MEASURING THE IMPACT OF FOOD SAFETY RECALLS ON FIRMS: AN EVENT STUDY OF THE 2008 LISTERIA MONOCYTGENES RECALL IN CANADA

A Thesis

Presented to

The Faculty of Graduate Studies

of

The University of Guelph

by

ROBIN SMART

In partial fulfilment of the requirements for the degree of

Master of Science

November, 2010

© Robin Smart, 2010
ABSTRACT

MEASURING THE IMPACT OF FOOD SAFETY RECALLS ON FIRMS: AN EVENT STUDY OF THE 2008 *LISTERIA MONOCYTOGENES* RECALL IN CANADA

Robin Lee Smart
University of Guelph, 2010

Advisors:
Professor John Cranfield
Professor Getu Hailu

This thesis investigates the economic impact of food safety recalls on the capital share returns of publicly traded meat processing firms using the 2008 *Listeria monocytogenes* recall in Canada as a case study. The event study method was applied to this study to identify the size, direction and duration of abnormal returns to Maple Leaf Foods Inc. and Premium Brands Holdings which may have resulted from the Listeria recall. Results show that capital share returns to Maple Leaf Foods Inc. and Premium Brands Holdings were negatively impacted by the recall during the event window. Abnormal returns calculated during the post-event window provided evidence that Maple Leaf’s reaction to the announcement may have restored investor confidence in Maple Leaf shares to some degree and that Premium Brands Holdings lack of communication about their meat processing safety protocols may have negatively impacted Premium Brands share returns.
ACKNOWLEDGEMENTS

“If I could solve all the problems myself, I would.”
~ Thomas Edison

If not for the persistent and helpful criticisms of my two advisors, John Cranfield and Getu Hailu, this thesis could not have come to fruition. I humbly thank both of them for their time and many sacrifices which sustained me through to the successful completion of this project.

A warm thank you is also extended to all of the members and faculty of the Department of Food Agriculture and Resource Economics for their valuable help, support and camaraderie – we’ve shared many laughs. You have all, in your own way, been a friend to me and for this, I am eternally grateful.

To my mother, I thank you for believing in me and making my return to school possible. Your mark on my life will never fade away.

To David, thank you for your patient support and valuable commentary.

Finally, to my favourite daughter, Matthea, and my favourite son, Ethan, I thank you both for being brave and inspiring little souls. Never be afraid to succeed. ~ Love, Mom
Table of Contents

Abstract................................................................................................................................. i
Acknowledgements.................................................................................................................... ii
Table of Contents...................................................................................................................... iii
List of Tables.............................................................................................................................. iv
List of Figures........................................................................................................................... v

Chapter 1................................................................................................................................. 1
  1.1 Background...................................................................................................................... 1
  1.2 Economic Problem......................................................................................................... 4
  1.3 Economic Research Problem....................................................................................... 5
  1.4 Purpose......................................................................................................................... 6
  1.5 Conclusions............................................................................................................... 7

Chapter 2................................................................................................................................ 8
  2.1 Introduction................................................................................................................... 8
  2.2 Theoretical Model......................................................................................................... 10
  2.3 Event Study Hypothesis............................................................................................... 16
  2.4 Event Study Literature Review.................................................................................... 18
  2.5 Conclusions................................................................................................................ 23

Chapter 3................................................................................................................................ 24
  3.1 Introduction................................................................................................................... 24
  3.2 The Event Study........................................................................................................... 24
  3.3 The Market Model......................................................................................................... 27
  3.3.1 Overview of Indices................................................................................................. 30
  3.3.2 Pre-regression Analysis of the Sample Variables.................................................... 32
  3.4 Statistical Testing......................................................................................................... 33
  3.5 Statistical Testing of Event Studies.............................................................................. 37
  3.6 Data................................................................................................................................ 39
  3.6.1 Data Manipulations................................................................................................. 40
  3.6.2 Summary Statistics................................................................................................. 45
  3.6.3 Identification of Events......................................................................................... 46
  3.7 Conclusions................................................................................................................ 46

Chapter 4................................................................................................................................ 47
  4.1 Introduction................................................................................................................... 47
  4.2 The Listeriosis Recall Event....................................................................................... 47
  4.3 Estimating Expected and Abnormal Returns............................................................. 53
  4.3.1 Regression Results................................................................................................. 53
  4.3.2 Forecasting Expected Returns.............................................................................. 68
  4.3.3 Abnormal Returns Estimations.............................................................................. 74
  4.4 Post-Event Returns Analysis....................................................................................... 76
  4.5 Sensitivity of CAR to Event Window Length.............................................................. 83
  4.6 The Impact of the Listeria Recall vs BSE Recalls in the US and UK......................... 87
  4.7 Abnormal Returns and Price..................................................................................... 90
  4.8 Conclusions................................................................................................................. 93

Chapter 5................................................................................................................................ 94
  5.1 Introduction................................................................................................................... 94
  5.2 Limitations.................................................................................................................. 97
  5.3 Recommendations for Further Research................................................................. 97
  5.4 Conclusions................................................................................................................. 98

References................................................................................................................................ 99
List of Tables

Table 3.1 Summary Statistics for the Period 3 December 2007 – 30 September 2008 for Maple Leaf Foods Inc., Premium Brands Holdings, S&P/TSX Smallcap Index and S&P/TSX Composite Index................................................................................................. 45

Table 4.1 Chronology of Significant Events for Maple Leaf Foods Inc.................................................. 48

Table 4.2 Dickey-Fuller Unit Root Tests for Maple Leaf Foods Inc., Premium Brands Holdings, S&P/TSX Smallcap Index and S&P/TSX Composite Index for the Period 3 December 2007 – 14 August 2008........................................................................................................... 59

Table 4.3 Market Model Regression Diagnostics for Maple Leaf Foods Inc. and Premium Brands Holdings on the S&P/TSX Smallcap and Composite Indices for the Estimation Window 3 December 2007 - 14 August 2008......................................................... 62

Table 4.4 Market Model Regression of Maple Leaf Foods Inc. and Premium Brands Holdings on the S&P/TSX Smallcap and Composite Indices for the Estimation Window 3 December 2007 - 14 August 2008...................................................................................... 63

Table 4.5 Estimation Window Correlations of Actual Ex Post Returns with Predicted Returns for Maple Leaf Foods Inc. and Premium Brands Holdings................................................. 69

Table 4.6 Event Window Returns Analysis.......................................................................................... 75

Table 4.7 Post-Event Window Returns Analysis.................................................................................. 83

Table 4.8 Comparison of Event Window Abnormal Returns to Firms for the 2008 Listeria Recalla, 1996 Creutzfeldt-Jacob disease and BSE Announcementb in the UK and 2003 BSEC Announcement in the US................................................................................. 89
# List of Figures

| Figure 1.1  | Toronto Stock Exchange Trade Price and Volume for Maple Leaf Foods Inc. Shares 2007 – 2009 | 3 |
| Figure 3.1  | Timeline of Event Study | 27 |
| Figure 3.2  | Illustration of mean-variance frontier | 28 |
| Figure 3.3  | Daily Returns to Maple Leaf Foods Inc. For the Period 3 December 2007 - 30 April 2009 | 41 |
| Figure 3.4  | Daily Returns to Premium Brands Holdings for the Period 3 December 2007 - 30 April 2009 | 42 |
| Figure 3.5  | Daily Returns to the S&P/TSX Smallcap Index For the Period 3 December 2007 - 30 April 2009 | 43 |
| Figure 3.6  | Daily Returns to the S&P/TSX Composite Index For the Period 3 December 2007 - 30 April 2009 | 44 |
| Figure 4.1  | Daily Closing Prices and Volume Trading for Maple Leaf Foods Inc. for the Period 5 August 2008 to 25 September 2008 | 51 |
| Figure 4.2  | Histogram of Returns to Maple Leaf Foods Inc. for the Period 3 December 2007 to 14 August 2008 | 55 |
| Figure 4.3  | Histogram of Returns to Premium Brands Holdings for the Period 3 December 2007 to 14 August 2008 | 55 |
| Figure 4.4  | Histogram of Returns to the S&P/TSX Smallcap Index for the Period 3 December 2007 to 14 August 2008 | 56 |
| Figure 4.5  | Histogram of Returns to the S&P/TSX Composite Index for the Period 3 December 2007 to 14 August 2008 | 56 |
| Figure 4.6  | Plot of Daily Returns to Maple Leaf Foods Inc. for the Period 3 December 2007 to 14 August 2008 | 57 |
| Figure 4.7  | Plot of Daily Returns to Premium Brands Holdings for the Period 3 December 2007 to 14 August 2008 | 57 |
| Figure 4.8  | Plot of Daily Returns to the S&P/TSX Smallcap Index for the Period 3 December 2007 to 14 August 2008 | 58 |
| Figure 4.9  | Plot of Daily Returns to the S&P/TSX Composite Index for the Period 3 December 2007 to 14 August 2008 | 58 |
| Figure 4.10 | Histogram of Residuals for Regression of Maple Leaf Foods on the S&P/TSX Smallcap Index for the Period 3 December 2007 – 14 August 2008 | 60 |
Figure 4.11  Histogram of Residuals for Regression of Maple Leaf Foods on the S&P/TSX Composite Index for the Estimation Window

Figure 4.12  Histogram of Residuals for Regression of Premium Brand Holdings on the S&P/TSX Smallcap Index for the Estimation Window

Figure 4.13  Histogram of Residuals for Regression of Premium Brand Holdings on the S&P/TSX Composite Index for the Estimation Window

Figure 4.14  Estimation Window; Actual versus Expected Returns to Maple Leaf Foods Inc. forecasted using the S&P/TSX Smallcap Index from 3 December 2007 to 14 August 2008

Figure 4.15  Estimation Window; Actual versus Expected Returns to Maple Leaf Foods Inc. forecasted using the S&P/TSX Composite Index from 3 December 2007 to 14 August 2008

Figure 4.16  Estimation Window; Actual versus Expected Returns to Premium Brand Holdings forecasted using the S&P/TSX Smallcap Index from 3 December 2007 to 14 August 2008

Figure 4.17  Estimation Window; Actual versus Expected Returns to Premium Brand Holdings forecasted using the S&P/TSX Composite Index from 3 December 2007 to 14 August 2008

Figure 4.18  Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Smallcap Index Compared to Maple Leaf Foods Inc. for the period 4 August 2008 through 30 April 2009

Figure 4.19  Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Composite Index Compared to Maple Leaf Foods Inc. for the period 4 August 2008 through 30 April 2009

Figure 4.20  Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Smallcap Index Compared to Premium Brands Holdings for the period 4 August 2008 through 30 April 2009

Figure 4.21  Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Composite Index Compared to Premium Brands Holdings for the period 4 August 2008 through 30 April 2009

Figure 4.22  Cumulative Abnormal Returns to Maple Leaf Foods Inc. (MFI) and Premium Brands Holdings (PBH) using the S&P/TSX Smallcap Index (SCP) Over Increasing Event Window Intervals

Figure 4.23  Estimation, Event and Post-event Windows; Daily Closing Maple Leaf Foods Inc. Share Price for the period 3 December 2007 through 30 September 2008
1.1 Background

Since the early 1980s, food trends in Canada have evolved to include many varieties of processed food products (Agriculture and Agri-Foods Canada, 2007). In 2001, households were allocating approximately 10 cents of every grocery dollar on convenience food products, a four cent increase over a ten year period (Agriculture and Agri-Foods Canada, 2007). By 2003, more than half of Canadian dinners consisted of some form of prepared or semi-prepared food product (Agriculture and Agri-Foods Canada, 2007). Important in the shift towards more convenient meals is the ability of firms to take advantage of scale economies and productivity gains associated with size. In this respect, centralized processing by food production firms has become a key factor in the viability and competitiveness of the firms producing ready-made food products and meals. Concurrent with these secular shifts is a transfer of many preparatory functions from consumers to firms; activities related to ensuring food safety are no exception in this regard.

Corporate responsibility for food safety and supply chain risk management is critical because ready-to-eat foods are often widely distributed from a single processing hub. The nature of centralized processing has consequently increased the probability that illness due to food contamination will also be widely distributed. To reduce the risk of food-borne illness to consumers, the Federal government formed the Canadian Food Inspection Agency (CFIA). The CFIA has the mandate of ensuring a continuous supply of safe food by assessing food quality and inspecting commercial food products and manufacturers. The CFIA also delivers quarantine services when deemed necessary (Canadian Food Inspection Agency, 2007), as well as issuing food recalls when contamination occurs.

For instance, in August of 2008 the Canadian Food Inspection Agency announced that Maple Leaf Sure Slice brand of Corned Beef and Roast Beef may have been contaminated with...
Listeria Monocytogenes (Canadian Food Inspection Agency, 2008b). This outbreak was quickly confirmed and has been noted as one of the deadliest and most widespread incidences of contamination due to food borne pathogens in recent Canadian history (Cheadle, 2008). The initial Listeria recall announcement was reported by the CFIA on 17 August 2008. By 19 August 2008, the recall was expanded to include 24 individual ready-to-eat (RTE) products under eight different brand labels (Canadian Food Inspection Agency, 2008b). The CFIA further reported on 19 August 2008 that the affected products had been shipped nationwide, primarily to food service institutions such as restaurants, hospitals and nursing homes. The first outbreak related death occurred in British Columbia and was reported by CBC news on 22 August 2008 (Hanson, 2008). Between 25 August and 29 August 2008, there were multiple reports of fatalities due to illness caused by Listeriosis infection (CityNews.ca Staff, 2008, Fitzpatrick and Barrera, 2008, Howlett, 2008, Sharma, 2008, The Canadian Press, 2008a). Further, a class action lawsuit was filed by a Regina law firm on 25 August 2008 (CBC News, 2008b). On 13 March 2009, the Public Health Agency of Canada (PHAC) issued a final report confirming 57 cases of illness due to ingesting Listeria monocytogenes which resulted in 22 deaths. Victims who succumbed to Listeriosis infection were located in Ontario, Manitoba, Quebec, New Brunswick, Saskatchewan, Alberta and British Columbia.

Reports of human death and illness due to Listeriosis infection, contracted from various RTE meat products, made Maple Leaf Foods Inc. the focus of multiple negative publications on at least a national level. The initial reaction of Maple Leaf shareholders to the outbreak and subsequent publicity can be observed within the trading activity that took place on the Toronto Stock Exchange (TSX) immediately following the recall and death announcements. A review of daily closing share values for Maple Leaf, as reported by the TSX, over the period immediately following the recall indicated that asset values dropped from a high of $11.01 on 18 August 2008 to a low of $7.99 on 26 August 2008, a 27 percent decline in closing price over seven trading
days. The trading volume of Maple Leaf shares peaked on 27 August 2008 at 2.6 million shares; a stark contrast to the 39,000 shares traded on 18 August 2008. Figure 1.1 shows the daily closing prices and volume traded for Maple Leaf shares from 5 October 2007 to 3 March 2009. This historical perspective of asset price and volume trading for Maple Leaf Foods Inc. shows that spikes in trading volume do not happen on a consistent basis. As such, it is reasonable to believe that the negative publicity of bacterial contamination in Maple Leaf RTE meat products may have economic implications for the firm and its shareholders.

Figure 1.1  Toronto Stock Exchange Trade Price and Volume for Maple Leaf Foods Inc. Shares 2007 - 2009

![Graph showing daily closing prices and volume traded for Maple Leaf shares from 5 October 2007 to 3 March 2009.]

Similar to the economic implications for Maple Leaf, the 2008 Listeria recall event may have induced consumer mistrust of other RTE food products. Popular media reports suggested that Canadian consumers purchased fewer ready-made meat products and ate out of the home less often as a result of the outbreak (CBC News, 2008a). Consequently, spillover effects may have

---

During this timeframe, there has been one other instance of heavy volume trading which occurred on 24 April 2008 and was subsequently followed by a drop in the two-period moving average share value. This appears to have followed an earnings announcement issued by Maple Leaf stating that there was a drop in earnings during the first quarter due to inflation (Maple Leaf Foods Inc., 2009).
economic implications for other RTE food processing firms and businesses that serve ready-made food products. For instance, in September, 2008, three Shopsy’s smoked-meat restaurants in Toronto reported a 15 percent decline in sales prior to 23 August 2008 (Donville and Bell, 2008). The report further indicated that Maple Leaf meat products were not on the Shopsy’s menu. In consideration of these reports, it is reasonable to question if the Listeria recall had economic spillover effects on the RTE meat processing industry collectively.

1.2 Economic Problem

The expected return to a firm’s share is conditioned on publicly available information. In other words, shareholders will pay a price for an asset based on the underlying expectations of the return or future wealth that the asset will bring to the investor. If a non-price factor of demand, such as the quality of a firm’s product, unexpectedly changes then the expected return (and possibly the riskiness) of the share may also change and therefore shareholders must decide whether to buy, sell or do nothing. Therefore, collective shareholder response to information such as negative press releases and management intervention tactics may have significant economic costs for Maple Leaf Foods Inc as well as other firms in the RTE meat processing sector.

Additionally, if the change in the non-price factor of demand is unfavorable for the firm, management must identify and carry out mitigating actions which will restore consumer confidence in the firm’s product. In the case of Maple Leaf Foods Inc., CEO Michael McCain’s television ads and accepting responsibility for the Listeria contamination are two examples of management attempting to restore consumer confidence in Maple Leaf products. The response by shareholders to negative press releases and management intervention tactics may generate a considerable economic burden for both Maple Leaf Foods Inc. and the RTE meat processing industry collectively. Consequently, it could be beneficial for managers of RTE meat firms to
publicly communicate process oversight strategies\(^2\) which have the potential to restore consumer confidence in the firm’s product and shareholders perception of the riskiness of the firm’s assets.

### 1.3 Economic Research Problem

In a Canadian context, the impact of a food safety recall, as deadly and widespread as the 2008 Listeria event, on the return to a publicly traded firm’s shares has not been subjected to economic analysis. Using the 2008 recall of Maple Leaf products as a case study, this research will determine if there was a significant impact on the return to Maple Leaf’s shares over the period immediately following the recall. Likewise, the 2008 Listeria recall may have spillover effects on other firms in the RTE meat processing sector. This study will determine if the returns to shares for other publicly traded ready-to-eat meat processing firms were affected by the 2008 event and, if so, the size, direction and duration of the effect.

This research will advance disciplinary knowledge by measuring how pathogen based food recalls impact the underlying fundamentals of publicly traded food processing firms as manifested through the closing share price and returns to these publically traded shares. The study will contribute to existing knowledge about how publicly owned firms recover from negative impacts arising from pathogen based food recalls and the length of time it takes for recovery to happen. Additionally, the duration of abnormal returns can give an indication of management's effectiveness in restoring consumer and investor confidence and as such may reveal best management practices when dealing with events such as the 2008 *Listeria monocytogenes* recall.

