is the S&P/TSX Composite Index, and was collected from Google Finance. This is the primary indicator for Canadian-based, Toronto Stock Exchange listed companies, covering approximately 95% of the Canadian equities market. Following Boyle and Walter (2003) two regression models were used. For the first regression, a binary dependent variable will be set equal to 1 if the Canadian stock market return is positive, and 0 otherwise. For the second regression, the dependent variable is the daily Canadian stock market return.

2.2. Canadian Game Results

Since the analysis is on a daily frequency, as opposed to monthly, the effect of the game results will be found on the first trading day following the game. This is consistent with Edmans, Garcia and Norli (2007), who also used daily data for their research.[1] The justification is that in choosing to use the first trading day after the match for all games, the authors ensure that they have the return for a full day when the game outcome is known. To allow for yesterday's game to be measured with today's variables, a lag effect is placed on the game results in the regression. Edmans, Garcia and Norli (2007) do, however, note that this provides the potential for weaker results, since part of the reaction to the sporting event may have been captured in the prices before their measurement day (Edmans, Garcia and Norli, 2007). Therefore, when using the lag effect, it should be noted that on the opening day of trading, the event value would be the sum of Friday, Saturday and Sunday in order to properly capture its effect on a full trading day. From here on, this variable will be referred to as 'CDN game results'. To deal with the issue of certain games being more important than others, an additional categorization has been included to recognize possible differences in the game results between regular season games and playoff games.

2.3. Control Variables

In developing their regression equation, Boyle and Walter (2003) determine that the broad economic factors that could potentially affect the New Zealand stock market were international investor sentiment, country risk and domestic economic

conditions, which are explained below. These were used as independent variables within their regression. Although these authors discovered that international investor sentiment was best measured by a world stock price index, their long sample period made this impossible, forcing them to use the United States stock returns as a proxy. Fortunately, there is a world stock price index available for this study's sample period: the Vanguard Total World Stock Index. For country risk, Boyle and Walter (2003) used the spread between the New Zealand long-term bond rate and the corresponding US rate. For this study, the spread between the Canadian 10-year bond rate and the corresponding U.S. rate is used. The last independent variable, domestic economic conditions, was proxied for by Boyle and Walter (2003) using the percentage change in the manufacturing employment index maintained by the NZ Department of Statistics. Diverging from Boyle and Walter (2003), the Ivey Purchasing Manager's Index (PMI) will be used, which "is an economic index which measures the month to month variation in economic activity as indicated by a panel of purchasing managers from across Canada".[2] Supporting the use of this measure, an author wrote "The PMI for a given month is released on the first business day of the following month, and it usually gives us the earliest information on changes in the economy's performance, which is usually measured by Gross Domestic Product (GDP)" (Tsuchiya, 2012). As the earliest information on changes in the economy's performance, it seems appropriate to use the Ivey PMI as a proxy for domestic economic conditions.

2.4 Preliminary Analysis

As mentioned above, two regressions will be used for the analysis. Panel A displays the binary dependent variable and its relationship to the CDN game results, and Panel B illustrates the CDN stock market return and its relationship to the CDN game results. Following Boyle and Walter (2003), a logistic regression is used for the first regression, while an OLS regression is used on the daily stock market returns for the second regression.

The results of the preliminary analysis are displayed in Table 1. There are two major categories: Sentiment Persists and No Sentiment Persists. The Sentiment Persists category assumes, as Edmans, Garcia, and Norli (2007) did, that any results that occur on a day that has no trading day directly following it must have their effect added to the following trading day. To do so, using the lag effect, the results from Friday and Saturday must be added into Sunday's results, which in turn are used for Monday's regression. For the second category, No Sentiment Persists, this assumption is dropped and any results occurring on Friday or Saturday are eliminated. The underlying assumption behind this category is that any effect on sentiment caused by these events will vanish before the next trading day.