---

\(^2\) Maple Lodge began using “high pressure processing technology” on 23 March, 2009 and issued many public announcements about this process management strategy (Maple Lodge Farms, 2010).
1.4 Purpose

The purpose of this study is to estimate the magnitude, direction and duration of abnormal returns to the shares of Maple Leaf Foods Inc. and other publicly traded ready-to-eat meat processors arising from the 2008 *Listeria monocytogenes* recall of ready-to-eat meats.

The specific objectives of this study are:

1. To construct a conceptual framework that identifies the relevant factors that affect returns to publicly traded assets by conducting a critical review of the event study and asset pricing literature. Construction of a conceptual framework is necessary to identify an empirical model that will accurately measure possible abnormal returns to Maple Leaf Foods Inc. shares and for developing the hypothesis to be tested.

2. To estimate and test for abnormal returns to Maple Leaf Foods Inc. due to the *Listeria monocytogenes* outbreak in August 2008 by using an event study analysis of the returns to Maple Leaf shares over a period of time covered by the *Listeria monocytogenes* recall. By evaluating the change in returns to Maple Leaf shares, this study will test whether event window returns were abnormal, assess the size of the abnormal return, measure the period of time over which the abnormal returns occurred and make inferences regarding the duration of time needed for Maple Leaf share returns to regain normal market levels.

3. To identify other publicly traded Canadian ready-to-eat meat processors and to estimate and test for abnormal returns to those processors due to the August 2008 *Listeria monocytogenes* recall by using an event study analysis of returns to these other firm’s stock. By evaluating the change in returns of other industry processors, this study will evaluate whether the effects of the *Listeria monocytogenes* contamination of ready-to-eat meats was transmitted to processors beyond Maple Leaf Foods Inc., the size of the abnormal returns experienced by those
processors and the period of time over which the abnormal returns occurred. Inferences may then be made about the extent to which other industry processors were affected by the outbreak and how long it took for stock returns to regain their normal market levels.

4. To cast the aforementioned results in the broader context by providing conclusions and recommendations.

Provision of these comments will provide scholarly insight into the conceptual and empirical results of this study as well as recommendations for areas of further research.

1.5 Conclusions

The purpose of this study is to assess the economic impact of the 2008 *Listeria monocytogenes* recall on the returns to publicly traded shares of Canadian food processing firms using event study methods. By measuring how pathogen based recalls impact the underlying fundamentals of publicly traded food processing firms, this study will draw inferences about how firms may or may not recover from the effects of food safety recalls over time.

Chapter 2 develops a conceptual framework and literature review which clarifies the broader literature. Previously published event studies do not provide a comprehensive conceptual framework linking economic theory to empirical estimation. This study attempts to provide such a link by using asset pricing theory as a conceptual framework for the event study analysis. Chapter 3 illustrates the methods and data used to estimate potential abnormal returns within the context of an event study. Chapter 4 reports results of this study. Chapter 5 provides conclusions of this study and recommendations for future research.
Chapter 2

Literature Review and Conceptual Framework

2.1 Introduction

This study assumes that free markets, and more generally stock markets, are an efficient forum for exchanging goods and services within an economy. Stock markets act as mechanisms which enable shares of publicly held firms to be traded efficiently between investors, who demand returns, and competing firms, which offer returns. Shares are traded within stock exchanges at a highly competitive rate, making stock market transactions a field which is broadly studied. Since this study relies on the assumption that free markets are efficient, a theory will have to be developed that identifies the relevant factors affecting the price of publicly traded assets and allows them to be exchanged within stock market forums efficiently.

In general, asset pricing theories assume that changes in stock prices are conditioned on external information. More specifically, investors cause share prices to change based on the investment decisions made, given the information that is readily available to the investor. However, asset pricing theories diverge with assumptions about whether investors react rationally to external information. Some theories assume that investors react rationally to information (Malkiel, 2003), while others assume that investors react irrationally to information (Scharfstein and Stein, 1990).

Theories which assume that investors are rational commonly support the efficient market hypothesis, which states that market prices reflect all publicly available information (Fama, 1965). Theories that argue otherwise presume that investors exhibit nonstandard behavior, irrationality and nonstandard preferences. Often human behaviour based theorists cite anomalies such as the “January effect” or the internet bubble of the 1990’s as proof of stock market inefficiency, however, these phenomena tend to be an exception rather than the rule (Malkiel, 2003). Moreover, studies often find evidence supporting market efficiency; particularly in

The efficient market hypothesis is comprised of three special forms: the weak, semi-strong and strong forms. The weak form hypothesizes that the marginal and conditional probability functions for price changes are equal and therefore a random walk\(^3\). The semi-strong form\(^4\) hypothesis states that price changes are sub-martingale\(^5\) movements and tests whether market prices reflect publicly available information. Finally, the strong form hypothesis asks whether market participants have special knowledge within that market by hypothesizing that price changes follow martingale\(^6\) movements. The weak form and semi-strong form tests are applicable to this study and will be discussed in the following sections of this chapter. The strong form test is beyond the scope of this study and will be ignored.

The null of the efficient market hypothesis proposes that at any point in time, security prices will fully reflect all apparent, publicly available information. This proposition is absolute and implies that costs pertaining to information and transactions are always zero (Grossman and Shiller, 1980). Since information and transaction costs are likely to be positive, a more realistic null hypothesis would state that at any given point in time, security returns will reflect information to the point where the marginal benefits of acting on information does not exceed the

---

\(^3\) A random walk is defined as random changes in price that are independent of one another (Fama, 1970).

\(^4\) The expected return model of the sub-martingale or semi-strong form test of the efficient market hypothesis is an event study analysis (Fama, 1970).

\(^5\) A sub-martingale is a stochastic process which increases on average (Neftci, 2000, p. 120).

\(^6\) The operation of a stochastic process is a martingale if it displays no trend or periodicities (Neftci, 2000, p. 120). In finance, the martingale model simply says that the best predictor of future prices is simply the previous periods price (Campbell et al., 1997, p. 30).
marginal costs (Jensen, 1978). Thus, transaction costs and information costs are accounted for within the null hypothesis being tested.

2.2 Theoretical Model

In order to measure the effect of information on the returns to a firm’s shares, this event study tests the semi-strong form of the efficient market hypothesis by comparing the actual ex-post return generated by an asset against the expected return generated by the same asset. The conceptual framework developed for this study will begin by presenting the salient factors used by investors to determine what price to pay for an asset. To begin, the mechanism of asset pricing is defined as follows: the price that an investor pays for an asset is equal to its expected discounted payoff (Cochrane, 2001). This simple concept forms the basis of many different models and applications in asset pricing. This study will use a single factor model\(^7\) approach to asset pricing which will be derived from the consumption-based model.

The capital asset pricing model (CAPM) is suitable for application within this study because it prices assets based on exposure to fundamental sources of broad market or macroeconomic\(^8\) risk (Cochrane, 2001). In other words, the external pressures of the macro economy on the price of an asset are represented within the model. For example, external pressures could include policy effects, external market wide events and so forth. Notwithstanding, when the CAPM is used in practice, an asset is priced relative to the market or other risk factors (Cochrane, 2001). The CAPM by design will therefore control for common market externalities in both the dependent and independent variables thus creating a stable platform for later empirical application.

\(^7\) Factor models are considered successors to the capital asset pricing model (CAPM) (Cochrane, 2001)
\(^8\) While this study does not seek to measure or identify macroeconomic sources of risk, it is important to cover the macroeconomic effects of risk because many studies have linked macroeconomic events (recession or financial distress) to many asset prices (Cochrane, 2001).
Begin by assuming that the investor maximizes total utility from intertemporal consumption subject to an intertemporal budget constraint. The investor’s utility is maximized at the point where marginal utility of lowering present consumption in favour of purchasing some level of asset is equal to the marginal utility gained from consuming more of the asset’s payoff in the future (Cochrane, 2001). The first step then is to analyze the investor’s utility from total consumption over time given by:

$$U(c_t, c_{t+1}) = u(c_t) + BE_t[u(c_{t+1})]$$ \hspace{1cm} (2.1)

where,
- $U(c_t, c_{t+1})$ is total utility from consumption in periods $t$ and $t + 1$
- $u(c_t)$ is utility from consumption, $c$ in period $t$
- $c_t$ is consumption in period $t$
- $B$ is the investor’s time preference factor
- $E_t[u(c_{t+1})]$ is the expected value of utility in period $t$ from $c_{t+1}$
- $c_{t+1}$ is consumption in period $t + 1$

This model shows that the investor has utility from present consumption and expected utility from future consumption. There is also a time preference factor ($B$) which reflects the investor’s level of impatience and will impact the investor’s level of expected utility for future consumption.

Since investors want to gain the highest level of utility possible, any given volume or units ($I$) of asset(s) will be purchased to maximize the investor’s total utility from intertemporal consumption subject to intertemporal wealth constraints given by:

$$c_t = W_t - p_{i,t}I$$ \hspace{1cm} (2.2)

$$c_{t+1} = W_{t+1} + x_{i,t+1}I$$ \hspace{1cm} (2.3)

where,
- $W_t$ is the total wealth available in period $t$
- $p_{i,t}$ is the $i$th asset’s price in period $t$
- $I$ is the total units of assets purchased
- $W_{t+1}$ is the total wealth available in period $t + 1$
$x_{i,t+1}$ is asset $i$’s expected payoff in period $t + 1$

Substituting the wealth constraints into equation (2.1) gives the investor’s objective function

$$U(c_t, c_{t+1}) = u(W_t - p_{i,t}I) + E_t[Bu(W_{t+1} + x_{i,t+1}I)]$$

(2.4)

To find the price that the investor is willing to pay for asset $i$, differentiate the objective function with respect to the units ($I$) of asset purchased, and set the derivative equal to zero. This gives the first order condition,

$$-p_{i,t}u'(c_t) + E_t[Bu'(c_{t+1})x_{i,t+1}] = 0$$

(2.5)

The equation can then be rearranged to equate marginal utility from consumption in period $t$ with the expected marginal utility of consumption in period $t + 1$.

$$p_{i,t}u'(c_t) = E_t[Bu'(c_{t+1})x_{i,t+1}]$$

(2.6)

where,

$p_{i,t}u'(c_t)$ is the marginal utility of consumption given up in period $t$ for each unit of asset $i$ purchased

$E_t[Bu'(c_{t+1})x_{i,t+1}]$ is the increase in discounted, expected marginal utility of consumption in period $t + 1$ obtained from the expected extra payoff from asset $i$ in period $t + 1$.

The investor will therefore buy and sell units of asset until the value of the marginal utility of consumption in period $t$ is equal to the expected discounted marginal utility of consumption in period $t + 1$.

To find the price ($p$) that the investor is willing to pay to obtain his optimal volume $I$ of asset $i$, divide by the marginal utility of period $t$ consumption. This gives the basic asset pricing equation

$$p_{i,t} = E_t[B\frac{u'(c_{t+1})}{u'(c_t)}x_{i,t+1}]$$

(2.7)
The price of asset $i$ in period $t$ is made up of two parts: the stochastic discount factor $\left( B \frac{u'(c_{t+1})}{u'(c_t)} \right)$ and the future payoff $\left( x_{i,t+1} \right)$ (Cochrane, 2001). The stochastic discount factor consists of the investor’s time preference factor or impatience ($B$) and marginal rate of substitution of future for present consumption. The expected future payoff represents the expected future market riskiness of asset $i$. To compare the riskiness of asset $i$ with the riskiness of another asset defined as asset $j$, it is useful to think in terms of relative riskiness.

Assets are often expressed in terms of returns so that the relative riskiness of one asset can be compared with that of another asset. According to Cochrane (2001), the stochastic discount factor $\left( B \frac{u'(c_{t+1})}{u'(c_t)} \right)$ can be generalized in terms of a discount rate of return such that

$$\left( B \frac{u'(c_{t+1})}{u'(c_t)} \right) = \frac{1}{\bar{R}_i}$$

(2.8)

Where

$\bar{R}_i$ is the risk-adjusted gross rate of return for asset $i$

and then equation (2.7) simplifies to

$$p_{i,t} = \frac{1}{\bar{R}_{i,t+1}} E_t[ x_{i,t+1} ]$$

(2.9)

Riskier assets have a higher risk-adjusted gross rate of return and as such, equation (2.9) implies that riskier assets have lower prices. The discount rate $\left( \frac{1}{\bar{R}_{i,t+1}} \right)$ lies outside of the expectation bracket because investors make risk corrections for individual assets and as such the discount rate is no longer a random variable (Cochrane, 2001).

The risk-adjusted gross rate of return is therefore given by

$$\bar{R}_{i,t+1} = \left( \frac{E_t[ x_{i,t+1} ]}{p_{i,t}} \right) 100$$

(2.10)
however, it is more meaningful to distinguish between gains and losses for this event study. To begin, recall that the expected payoff of asset $i$ in period $t + 1$ is a gross future payoff such that

$$E_t(x_{i,t+1}) = E_t(p_{i,t+1} + d_{i,t+1})$$

(2.11)

where,

$d_{i,t+1}$ is the expected dividend payment to asset $i$ in period $t + 1$

Then the expected net future payoff of asset $i$ in period $t + 1$ is given by

$$E_t(\Delta x_{i,t+1}) = E_t(p_{i,t+1} + d_{i,t+1}) - p_{i,t}$$

(2.12)

where

$E_t(\Delta x_{i,t+1})$ is the expected net future payoff of asset $i$ in period $t + 1$

and therefore equation (2.10) can be manipulated to express net returns to asset $i$ in period $t + 1$, such that

$$R_{i,t+1} = \left(\frac{E_t(\Delta x_{i,t+1})}{p_{i,t}}\right) 100$$

(2.13)

where

$R_{i,t+1}$ is the risk-adjusted net rate of return for asset $i$ in period $t + 1$

The risk-adjusted gross rate of return (equation (2.10)) and the risk-adjusted net rate of return shown in equation (2.13) both measure returns on total wealth from asset $i$. In order for investors to determine the level of the risk-adjusted rate of return to demand, they must also have information on which to base those decisions.

Asset prices and hence returns fluctuate to some degree in response to a large number of traders concurrently making decisions based on the information that they have access to and each

---

9 This event study measures if the net returns to an asset are statistically different from their expected value of zero.

10 Both the gross and net risk-adjusted rates of return can be adjusted to measure only returns on capital by ignoring dividends paid by asset $i$. 

14
trader’s willingness to accept risk. The relationship between returns and information is an important detail of this analysis because event studies test whether investor reaction to unprecedented or unusual information caused a statistically significant change in net asset returns. Since investors form expectations \( (E_t) \) in period \( t \) about future returns to asset \( i \), it is prudent to assume that the investor will form these expectations based on some sort of conditioning information. Therefore, for the purposes of this study, prices will be based on conditional expectations such that

\[
p_{i,t} = \left( \frac{1}{R_{i,t+1}} \right) E_t(\Delta x_{i,t+1} | \phi_t)
\]

(2.14)

where \( \phi_t \) is all publicly available information in period \( t \)

it then stands to reason that expected net returns are given by

\[
E_t[R_{i,t+1} | \phi_t] = \frac{E_t[\Delta x_{i,t+1} | \phi_t]}{p_{i,t}}
\]

(2.15)

So, investors form expectations about period \( t + 1 \) net returns which are conditional upon market information that is readily available to the investor in period \( t \). The same is true for the period \( t + 1 \) net payoff where the future price of an asset and its expected future dividend are also conditioned on period \( t \) information.

The basic asset pricing model shows that changes in an asset’s price are attributable to the investor’s impatience, the marginal rate of substitution of future for present consumption and the amount of risk attributable to the asset through expected future prices plus dividends. Since investor preferences are only likely to change in the long-run, this study will assume that unexpected events initially change the perceived riskiness of the asset. Additionally, unexpected events are communicated to market participants through many different forums such as news
releases on the television, internet or newspapers. The efficient market hypothesis states that information delivered to markets via the aforementioned forums are then reflected within those markets through changes in returns. Therefore, a testable hypothesis about the impact of the 2008 Listeria recall on the net capital returns to Maple Leaf Foods and other publicly traded Canadian RTE meat processors can be developed using the basic asset pricing model and the efficient market hypothesis.

2.3 Event Study Hypothesis

This study uses the basic asset pricing model in conjunction with the efficient market hypothesis to form a testable hypothesis about the effects of the 2008 Listeria recall on the returns to the shares of Maple Leaf Foods and Premium Brands Holdings. Investors use both broad market information and asset specific information to determine the price of the asset in the present period. Specifically, investors use market information to form expectations about payoffs and dividends \( x_{i,t+1} \) to asset \( i \) in period \( t + 1 \) concurrently with the investor’s impatience factor \( \beta \) and the investor’s marginal rate of substitution of future over present consumption \( \frac{u'(c_{t+1})}{u'(c_t)} \). This study seeks to determine how aggregate investor reaction to information such as the 2008 Listeria recall, as manifested through the change in price and share returns, affects Maple Leaf Foods and Premium Brands Holdings. Statistically significant changes in share returns will also implicitly indicate how serious recalls such as the 2008 Listeria recall impact the underlying fundamentals of publicly traded food processing firms.

Since this study aims to measure the impact of the 2008 Listeria recall on prices and share returns to Maple Leaf Foods Inc. and spillover effects of the recall on Premium Brands Holdings, this study will evaluate four testable hypotheses.
The hypotheses of this study are:

1. The 2008 Listeria recall had no impact on the daily share returns to Maple Leaf Foods Inc. during the event window.

Testing this hypothesis will indicate if initial investor reaction to the recall changed Maple Leaf share returns significantly. This will implicitly indicate if the underlying fundamentals of the firm were significantly impacted by the recall.

2. The 2008 Listeria recall had no spillover effects on the daily share returns to Premium Brands Holdings during the event window.

Testing the second hypothesis will indicate if investor reaction to the recall had industry wide spillover effects. This will give insight into two issues; it will indicate if investors expected consumers to mistrust brand specific products (i.e. only Maple Leaf products) or if investors expected consumers to mistrust RTE meat products inclusively.

3. The 2008 Listeria recall had no impact on the daily share returns to Maple Leaf Foods Inc. during the post-event window.

Testing the third hypothesis will indicate how Maple Leaf share returns were impacted after the event window period ended. If Maple Leaf share returns were significantly impacted during the event window, then testing the impact of the 2008 recall during the post-event window will indicate whether Maple Leaf share returns recovered to their original levels and the length of time the recovery took or if recovery took place. Assuming that price changes occurred, the changes in share return during the post-event window can also indicate if there was a true impact on the price or value of Maple Leaf’s capital.

4. The 2008 Listeria recall had no spill-over effects on the daily share returns to Premium Brands Holdings during the post-event window.
Testing the fourth hypothesis will indicate if there were spillover effects after the event window period ended. If Premium Brands share returns were impacted during the event window, then testing if there was a spillover effect that lasted into the post-event window will give an indication about how serious investors felt that the RTE meat industry was impacted by the recall.

To provide greater content, the next section provides a critical review of the broader event study literature which will be used to guide the empirical estimation used in this study.

2.4 Event Study Literature Review

Initially, event studies were used to analyze how abnormal events impacted the spot prices of publicly traded firms. The first example of an event study is thought to have been published in 1933 by Dolley that estimated the effects of stock splits on asset returns (Campbell et al., 1997, Dolley, 1933). Innovations occurring over the following thirty years improved event studies by developing methods for removing general stock price movements and confounding events. These innovations augmented event study approaches so that they were relevant to issues such as assessing the information content of earnings (Ball and Brown, 1968) and estimating the effects of stock splits after removing the effects of simultaneous dividend increases (Fama et al., 1969). In fact, innovations to event study processes have evolved tremendously over the past 40 years; so much so that they are used to assess virtually any issue which has or may affect publicly traded companies or economies.

In macroeconomics, event studies have been adopted to determine: if macro news announcements induced trading changes in major end-user segments of money markets and non-financial corporation’s (Evans and Lyons, 2005); major causes of currency crashes (Frankel and Rose, 1996); and the impact of central bank interventions on exchange markets (Dominguez, 2003). Primarily, event studies conducted in a macro context can be used to inform government policy.
Similarly, event studies have been applied to a diverse array of microeconomic issues such as: stock market reaction to layoff announcements (Hahn and Reyes, 2004), weekend and option expiration effects (De Jong et al., 1992), information and technology announcements (Nagm and Kautz, 2008), the effects of celebrity endorsements on a firm's return (Agrawal and Kamakura, 1995), and the effects of oligopolistic rivalry in global airlines (Gong, 2009).

Interestingly, event studies have also been applied to study the stock market effects to companies that misrepresented the blending ratio of waste paper into paper goods which were labeled and sold as “green” products (Yamaguchi, 2009). It is clear that event studies are a useful tool to analyze the impact that announcements have on publicly traded firms. In fact, the large number of contrasting market issues applied to event studies has necessitated advancement and innovation in event study regression modeling techniques.

One of the earliest studies by Fama et al. (1969) shows how stock prices adjust to new information. The FFJR model, used in the Fama et al. (1969) paper, is a single factor model\textsuperscript{11} and has been shown to be analogous to the commonly used simple market model (Binder, 1998). In fact, it seems that the market model\textsuperscript{12} is often chosen as a regression tool for many studies (Agrawal and Kamakura, 1995, Gong, 2009, Henson and Mazzocchi, 2002, Jin and Kim, 2008, Nagm and Kautz, 2008, Salin and Hooker, 2001, Yamaguchi, 2009). Market models have often been altered to include: dummy variables (Hahn and Reyes, 2004, Sloan et al., 2005), time dependent beta’s (De Jong et al., 1992), and two factors (Gong, 2009). There are, however, circumstances where simply modifying the market model does not provide statistically reliable results. In these cases, alternative models must be specified.

\textsuperscript{11} A single factor model is a mathematical model which measures the effect of a single factor (independent variable) on a dependent variable.

\textsuperscript{12} Developed by William Sharpe, the market model assumes that the return on an asset is dependent on the return of a relative market portfolio.
However, there are a number of statistical problems which generally occur in event studies. It has been suggested that most of the statistical problems which occur in an event study can simply be ignored because they are minor (Binder, 1998). On the other hand, some have concluded that misspecification is a chronic problem in studies of this type (Coutts et al., 1994). For example, Coutts et al. (1994) studied 29 industry baskets categorized by: finance, consumer, industry and other using the single index market model. Diagnostic tests for: heteroskedasticity, misspecification, autocorrelation, ARCH effects and skewness and excess kurtosis were run for the model. Coutts et al. (1994) concluded that none of the 29 regressions passed all of the tests at the one percent critical level. However, the authors did not report if any of the regressions were or were not statistically significant at five or ten percent.

To address ARCH effects and non-normality, researchers have applied generalized autoregressive conditional heteroskedasticity (GARCH) (De Jong et al., 1992, McKenzie et al., 2004, Sloan et al., 2005) and exponential generalized autoregressive conditional heteroskedasticity (EGARCH) (Hahn and Reyes, 2004) models to correct for autoregressive conditional heteroskedasticity (ARCH) effects and non-normality. Autoregressive distributed lag (ARDL) models have been implemented to correct for autocorrelation and non-normality (Henson and Mazzocchi, 2002, Jin and Kim, 2008). Finally, misspecification concerns have been addressed with multifactor models such as a characteristic based benchmark (CBBM) model (Ahern, 2009), the Fama French three-factor model (Ahern, 2009), the Carhart four-factor model (Ahern, 2009) and the two factor market model (Gong, 2009). Diagnostic problems in applied event studies have benefitted from many technical innovations, similarly, parameter stability concerns have also been widely addressed in the broader literature.

According to Coutts et al. (1994), many studies have examined the stability of the market model parameters. Overall, the intercept ($\alpha_i$) is more stable than the slope coefficient ($\beta_i$) in the following single index model:
\[ R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_t \]  \hspace{1cm} (2.16)

where,
- \( R_{it} \) is the ex post return of asset \( i \) in period \( t \).
- \( \alpha_i \) is the intercept of the asset \( i \).
- \( \beta_i \) is the slope coefficient of asset \( i \).
- \( R_{mt} \) is the return on a market portfolio \( m \) in period \( t \).
- \( \varepsilon_t \) is the disturbance term in period \( t \).

but neither is truly stable over time, in part due to the existence of business cycles. Further, both portfolio and individual security beta’s may be unstable for durations as short as 100 days. While studying the effects of weekend and option expiration effects on returns, De Jong et al. (1992) did find that beta was not constant over time and developed an extended market model to allow for a time dependent beta. Binder (1998) also found that parameter instability can be mitigated by including five to seven years of data for monthly observations and one year of data for daily observations. Assessing diagnostic and parameter stability issues in event studies seems to beg the question, with all of these problems, how reliable are abnormal returns calculations?

The answer to the question of how reliable abnormal returns calculations are is addressed by assessing the inferential reliability of event studies. Inferential reliability refers to conclusions about the economic impact or significance of an event that can be made by researchers and the accuracy of those conclusions. Event studies provide statistically significant measures of abnormal returns when they exist and economic inferences made from the findings of event studies have been shown to be reliable.

The inferential reliability of event study approaches has been assessed by McKenzie, et al. (2004) using daily U.S. futures returns on corn, soybeans, live cattle and hogs by comparing and contrasting the rejection rate of the null hypothesis of zero abnormal returns. Constant mean return models\(^{13}\) (CMR) and three regression models: Ordinary Least Squares model (OLS),

\(^{13}\) The constant mean return model assumes that an asset’s return is normally distributed over time with a constant mean and variance.
GARCH (1,1) and a GARCH (1,1) were used to assess the event study’s inferential reliability. The constant mean return models did not perform reliably but the three regression models tested perform well under the null hypothesis of zero abnormal returns (McKenzie et al., 2004). Further, Henson and Mazzocchi (2002) found that the ARDL model produced the most statistically reliable results reporting that 33 percent of the cases studied showed that the announcement made an immediate negative impact on beef processors which increased steadily over the first four days of the event window. In the broader literature, event studies have proven to be an effective tool for assessing the impact of unexpected announcements or events on the returns of publicly traded firms. More specifically, event studies are ideal for assessing the impact of unexpected events on publicly traded agribusinesses.

In agriculture, event studies have been used to assess the impact of negative announcements on the stock for trade values of food processing firms and tobacco companies, as well as futures prices of commodities and livestock. The effects of litigation on the stock prices of tobacco companies and futures prices for lumber have been assessed by Sloan et al. (2005) and Rucker et al. (2005) respectively. It was determined that the effects of negative litigation announcements about tobacco companies in the United States between 1986 and 2003 did not cause an immediate revaluation of their share prices but still showed mild negative effects (Sloan et al., 2005). This was attributed to the fact that the affected tobacco companies were well diversified (Sloan et al., 2005). The effects of litigation on lumber futures prices were found to occur over long periods of time due to the drawn out nature of litigation events (Rucker et al., 2005). In order to identify the costs borne by various stake holders of food recall announcements which occurred between 1996 and 1998 in the United States, Salin and Hooker (2001) examine the changes in stock prices of three firms affected by food safety based recalls using a market model event study method. Their findings showed that abnormal returns varied with the size and diversity of the firm (Salin and Hooker, 2001). An event study was used to show that food borne
pathogens, diseases and dietary health concerns for consuming beef have been a few of the causes for the decrease in consumer demand (McKenzie and Thomsen, 2001). Finally, Jin and Kim (2008) used an event study to measure the economic impact that a single case of BSE found in the United States on December 23, 2003 had on the security values of industry processors and primary producers.

2.5 Conclusions

Event studies are commonly used in the broader literature to assess the impact of notable events on the share returns of respective firms. Similarly, an event study can be used to measure the economic impact that the 2008 Listeria recall had on the share returns of Maple Leaf Foods Inc. Further, since processed meat products were the focus of the recall, there is an opportunity to assess if there were spill-over effects onto other publicly traded Canadian meat processing firms. Following from the conceptual framework developed in this chapter, the elements of event study methods can be detailed. The event study methods adopted for this study as well as data considerations are discussed in Chapter 3.
Chapter 3

Methods and Data

3.1 Introduction

The consumption-based asset pricing model derived in Chapter 2, shows that an investor will pay a price for an asset which is equal to the asset’s expected discounted payoff. The future payoff is discounted by a rate of return or factor that is set by the investor. The investor determines the level of the discounted rate or return subject to market information that is readily available. The efficient market hypothesis states that information is reflected in markets through changes in price or returns. This chapter links the conceptual framework to the methods and theory that will be used to estimate possible abnormal returns to Maple Leaf Foods Inc. and other publicly traded Canadian meat processing firms. Data requirements and conversions will be discussed at the end of chapter 3.

3.2 The Event Study

Event studies follow the Expected Return or “Fair Game” model which hypothesizes that asset returns and hence prices reflects all publicly available information. Additionally, the model shows that conditions of market equilibrium can be stated in terms of expected values and information is fully utilized\(^\text{14}\) by the market in forming equilibrium expected returns and thus current prices. Begin by recalling equation (2.15)

\[
E_t[R_{t+1} | \phi_t] = \frac{E_t[\Delta x_{i,t+1} | \phi_t]}{p_{i,t}}
\]

then, by expanding, rearranging and ignoring dividends, the expected net return on capital in period \(t + 1\) is given by

\(^{14}\)Ignoring information costs and transaction costs.
The expected net return, $R_{i,t+1}$, in excess of equilibrium returns in period $t + 1$ is zero in the absence of information $\phi_t$ available to investors in period $t$, where $R_{i,t+1}$ is the net return to asset $i$ in period $t + 1$. Importantly, both the left and right hand side of the model are conditioned on information in period $t$. The event study’s distinction between normal and abnormal returns hinges on the presence of the information set in period $t$, whereby statistically significant abnormal returns in period $t + 1$ are those where abnormal information is present in period $t$.

Further, event studies assess the effects of information on asset returns by comparing the actual ex post returns, which occur at time $t$, with predicted returns that would have been expected at time $t − 1$, had the prevailing market information remained unchanged. Actual ex post returns on capital are given by

$$R_{i,t} = \left( \frac{p_{i,t} - p_{i,t-1}}{p_{i,t-1}} \right) 100$$

(3.1)

and are not expectations nor are they conditioned on information because the prices already reflect the information available in previous periods and there is no onus on the investor to make decisions. In contrast, predicted returns must account for investor expectations and information even though they occur in period $t$. This is because they are being predicted on the assumption that the prevailing market information in previous periods did not change. Predicted net returns to asset $i$ in time $t$ are conditioned on the previous periods information set and are given by

$$E_{t-1}[\hat{R}_{i,t} | \phi_{t-1}] = \frac{E_{t-1}[p_{i,t} | \phi_{t-1}] - p_{i,t-1}}{p_{i,t-1}}$$

(3.2)

\[\text{15 Returns estimated for this study are specifically returns on capital.}\]
Abnormal returns are therefore identified by obtaining the actual ex post return from equation (3.2) of the security over the event window and subtracting the predicted market return given by equation (3.3) as shown below.

\[ \epsilon_{it}^* = R_{it} - E_{t-1}[\hat{R}_{it} | \phi_{t-1}] \]  

(3.3)

where,
\( \epsilon_{it}^* \) is the abnormal return of asset \( i \) in period \( t \).
\( R_{it} \) is the actual ex post return of asset \( i \) in period \( t \).
\( E_{t-1}[\hat{R}_{it} | \phi_{t-1}] \) is the predicted market return of asset \( i \) in period \( t \) given \( \phi_{t-1} \).
\( \phi_{t-1} \) is the conditioning information for the normal performance model for period \( t - 1 \).

Therefore, adhering to event study theory, if there is no new conditioning information (\( \phi_{t-1} \)) in period \( t - 1 \) (i.e. an unexpected event), then the actual ex post return (\( R_{it} \)) for asset \( i \) during period \( t \) will be the same as the predicted net return (\( E_{t-1}[\hat{R}_{it} | \phi_{t-1}] \)) for asset \( i \) in period \( t \).

Then, a priori, abnormal returns (\( \epsilon_{it}^* \)) will not be statistically different from zero. Specifically, this study assesses the statistical significance of the deviation of abnormal returns from the first moment of the distribution of expected returns. Therefore, when new conditioning information (\( \phi_{t-1} \)) is present in the market, the abnormal returns (\( \epsilon_{it}^* \)) to a firm’s shares may be statistically different from zero. Since event studies test the effects of new conditioning information on returns, it is necessary to identify this information. Events of interest are identified through media resources such as newspapers, internet reports, or financial reporting agencies such as the Canadian Securities Commission. These sources of information are vital to event studies because they allow researchers to identify the date that an announcement was made public and provide peripheral information that may be relevant to the event.

Once an event has been identified and the event date determined, abnormal returns are estimated by partitioning three relevant timeframes: the estimation window, the event window and the post-event window (Figure 3.1). The estimation window will be used to calculate the predicted net return (\( E_t[\hat{R}_{it} | \phi_{t-1}] \)) using regression techniques. The estimation window begins
on day \( (T_0) \) and is comprised of about 100 – 200 days of trading data leading up to but not including trading information of the first day of the event window \( (T_1) \). Determining the length of the estimation window is left to the discretion of the researcher. The event window contains the event date \( (0 \text{ or } \tau) \) and ranges from \( T_1 \) to one day prior to \( T_2 \). The event window starts on day \( T_1 \) which may or may not be the same as the event date \( (0 \text{ or } \tau) \). In some cases, a few days prior to the event date \( (0 \text{ or } \tau) \) may be included if there is evidence that information may have leaked prior to the official announcement. The post event window is not always included in event studies but can be used to determine the length of time that asset returns were affected by an announcement and ranges from day \( T_2 \) through \( T_3 \). The last day of the post-event window (day \( T_3 \)) is also left to the discretion of the researcher. It is important to note that each window does not overlap and should not include other significant economic events or company specific announcements. Abnormal returns are calculated over the event and post-event windows using equation (3.3) as the difference between actual returns in period \( t \) and the expected return for that day. The expected returns for the asset are determined by using a regression method such as the market model to estimate the mean return to the asset over the estimation window from day \( T_0 \) to one day prior to \( T_1 \).

### 3.3 The Market Model

Predicted net returns \( \left( E_t[\hat{R}_{it} \mid \phi_{t-1}] \right) \) will need to be estimated since they are not readily observed in the market. Estimating expected returns \( (E_t[R_{it} \mid \phi_{t-1}]) \), after the information set \( (\phi_{t-1}) \) changes (during the event and post-event windows) can be accomplished by regressing
the actual ex post returns \( R_{it} \) to asset \( i \) on a set of benchmark market returns \( R_{mt} \) over the estimation window (Figure 3.1) using a single factor model. This allows returns to be assessed prior to the change in the information set \( \phi_{t-1} \) and then returns can be predicted over the event and post-event windows using the information set \( \phi_{t-1} \) that was present during the estimation window. As is shown by equation (3.3), the actual ex post returns can then be compared with the predicted returns for the same period to assess if the change in the information set \( \phi_{t-1} \) had a significant impact on the expected returns to asset \( i \). To implement such an analysis, a single factor regression model, such as the market model, can be used.

To show that a single factor regression model is suitable for estimating and predicting expected returns of the event study model, mean-variance analysis is used. According to Cochrane (2001), shareholders demand a premium for systematic risk which maximizes the mean return and minimizes the variance of that return. The number of possible returns that satisfies this condition is limited by a mean-variance frontier (Figure 3.2). If \( R_f \) represents an asset with zero risk then that asset will have no standard deviation \( \sigma(R) \) and the return is a risk-free rate of return \( R_f \). As the return to an asset becomes more variable, then the standard deviation of the

![Figure 3.2 Illustration of the mean-variance frontier](Cochrane, 2001)
return increases and as such the expected return $E(R)$ changes (Figure 3.2). Then, returns to firm $i$ lying on the mean-variance frontier ($R_{mv}$) can be estimated using:

$$E(R_{i,mv}) = R_f + \beta_{i,mv}[E(R_{mv}) - R_f]$$

(3.4)

where
- $E(R_{i,mv})$ is the expected return to asset $i$ lying on the mean-variance ($mv$) frontier
- $\beta_{i,mv}$ is the ratio of the mean to variance of asset $i$ from the risk-free rate of return and lying on the mean-variance ($mv$) frontier
- $E(R_{mv})$ is the expected return for a mean-variance efficient asset

To this point, the single factor model only accounts for systematic risk; but idiosyncratic risk in an investment does not command a higher return and is nearly always present (Figure 3.2). The model can be relaxed to include a residual that will capture the effects of idiosyncratic risk such that

$$E(R_i) = R_f + \beta_i[E(R_{mv}) - R_f] + \epsilon_i$$

(3.5)

where
- $\epsilon_i$ is the idiosyncratic risk of asset $i$
- $E[\epsilon] = 0, \forall \epsilon = 1...i$

Note that once the model is relaxed to include idiosyncratic risk the mean-variance scripts are no longer appropriate as expected returns ($E(R_i)$) and the coefficient $\beta_i$ are no longer necessarily mean-variance efficient. Rearranging equation (3.5) and adding time scripts approximates the event study model shown in equation (3.2) such that

$$\epsilon_{it} = E(R_{it}) - \left[R_f + \beta_i[E(R_{mv}) - R_f]\right]$$

where
- $\left[R_f + \beta_i[E(R_{mv}) - R_f]\right] \equiv E_t[R_{it} | \phi_{t-1}]$

and

$$\epsilon_{it} \equiv \epsilon^*_{it}$$
The market model (equation (3.6)) is similar to equation (3.5) in that the risk-free rate of return \( R_f \) is approximated by \( \alpha \) and \[ E(R_{mv}) - R_f \] is approximately equal to a market portfolio returns \( R_{mt} \). Some analyses have found that the inferential reliability of the market model is at least as good as many others assuming that ordinary least squares holds to be the best linear unbiased estimator (Armitage, 1995, Binder, 1998). For this reason, the market model has been chosen for this study and is given by

\[
\epsilon_{it} = R_{it} - (\alpha_i + \beta_i R_{mt})
\]  

(3.6)

where,
- \( \epsilon_{it} \) is the abnormal return of asset \( i \) in period \( t \).
- \( R_{it} \) is the ex post return of asset \( i \) in period \( t \).
- \( \alpha_i \) is the least squares (LS) intercept of the asset \( i \).
- \( \beta_i \) is the slope coefficient of stock \( i \).
- \( R_{mt} \) is the return on a market portfolio \( m \) in period \( t \).