Table 1. Preliminary Results

	Sentiment Persists		No Sentiment Persists	
Independent Variable	All	Playoff	All	Playoff
Panel A: Sign of market return				
CDN game result	0.021	-0.007	0.037	-0.115
	(0.70)	(0.97)	(0.51)	(0.51)
Panel B: Size of market return				
CDN game result	0.000	0.000	0.000	-0.001
	(0.71)	(0.92)	(0.26)	(0.37)

Notes: This table examines the regression models between daily Canadian stock market returns and CDN game results for the period July 2009 to July 2015. Categories 'Sentiment Persists' and 'No Sentiment Persists' are explained in text, as well are sub-categories 'All' and 'Playoff'. P-values in parenthesis.

In Panel A, when sentiment is assumed to not persist, the relationship between positive playoff game results and the probability of positive stock market returns is strongest. The playoff results under 'sentiment persists' category are the strongest in regards to the size of the effect that game results have on the stock market return, although the impact is negative. It should be noted, however, that the playoff results for each regression have very few observations, and therefore will not be used henceforth. The estimates for all of the regressions are statistically insignificant. Only in Panel A, when including all games, are the results consistent with the theory. For example, if sentiment persists, a positive game result will lead to a 2.10% higher probability of an increase in stock market returns. If sentiment does not persist, the probability increases to 3.70%. None of these results are significant, and therefore there is no evidence of any effect by CDN game results on the CDN stock market.

In the next section, multiple control variables are included in an attempt to isolate the CDN game results from broad economic factors. Although the initial analysis did not show any significant relationship between game results and the stock market, there is potential the regression results were clouded by other factors.

3. Sample Description

In regards to the data source, National Hockey League game results from January 2009 to July 2015 were obtained from Hockey-Reference.com. The starting population was 7388 observations. This data was exported to an excel file, where several formulas were employed to separate Canadian versus U.S. game results from the population, with the remainder being eliminated, leaving 2499 observations. Furthermore, there were several games on one day. To eliminate these duplicate dates, they were imported into Stata to perform the collapse command. This command merged each observation by date, leaving only one observation per day, and summed the amount of wins and losses within each date collapsed. Google Finance and Bloomberg were then used to obtain the dependent variable and the control variables. After eliminating the observations from January 1st, 2009 until June 30th, 2009, since the game results data begins on July 1st, 2009, the sample is reduced to 2193 observations. In dealing with stock market returns, a business calendar is used, making weekends and holidays missing values. This gives a final sample size of 1507 observations. In Table 2, the summary statistics for my sample are displayed.

Table 2: Summary Statistics

Variable	n	mean	sd	min	max	p25	p50	p75
Canadian Stock Market Returns	1507	0.0003	0.0084	-0.0404	0.0402	-0.0040	0.0007	0.0050
World Stock Returns	1564	0.0006	0.0100	-0.0693	0.0506	-0.0038	0.0006	0.0055
CDN U.S. Bond Rate Spread	1559	-0.0821	0.2245	-0.7810	0.4412	-0.2432	-0.0660	0.0856
Ivey PMI	1559	0.0006	0.0291	-0.2187	0.5128	0.0000	0.0000	0.0000

Notes: This table shows a summary of the statistics for each variable. The difference in number of observations is due to missing values, and these discrepancies occur because of the different holidays in Canada and the United States of America.

4. Empirical Results

As mentioned above, two regression models are used, with four separate categories for the Canadian game results. For the first regression, a binary dependent variable is used. This is equal to 1 if the Canadian stock market return is positive, and 0 otherwise. As done in the preliminary analysis, a logistic regression for the first regression, while an OLS regression is used on the daily stock market returns for the second regression. Both models will contain the three control variables described above. The CDN game results variable will be different between the two regressions, and both will be employed over the two categories used in the preliminary analysis: Sentiment Persists and No Sentiment Persists.

For the first game result variable the daily values are positive, negative or neutral. A day is classified as positive if the combined daily wins exceed the losses. It would be classified as negative if there were fewer games won than lost, and neutral if they are equal, which is either a result of equal wins and losses or if Canadian teams did not play altogether. Positive results are set equal to 1, negative results

equal to -1, and neutral results equal to 0 (Boyle and Walter, 2003). The second CDN game results variable is simply the ratio between the total daily wins and losses for Canadian games.[3]

Table 3 reports the results of the two regressions. Panel A tabulates the results from the logistic regressions while Panel B illustrates the results of the OLS regressions. The results from Panel A convey that the sign of the Canadian stock market return has no significant relationship to Canadian team performance. Panel B has similar results in regards to the size of the market return to game results. As anticipated, in both Panel A and B, positive game results are associated with a higher probability of a positive return, although this is insignificant and economically small. When looking at the ratio category, however, we see that for both Panels that a positive increase in the ratio of game results leads to an insignificant decrease in the stock market returns in most cases. A positive, and significant, relationship can be found in both the sign and size of the CDN stock market return to the world stock market index. The domestic economic conditions are also positively related, although they are not statistically significant.

In summary, there was no significant relationship found between CDN game results and CDN stock market returns. In order to test whether this is the result of no effect being present or if the game results are not observable in the stock market at the time of the regression, several additional tests will be employed.

Table 3. Regression Results

	Sentiment Persists		No Sentiment Persists	
Independent Variable	Sign	Ratio	Sign	Ratio
Panel A: Sign of market return				
Intercept	-0.8002	-0.8049	-0.8011	-0.8048
	(0.00)	(0.00)	(0.00)	(0.00)
World Stock Return	47.3819	47.3823	47.3582	47.3899
	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.3362	-0.3308	-0.3358	-0.3293
differential	(0.03)	(0.04)	(0.03)	(0.04)
Ivey Purchasing Managers' Index	0.6860	0.6869	0.6977	0.6821
	(0.55)	(0.55)	(0.54)	(0.55)
Canadian game result variable	0.0236	-0.0123	0.0052	-0.0155
	(0.66)	(0.80)	(0.93)	(0.78)
Model $\chi 2$	197.87	197.74	197.69	197.76
	(0.00)	(0.00)	(0.00)	(0.00)
Panel B: Size of market return				
Intercept	-0.0001	-0.0001	-0.0001	-0.0001
	(0.64)	(0.63)	(0.63)	(0.66)
World Stock Return	0.6425	0.6423	0.6421	0.6424
	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.0002	-0.0001	-0.0001	-0.0002
differential	(0.81)	(0.81)	(0.82)	(0.79)
Ivey Purchasing Managers' Index	0.0074	0.0075	0.0074	0.0076
	(0.12)	(0.11)	(0.12)	(0.11)
Canadian game result variable	0.0002	0.0000	0.0003	0.0001
	(0.32)	(0.91)	(0.22)	(0.78)
Adjusted R2	0.592	0.591	0.592	0.591
F-Stat	545.76	545.17	546.07	545.20
	(0.00)	(0.00)	(0.00)	(0.00)

Notes: This table contains regression models of the relationship between daily Canadian stock market returns and CDN game results for the period July 2009 to July 2015. Categories 'Sentiment Persists' and 'No Sentiment Persists' and sub-categories 'Sign' and 'Ratio' are explained in text. In Panel A, the dependent variable is set equal to one if the Canadian stock market return is positive and zero otherwise and logistic regression is used. Panel B has the dependent variable set as the daily stock market return and OLS is used. P-values in parenthesis.

5. Additional Tests

5.1 The Loss Effect

In conducting their study, Edmans, Garcia and Norli (2007) tested for the Loss Effect. This test came with the belief that investors would be more likely to be emotionally impacted by a negative game result, and the impact is likely to be stronger. To utilize the loss effect, a dummy variable is used where days that had more losses than wins were set as 1, and all other results were zero. Both Sentiment Persists and No Sentiment Persists categories will be included. The results are found in Table 4.

For all categories, the sign of the game results effect is negative. This is consistent with the theory that a negative game will negatively impact the investors' sentiment. As with when using all game result days, the results from negative only days are statistically insignificant.