In this model, \( \alpha_i + \beta_i R_{mt} \) will be regressed on the ex post returns \( R_{it} \) of the shares of asset \( i \) over the time period spanning the estimation window. This estimated model will then be used to predict the daily expected value of asset \( i \) returns \( E_t(R_i) \) over the event and post-event windows. Where, the market portfolio is often used as the independent variable of the regression is a stock market index. Since this study will rely heavily on indices, it is necessary to understand how and why indices are constructed and what sorts of properties they hold that will best suit this analysis.

### 3.3.1 Overview of Indices

Stock market indices proxy as performance benchmarks for various industry segments. Some of the most common North American indices are compiled by companies such as: Dow Jones and Company, Standard and Poor’s, Wilshire Associates and Frank Russell and Company. Even though groups of indices may reflect the performance of different segments of the market, indices within these groups express nearly the same information and may therefore be
interchangeable to some extent (Fortune, 1998). This means that the index selected for this study can be general in nature and will not necessarily need to be harmonized with the RTE meat industry.

Indices are aggregated to manifest some measure of quantity, price or value; price aggregated being the most common and most suitable for this study. Price aggregated indices can be calculated in two ways; those that use prices alone are price indices and those that aggregate prices plus dividend payments compounded over time are wealth indices. Price indices measure capital appreciation in the asset while wealth indices estimate the total returns to the asset over a given period of time. Distinguishing between capital appreciation and total return is important because as shown by Fortune (1998), growth in some stock wealth indices will increase at a different rate than growth in stock price for the same indices. However, this effect is only likely to produce a distinct difference in growth rates of wealth versus price returns over longer time horizons. Additionally, the dividend yields of small companies may be much lower than the dividend yields of large companies and therefore, stock price indices may overstate the relative performance of small companies compared to the performance of large companies (Fortune, 1998). This study focuses on the short term effects of information on share returns, therefore, only capital appreciation will be considered because growth in wealth and capital appreciation are likely to be similar in the short term. Additionally, an index which is tailored to firms that are approximately the same size as the subject firms will be used as a proxy for market returns.

Fortune (1998) suggests that an index should possess five primary characteristics in order to be a good market indicator. First, the benchmark index will ideally contain stocks which represent a significant portion of investors. Secondly, indices are used to measure price changes given information or forces that affect the market. Ideally, a well diversified index will minimize the effect of idiosyncratic risk. Third, the internal decisions made by companies should not affect shareholder risk or return. Actions such as splitting stocks are likely to change the firms share
price and this in turn may affect the price level of the index. All else equal, indices that are value-weighted or market capitalization weighted are designed to automatically correct for events such as stock splits and are more desirable than equally weighted indices which do not automatically adjust for internal company decisions. Similarly, as share prices change for any given stock, the weight of that stock within the portfolio will also change. Hence, the weight of stocks in an index with appreciation higher than average will rise, while the weight of below average performers will fall within the same index. Thus the fourth desirable aspect of an index is that it automatically corrects for the repercussions of price changes. Finally, if an index contains a large number of infrequently traded stocks, it will not accurately reflect the market. As such, an ideal index will primarily contain stocks that are frequently traded.

3.3.2 Pre-regression Analysis of the Sample Variables

Once the variables for the single factor model have been identified, a sample of their daily returns will be calculated. The daily returns for each variable will then be tested for a unit root to ensure they are stationary. Further, the sample’s distribution of returns will be examined for obvious signs of non-normality.

Processes that are not stationary have means and variances that change over time; they exhibit trending and thus, a meaningful average cannot be taken. Further, if variables containing unit roots are regressed on one another, the results will be spurious (Elder and Kennedy, 2001). Spurious regression is characterized as having t-test statistics and R-squares that are misleadingly high and Durbin-Watson statistics that are low (Elder and Kennedy, 2001). Therefore testing for a unit root will indicate whether the returns will need to be differenced or if a different method of estimation needs be identified.

There are a number of unit root tests for stationarity; the most recommended within the broader literature and textbooks is the Dickey-Fuller test (Elder and Kennedy, 2001). The
Dickey-Fuller test requires a testing strategy to identify if a constant, constant and slope or neither a constant or slope should be included in the unit root test regression (Elder and Kennedy, 2001). The most suitable equation and hypothesis to test can be determined by visually inspecting a plot of returns. If the sample is mean reverting around zero, then the no constant and no trend equation and hypothesis should be used. If the series is mean reverting around an average other than zero, then the constant and no trend equation and hypothesis will be used. Finally, if the sample is reverting around a linear trend, then the constant and trend hypothesis and equation will be used.

Following the unit root test and corrections should they be required, the distribution of returns will be visually examined for obvious signs of non-normality. This pre-regression analysis will help to determine whether the returns of the sample variables are bi-modal or exhibit obvious signs of a distribution that is something other than normal. If the distribution of returns is not normal, then classical statistical inference cannot be used.

Once the sample variables have been inspected and any necessary transformations made, the single factor market model will be estimated. The purpose for the regression is to obtain estimated coefficients which will be used to forecast expected returns to the dependent variable over the event and post-event windows. To implement this procedure, the market model will have to undergo statistical and diagnostic testing.

3.4 Statistical Testing

Statistical tests performed on the market model are done to confirm that the ordinary least squares estimator is the most appropriate estimator. The primary assumption is that price changes are random movements and are statistically independent of one another, in other words, price changes follow a random walk. The random walk model is the weak form of the efficient market hypothesis and is nested as an assumption within the submartingale or event study model. Conceptually, the random walk model proposes that the conditional and marginal probability
distributions of an independent random variable are identical in all periods. The random walk model is given by

\[ f(\tilde{r}_{i,t+1}|\phi_t) = f(\tilde{r}_{i,t+1}) \]  

(3.7)

where,
- \( f(\tilde{r}_{i,t+1}|\phi_t) \) is the conditional probability distribution function of the return \( r \) of asset \( i \) in period \( t + 1 \)
- \( f(\tilde{r}_{i,t+1}) \) is the marginal probability distribution function of the return \( r \) of asset \( i \) in period \( t + 1 \)

This model shows that price changes are random movements and are statistically independent of each other but this is conditional on publicly available information. The conditioning information could be related to announcements of an event such as the 2008 Listeria recall. In such a case, the announcements would change next period’s \( (t + 1) \) marginal probability distribution such that it would be identical to the conditional probability distribution of the \( t + 1 \) period.

The random walk theory proposes that historical common stock returns cannot be used to make meaningful predictions concerning the future price of the stock. To assess the presence of random walks in asset returns, two hypotheses are presented. Hypothesis I states that successive changes in return are independent. Hypothesis II states that the changes in returns conform to some probability distribution. These two hypotheses form the basis of the identical and independent distribution (IID) assumption of the ordinary least squares estimator. If the IID assumption is violated, the statistical significance for any measure of abnormal return obtained from the expected returns model may be misspecified, affecting the inferential reliability of the model.

Specifically, Hypothesis I states that changes in returns are independent of the previous sequence of changes in returns. In other words, the previous sequence of changes in returns cannot be used to meaningfully predict a future sequence of changes in returns. Prior empirical testing of this hypothesis has shown that dependence among successive changes in returns are
very slight or almost non-existent and therefore is not likely to be a cause of the non-normality commonly observed in fluctuating returns (Fama, 1965). Some common sources of dependence in price changes can be found in autocorrelation of changes in returns with themselves, multicollinearity between independent variables, and endogeneity (Fama, 1965).

Autocorrelation occurs when the off-diagonal elements of the variance-covariance matrix of the disturbance term are nonzero. As a consequence, standard errors obtained from the OLS estimator will generally be underestimated. In turn, this will cause the student’s t-statistic to be overestimated thereby increasing the chances of inappropriately rejecting the null hypothesis and committing a type I error.

Autocorrelation occurs most often in time series data and are often due to shocks such as negative announcements. It can be the case that these shocks have lingering effects lasting one time period or longer. Autocorrelation commonly occurs as a first order auto-regressive disturbance meaning that the disturbance in the current time period will depend on the period \( t - 1 \) disturbance plus a white noise term. The market model will be tested for first order autocorrelation by using a Durbin-Watson test. A Durbin-Watson upper and lower bound will be used to interpret the Durbin-Watson \( d \) statistic. The \( d \) test statistic will be indicative of the presence of positive \( (d < 2) \), negative \( (d > 2) \) or no autocorrelation \( (d \sim 2) \).

Multicollinearity occurs when two or more independent variables in a regression are highly correlated. Since the market model is a single factor model, multicollinearity will not present as a problem and as such will not be tested for.

Endogeneity occurs when the independent variables are correlated with the error term. If the dependent, independent and/or omitted variables are an outcome of the same process, simultaneity may occur. For this reason, it is particularly important to ensure that the market indices chosen are not calculated using the share price of the dependent variable.

Hypothesis II states that asset price changes conform to some probability distribution that is identical to the probability distribution of subsequent price changes for the same asset. To
apply the ordinary least squares estimator, assume that the distribution of asset price changes have a normal or Gaussian distribution. One drawback to this assumption is that the distribution of asset price changes has empirically been shown to have an unusual number of observations in the tails of the distribution. Despite the propensity for the distribution of price changes to be leptokurtotic, ordinary least squares is still one of the most commonly used estimators in event study analysis and has been shown to be reliable for these purposes. To test the Gaussian distribution for normality, the third and fourth moments of the distribution will be tested for skewness and kurtosis. Additionally, the market model regression will be tested for overall normality using the Jarque-Bera test.

Heteroskedasticity is present within a regression model when the dispersion of the variance of the estimated residuals is not constant throughout the sample. The ordinary least squares estimator will remain unbiased and consistent but will no longer provide a minimum variance estimate. As such, the standard errors calculated will be incorrect and could provide misleading hypothesis test results. There are a number of tests which may indicate the presence of heteroskedasticity and this study will employ White’s test.

Event studies that adopt a regression estimator such as OLS to forecast the expected normal return to a share are susceptible to violations of the IID assumption. This is because the ordinary least squares estimator assumes the hypotheses of the random walk model to be true. In order for the assumption to hold, the changes in price or return to the share must have a normal or Gaussian distribution. However, according to Fama (1965), changes in price or share return often do not have a normal distribution. As a consequence, regression estimators such as OLS, which rely on the IID assumption, may produce unreliable beta coefficients due to a violation of one or both of the random walk hypotheses. If such is the case, an alternative method of forecasting expected returns will need to be identified.
3.5 Statistical Testing of Event Studies

If the regression is not affected by departures from the model assumptions, then the estimated coefficient \( \hat{\beta}_i \) can be used to forecast the expected returns (per equation (3.6)) which will be used to calculate the abnormal returns to the firm’s shares. If the estimated coefficient \( \hat{\beta}_i \) is statistically significant and all assumptions of the model hold, then for every unit increase in the return of market portfolio \( R_{m,t} \), the return to share \( i \) will increase by \( \hat{\beta}_i \) units. Since the relationship of the market portfolio \( m \) to share \( i \) is the estimated coefficient \( \hat{\beta}_i \) then the expected returns to share \( (E_t[R_{i,t}]) \) can be forecast by multiplying the observed value of the daily return to the market portfolio \( R_{m,t} \) over the event window by the estimated coefficient \( \hat{\beta}_i \) and adding the estimated intercept \( \hat{\alpha}_i \). This is given by

\[
E_t[R_{it} | \phi_{t-1}] = \hat{\alpha}_i + \hat{\beta}_i(R_{mt})
\]  

(3.8)

where

\( E_t[R_{it} | \phi_{t-1}] \) is the period \( t \) expectation of returns conditioned on the information set in period \( t - 1 \)

The expected period \( t \) return calculated in equation (3.8) is then subtracted from the period \( t \) actual ex-post returns for firm \( i \) over the specified event window as was show in equation (3.3). The resultant abnormal return will give some indication about how shareholder’s react to publicly available information, however, the abnormal returns obtained must be tested for statistical significance.

The statistical significance of abnormal returns are tested by cumulating abnormal returns (CAR) and then standardizing the cumulative abnormal returns (SCAR). The SCAR is a test of the semi-strong form of the efficient market hypothesis. One primary assertion in support of this model is that conditioning information, while not always perfectly assimilated into future price expectations, is assimilated with statistical significance on a consistent basis (Fama, 1970). Therefore, the null hypothesis, \( H_0 \), that the event has no impact on the mean of returns can be
tested using the assumptions of joint normal distribution with a zero conditional mean and a conditional covariance matrix \( V_i \). The distribution of the estimated abnormal returns can be shown as

\[
\varepsilon_i^t \sim N(0, V_i).
\] (3.9)

Equation (3.9) is the distribution for any single abnormal return observation and as such, is the basis for aggregating abnormal returns both through time and across securities.

In order to test the hypothesis, the abnormal returns will have to be aggregated. Aggregation procedures will vary depending on the number of events being studied. For a single event and firm estimated by using the market model, aggregation of abnormal returns can be accomplished using the cumulative abnormal return method (CAR) and then standardizing the cumulative abnormal returns (SCAR) using the standard deviation of the estimate.

The \( \overline{\text{CAR}}_i (\tau_3, \tau_4) \) is the sum of abnormal returns for a single firm \( i \) during the event window which is defined by \((\tau_3, \tau_4)\) where \( \tau_3 \) is the first day of the event window and \( \tau_4 \) is the last day of the event window. Under the null hypothesis that the event has zero effect on the value of the firm’s stocks,

\[
\overline{\text{CAR}}_i (\tau_3, \tau_4) \sim N(0, \sigma_i^2(\tau_1, \tau_2)).
\] (3.10)

where

\( \tau_1 \) is the first day of the estimation window
\( \tau_2 \) is the last day of the estimation window

The null can then be tested using the SCAR

\[
\overline{\text{SCAR}}_i (\tau_3, \tau_4) = \frac{\overline{\text{CAR}}_i (\tau_3, \tau_4)}{\hat{\sigma}_i(\tau_1, \tau_2)}
\] (3.11)

One of the primary assumptions of this study is that expected returns should be mean reverting around zero. This means that cumulating expected returns over time should also be zero.

Therefore, to measure whether \( \overline{\text{CAR}}_i (\tau_3, \tau_4) \) is statistically significant from zero, the
\( \overline{CA_R}_i ( \tau_3, \tau_4 ) \) must be divided by the standard deviation of the estimate \( \left( \hat{\sigma}_i(\tau_1, \tau_2) \right) \) thus giving the \( S\overline{CA}_R_i \). The distribution of the \( S\overline{CA}_R_i \) is a Student’s-\( t \) with \( L_1 - 2 \) degrees of freedom, where, \( L_1 \) is the number of observations in the estimation window. As the number of observations in the estimation window surpasses 30, the distribution of the \( S\overline{CA}_R_i \) approaches a standard normal distribution (Campbell et al., 1997, p. 161).

### 3.6 Data

The first objective of this study is to assess the economic impact of the 2008 Listeria recall on the returns to Maple Leaf Foods Inc. Then by default, data in the form of new events and daily share prices for Maple Leaf Foods Inc. will be gathered. The second objective of this study is to assess if there were spillover effects from the 2008 Listeria recall onto other publicly traded Canadian meat processing firms. In order to meet this objective, other publicly traded Canadian meat processing firms had to be identified\(^{16}\). While there are many provincially and federally registered meat processing firms, the only other publicly traded firm comparable to Maple Leaf Foods Inc. is Premium Brands Holdings\(^{17}\). The final requirement to begin estimation of possible abnormal returns to both Maple Leaf Foods Inc. and Premium Brands Holdings is to identify suitable benchmark indices.

Once all publicly traded meat processing firms relevant to this study were identified, a search for a suitable broader market index was conducted. Potential benchmarks for the ready-to-eat meat industry were identified by searching DataStream for indices containing only Canadian companies. Indices were automatically eliminated if either Maple Leaf Foods Inc. or Premium Brands Holdings were companies included in the calculation of the index. All indices identified were constructed by Standard and Poor’s as value-weighted or market capitalization weighted


\(^{17}\) Premium Brands Holdings was identified by cross-referencing the firms on the list of federally registered firms (Canadian Food Inspection Agency, 2009) with firm records on the Canadian Securities Commission website [http://www.sedar.com/homepage_en.htm](http://www.sedar.com/homepage_en.htm).
indexes. The search identified seven benchmark indices which fell into broad market, large company, medium company and small company representations. This list was further reduced by selecting only indices that reflected medium and small company performance, thus leaving the Standard and Poor’s Smallcap (S&P/TSX Smallcap) and Standard and Poor’s Composite Indexes (S&P/TSX Composite). Both indices are calculated using only companies traded on the Toronto Stock Exchange (TSX) and are representative of market sizes similar to Maple Leaf Foods Inc. and Premium Brands Holdings.