5.2 Event-day Effect

A key assumption used in the previous regressions was that the CDN game results affected the following trading day. As mentioned above, Edmans, Garcia and Norli (2007) acknowledged that their results might be weak in the event that some of the effects from the event were absorbed into the stock market on the day of the event. To discover if there is an effect from the game results on the CDN stock market on the event day, the same regressions from Table 3 are used, but the lag effect on the CDN game results is omitted. The results are seen in Table 5.

Table 4. Additional Test: The Loss Effect

Independent Variable	Sentiment Persists	No Sentiment Persists
Panel A: Sign of market return		
Intercept	-0.7899	-0.7966
	(0.00)	(0.00)
World Stock Return	47.4139	47.3457
	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.3457	-0.3396
differential	(0.03)	(0.03)
Ivey Purchasing Managers' Index	0.6839	0.6946
	(0.55)	(0.54)
Canadian game result variable	-0.0543	-0.0234
	(0.52)	(0.79)
Model $\chi 2$	198.10	197.750
	(0.00)	(0.00)
Panel B: Size of market return		
Intercept	0.0000	0.0000
	(0.92)	(0.92)
World Stock Return	0.6427	0.6425
	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.0002	-0.0002
differential	(0.74)	(0.75)
Ivey Purchasing Managers' Index	0.0074	0.0074
	(0.12)	(0.11)
Canadian game result variable	-0.0003	-0.0003
	(0.35)	(0.34)
Adjusted R2	0.5916	0.5916
F-Stat	545.69	545.72
	(0.00)	(0.00)

Notes: Regression model and variables are the same as prior tables. CDN game results equals one if the there were more losses than wins and zero otherwise. P-value in parenthesis

Intriguingly, when the regression is done without the game result lag, the statistical significance of the CDN game results relationship to the CDN stock market returns increase, although all regressions in Panel A on the relationship of the stock markets' sign to the game results are still insignificant. Most notably, Panel B is statistically significant when looking at the sign for game results, but not for the

ratio. For example, an increase in CDN game results by one unit will lead to an increase in the CDN stock market returns by 0.0006 regardless of the sentiment category, significant at the 99% confidence level. Said differently, a one unit increase in CDN game results will lead to a 0.06% increase in the CDN stock market. This result is confusing when faced with the fact that nearly every NHL game doesn't occur until after the stock market is closed. Therefore, the stock market would have already increased before the day was known to have positive results. The proposition of reverse causality is unlikely. This would be to suggest that the increase in the stock market increased the performance of hockey teams; more specifically, that the news of an increase in the Canadian stock market increased the performance of individual players on Canadian hockey teams. Since these results are not the primary focus of this paper, they are recommended for further analysis.

5.3. Individual Result Classification

The results from the loss effect study encourage further analysis; in particular, whether or not the sign and significance of both Positive and Neutral game result days are consistent with theory. Prior to computing their main regression, Boyle and Walter (2003) performed a preliminary analysis that segmented the result classification into three separate categories: Positive, Negative and Neutral, which were represented by the signs 1, -1 and 0, respectively. By isolating each result day by its category, it is determined whether, on average, wins (losses) lead to positive (negative) results, both when looking at the probability of results affecting the stock market sign as well as the size of the effect on the stock market returns. To do so,

the same regression used in Section 3 is employed with three dummy variables that represent their result classification. The results from this regression are in Table 6.