3.6.1 Data Manipulations

Daily closing prices for Maple Leaf Foods Inc., Premium Brands Holdings, S&P/TSX Smallcap and S&P/TSX Composite were collected from DataStream for the period 30 November 2007 through 30 April 2009. Closing share prices were then transformed to daily returns as described in equation 3.1 leaving observations for the period 3 December 2007 through 30 April 2009. The plot of daily returns for Maple Leaf Foods Inc., Premium Brands Holdings, S&P/TSX Smallcap and S&P/TSX Composite are presented in Figures 3.3, 3.4, 3.5 and 3.6 respectively. The daily returns to Premium Brands Holdings, the S&P/TSX Smallcap and the S&P/TSX Composite indices appear to be relatively stable from approximately 3 December 2007 into late September 2008. However, daily returns show some visual signs of increasing volatility beginning in the latter part of September 2008. Daily returns to Maple Leaf Foods Inc. do not readily appear to reflect the obvious increase in volatility that Premium Brands Holdings, the S&P/TSX Smallcap and the S&P/TSX Composite index does. The signs of increased volatility prompted a Google search for news of broad market failure\(^\text{18}\) in addition to news press releases for Maple Leaf Foods Inc. and Premium Brands Holdings.

\(^{18}\) In early October 2008, a worldwide financial crisis was reported by the CBC (CBC News, 2008c). The last day of the post-event window of this study is therefore bounded to 30 September 2008.
Figure 3.3  Daily Returns to Maple Leaf Foods Inc. For the Period 3 December 2007 - 30 April 2009

Date (yyyymmdd)

- Actual Return to Maple Leaf Foods Inc.
Figure 3.4  Daily Returns to Premium Brands Holdings for the Period 3 December 2007 - 30 April 2009
Figure 3.5 Daily Returns to the S&P/TSX Smallcap Index For the Period 3 December 2007 - 30 April 2009
Figure 3.6 Daily Returns to the S&P/TSX Composite Index For the Period 3 December 2007 - 30 April 2009
3.6.2 Summary Statistics

Analysis of the summary statistics of the daily returns to Maple Leaf Foods Inc., Premium Brands Holdings, the S&P/TSX Smallcap Index and the S&P/TSX Composite Index, is presented in Table 3.1. Daily returns to Maple Leaf Foods for the period 3 December 2007 – 30 September 2008 show about two times more variability than the daily returns to Premium Brands Holdings, the S&P/TSX Smallcap and S&P/TSX Composite indices. The mean daily returns to all variables were negative, however, the mean daily returns to the S&P/TSX Composite Index was notably much lower than the mean daily returns to Maple Leaf Foods Inc., Premium Brands Holdings and the S&P/TSX Smallcap Index. The correlation between the daily returns to Maple Leaf Foods Inc. and both the Smallcap and Composite indices was low but positive.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean Return</th>
<th>St. Dev.</th>
<th>Correlation with S&amp;P/TSX Smallcap</th>
<th>Correlation with S&amp;P/TSX Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Returns to Maple Leaf Foods Inc.</td>
<td>217</td>
<td>-1.66E-03</td>
<td>2.39E-02</td>
<td>0.321</td>
<td>0.335</td>
</tr>
<tr>
<td>Daily Returns to Premium Brands Holdings</td>
<td>217</td>
<td>-1.64E-03</td>
<td>1.65E-02</td>
<td>0.313</td>
<td>0.291</td>
</tr>
<tr>
<td>Daily Returns to S&amp;P/TSX Smallcap Index</td>
<td>217</td>
<td>-1.31E-03</td>
<td>1.51E-02</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Daily Returns to S&amp;P/TSX Composite Index</td>
<td>217</td>
<td>-5.89E-04</td>
<td>1.41E-02</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Similarly, the correlation between the daily returns to Premium Brands Holdings and both the Smallcap and Composite indices were also low but positive.
3.6.3 Identification of Events

Event announcements of interest were identified by using press releases and announcements posted on the Maple Leaf website, the System for Electronic Document Analysis and Retrieval (SEDAR), the Canadian Food Inspection Agency food recall website, newsfeeds from the Toronto Stock Exchange and Google finance. Keywords used for Google searches were: Maple Leaf, recall and Listeriosis. Google internet searches were conducted for Premium Brands Holdings using the keywords: 2008 Premium Brands Holdings. The Premium Brands Holdings website discloses press releases for the company, which was also searched. A Google search of the broader market was also conducted to identify overall world financial market conditions. Keywords used for this search were 2008 financial markets. The data collected was used to identify the specific dates that initial announcements were made and to cross-reference those dates with asset returns on those days.

3.7 Conclusions

Through a few mathematical manipulations, the investor’s stochastic discount factor has been equated to an asset-specific risk-adjusted discount factor. Using mean-variance analysis, the risk-adjusted discount factor was shown to be equal to a risk-free rate of return plus the ratio of the mean to variance of an asset times some expected market rate of return, otherwise known as a single factor model of asset returns. The model was further relaxed to include a residual component meant to capture the effects of idiosyncratic risk and this then linked the single factor model of asset returns to the market model. Chapter 4 uses the data identified in Chapter 3 and applies the market model as the first of two steps in identifying potential abnormal returns to Maple Leaf Foods Inc. and Premium Brands Holdings which may have resulted from negative announcements due to the 2008 Listeria recall.
Chapter 4

Event Study Results

4.1 Introduction

The semi-strong form of the efficient market hypothesis states that at any given moment in time, all publicly available information is fully reflected in security prices. According to Fama (1970) empirical evidence supports this hypothesis. Additionally, the economic impact of a recall as large and widespread as the 2008 Listeria recall on meat processing firms in Canada is not very well understood. Since the 2008 Listeria recall materialized in a publicly traded firm, there is opportunity to assess the economic impact of the recall on both the subject firm and other publicly traded Canadian firms. Using the efficient market hypothesis to test the statistical significance of the recall, this chapter presents the results of the impact of the of the 2008 Listeria recall on the daily share returns of Maple Leaf Foods Inc. during the event and post-event windows. Further, the impact of the recall on the daily returns to Premium Brands Holdings during the event and post-event windows was also completed.

4.2 The Listeriosis Recall Event

To begin this event study, the dates and duration of the estimation, event and post-event windows needed to be defined. This was accomplished by conducting internet searches using: the Google search engine, Google Finance, Yahoo! Canada finance and the Canadian Securities Commission websites. Two Google searches were completed, the first using the keywords: Maple Leaf, Listeria, and recall. The resulting search showed about 150,000 articles matching the keywords description. A second Google search using the keywords: Maple Leaf, Listeria and outbreak showed about 104,000 websites matching the search description. Articles were selected based on the criteria that the report was made on or after 17 August 2008 and that the reporting agency would have a substantial body of readers. Announcements were selected from: Maple
Leaf Foods Inc. website, the CBC News website, the Canadian Food Inspection Agency website, the star.com, the Canwest News Service, the Globe and Mail website and CTV.ca.

Announcements publicized on the Google Finance and Yahoo! Canada finance websites were also used to determine the dates of and length of the estimation, event and post-events windows.

Publications of the Listeria recall were next arranged into a chronology of events from earliest to latest. Event announcements were hypothesized to have positive, negative or indeterminable effects on returns as may be interpreted by an investor. Table 4.1 shows the chronology of events following the initial Listeria recall announcement which occurred on

<table>
<thead>
<tr>
<th>Date</th>
<th>Report Heading</th>
<th>Effect</th>
<th>Corresponding Figure 4.1 Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 August</td>
<td>Listeria Investigation and Recall – 2008 (The Canadian Food Inspection Agency, 2008c)</td>
<td>Negative</td>
<td>A</td>
</tr>
<tr>
<td>18 August</td>
<td>No Reports</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>20 August</td>
<td>No Reports</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>21 August</td>
<td>Clarification – Health Hazard Alert (The Canadian Food Inspection Agency, 2008b)</td>
<td>Negative</td>
<td>D</td>
</tr>
<tr>
<td>21 August</td>
<td>Canada: Maple Leaf Expands Recall and Closes Plant (Meat International.com, 2008)</td>
<td>Negative</td>
<td>D</td>
</tr>
<tr>
<td>22 August</td>
<td>Death of B.C. Man Linked to Listeria Outbreak (Hanson, 2008)</td>
<td>Negative</td>
<td>E</td>
</tr>
<tr>
<td>23 August</td>
<td>Maple Leaf Foods Joins YouTube and Posts Advertisements and Action Plans</td>
<td>Positive</td>
<td>F</td>
</tr>
</tbody>
</table>
Table 4.1 Continued

<table>
<thead>
<tr>
<th>Date</th>
<th>Report Heading</th>
<th>Effect</th>
<th>Corresponding Figure 4.1 Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 August</td>
<td>Financial Estimate of Impact of Bartor Rd Recall (Maple Leaf Foods Inc., 2008a)</td>
<td>Negative</td>
<td>F</td>
</tr>
<tr>
<td>25 August</td>
<td>Maple Leaf News Release Product Recall Expansion (Maple Leaf Foods Inc., 2008b)</td>
<td>Negative</td>
<td>F</td>
</tr>
<tr>
<td>25 August</td>
<td>Expanded Health Hazard Alert (Canadian Food Inspection Agency, 2008a)</td>
<td>Negative</td>
<td>F</td>
</tr>
<tr>
<td>25 August</td>
<td>Listeria Death Toll Grows to 12 (CityNews.ca Staff, 2008)</td>
<td>Negative</td>
<td>F</td>
</tr>
<tr>
<td>26 August</td>
<td>Death Toll Rises in Maple Leaf Foods Outbreak (Sharma, 2008)</td>
<td>Negative</td>
<td>G</td>
</tr>
<tr>
<td>26 August</td>
<td>Maple Leaf Shares Fall (McConnell, 2008)</td>
<td>Negative</td>
<td>G</td>
</tr>
<tr>
<td>26 August</td>
<td>Death Toll Linked to Listeriosis Rises to Twelve (Fitzpatrick and Barrera, 2008)</td>
<td>Negative</td>
<td>G</td>
</tr>
<tr>
<td>26 August</td>
<td>Class Action Lawsuit Launched over Listeria Outbreak (CBC News, 2008b)</td>
<td>Negative</td>
<td>G</td>
</tr>
<tr>
<td>27 August</td>
<td>Four Lawsuits Filed Against Maple Leaf Foods over Tainted Meat (Hernandez, 2008)</td>
<td>Negative</td>
<td>H</td>
</tr>
<tr>
<td>27 August</td>
<td>Maple Leaf CEO Michael McCain Holds a Press Conference (Hughes, 2008)</td>
<td>Indeterminable</td>
<td>H</td>
</tr>
<tr>
<td>28 August</td>
<td>Eight Confirmed Dead from Listeriosis Outbreak (The Canadian Press, 2008b)</td>
<td>Negative</td>
<td>I</td>
</tr>
<tr>
<td>29 August</td>
<td>Maple Leaf Causes More Death (ChatterShmatter.com, 2008)</td>
<td>Negative</td>
<td>J</td>
</tr>
<tr>
<td>29 August</td>
<td>Maple Leaf Criticized in 2007 Audit (Curry, 2008)</td>
<td>Negative</td>
<td>J</td>
</tr>
<tr>
<td>29 August</td>
<td>Canada Fails to Track Food Illnesses, Expert Says (Howlett, 2008)</td>
<td>Negative</td>
<td>J</td>
</tr>
</tbody>
</table>
Sunday 17 August 2008. Daily closing prices and volume trading collected from DataStream were then compared to the chronology of significant events to assist with establishing the initial date and duration of the event window. It must be noted that only trading days were included in this analysis and as such, any announcement that occurred outside of a trading day was correlated with the first trading day following the announcement. Figure 4.1 shows the daily closing share prices and trade volume for Maple Leaf Foods Inc. shares from 5 August 2008 through 25 September 2008.

The initial product recall, which occurred on 17 August 2008, would not have been reflected in stock market trading until 18 August 2008. As shown in Figure 4.1, the volume of shares traded did not differ from normal volume trading over the previous two weeks. In fact, on 18 August 2008, Maple Leaf shares closed at $11.01, up four cents over the closing price on 15 August 2008. There were a number of negative announcements pertaining to the recall for the remainder of the week from 19 August through 22 August 2008, including an announcement that the Bartor Road plant\(^\text{19}\) was closed. The initial shareholder response to these announcements did not affect share trading volume but Maple Leaf’s closing share prices steadily declined from $11.01 on 18 August 2008 to $9.80 on 22 August 2008. Daily announcements and trading activity for the week of 18 August through 22 August 2008 are denoted by the letters A, B, C, D and E in Table 4.1 and Figure 4.1.

The first death related to the Listeria recall was announced on 22 August 2008 but the effects of the announcement were not clearly reflected in stock market trading until 25 August 2008. As shown in Table 4.1, there were multiple announcements the week of 25 August through 29 August 2008. News headlines included issues such as: Listeria related deaths, various brands of Maple Leaf processed meat recalls, Maple Leaf stock prices, lawsuits filed, press conferences

\(^{19}\) The Bartor Road plant was identified as the source of the 2008 Listeria contamination by the CFIA (Canadian Food Inspection Agency, 2008a).
Figure 4.1  Daily Closing Prices and Volume Traded for Maple Leaf Foods Inc. for the Period 5 August 2008 to 25 September 2008

Daily Closing Price in CDN Dollars

Daily Volume Trading (Thousands)

Date

Daily Maple Leaf Foods Inc. Volume Traded  Daily Maple Leaf Foods Inc. Closing Price
held by Maple Leaf CEO Michael McCain and unease about the safety of Canadian processed meat products. Daily announcements and trading activity for the week of 25 August through 29 August 2008 are denoted by the letters F, G, H, I and J in Table 4.1 and Figure 4.

The initial date of the event window \( T_1 \) was determined to be 15 August 2008; the date for the event announcement \( \tau \) is 18 August 2008. There was very little evidence that news of the recall was publicized prior to 17 August 2008; however, thestar.com published after the fact, an article indicating that the Canadian Food Inspection Agency (CFIA) was conducting an investigation of Maple Leaf Foods Inc. prior to the initial announcement (The Canadian Press, 2008a). Additionally, the report stated that distributors for Maple Leaf Foods Inc. were notified that the CFIA was conducting an investigation on 14 August 2008. Hence, there is a slight possibility that leakage of the announcement may have occurred prior to 17 August 2008 and as such the event window was extended to 15 August 2008.

The duration of the event window was further complicated by Listeria related death announcements starting on 22 August 2008 and continuing through the week 25 August through 29 August 2008. Announcements of fatalities appear to have prompted excessively high volumes of shares traded and a significant drop in share price. Given the number of public announcements published from 17 August through 29 August 2008, it was determined that the event window should encompass the time period 15 August \( (T_1) \) through 29 August 2008 \( (T_2 - 1) \).

The Listeria recall announcement and subsequent death announcements are interrelated announcements all occurring within a short period of time. Any measureable abnormal returns caused by a death announcement during the week of 25 August through 29 August 2008, may be biased by the initial recall announcement and prior death announcement(s). Hence, all announcements will be treated as a single event since they all result from the initial Listeria recall.
Having defined days $T_1$ and $T_2 - 1$ of the event window, means that the estimation window spanned from day $T_0$ through 14 August 2008 ($T_1 - 1$). The only criteria required to define day $T_0$ is that the length of the estimation window should be approximately 120 trading days prior to the event (Campbell et al., 1997, p. 152). For this study, restricting the estimation window to 120 trading days resulted in regressions with zero explanatory power between the dependent and independent variables and no overall significance. This problem was easily overcome by extending the estimation window to 184 trading days, thus day $T_0$ of the estimation window is 3 December 2007.

Finally, the post-event window was consequential to this study to determine the length of time that abnormal returns were present and to study any potential after effects of the announcement on the shares of Maple Leaf Foods Inc. and Premium Brands Holdings if any exist. Since the final day of the event window ($T_2 - 1$) is 29 August 2008, then the first day of the post-event window is 1 September 2008. Google searches relating to the condition of broader financial markets indicated broad market instability in early October 2008. Therefore, the post-event window was specified to span from 1 September 2008 through 30 September 2008 to allow for analysis of the post-event returns to Maple Leaf Foods Inc. and Premium Brands Holdings.

### 4.3 Estimating Expected and Abnormal Returns

The event study has now been segregated into three separate windows of interest: the estimation window; the event window; and the post-event window. The next three sections of this chapter will provide the analysis for each of these three windows.

#### 4.3.1 Regression Results

As indicated in Chapter 3, the S&P/TSX Smallcap (SCP) and the S&P/TSX Composite (SCI) Indices were selected as independent variables for the market model regression. They were selected for this study because they represent markets that are comparable to Maple
Leaf Foods Inc. (MFI) and Premium Brands Holdings (PBH). Initially, the daily returns of each variable were calculated using the daily price data from DataStream for the period 30 November 2007 through 6 October 2009. This resulted in daily returns for the time period 3 December 2007 through 6 October 2009. Histograms of the distribution of returns for each variable were plotted and visually inspected for obvious signs of non-normality during the estimation window (3 December 2007 – 14 August 2008). Figures 4.2, 4.3, 4.4 and 4.5 show that returns to Maple Leaf Foods Inc., Premium Brands Holdings, the S&P/TSX Smallcap Index and the S&P/TSX Composite Index respectively, all appear to be normal over the estimation window time period. Additionally, Dickey-Fuller tests\textsuperscript{20} were further performed to test the null hypothesis of unit root for daily returns to each of the variables of interest. As noted in Chapter 3, there are three possible testing strategies for a Dicky-Fuller test. To identify the appropriate testing strategy, the plot of daily returns for Maple Leaf Foods Inc., Premium Brands Holdings, the S&P/TSX Smallcap and S&P/TSX Composite indices were examined. Figures 4.6, 4.7, 4.8 & 4.9 illustrate the plots of daily returns for each of variable respectively. Plots of daily returns for Maple Leaf, Premium Brands, the Smallcap Index and the Composite Index show that returns to each variable are mean reverting around zero and did not show signs of upward or downward trending. For these reasons, the unit root testing strategy was to test the no constant, no trend Dicky-Fuller test. Results of the unit root testing are presented in Table 4.2. The null of a unit root was rejected at the 5 percent level of significance for each variable, indicating all variables have stationary processes.