Table 5. Additional Test: Event-day Effect

	Sentiment Persists		No Sentiment Persists	
Independent Variable	Sign	Ratio	Sign	Ratio
Panel A: Sign of market return				
Intercept	-0.7994	-0.7934	-0.7995	-0.7972
	(0.00)	(0.00)	(0.00)	(0.00)
World Stock Return	47.2374	47.4979	47.2413	47.4050
	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.3371	-0.3507	-0.3355	-0.3434
differential	(0.03)	(0.03)	(0.03)	(0.03)
Ivey Purchasing Managers' Index	0.7021	0.7453	0.7089	0.7297
	(0.54)	(0.51)	(0.53)	(0.52)
Canadian game result variable	0.0436	0.0292	0.0744	0.0182
	(0.42)	(0.55)	(0.18)	(0.73)
Model $\chi 2$	198.33	198.05	199.48	197.80
	(0.00)	(0.00)	(0.00)	(0.00)
Panel B: Size of market return				
Intercept	0.0000	-0.0001	-0.0001	-0.0001
	(0.75)	(0.50)	(0.70)	(0.39)
World Stock Return	0.6411	0.6422	0.6411	0.6419
	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.0002	-0.0001	-0.0002	0.0000
differential	(0.80)	(0.09)	(0.80)	(0.95)
Ivey Purchasing Managers' Index	0.0077	0.0074	0.0078	0.0072
	(0.10)	(0.12)	(0.10)	(0.12)
Canadian game result variable	0.0006	-0.0001	0.0006	-0.0002
	(0.00)	(0.66)	(0.00)	(0.29)
Adjusted R2	0.594	0.591	0.594	0.592
F-Stat	550.48	545.28	550.29	545.85
	(0.00)	(0.00)	(0.00)	(0.00)

Notes: Regression model, and all variables but CDN game results, are the same as prior tables. CDN game results are no longer lagged. P-value in parenthesis.

Table 6 illustrates that, while using the lag effect, there is no change to the statistical significance. All results are still insignificant. Interestingly, however, by segmenting the result days by their classification, all of the categories have a sign

consistent with theory, with the exception of the positive game results effect on the probability of the sign of the stock market returns being negative, when no sentiment persists. As with the earlier tests, regressions on the size of the market return have more statistical significance, but are still insignificantly different from zero.

Table 6. Individual Result Classification: Lagged Effect

	Sentiment Persists			No Sentiment Persists		
Independent Variable	Positive	Neutral	Negative	Positive	Neutral	Negative
Panel A: Sign of market return						
Intercept	-0.8016	-0.8260	-0.7899	-0.7995	-0.8168	-0.7966
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
World Stock Return	47.3807	47.4279	47.4139	47.4162	47.4144	47.3457
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.3358	-0.3498	-0.3457	-0.3383	-0.3442	-0.3396
differential	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Ivey Purchasing Managers' Index	0.6992	0.6991	0.6839	0.7014	0.6980	0.6946
	(0.54)	(0.54)	(0.55)	(0.54)	(0.54)	(0.54)
Canadian game result variable	0.0016	0.0393	-0.0543	-0.0118	0.0238	-0.0234
	(0.99)	(0.58)	(0.52)	(0.90)	(0.74)	(0.79)
Model $\chi 2$	197.68	197.98	198.10	197.69	197.79	197.750
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Panel B: Size of market return						
Intercept	-0.0001	-0.0001	0.0000	0.0001	-0.0001	0.0000
	(0.46)	(0.56)	(0.92)	(0.39)	(0.71)	(0.92)
World Stock Return	0.6422	0.6425	0.6427	0.6419	0.6424	0.6425
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.0001	-0.0002	-0.0002	-0.0001	-0.0001	-0.0002
differential	(0.87)	(0.79)	(0.74)	(0.90)	(0.82)	(0.75)
Ivey Purchasing Managers' Index	0.0074	0.0075	0.0074	0.0074	0.0075	0.0074
	(0.12)	(112.00)	(0.12)	(0.12)	(0.11)	(0.11)
Canadian game result variable	0.0002	0.0001	-0.0003	0.0004	0.0000	-0.0003
	(0.53)	(0.76)	(0.35)	(0.33)	(0.96)	(0.34)
Adjusted R2	0.5915	0.5914	0.5916	0.5916	0.5914	0.5916
F-Stat	545.41	545.21	545.69	545.74	545.16	545.72
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Notes: Regression model and variables are the same as prior tables. The sub-categories 'Positive', Neutral' and 'Negative' are when CDN game results are equal to 1, 0 or -1, respectively. P-values in parenthesis.

The event-day effect is also used, in companionship with individual results classification, to further scrutinize the results from Section 5.2. By analyzing the effect by result classification, the root cause of the significant results may be revealed. Table 7 tabulates the results from this regression.