To estimate expected returns to Maple Leaf Foods Inc. and Premium Brands Holdings, four market model regressions were completed. Daily returns to Maple Leaf Foods Inc. was first regressed on the daily returns of the S&P/TSX Smallcap Index and then on the S&P/TSX Composite Index. Daily returns to Premium Brands Holdings were then regressed on the S&P/TSX Smallcap Index and then on the S&P/TSX Composite Index. To ensure the estimated

\textsuperscript{20} Philips-Perron tests support the results of the Dickey-Fuller tests presented in this thesis.
Figure 4.2  Histogram of Returns to Maple Leaf Foods Inc. for the Period 3 December 2007 to 14 August 2008

Figure 4.3  Histogram of Returns to Premium Brands Holdings for the Period 3 December 2007 to 14 August 2008
Figure 4.4  Histogram of Returns to the S&P/TSX Smallcap Index for the Period 3 December 2007 to 14 August 2008

Figure 4.5  Histogram of Returns to the S&P/TSX Composite Index for the Period 3 December 2007 to 14 August 2008
Figure 4.6  Plot of Daily Returns to Maple Leaf Foods Inc. for the Period
3 December 2007 to 14 August 2008

Figure 4.7  Plot of Daily Returns to Premium Brands Holdings for the Period
3 December 2007 to 14 August 2008
Figure 4.8  Plot of Daily Returns to the S&P/TSX Smallcap Index for the Period 3 December 2007 to 14 August 2008

Figure 4.9  Plot of Daily Returns to the S&P/TSX Composite Index for the Period 3 December 2007 to 14 August 2008
Table 4.2  Dickey-Fuller Unit Root Tests for Maple Leaf Foods Inc., Premium Brands Holdings, S&P/TSX Smallcap Index and S&P/TSX Composite Index for the Period 3 December 2007 – 14 August 2008

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dickey-Fuller Test Statistic</th>
<th>Critical Value 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maple Leaf Foods Inc.</td>
<td>-3.37</td>
<td>-1.95</td>
</tr>
<tr>
<td>Premium Brands Holdings</td>
<td>-4.21</td>
<td>-1.95</td>
</tr>
<tr>
<td>S&amp;P/TSX Smallcap</td>
<td>-3.74</td>
<td>-1.95</td>
</tr>
<tr>
<td>S&amp;P/TSX Composite</td>
<td>-4.30</td>
<td>-1.95</td>
</tr>
</tbody>
</table>

model conforms to the assumptions of the statistical model, a number of misspecification tests were performed. Specifically, diagnostic tests completed for this regression examined normality, autocorrelation and homoskedasticity of the models residuals; results of these tests are presented in Table 4.3. For the model regression MLF returns on the S&P/TSX Smallcap, the coefficient of skewness was -0.295, here the null of no skew could not be rejected at the, ten percent level of significance. The coefficient of kurtosis was 0.734 and the null of no kurtosis was rejected at the five percent level of significance, indicating that the distribution may be leptokurtotic. The Jarque-Bera test statistic of overall normality was 6.193 and thus the null of normality could not be rejected at the one percent level of significance. Figure 4.10, shows that the histogram of residuals also appears to be normally distributed. It was therefore concluded that there is evidence that the distribution of residuals for this regression are normal. Tests for autocorrelation were completed using the Durbin-Watson statistic. The lower and upper critical values at the five percent level of significance for the Durbin-Watson test are 1.73 and 1.78. The DW statistic was 1.94, indicating that there was no first-order autocorrelation in the model. White’s test statistic was 1.089, thus the null of homoskedasticity could not be rejected at the one percent level of

---

21 Testing has shown that the empirical distributions of price changes have longer tails than the normal distribution (Fama, 1965). It is therefore expected that the error terms estimated by the market model would also be leptokurtotic.
significance. Further tests for autoregressive conditional heteroskedasticity (ARCH) did not provide evidence of ARCH effects.

Results from the regression of daily returns to Maple Leaf Foods Inc. on the daily returns of the S&P/TSX Smallcap Index are presented in Table 4.4. The estimated coefficient on the daily returns to the S&P/TSX Smallcap Index was 0.538 and was statistically significant from zero at the one percent level of significance. The coefficient was also positive, as expected, and therefore suitable for the purpose of forecasting expected returns to Maple Leaf Foods Inc. The intercept for this regression was negative but not statistically significant. This was expected, as the intercept should reflect the risk-free rate of return and will also capture the effects of unaccounted for variables and errors. The coefficient of determination \( R^2 \) for Maple Leaf Foods Inc. regressed on the S&P/TSX Smallcap Index was 0.093, indicating the estimated model
had very little explanatory power. The low value of $R^2$, however, does not seem to be consistent with other statistics of the model; the estimated coefficient on the Smallcap Index was highly significant and the F-Statistic is 18.737 which is also significant at a one percent significance level.

Similarly, a regression of the daily returns to Maple Leaf Foods Inc. on the daily returns to the Composite index was also performed. The coefficient of skewness for this model was -0.258 (See Table 4.3), hence the null of no skewness could not be rejected at the ten percent level of significance. The coefficient of kurtosis was 0.689 and the null of no kurtosis was rejected at the five percent level of significance. The Jarque-Bera test statistic of overall normality was 5.125, thus the null of normality could not be rejected at the one percent level of statistical significance. Figure 4.11 shows that the distribution of the residuals appears to be normal and it was therefore concluded there is sufficient evidence to expect the residuals to be normally distributed. Again, the upper and lower Durbin-Watson critical values are 1.73 and 1.78. The Durbin-Watson statistic was 2.2, indicating that there was no first-order autocorrelation in the model. White’s test statistic was 0.830, thus the null of homoskedasticity could not be rejected at the one percent level of significance. Evidence therefore supports that the residuals of this model were homoskedastic. Further tests for autoregressive conditional heteroskedasticity (ARCH) did not provide evidence of ARCH effects.

The regression of Maple Leaf Foods Inc. on the S&P/TSX Composite Index was similar to the Maple Leaf regression on the Smallcap Index (Table 4.4). The Composite Index has an estimated coefficient of 0.481 and was statistically significant from zero at the one percent level of significance. The coefficient was positive and ideal for the purpose of forecasting expected returns to Maple Leaf Foods Inc. The intercept for this regression was also negative but not statistically significant from zero. The coefficient of determination ($R^2$) was 0.079 and again
<table>
<thead>
<tr>
<th></th>
<th>Maple Leaf Foods Inc. on the S&amp;P/TSX Smallcap Index</th>
<th>Maple Leaf Foods Inc. on the S&amp;P/TSX Composite Index</th>
<th>Premium Brands Holdings on the S&amp;P/TSX Smallcap Index</th>
<th>Premium Brands Holdings on the S&amp;P/TSX Composite Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient of Skewness(^a)</td>
<td>-0.295</td>
<td>-0.258</td>
<td>0.503</td>
<td>0.371</td>
</tr>
<tr>
<td>Coefficient of Kurtosis(^a)</td>
<td>0.734</td>
<td>0.689</td>
<td>2.305</td>
<td>2.318</td>
</tr>
<tr>
<td>Jarque-Bera Normality Test</td>
<td>6.193</td>
<td>5.125</td>
<td>45.089</td>
<td>42.039</td>
</tr>
<tr>
<td>Durbin-Watson d-Statistic</td>
<td>1.94</td>
<td>2.2</td>
<td>1.98</td>
<td>1.94</td>
</tr>
<tr>
<td>White's Test for Heteroskedasticity</td>
<td>1.089</td>
<td>0.830</td>
<td>2.180</td>
<td>0.398</td>
</tr>
</tbody>
</table>

\(^a\) Two tailed test
### Table 4.4  Market Model Regression of Maple Leaf Foods Inc. and Premium Brands Holdings on the S&P/TSX Smallcap and Composite Indices for the Estimation Window 3 December 2007 - 14 August 2008

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P/TSX Smallcap Index</th>
<th></th>
<th>S&amp;P/TSX Composite Index</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parameter</td>
<td>t-Statistic</td>
<td>Parameter</td>
<td>t-Statistic</td>
</tr>
<tr>
<td>Maple Leaf Foods Inc.</td>
<td>0.538***</td>
<td>(4.329)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Maple Leaf Foods Inc.</td>
<td>n/a</td>
<td>n/a</td>
<td>0.481***</td>
<td>(3.938)</td>
</tr>
<tr>
<td>Premium Brands Holdings</td>
<td>0.273***</td>
<td>(2.891)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Premium Brands Holdings</td>
<td>n/a</td>
<td>n/a</td>
<td>0.182**</td>
<td>(1.953)</td>
</tr>
</tbody>
</table>

***Statistically significant at one percent one tailed test
**Statistically significant at five percent one tailed test
*Statistically significant at ten percent one tailed test
indicates very little explanatory power in the model. However, similar to the Maple Leaf regression on the Smallcap Index, the low value of \( R^2 \) did not seem to be consistent with other performance related statistics of the model; the t-statistic of the estimated coefficient on the Composite Index was significant and the F-Statistic was 15.504 was also significant at the one percent level.

Next, the daily returns to Premium Brands Holdings were regressed on the daily returns of the S&P/TSX Smallcap Index. The null of no skewness was rejected at the one percent level of significance, as was the null of no kurtosis (Table 4.3). The Jarque-Bera test statistic of

Figure 4.11  Histogram of Residuals for Regression of Maple Leaf Foods on the S&P/TSX Composite Index for the Estimation Window

overall normality was 45.089 and thus the null of normality was rejected at the one percent level of significance. Figure 4.12 shows the residuals for the regression of Premium Brands Holdings on the S&P/TSX Smallcap Index. Residuals appear to be leptokurtotic but this is a common
characteristic of residuals of regressions on asset returns and therefore, no transformations of the data will be completed. It is therefore concluded that while the residuals may not be normally distributed, the extent of non-normality does not appear to be a serious problem. The upper and lower bounds for the DW statistic are 1.73 and 1.78. The Durbin-Watson statistic was 1.98, indicating that there was no first-order autocorrelation in the model. White’s test statistic was 2.180 thus the null of homoskedasticity could not be rejected at the one percent level of significance, hence, it was concluded that the residuals are homoskedastic. Further tests for autoregressive conditional heteroskedasticity (ARCH) did not provide evidence of ARCH effects.

The regression of Premium Brands Holdings on the S&P/TSX Smallcap Index had an estimated coefficient of 0.273 on the Smallcap Index and was statistically significant from zero at a one percent level of significance (Table 4.4). The coefficient was also positive, which is ideal for the purpose of forecasting expected returns to Premium Brands Holdings. The intercept for this regression was negative but not statistically significant from zero, again, this is consistent
with theory. The coefficient of determination \( R^2 \) for Premium Brands Holdings regressed on the S&P/TSX Smallcap Index was 0.044, again indicating very little explanatory power. Nevertheless, the estimated coefficient on the Smallcap Index was significant and the F-Statistic was 8.360 which was also significant at the one percent level.

Lastly, the daily returns to Premium Brands Holdings were regressed on the daily returns of the S&P/TSX Composite Index. The coefficient of skewness for this model was 0.371 (Table 4.3), so the null of no skewness was rejected at the five percent level of significance. The coefficient of kurtosis was 2.318, and so the null of no kurtosis was also rejected at the one percent level of significance. The critical value for the standard normal two-tailed test at the one percent level of significance was 2.58. The Jarque-Bera test statistic of overall normality was 42.039 and the null of normality was rejected at a one percent level of significance. Figure 4.13 shows the residuals for the regression of Premium Brands Holdings on the S&P/TSX Composite Index. Residuals appear to be more kurtotic than the residuals of the Premium Brands regression on the Smallcap Index. Therefore, while the residuals may not be normally distributed, the extent of non-normality did not appear to be a serious problem and transformations of the data were not undertaken. The upper and lower bounds of the DW statistic are 1.73 and 1.78 at the five percent level of significance. The Durbin-Watson statistic was 1.94, indicating that there was no first-order autocorrelation in the model. White’s test statistic was 0.398 thus the null of homoskedasticity could not be rejected at the one percent level of significance. Thus, evidence supports that the residuals of this model are homoskedastic. Further tests for autoregressive conditional heteroskedasticity (ARCH) did not provide evidence of ARCH effects.

The regression of Premium Brands Holdings on the S&P/TSX Composite Index did not perform as well as the Premium Brands regression on the Smallcap Index (Table 4.4). The Composite Index has an estimated coefficient of 0.182 and was statistically significant from zero.
Figure 4.13  **Histogram of Residuals for Regression of Premium Brand Holdings on the S&P/TSX Composite Index for the Estimation Window**

at the five percent level of significance. The coefficient was positive which was ideal for the purpose of forecasting expected returns to Premium Brands Holdings. The intercept for this regression was also negative but not statistically significant from zero. The coefficient of determination ($R^2$) was 0.021 and again indicates very little explanatory power, but the F-Statistic was significant at the ten percent level.

All four regressions provide reasonable evidence to believe that expected returns to Maple Leaf Foods Inc. and Premium Brand Holdings can be forecasted using both the S&P/TSX Smallcap and Composite Indices. The estimates of expected returns will then be used to calculate abnormal returns to Maple Leaf Foods Inc. and Premium Brand Holdings for the event window.
4.3.2 Forecasting Expected Returns

Expected returns were first predicted over the estimation window to confirm that expected returns track actual returns. Using the market model (equation 3.8) expected returns to Maple Leaf Foods Inc. and Premium Brand Holdings were calculated as

\[ E(R_{i,t}) = \hat{\alpha} + \hat{\beta}_{m,t}(R_{m,t}) \]

where,
- \( E(R_{i,t}) \) are predicted expected returns to asset \( i \) in period \( t \)
- \( \hat{\alpha} \) is the intercept of the market model regression
- \( \hat{\beta}_{m,t} \) is the estimated market model coefficient for period \( t \) returns to a market index \( m \)
- \( R_{m,t} \) is the return to a market index \( m \) in period \( t \)

Figure 4.14 plots expected returns and actual returns during the estimation window (3 December 2007 – 14 August 2008) for Maple Leaf Foods Inc. regressed on the S&P/TSX Smallcap Index, while Figure 4.15 plots predicted expected returns and actual returns during the estimation window for Maple Leaf Foods Inc. regressed on the S&P/TSX Composite Index. Both the Smallcap and Composite indices produce predicted expected returns to Maple Leaf Foods Inc. that appear to be mean reverting around zero. This is consistent with the semi-strong form of the efficient market hypothesis as the expected return of a random walk variable is zero in the absence of extraordinary information\(^{22}\). Additionally, the expected return to Maple Leaf forecasted by the Smallcap and Composite indices are similar to one another. Table 4.5 shows correlations between actual ex post returns to Maple Leaf and predicted returns to Maple Leaf using the Smallcap and Composite Indices for the estimation window. The correlation coefficient between actual ex post returns and predicted returns to Maple Leaf using the Smallcap index was 0.31. Similarly, the correlation coefficient between the actual ex post returns and predicted returns to Maple Leaf using the Composite index was 0.28. It is therefore expected that abnormal return estimates using either index will have similar results.

\(^{22}\) Ordinary Least Squares also minimizes the sum of squared errors thus predicted returns should be mean reverting around zero.
Figures 4.16 and 4.17 plot predicted expected returns and actual returns during the estimation window for Premium Brand Holdings regressed on the Smallcap and Composite indices respectively. Again, predicted expected returns estimated with the Smallcap and Composite indices appeared to be mean reverting around zero. The correlation coefficients between the actual ex post returns to Premium Brands Holdings and predicted returns to Premium Brands using the Smallcap and Composite indices are presented in Table 4.5. The correlation coefficient between the actual ex post returns and predicted returns to Premium Brands using the Smallcap index was 0.21. Alternatively, the correlation coefficient of the actual ex post returns and predicted returns to Premium Brands using the Composite index was 0.14. The difference between correlation coefficients for Premium Brands generates an expectation that there may be some small differences between abnormal returns estimates of the Smallcap and Composite indices.

<table>
<thead>
<tr>
<th></th>
<th>Predicted Return to Maple Leaf Foods Inc. using the S&amp;P/TSX Smallcap Index</th>
<th>Predicted Return to Maple Leaf Foods Inc. using the S&amp;P/TSX Composite Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Ex Post Return to Maple Leaf Foods Inc.</td>
<td>0.31</td>
<td>0.28</td>
</tr>
<tr>
<td>Actual Ex Post Return to Premium Brands Holdings</td>
<td>0.21</td>
<td>0.14</td>
</tr>
</tbody>
</table>

All four models appear to be following actual returns to Maple Leaf Foods Inc. and Premium Brand Holdings to a reasonable extent (Table 4.5). The next step will be to forecast expected returns to Maple Leaf Foods Inc. and Premium Brand Holdings over the event and post-event windows.

23 Predicted expected returns to Premium Brands were also estimated using a constant mean return model. The mean return to Premium Brands over the estimation window was zero. Abnormal returns calculated by the constant mean return model were very similar to the abnormal returns calculated by the market model. For the purpose of estimating abnormal returns to Premium Brands, the market model was chosen over the constant mean return model for consistency and comparability with abnormal returns estimated for Maple Leaf Foods.
Figure 4.14 Estimation Window: Actual versus Expected Returns to Maple Leaf Foods Inc. forecasted using the S&P/TSX Smallcap Index from 3 December 2007 to 14 August 2008

--- Actual Return to Maple Leaf Foods Inc.  Expected Return to Maple Leaf Foods Inc.
Figure 4.15 Estimation Window: Actual versus Expected Returns to Maple Leaf Foods Inc. forecasted using the S&P/TSX Composite Index from 3 December 2007 to 14 August 2008
Figure 4.16 EstimationWindow; Actual versus Expected Returns to Premium Brand Holdings forecasted using the S&P/TSX Smallcap Index from 3 December 2007 to 14 August 2008
Figure 4.17 Estimation Window: Actual versus Expected Returns to Premium Brand Holdings forecasted using the S&P/TSX Composite Index from 3 December 2007 to 14 August 2008.
4.3.3 Abnormal Returns Estimations

Expected returns to Maple Leaf Foods Inc. and Premium Brand Holdings were forecasted over the event window (15 August 2008 – 29 August 2008) using the same method as previously stated. Abnormal returns were then estimated by subtracting the expected return from the actual ex-post return to Maple Leaf Foods Inc. and Premium Brand Holdings. Estimated abnormal returns were then cumulated (CAR) and standardized (SCAR); both CAR and SCAR are presented in Table 4.6.

Abnormal returns to Maple Leaf Foods Inc. are presented for both the S&P/TSX Smallcap and Composite indices. Each index predicts similar abnormal returns to Maple Leaf Foods Inc. to the other and will therefore be discussed concurrently. For the period 19 August 2008 through 26 August 2008 abnormal returns were negative and for the dates 18, 27, 28 and 29 August, abnormal returns were positive. Since the initial Listeria recall announcement occurred on 17 August 2008, it is somewhat surprising that 19 August 2008 is the first day to reflect the recall. This also seems to indicate that information about the recall may not have been leaked prior to the initial recall announcement day. The first death announcement related to the Listeria outbreak was made on 22 August 2008 and abnormal returns to Maple Leaf Foods Inc. appear to be lowest on 25 August 2008 and 26 August 2008. On 23 August Maple Leaf Foods Inc. CEO Michael McCain joins YouTube and begins to post actions plans that are being undertaken to mitigate the *Listeriosis monocytogenes* contamination in the Bartor Road plant. The first class action lawsuit announcement occurs on 26 August 2008 but returns are near zero on 27 and 28 August 2008 and positive on 29 August 2008. This seems to indicate that the lawsuit announcement had little or no effect on returns to Maple Leaf Foods or that the stream of actions and announcements started by Michael McCain on 23 August 2008 were effective. The cumulative abnormal return to Maple Leaf using the Smallcap index was -21.7 percent and cumulative abnormal returns to Maple Leaf using the Composite index was -20.8 percent.
### Table 4.6: Event Window Returns Analysis

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Abnormal Returns to Maple Leaf Foods Inc.</th>
<th>Abnormal Returns to Premium Brands Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S&amp;P/TSX Smallcap Index</td>
<td>S&amp;P/TSX Composite Index</td>
</tr>
<tr>
<td>20080815</td>
<td>+1</td>
<td>1.80</td>
<td>2.10</td>
</tr>
<tr>
<td>20080818</td>
<td>0</td>
<td>0.60</td>
<td>0.40</td>
</tr>
<tr>
<td>20080819</td>
<td>-1</td>
<td>-2.60</td>
<td>-2.50</td>
</tr>
<tr>
<td>20080820</td>
<td>-2</td>
<td>-1.80</td>
<td>-2.00</td>
</tr>
<tr>
<td>20080821</td>
<td>-3</td>
<td>-3.80</td>
<td>-3.60</td>
</tr>
<tr>
<td>20080822</td>
<td>-4</td>
<td>-4.00</td>
<td>-4.20</td>
</tr>
<tr>
<td>20080825</td>
<td>-5</td>
<td>-9.80</td>
<td>-9.60</td>
</tr>
<tr>
<td>20080826</td>
<td>-6</td>
<td>-9.40</td>
<td>-9.20</td>
</tr>
<tr>
<td>20080827</td>
<td>-7</td>
<td>3.20</td>
<td>3.00</td>
</tr>
<tr>
<td>20080828</td>
<td>-8</td>
<td>1.70</td>
<td>1.80</td>
</tr>
<tr>
<td>20080829</td>
<td>-9</td>
<td>2.40</td>
<td>2.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Cumulative AR</strong></td>
<td><strong>Standardized CAR</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-21.7</td>
<td>-10.886***</td>
</tr>
</tbody>
</table>

*** indicates 1 percent level of significance, two tailed test  
** indicates 5 percent level of significance, two tailed test  
* indicates 10 percent level of significance, two tailed test

The cumulative abnormal returns were then standardized by dividing each by their respective standard deviations giving a standardized cumulative abnormal return to Maple Leaf using the Smallcap index of -10.886 and a standardized cumulative abnormal return to Maple Leaf using the Composite index of -10.385. In both cases, the null that the Listeria recall announcement had no impact on the returns to Maple Leaf Foods Inc. over the event window was rejected at the one percent level of significance.\(^{25}\)

Abnormal returns to Premium Brands Holdings are presented for both the S&P/TSX Smallcap and Composite indices. Each index predicts similar abnormal returns to Premium Brands Holdings to the other and will therefore be discussed concurrently. Abnormal returns were negative for 18, 19, 26, 28 and 29 August 2008 and positive for the period 20 August 2008.

\(^{24}\) Since the estimation has more than 30 observations, the distribution of the SCAR will be taken to be standard normal (Campbell et al., 1997, p. 161).

\(^{25}\) A two tailed test was used because abnormal returns were expected to be either positive or negative.
through 25 August 2008 and 27 August 2008. There does not appear to be a strong link between Maple Leaf’s Listeria and Listeria related announcements and the abnormal returns to Premium Brands Holdings. Cumulative abnormal returns to Premium Brands using the Smallcap index were -3.00 percent and -2.40 percent using the Composite index. Dividing cumulative abnormal returns to Premium Brands for the Smallcap and Composite models by their respective standard deviations gave standardized cumulative abnormal returns of -1.983 and -1.555 respectively. Despite that there was no clear link between specific Listeria and Listeria related announcements to Premium Brands abnormal returns, the null hypothesis that the Listeria announcement had no effect on Premium Brands returns over the event window was rejected at the five percent level of significance using the Smallcap index. However, the null that the Listeria announcement had no effect on Premium Brands returns over the event window could not be rejected using the Composite index.

Overall, the Listeria and Listeria related announcements had a significant impact on returns to Maple Leaf Foods Inc. and to a lesser degree may have had spillover effect on returns to Premium Brands Holdings. Analyzing abnormal returns during the post-event window will indicate if the duration of abnormal returns experienced by Maple Leaf shares lasted beyond the eleven day event window. Similarly, the post-event window may provide additional information about abnormal returns experienced by Premium Brands Holdings during the event window.

4.3.4 Post-Event Returns Analysis

The post-event window for the 2008 Listeria recall was complicated by the world financial crisis which began in early October of 2008 (CBC News, 2008c). Figure 4.18 shows daily returns to the S&P/TSX Smallcap Index compared to Maple Leaf Foods Inc. for the period 4 August 2008 through 30 April 2009. Figure 4.19 shows daily returns to the S&P/TSX Composite Index compared to Maple Leaf Foods Inc. for the same period. Returns to Maple Leaf Foods seem to have been affected by the market crash in the same way that both the S&P/TSX
Smallcap and Composite indices were affected. The vertical bars in Figures 4.18 and 4.19 define
the event window from 15 August 2008 through 29 August 2008. The event window seems to be
unaffected by the 2008 financial crisis, however, the post-event window was limited to 30
September 2008 to account for world market volatility for which announcements began in early
October of 2008. Similarly, figure 4.20 shows daily returns to the Smallcap Index compared with
Premium Brands for the period 4 August 2008 through 30 April 2009. It appears that returns to
Premium Brands Holdings became volatile during the post-event window also. Figure 4.21 shows
daily returns to the Composite index compared with Premium Brands; like the figures presented
previously, Figure 4.21 seems to confirm that returns to Premium Brands experienced similarly
high levels of volatility during the world market collapse. The vertical bars in Figures 4.20 and
4.21 define the event window. Like Maple Leaf, returns to Premium Brands appear to be
unaffected by the 2008 financial crisis for the period 15 August through 29 August 2008.

Abnormal returns were then calculated for Maple Leaf Foods Inc. and Premium Brands
Holdings using both the Smallcap and Composite indices. The results are presented in Table 4.7
for the post-event window from 2 September 2008 through 30 September 2008. It seems that the
ex-post return to Maple Leaf Foods Inc. was higher than the forecasted expected return during the
post-event period. Positive abnormal returns to Maple Leaf Foods were statistically significant
from zero at the one percent level of significance.

During the post-event window, there were at least 10 Listeria related news
announcements; most were predominately concerned with Listeria related deaths. There is only
one news announcement published by CTV.ca which refers to Michael McCain’s press
conference held on 27 August 2088, where Maple Leaf’s CEO, Michael McCain, personally
communicates the activities undertaken by Maple Leaf Foods Inc. to eradicate *Listeria*
Monocytogenes bacteria from their prepackaged meat products. Further, there were many
advertisements posted on the Maple Leaf website and the YouTube website, which openly
Figure 4.18 Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Smallcap Index Compared to Maple Leaf Foods Inc. for the period 4 August 2008 through 30 April 2009

- - - - Actual Return to Maple Leaf Foods Inc.  Actual Returns to S&P/TSX Smallcap Index  Event Window
Figure 4.19 Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Composite Index Compared to Maple Leaf Foods Inc. for the period 4 August 2008 through 30 April 2009
Figure 4.20  Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Smallcap Index Compared to Premium Brands Holdings for the period 4 August 2008 through 30 April 2009
Figure 4.21  Estimation, Event and Post-event Windows; Actual Returns to The S&P/TSX Composite Index Compared to Premium Brands Holdings for the period 4 August 2008 through 30 April 2009
communicated about the outbreak and Maple Leaf’s corporate actions to upgrade their meat processing safety protocols and procedures. It seems that the ongoing public announcements started by Michael McCain using various public forums, benefitted share returns to Maple Leaf Foods Inc.

Abnormal returns to Premium Brands Holdings were negative during the post-event window and were statistically significant from zero at the one percent level. Similar to the event window, post-event abnormal returns were either positive or negative with no apparent correlation between specific announcements. However, abnormal returns were more negative in the post-event window than they were during the event window and statistically significant at the one percent level of significance rather than the five and ten percent levels of significance. Even more surprising is the fact that there were no negative press releases for Premium Brands Holdings during 2008. The time lag may result from Premium Brands investors watching what was happening with Maple Leaf Foods Inc. and then making decisions after the fact. On 27 March, 7 May and 2 August 2008, Premium Brands Holdings announced record sales and earnings (Premium Brands Holdings, 2008). On 13 August, 2008 Premium Brands announced the acquisition of B&C Food Distributors26 (Premium Brands Holdings, 2008). Further, Premium Brands Holdings did not make any announcements that it would be upgrading or making sure that current steps to control bioburden27 were adequate. There are some indications that it may have been prudent for Premium Brands to make preemptive announcements regarding process controls, at least in the eyes of investors. One example of this are Maple Lodge’s multiple announcements for their High Pressure Protection technology (Maple Lodge Farms, 2010). It is therefore possible that there may have been negative spillover effects from the 2008 Listeria announcements on the share returns of Premium Brands Holdings.

26 No negative or positive announcements were identified by a Google search for “B&C Food Distributors”.
27 Bioburden is a measure of an object’s contamination with microorganisms.
Table 4.7 Post-Event Window Returns Analysis

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Abnormal Returns to Maple Leaf Foods Inc.</th>
<th>Abnormal Returns to Premium Brands Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S&amp;P/TSX Smallcap Index</td>
<td>S&amp;P/TSX Composite Index</td>
</tr>
<tr>
<td>20080902</td>
<td>-10</td>
<td>-1.60</td>
<td>-1.70</td>
</tr>
<tr>
<td>20080903</td>
<td>-11</td>
<td>3.80</td>
<td>3.40</td>
</tr>
<tr>
<td>20080904</td>
<td>-12</td>
<td>-1.50</td>
<td>-1.40</td>
</tr>
<tr>
<td>20080905</td>
<td>-13</td>
<td>0.80</td>
<td>0.70</td>
</tr>
<tr>
<td>20080908</td>
<td>-14</td>
<td>-1.10</td>
<td>-1.20</td>
</tr>
<tr>
<td>20080909</td>
<td>-15</td>
<td>5.40</td>
<td>4.70</td>
</tr>
<tr>
<td>20080910</td>
<td>-16</td>
<td>3.10</td>
<td>2.50</td>
</tr>
<tr>
<td>20080911</td>
<td>-17</td>
<td>-2.10</td>
<td>-2.80</td>
</tr>
<tr>
<td>20080912</td>
<td>-18</td>
<td>-2.70</td>
<td>-1.90</td>
</tr>
<tr>
<td>20080915</td>
<td>-19</td>
<td>1.70</td>
<td>1.40</td>
</tr>
<tr>
<td>20080916</td>
<td>-20</td>
<td>2.20</td>
<td>1.40</td>
</tr>
<tr>
<td>20080917</td>
<td>-21</td>
<td>1.00</td>
<td>1.90</td>
</tr>
<tr>
<td>20080918</td>
<td>-22</td>
<td>0.90</td>
<td>0.60</td>
</tr>
<tr>
<td>20080919</td>
<td>-23</td>
<td>7.00</td>
<td>6.40</td>
</tr>
<tr>
<td>20080922</td>
<td>-24</td>
<td>-1.50</td>
<td>-1.00</td>
</tr>
<tr>
<td>20080923</td>
<td>-25</td>
<td>-1.30</td>
<td>-1.90</td>
</tr>
<tr>
<td>20080924</td>
<td>-26</td>
<td>-1.80</td>
<td>-1.80</td>
</tr>
<tr>
<td>20080925</td>
<td>-27</td>
<td>-0.30</td>
<td>-0.60</td>
</tr>
<tr>
<td>20080926</td>
<td>-28</td>
<td>1.30</td>
<td>1.80</td>
</tr>
<tr>
<td>20080929</td>
<td>-29</td>
<td>-0.30</td>
<td>-0.50</td>
</tr>
<tr>
<td>20080930</td>
<td>-30</td>
<td>-2.00</td>
<td>-2.60</td>
</tr>
</tbody>
</table>

| Cumulative AR | 11.2 | 7.30 | -7.80 | -10.7 |
| Standardized CAR | 5.636*** | 3.650*** | -5.150*** | -6.976*** |

*** indicates 1 percent level of significance, two-tailed test
** indicates 5 percent level of significance, two-tailed test
* indicates 10 percent level of significance, two-tailed test

4.3.5 Sensitivity of CAR to Event Window Length

There were numerous Listeria and Listeria related announcements released during the event and post-event windows. Since the length of the event window is selected by the researcher using the researcher’s judgment, it is beneficial to rationalize the length of the event window by varying its length to allay any subjectivity that may be contained within the abnormal returns analysis.
Abnormal returns were cumulated for Maple Leaf Foods and Premium Brands Holdings by systematically increasing the event window by one day. As before, the first day of the event window was defined as 15 August 2008 because media press releases indicated that there may have been knowledge of the Listeria recall before the official announcement was made by the CFIA on 17 August 2008 (The Canadian Press, 2008a). Figure 4.22 shows the cumulative abnormal returns to Maple Leaf Foods Inc. and Premium Brands Holdings using the S&P/TSX Smallcap Index for the period spanning 15 August to 30 September 2008.

The cumulative abnormal returns (CAR) to Maple Leaf Foods became negative on 19 August and reached a low of -29 percent after being cumulated until 26 August. The CAR steadily increased from day 26 August through 29 August after which the CAR became more erratic from 1 September through 30 September. The original event window chosen for this study cumulated abnormal returns for eleven days from 15 August to 29 August 2008. Given that the CAR steadily dropped from 18 August up to and including 26 August, then steadily increased from 27 August through 29 August, it appears that the original 11 day event window caught the initial impact of the Listeria and Listeria related announcements. The period over which the CAR showed volatility spanned from day 1 September through 30 September. This mimics the transitory effects of investors over and under-valuing the level of share returns after a shock, which is consistent with the findings of a study, published by Fama et al. (1969) showing that stock market returns fluctuate after information shocks. Again, the behaviour of the cumulative abnormal returns to Maple Leaf Foods from 1 September through 30 September indicated that the post-event window was also well defined.

---

28 This time period encompasses both the event and post-event windows and could not be extended beyond 33 days due to the confounding effects of financial market instability and the 2008 Listeria and Listeria related announcements.

29 An identical procedure completed for CAR’s to Maple Leaf Foods Inc. and Premium Brands Holdings using the S&P/TSX Composite Index produced similar results.
Figure 4.22  Cumulative Abnormal Returns to Maple Leaf Foods Inc. (MFI) and Premium Brands Holdings (PBH) using the S&P/TSX Smallcap Index (SCP) Over Increasing Event Window Intervals
An identical procedure was followed for calculating cumulative abnormal returns to Premium Brands Holdings (Figure 4.22). The CAR’s were mean reverting from the 15 August through 16 September after which, the CAR’s steadily fell until 29 September. This did not provide evidence that the event and post-event windows should have been changed because they are defined by announcements pertaining to Maple Leaf Foods. Additionally, redefining the event and post-event windows to suit Premium Brands is not acceptable because the time frames need to be comparable. The CARs to Premium Brands do suggest that the firm may not have been impacted by the event window announcements until about half way through the post-event window or that the 2008 world financial crisis was beginning to affect Premium Brands. However, media reports of the financial crisis were not yet predominant in Canada during the post-event window and reports of financial trouble in the United States had been in the media even into the estimation period. It seems then that the effects of information surrounding the world financial crisis may not have affected Premium Brands during the post-event window. This indicates that the spill-over effects of negative Listeria and Listeria related announcements may be delayed longer than originally indicated in the post event window analysis. Nevertheless, evidence suggests that Premium Brands may have been negatively impacted by the Listeria and Listeria related announcements.

The 2008 Listeria and Listeria related recalls negatively impacted Maple Leaf Foods Inc. and Premium Brands Holdings during the event window. However, the magnitude of the impact of the recall on Maple Leaf and Premium Brands share returns is better appreciated when framed within the context of similar recalls. The next section compares the magnitude, direction and duration of the event window abnormal returns to Maple Leaf and Premium Brands with abnormal returns to firms which were impacted by BSE related recalls in the United States and the United Kingdom.
4.3.6 The Impact of the Listeria Recall vs BSE Recalls in the US and UK

There are many studies within the broader literature which assess the impact of food safety recalls on firms using event study methods. Bovine Spongiform Encephalopathy (BSE) is one example of a food safety topic which has been studied by researchers using event study methods. In 1996, the government of the United Kingdom issued press releases linking Creutzfeldt-Jacob (CJD) disease to BSE. The effect of the 1996 announcements on publicly traded meat producers was studied by Henson and Mazzocchi (2002). Similarly, the impact of BSE announcements made in the United States in 2003 on meat producing firms was studied by Jin and Kim (2008). A comparison of the results of event window abnormal returns to Maple Leaf, Premium Brands and BSE affected firms are presented in table (4.8).

Each study had varying event window lengths and estimation methods. The Henson and Mazzocchi (2002) study had an event window which ran for eight days, the Jin and Kim (2008) study was ten days and the event window for this study was eleven days. The event announcement for each study was labeled day “0” in table (4.8). Day “+1” is one day prior to the event and negative days are days following the event announcement. This event study and the Jin and Kim (2008) study measured abnormal returns using the market model while the Henson and Mazzocchi (2002) study measured abnormal returns using the Scholes-Williams method. For the purpose of this comparison, all abnormal returns are assumed to be comparable across all three studies.

There are some interesting comparisons that can be derived from the abnormal returns data presented in table 4.8. For instance, the length of the transition period between the event announcement and negative abnormal returns very. Whitchurch, Cavanaugh and Gray and Sims Food Group had measurable negative abnormal returns on day zero of the BSE and CJD announcements in the U.K. Perkins had negative abnormal returns on day -1 and Global Group experienced negative abnormal returns on day -2. For BSE announcements made in the U.S.,
Tyson Fresh Meats and Smithfield Foods had negative abnormal returns on the announcement date whereas, Hormel Foods experienced negative abnormal returns on day -1. In comparison, Maple Leaf Foods Inc. had measurable abnormal returns on day -1 and Premium Brands on the recall date. Further, Whitchurch, Cavanaugh and Gray and Sims Food Group all had negative abnormal returns for the duration of the eight day event window. All other firms, including Maple Leaf Foods and Premium Brands Holdings had positive abnormal returns during respective event windows.