As with the results from Section 5.2, the statistical significance of the results in both Panels A and B increase. In all cases, the sign of the game results effect is consistent with theory. For example, in Panel A, when No Sentiment Persists, Positive (Neutral) (Negative) game result days are associated with a 0.1106 (-0.0197) (-0.0766) increase in the probability of positive stock market returns, with a p-value of 0.21 (0.79) (0.38). As expected, the sign of positive days is positive, negative days are negative, and neutral days are very statistically insignificant from zero. Of more interest, Panel B continues to provide statistically significant results, while also containing the expected sign. For example, when No Sentiment Persists, Positive (Negative) (Neutral) game result days are associated with a 0.0009 (0.0000) (-0.0008) increase in the size of the effect on the stock market return, with p-values of 0.02 (0.95) (0.03). This illustrates that, even when separating the results by their classification, the size effect is statistically significant and consistent with theory. These results remain puzzling since the large majority of games would have occurred after the closing of the Canadian Stock Market, and warrant further examination in the future.

Table 7. Individual Result Classification: Day Effect

	Sentiment Persists			No Sentiment Persists		
Independent Variable	Positive	Neutral	Negative	Positive	Neutral	Negative
Panel A: Sign of market return						
Intercept	-0.8121	-0.7965	-0.7912	-0.8196	-0.7886	-0.7868
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
World Stock Return	47.2541	47.3770	47.3185	47.1844	47.3496	47.3746
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.3242	-0.3330	-0.3460	-0.3149	-0.3287	-0.3503
differential	(0.04)	(0.04)	(0.03)	(0.05)	(0.04)	(0.03)
Ivey Purchasing Managers' Index	0.7063	0.7008	0.6947	0.7104	0.7009	0.7018
	(0.54)	(0.54)	(0.54)	(0.53)	(0.54)	(0.54)
Canadian game result variable	0.0642	-0.0078	-0.0475	0.1106	-0.0197	-0.0766
	(0.46)	(0.91)	(0.57)	(0.21)	(0.79)	(0.38)
Model χ2	198.21	197.69	198.00	199.25	197.75	198.450
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Panel B: Size of market return						
Intercept	-0.0002	-0.0001	0.0001	-0.0002	-0.0001	0.0001
	(0.18)	(0.52)	(0.57)	(0.17)	(0.69)	(0.67)
World Stock Return	0.6409	0.6425	0.6422	0.6407	0.6424	0.6424
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	0.0000	-0.0002	-0.0003	0.0000	-0.0001	-0.0003
differential	(1.00)	(0.77)	(0.63)	(1.00)	(0.82)	(0.66)
Ivey Purchasing Managers' Index	0.0077	0.0074	0.0075	0.0077	0.0075	0.0076
	(0.10)	(0.11)	(0.11)	(0.10)	(0.11)	(0.11)
Canadian game result variable	0.0008	0.0001	-0.0008	0.0009	0.0000	-0.0008
	(0.03)	(0.71)	(0.01)	(0.02)	(0.95)	(0.03)
Adjusted R2	0.5927	0.5914	0.5930	0.5929	0.5914	0.5927
F-Stat	548.20	545.25	548.86	548.50	545.16	(548.25)
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	0.000

Notes: Regression model and variables, aside from CDN game results, are the same as in Table 6. CDN game results are not lagged. P-values in parenthesis.

5.4. Lagged Stock Returns Controlled

Boyle and Walter (2003) used only three control variables in an attempt to provide explanatory power for their regression. To amplify the robustness of this study, providing an extra control variable with high explanatory power could be beneficial. In an effort to increase the explanatory power of this study's regression, lagged stock returns will be included. The use of lagged stock returns is supported by the

theory that lagged stock returns is a good forecasting variable (Campbell, 1991). If this new control variable provides explanatory power, it may either increase or decrease the explanatory power of CDN game results, providing a clearer picture of the CDN game results effect on the CDN equity market. First, the new control variable is added to the primary regression. The results from this regression are found in Table 8.