The magnitude of abnormal returns during event windows also carries some interesting insights. The three firms most affected in magnitude by the 1996 BSE and CJD announcements were Whitchurch, Cavanaugh and Gray and Sims Food Group. By day -3, abnormal returns attributable to the BSE and CJD announcement bottomed out at -31.1 percent for Whitchurch, Cavanaugh and Gray’s were -19.2 percent and Sims Food Group had abnormal returns of -22.7 percent. In contrast, Maple Leaf’s abnormal returns bottomed out on day -5 at -9.80 percent, significantly higher than abnormal returns experienced by firms most affected by the 1996 BSE and CJD announcements. In contrast, Maple Leaf’s abnormal returns were more negative than abnormal returns to Tyson Fresh Meats, the firm most affected by the 2003 BSE announcement in the U.S. Tyson Fresh Meats had measurable abnormal returns which bottomed out on day zero at -4.49 percent.

Why were firms impacted so differently across studies? It is very likely that investors were not as concerned about BSE when the announcement was made in 2003 as compared to the 1996 announcement. Jin and Kim (2008) highlighted that the USDA insisted that the single case of BSE was isolated and reassured consumers that muscle cuts were safe to consume. This seems to provide further evidence that proactive disclosure by key figures such as company managers and government agencies may alleviate rash investment
Table 4.8  Comparison of Event Window Abnormal Returns to Firms for the 2008 Listeria Recall, 1996 Creutzfeldt-Jacob disease and BSE Announcement in the UK and 2003 BSE Announcement in the US

<table>
<thead>
<tr>
<th>Company</th>
<th>Estimation Method</th>
<th>+1</th>
<th>0</th>
<th>-1</th>
<th>-2</th>
<th>-3</th>
<th>-4</th>
<th>-5</th>
<th>-6</th>
<th>-7</th>
<th>-8</th>
<th>-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maple Leaf Foods Inc.</td>
<td>Market Model</td>
<td>1.80</td>
<td>0.60</td>
<td>-2.60</td>
<td>-1.80</td>
<td>-3.80*</td>
<td>-4.00**</td>
<td>-9.80***</td>
<td>-9.40***</td>
<td>3.20</td>
<td>1.70</td>
<td>2.40</td>
</tr>
<tr>
<td>Premium Brands Holdings</td>
<td>Market Model</td>
<td>0.30</td>
<td>-1.10</td>
<td>-1.50</td>
<td>0.60</td>
<td>2.60*</td>
<td>0.30</td>
<td>0.30</td>
<td>-3.30**</td>
<td>0.90</td>
<td>-0.20</td>
<td>-1.90</td>
</tr>
<tr>
<td>Whitchurch b</td>
<td>Scholes-Williams</td>
<td>N/A</td>
<td>-11.8*</td>
<td>-21.8**</td>
<td>-22.8**</td>
<td>-31.1**</td>
<td>-25.1**</td>
<td>-24.1**</td>
<td>-24.0**</td>
<td>-21.9**</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cavaghan &amp; Gray b</td>
<td>Scholes-Williams</td>
<td>N/A</td>
<td>-6.9**</td>
<td>-7.9**</td>
<td>-14.8**</td>
<td>-19.2**</td>
<td>-17.9**</td>
<td>-18.1**</td>
<td>-16.3**</td>
<td>-16.9</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Perkins b</td>
<td>Scholes-Williams</td>
<td>N/A</td>
<td>1.6</td>
<td>-8.3</td>
<td>-6.5</td>
<td>-5.5</td>
<td>-9.1</td>
<td>-9.8</td>
<td>-9.6</td>
<td>-7.3</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Global Group b</td>
<td>Scholes-Williams</td>
<td>N/A</td>
<td>3.2</td>
<td>2.6</td>
<td>-3.2</td>
<td>-0.1</td>
<td>-2.1</td>
<td>-2.6</td>
<td>-2.7</td>
<td>-6.4</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Sims Food Group b</td>
<td>Scholes-Williams</td>
<td>N/A</td>
<td>-5.3</td>
<td>-18.1**</td>
<td>-22.3**</td>
<td>-22.7**</td>
<td>-21.8**</td>
<td>-16.9**</td>
<td>-18.3**</td>
<td>-18.9</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Hormel Foods c</td>
<td>Market Model</td>
<td>N/A</td>
<td>0.61</td>
<td>-1.17</td>
<td>-2.76**</td>
<td>1.62</td>
<td>-0.94</td>
<td>-0.38</td>
<td>0.85</td>
<td>-1.70***</td>
<td>-1.39</td>
<td>0.42</td>
</tr>
<tr>
<td>Tyson Fresh Meats c</td>
<td>Market Model</td>
<td>N/A</td>
<td>-4.49**</td>
<td>-1.66***</td>
<td>1.65***</td>
<td>0.54</td>
<td>-0.02</td>
<td>-0.27</td>
<td>-1.52</td>
<td>1.95***</td>
<td>-0.03</td>
<td>-0.69</td>
</tr>
<tr>
<td>Smithfield Foods c</td>
<td>Market Model</td>
<td>N/A</td>
<td>-0.24</td>
<td>-0.71</td>
<td>-2.71**</td>
<td>-0.49</td>
<td>-0.61</td>
<td>-0.67</td>
<td>-0.18</td>
<td>-0.08</td>
<td>-0.60</td>
<td>1.08</td>
</tr>
</tbody>
</table>

*** indicates 1 percent level of significance, two-tailed test  
** indicates 5 percent level of significance, two-tailed test  
* indicates 10 percent level of significance, two-tailed test
decisions by shareholders. This study showed that disclosure or lack of disclosure effects may not be separable from event announcements during the event window but may have lingering effects that may be measurable during the post-event window.

For example, abnormal returns to Maple Leaf Foods Inc. became cumulatively positive during the post-event window. This seems to indicate that public announcements made by Maple Leaf’s CEO Michael McCain and activities undertaken by Maple Leaf during the event window, may have been effective in restoring investor confidence. Abnormal returns to Premium Brands Holdings, however, became more negative in the post-event window. Interestingly, there are no announcements relating the Maple Leaf Listeria outbreak to slumping returns to Premium Brands Holdings; however it is possible that investors reacted negatively to Premium Brands Holdings failure to make announcements about their production safety features or protocols. Since abnormal returns to Maple Leaf Foods Inc. became positive during the post-event window, it is worthwhile to make comments about the effects of the Listeria announcement on the mean daily price of Maple Leaf shares for the estimation, event and post-event windows.

4.4 Abnormal Returns and Price

The relationship between abnormal returns and price are such that when abnormal returns are negative and statistically significant for a given period, the price of the share has fallen for that same period by an amount that is larger than normal. Similarly, if abnormal returns are positive and statically significant, then the price of the share has increased by an amount larger than normal. Finally, when abnormal returns are zero, the price of the share has neither increased nor decreased to an extent that could be considered abnormal for the asset over a given period of time. These observations have important implications for the shareholders of a company as a change in the value of a company’s capital assets will have a direct impact on its stakeholders.
With respect to the price or value of Maple Leaf’s capital assets, it is interesting to show how Listeria related announcements impacted the value or price of Maple Leaf shares as this will have directly impacted the capital value of shares that investors held over the event and post-event windows. For example, an investor who held 10,000 shares in Maple Leaf Foods Inc. on 15 August 2008 would have had a net worth of CDN $109,700 on closing that day (assuming no other assets or debts). Had the investor traded shares on 26 August 2008, the investor would have had only CDN $79,900 on closing (assuming no other assets or debts and zero transaction costs). This represents depreciation in value to Maple Leaf shareholders of almost CDN $30,000 on 10,000 shares in 11 days. Additionally, since abnormal returns to Maple Leaf Foods Inc. were negative over the event window at the one percent level of significance, then it is valid to say that the price depreciation of Maple Leaf Shares was also significant for the event window.

The value of Maple Leaf shares did experience some positive abnormal returns over the post-event window indicating that prices were rising. However, Figure 4.22 shows that the post-event window mean closing price of Maple Leaf shares did not return to the same mean closing price level which prevailed during the estimation window. It can therefore be concluded that while Maple Leaf’s abnormal share returns were positive during the post event window, the daily mean share price did not return to the pre-event daily mean share price level. This means that the impact of an event such as the 2008 Listeria recall caused at least a short-run revaluation of Maple Leaf’s share prices evidenced by the fact that statistically significant abnormal returns were present during both the event and post-event windows. Additionally, the presence of positive abnormal returns to Maple Leaf shares does not indicate that the value or price of Maple Leaf share’s recovered to their pre-event values, indicating at least a short-term impact on the value of Maple Leaf’s capital share.
Figure 4.23: Estimation, Event and Post-event Windows; Daily Closing Maple Leaf Foods Inc. Share Price for the period 3 December 2007 through 30 September 2008.
4.5 Conclusions

Event study methods were used to test the semi-strong form of the efficient market hypothesis using the 2008 Listeria recall as a case study. The single factor market model proved to be a reliable method for determining how share returns to Maple Leaf Foods and Premium Brands Holdings change in comparison to the S&P/TSX Smallcap and S&P/TSX Composite Indices. Four separate regressions were estimated and the market model produced similar results on all accounts. Using the intercept and estimated coefficients for each regression, predictions of expected returns to Maple Leaf Foods Inc. and Premium Brands Holdings were made for the event and post-event windows with the assumption that the 2008 Listeria recall did not happen. The expected returns were then subtracted from the actual ex-post return for each share, giving an estimation of abnormal returns for Maple Leaf and Premium Brands Holdings.

Abnormal returns estimates for Maple Leaf Foods Inc. during the event window were negative and statistically significant. However, abnormal returns to Maple Leaf Foods Inc. were positive during the post-event window, indicating that reactions by Maple Leafs management may have been effective in restoring investor confidence. Alternatively, abnormal returns to Premium Brands Holdings were negative and statistically significant during the event window and more negative and statistically significant during the post-event window. This indicates that there may have been spill-over effects into the meat processing industry in general and that manager’s of Premium Brands Holdings should have made some sort of announcement with respect to their meat processing safety protocols and procedures.
Chapter 5
Conclusions

5.1 Introduction

This study measures the economic impact of negative food-safety related recalls on the share returns for Maple Leaf Foods Inc. (MFI) and Premium Brands Holdings (PBH) using event study methods. Publications relating to the 2008 Listeria recall were identified using various electronic forums such as Google, the Toronto Stock Exchange, the Consumer Securities Commission and DataStream. The dates at which announcements were published were used to assist in specifying the estimation, event and post-event windows for the event study. Daily closing trading prices for Maple Leaf Foods Inc. and Premium Brands Holdings were collected from DataStream for the time period 30 November 2007 through 30 September 2008. These dates cross correlate with the 2008 *Listeria monocytogenes* announcements which were publicized through various electronic media forums which were identified by using the Google search engine. The S&P/TSX Smallcap (SCP) and S&P/TSX Composite Indices (SCI) were then selected to represent expected or normal market returns for both Maple Leaf Foods Inc. and Premium Brands Holdings based on the criteria that both of these indices are representative of: the market size for MFI and PBH, neither index is made up of assets that have suffered a negative event and neither index contains either MFI or PBH within its base of assets. The daily closing trading prices for the S&P/TSX Smallcap and the S&P/TSX Composite indices were collected for the time period 30 November 2007 through 30 September 2009.

The daily closing prices for MFI, PBH, SCP and the SCI were converted to daily returns on capital\(^30\). These returns were then used to identify the market risk-free rate of return \((\hat{\alpha})\) and the coefficient of expected returns \((\hat{\beta})\) to market returns for both Maple Leaf Foods Inc. and

---

\(^{30}\) Returns on capital are measured by changes in asset prices between periods divided by the most recent period’s price while total returns or returns to wealth are measured by the change in asset prices between periods plus dividend payments, all divided by the most recent period’s price.
Premium Brands Holdings using an ordinary least squares (OLS) regression. Results of the four OLS regressions for MFI and PBH were consistent between both the SCP and SCI indices in that the risk-free rate of return and the coefficient of expected returns to market returns were statistically significant. All four regressions had low explanatory ability but significant F-statistics, indicating that there was economic explanatory power in the estimated models. The risk-free rate of return and coefficient of expected returns were then used to predict expected returns to MFI and PBH for the event and post-event windows. Abnormal returns to MFI and PBH were then calculated by subtracting the actual ex-post return from the predicted expected returns. The key distinction between actual ex-post returns and predicted returns during the event and post-event window was that the actual ex-post returns to MFI and PBH are conditioned on the 2008 Listeria recall while the predicted expected returns are conditioned on normal market information (i.e. the 2008 Listeria announcement has been isolated from the capital market returns to MFI and PBH).

Abnormal returns to MFI and PBH calculated during the event window were negative and statistically significant. This finding supports the efficient market hypothesis in that the null hypothesis\(^{31}\) was rejected at the one percent level of significance. Daily abnormal returns to MFI began on the second trading day following the initial recall announcement\(^{32}\) and remain negative up to and including the second trading day following the public relations announcements issued by Maple Leaf on 23 August 2008. Further, there was evidence that there may have been spillover effects into the meat processing industry as abnormal returns to PBH were also negative and statistically significant at the one percent level during the event window. While cumulative abnormal returns for the event window were negative, daily negative abnormal returns occurring during the same period appear to be random do not correlate with any specific announcements issued.

\(^{31}\) The 2008 Listeria recall announcement had no effect on the share returns to MFI.

\(^{32}\) Issued on 17 August 2008
The abnormal returns estimated during the post-event window for Maple Leaf Foods Inc. and Premium Brands Holdings present a good opportunity to discuss best management practices. Cumulative abnormal returns to Maple Leaf Foods during the post-event window were positive and statistically significant at one percent. This result may indicate that Maple Leaf’s public relations initiatives effectively restored investor confidence to some extent. Further, it appears that actions taken by Maple Leaf Foods on 23 August 2008 to restore consumer confidence were not only reflected in Maple Leaf’s returns after two trading days during the event window but also held a cumulative positive effect for 21 trading days following the event window. This finding shows positive support for the actions taken by Maple Leaf Foods Inc. indicating that other firms suffering this type of process failure may benefit by taking similar actions. It should, however, be noted that the mean daily closing price of Maple Leaf shares during the post-event window did not regain their estimation window mean closing price, remaining approximately $2.00 CDN per share less. Even so, cumulative abnormal returns to PBH shares during the post-event window were more negative than the cumulative abnormal returns measured for PBH during the event window and were statistically significant at one percent. This is the most intriguing finding of this study because there are no negative announcements for PBH before or after the event window, in fact, there are a number of positive announcements for Premium Brands Holdings during the month of August 2008. Additionally, PBH made no announcements about the viability of their processes, procedures or equipment with respect to ensuring the safety of their meat products. It may have been important for PBH to take these actions as at least one other meat processing firm took steps to publicly announce upgrades to their production processes aimed at reducing bioburden. The fact that other firms took preemptive actions seems to further support suspicions that there were spill-over effects for other ready-to-eat meat processing firms due to the Listeria recall. As such there is evidence that it may be beneficial for meat processing firms to preemptively correct potentially inadequate processes, procedures and equipment which control bioburden and to publicly announce the details of these changes.
5.2 Limitations

While this study presents compelling evidence that announcements made by Maple Leaf Foods was somewhat successful in restoring investor confidence in their assets, the world financial crisis beginning in October 2008 limits analysis of the post-event window. The study shows that while the expected returns to Maple Leaf's capital assets recover, their mean closing trading prices do not return to the level they were during the estimation window. It is possible that Maple Leaf’s share price may have fully recovered over a longer time horizon. This fact, however, cannot be determined because the effects of the Listeria recall cannot be separated from the effects of the financial crisis.

This study also shows support for spill-over effects on other publicly held meat processing firms; however, other than Maple Leaf Foods Inc. there is only one other RTE meat processing firm that is publicly traded. Currently, there are about 575 federally registered meat processing establishments in Canada. So while there is indication that Premium Brands Holdings was affected by the recall, the same may not be true for smaller privately owned firms who have local clients and are well known. Private firms with close personal relations with customers may not have suffered significantly reduced sales but this study was not able to measure the impact of the 2008 Listeria recall due to data limitations for these companies.

5.3 Recommendations for Further Research

This study establishes that the 2008 Listeria announcement caused negative abnormal returns to Maple Leaf Foods Inc. assets and that while abnormal returns became positive during the post-event window, the mean closing share price during the post-event period did not return to the same level they were at during the estimation window. It therefore seems that there is positive evidence that those pre-event shareholders of Maple Leaf shares did suffer some financial loss in capital due to the announcement. It would therefore be interesting to estimate the economic cost to those shareholders using various methods of estimation.
This study was only able to take a limited look at the spill-over effects of the 2008 Listeria announcement and was able to establish that there may have been spill-over effects onto other meat processing firms. It would therefore be advisable to attempt to measure the impact of the recall on smaller private firms using consumption data. This task may, however, be limited by the availability of data.

The financial crisis which began in October 2008 was perhaps the greatest limiting factor to this study. Nevertheless, it presents very interesting opportunities to study the effects of major world events on food processing firms and how those firms fare with respect to other industries.

5.4 Conclusions

The results of this study show positive support that event study methods are well equipped to measure the direct and spillover effects of food safety recalls on meat processing firms. The abnormal returns attributable to Maple Leaf Foods Inc. during the event window were further supportive of the semi-strong form of the efficient market hypothesis; showing that abnormal returns occur within a period that reflects the timing of press releases, the transaction costs and information costs to investors of obtaining recall information. The study further shows that returns to food processing firms are consistent with random walk theory and as such support the weak form of the efficient market hypothesis. Although, this study does not measure the actual economic cost of the 2008 Listeria recall on food processing firms, the event study gives strong support that such a study would be well warranted.

This study has contributed to the broader literature by identifying a conceptual framework which identifies the relevant supply and demand factors for publicly traded assets; an area of deficiency which was identified through the critical review of event study literature. The work confirms that food safety recalls negatively impact the subject firm and may feasibly affect other firms within the broader industry.
References


http://www.cbc.ca/canada/story/2008/12/03/listeria-outcome.html

__. 2008b. "Class Action Lawsuit Launched over Listeria Outbreak,"

http://www.cbc.ca/money/story/2008/10/16/f-globaleconcrisis.html


Hanson, T. C. P. 2008. Cbcnews. In Death of BC Man Linked to listeria Outbreak.


____. 2008b. "Maple Leaf Expands Product Recall from Toronto Plant as a Precautionary Measure,"


Maple Lodge Farms. 2010. "High Pressure Protection from Maple Lodge Farms,"
http://www.pressureprotection.ca/


http://www.thestar.com/printArticle/485846