When adding the lagged stock returns control variable, there is an increase in the adjusted R-squared for each regression by a small amount. As expected, the control variable has strong explanatory power for the size of the market effect but not the sign. For example, a one unit increase in lagged stock returns leads to a $0.0527 increase in the size of the stock market returns with a confidence level of 99%, regardless of sentiment category. However, by including this new control variable, the CDN game results variable lost some explanatory power. Although its effect slightly increases for all regressions, the p-value decreases for the ratio regression when sentiment persists, and increased for all others. Despite including a new control variable, all regressions on CDN game variable remain statistically insignificant from zero.

Second, lagged stock returns are included in the same regression as in Section 5.3. These results are found in Table 9. As with Table 8, each regression in Table 9 has a higher adjusted R-squared. The lagged stock returns are also all significant at the 99% confidence level when looking at the size of the effect, with high explanatory power. When looking at the CDN game results effect on the size of the stock market returns, there is an increase in the effect of positive game results

Table 8. Lagged Stock Return Control Regression

	Sentiment Persists		No Sentiment Persists	
Independent Variable	Sign	Ratio	Sign	Ratio
Panel A: Sign of market return				
Intercept	-0.7525	-0.7549	-0.7525	-0.7549
	(0.00)	(0.00)	(0.00)	(0.00)
World Stock Return	47.1402	47.1621	47.1402	47.1621
	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.2475	-0.2444	-0.2475	-0.2444
differential	(0.16)	(0.00)	(0.16)	(0.17)
Ivey Purchasing Managers' Index	0.8574	0.8511	0.8574	0.8511
	(0.47)	(0.17)	(0.47)	(0.47)
Lagged Stock Returns	5.1081	5.1496	5.1081	5.1496
	(0.23)	(0.22)	(0.23)	(0.22)
Canadian game result variable	0.0098	-0.0078	0.0098	-0.0078
	(0.87)	(0.89)	(0.87)	(0.89)
Model χ2	155.76	155.76	155.76	155.76
	(0.00)	(0.00)	(0.00)	(0.00)
Panel B: Size of market return				
Intercept	-0.0001	-0.0001	-0.0001	-0.0001
	(0.61)	(0.64)	(0.61)	(0.64)
World Stock Return	0.6375	0.6377	0.6375	0.6377
	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.0002	-0.0002	-0.0002	-0.0002
differential	(0.75)	(0.73)	(0.75)	(0.73)
Ivey Purchasing Managers' Index	0.0057	0.0058	0.0057	0.0058
	(0.25)	(0.24)	(0.25)	(0.24)
Lagged Stock Return	0.0527	0.0539	0.0527	0.0539
	(0.00)	(0.00)	(0.00)	(0.00)
Canadian game result variable	0.0002	0.0000	0.0002	0.0000
	(0.36)	(0.86)	(0.36)	(0.86)
Adjusted R2	0.595	0.595	0.595	0.595
F-Stat	348.47	348.07	348.47	348.07
	(0.00)	(0.00)	(0.00)	(0.00)

Notes: Regression model and variables are the same as in prior tables with the exception of a new variable; lagged stock return. Lagged stock return is explained in text, and is used in both Panels. P-values in parenthesis.

by a small amount, with similar p-values, regardless of sentiment category. When looking at negative game outcomes, there are similar p-values and effects. All changes are economically small. Neutral game results remain statistically insignificant from zero. Overall, by adding the new control variable the entire

regression can explain the CDN stock market returns with a little more accuracy, positive games benefit from an economically small increase in explanatory power, and negative games have an economically small decrease in explanatory power.

Table 9. Lagged Stock Return Control: Individual Results/Day Effect

	Sentiment Persists			No Sentiment Persists		
Independent Variable	Positive	Neutral	Negative	Positive	Neutral	Negative
Panel A: Sign of market return						
Intercept	-0.7678	-0.7435	-0.7418	-0.7678	-0.7435	-0.7418
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
World Stock Return	47.1092	47.1505	47.1736	47.1092	47.1505	47.1736
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.2335	-0.2422	-0.2602	-0.2335	-0.2422	-0.2602
differential	(0.19)	(0.18)	(0.14)	(0.19)	(0.18)	(0.14)
Ivey Purchasing Managers' Index	0.8682	0.8611	0.8698	0.8682	0.8611	0.8698
	(0.46)	(0.47)	(0.46)	(0.46)	(0.47)	(0.46)
Lagged Stock Returns	5.2631	5.1644	5.2549	5.2631	5.1644	5.2549
	(0.21)	(0.22)	(0.21)	(0.21)	(0.22)	(0.21)
Canadian game result variable	0.0834	-0.0151	-0.0569	0.0834	-0.0151	-0.0569
	(0.39)	(0.85)	(0.55)	(0.39)	(0.85)	(0.55)
Model $\chi 2$	156.47	155.78	156.10	156.47	155.78	156.100
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Panel B: Size of market return						
Intercept	-0.0002	-0.0001	0.0001	-0.0002	-0.0001	0.0001
	(0.16)	(0.76)	(0.72)	(0.16)	(0.76)	(0.72)
World Stock Return	0.6358	0.6376	0.6375	0.6358	0.6376	0.6375
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDN-US 10-year interest rate	-0.0001	-0.0002	-0.0004	-0.0001	-0.0002	-0.0004
differential	(0.92)	(0.76)	(0.60)	(0.92)	(0.76)	(0.60)
Ivey Purchasing Managers' Index	0.0060	0.0057	0.0060	0.0060	0.0057	0.0060
	(0.23)	(0.25)	(0.23)	(0.23)	(0.25)	(0.23)
Lagged Stock Return	0.0546	0.0538	0.0542	0.0546	0.0538	0.0542
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Canadian game result variable	0.0009	0.0000	-0.0008	0.0009	0.0000	-0.0008
	(0.02)	(0.95)	(0.04)	(0.02)	(0.95)	(0.04)
Adjusted R2	0.5966	0.5948	0.5963	0.5966	0.5948	0.5963
F-Stat	350.66	348.05	350.16	350.66	348.05	(350.16)
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	0.000

Notes: Regression model and variables are the same as in Table 8. No lag effect on CDN game results. P-values in parenthesis.

6. Conclusions

The research conducted in this paper concentrates on a specific topic of behavioral finance that attempts to use sporting results as a potential explanatory factor that drives stock market performance. Previous research in this area has focused on the effect of football on European and New Zealand markets, and, to my knowledge, no study has examined the effect of sporting events on the Canadian market. Focusing on ice hockey, the empirical results show that there is a positive association between positive stock market returns and positive Canadian NHL game results. There is, however, only statistical significance found when the lag effect is dropped, which is inconsistent with theory. The lag effect outcome being statistically insignificant from zero is consistent with the efficient market hypothesis, as well as consistent with the findings of Boyle and Walter (2003). The authors argued that while the effects of sporting event results can cause a more powerful reaction than weather or time changes, the greater awareness of this effect makes it easier to counter and may cause weaker investor reaction. The authors succinctly explain "that while investors are susceptible to impersonal events that have a general effect on mood, they appear able to rationally discount shocks to confidence and self-esteem when the source of these shocks is easily recognizable" (Boyle and Walter, 2003). The significant findings when dropping the lag effect are puzzling, as they should not impact the Canadian stock market returns due to the stock market closing before the event. Lagged Canadian stock market returns are included in additional tests and prove to have strong explanatory power, but have a very economically small affect on the CDN game results variable in the model.

Future research in this field could focus on finding the causality of the statistically significant results discovered when dropping the lag effect on the game results variable. It could also focus on expanding the analysis to other markets and sporting events or to examine intra-day market data in an attempt to capture a potential short-lived effect that wouldn't be captured in daily data.

Endnotes:

1. Boyle and Walter (2003) also used daily data, but only as a robustness check, since there would not have been a lot of observations for their results. They did not find significant results.

2. This study also tried the PMI as reported. The PMI began as an unadjusted figure, and in February of 2011, changed to a seasonally adjusted PMI. Using this figure did not result in any significant difference, and is omitted.

3. Boyle and Walter (2003) also tried classifying days with the win/loss total. This method was also used in this study, although it produced insignificant results, and is thus omitted.

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