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Cover Page Footnote

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1. Introduction

On October 26th, the International Agency for Research on Cancer (IARC), an arm of the World Health Organization, released a press release stating the agency had enough evidence to link the consumption of red meat and processed meat with increased risk of cancer. The study made headlines, featuring prominently in news outlets across the United States. The release was not the result of any single study, but the aggregate evidence collected from more than 800 different studies on meat and cancer links.

The purpose of this paper is to examine the effect that this announcement had on the meat industry in the United States. This industry is highly concentrated in a few major corporations which control the majority of the meat production. The results of the IARC study, and the attention it received should have been bad news for these companies. The hypothesis was that these companies would experience a strong negative shock to their valuations, due to the news that a large piece of their business had been recognized as hazardous to consumers. In addition, it was hypothesized that health food companies that focused on plant based foods would see an increase in their valuations, as these products are substitutes for meats.

Consumers are constantly being barraged with advice on what foods to avoid and what foods are healthy. In supermarkets, almost every product comes with a bright label exclaiming the health benefits of the product inside. The government puts out advice, with figures such as the food pyramid, advising what foods to eat and what foods to avoid. Culture and heritage also inform decisions about diet, as many recipes date back many generations and are passed down as family traditions. There are claims everywhere as to what foods are healthy and what are unhealthy, yet there is no consensus about the healthiest diet to follow, and the constant confusion and changing guidelines may be too much for most people to follow. With the overwhelming amount of information and suggestions, it is very hard for any new dietary advice to be heard above the noise, and even harder for new dietary advice to be taken seriously. This study examines whether an announcement by one of the largest health organizations on the planet would be able to break through to consumers and have a measurable effect on meat companies.

The stock market valuations of these companies were used to evaluate how strongly they were affected by the IARC announcement in the days following its release. Using stock market data to provide accurate company evaluations is a technique reliant on the efficient markets hypothesis, which states that the stock market valuation of a company will reflect the value of all future earnings of the company, based on all of the information currently available on the company. When new information is made available that will affect a company's future earnings, this information will be taken into account and change the stock price. To control for

movements in the market and other news not related to the IARC announcement that could have affected stock prices, a two stage model was used, which looked at how each company moved with market in the past few months, and given this relationship, how they should have moved in days around the announcement. Thus, the two-stage model creates a control group of how the companies would have performed without the announcement, and compares it to the treatment group, which is how the company performed in actuality with the announcement.

The debate over the American diet, and what, if any, dietary suggestions the government should give is one with important economic, cultural, political and environmental consequences. With a few companies controlling the majority of such a large market, there are billions of dollars at stake. Government subsidies for meat production play a role in keeping meat cheap and available to all, and with such a strong financial backing the meat lobby is a powerful and well funded force in Washington D.C. Concerns about the costs of healthcare and the threat of global warming are also major problems facing the world today, and the meat industry plays an important role in both of these fields. The hazardous effects of the meat industry on the environment have been well documented, including methane gas from cows contributing to global warming and deforestation for grazing lands for cattle. Meat consumption has also been linked to other health problems such as heart disease, one of the leading causes of death in United States. Diet could play an important role in tackling these issues in the future. Thus it is important to know how people will respond to dietary advice and research, in order to optimize future policies and recommendations.

Many processed meats, such as bacon, ham and hot dogs, have long been associated with unhealthy eating, and yet remain staples of American culture. The important question that this study seeks to shed light on is if this new announcement by an internationally recognized organization will have any effect on consumers. If announcements such as this one by IARC do not affect consumers, it may be necessary to look to new ways to spread important information, or find other ways apart from diet to affect consumer's health and the environment.

2. Literature Review

While not much other literature has been released on the IARC announcement due to how recently it was released, there exists a great deal of relevant literature which looks at analyzing the effects of other important events on company and industry performance. Some of the most relevant research in this area is on the Toxic Release Inventory (TRI), which was the first mandatory reporting of an array of toxic chemical releases for chemical companies in the United States. The companies were first required to release this information on June 19, 1989, and a great deal of literature has focused on both the immediate effects of the

announcement as well as longer term consequences. Similar to the IARC announcement, the TRI release was a negative public announcement that had no immediate repercussions for the company, however could affect the future earnings.

One of the first studies on the effects of the TRI announcement was a paper by James T. Hamilton, "Pollution as News: Media and Stock Market Reactions to the Toxic Release Inventory Data," (Hamilton, 1995). In this paper, Hamilton uses the event study methodology to examine the stock market consequences for companies who reported TRI releases in the days immediately following the release, and how media coverage of specific firms affected the magnitude of their stock market losses. Hamilton's use of the event study methodology builds on a wide base of previous literature (Fama, 1969, Fama, 1970, Dodd, 1983, Brown, 1985). The event study methodology in this paper has a similar theoretical framework to the one used by Hamilton.

One of the most important assumptions of the event study methodology is the efficient markets hypothesis, which states that the value assigned to a company by the stock market will be "the best available unbiased estimates of the value of a company's assets," (Fama, 1970, Konar, 1997). This value is based on all publicly available information about a company. When new information becomes publicly available pertinent to the performance of a company, the company stock price will change to reflect this news, which in the case of the Hamilton paper was the release of previously unreported pollution data, and in this paper is the release of the IARC announcement.

Hamilton finds a statistically significant negative change in the stock performances of companies on the day of the release and in the five days following the release for companies that released TRI information, after controlling for movements of the market. The paper also finds no statistically significant changes in the stock performances on the day prior to the announcement, which supports that there are few other confounding variables in the model.

A few years later in 1997, Shameek Konar and Mark A. Cohen released a study that followed up on the work of Hamilton, looking at how firms changed behaviors in response to the mandatory release of the TRI data, and how stock market returns influenced these changes. They found that firms with the largest negative stock market returns following the announcement were the companies that made the largest changes in TRI releases later on. This study shows that stock market reactions are important to companies, and can help predict how a company might respond to new information. The empirical approach in this paper draws heavily from the the empirical approach of Konar and Cohen.

There have also been studies examining how food related announcements affect consumer decisions. Many of these studies have focused on food safety recalls, and not on the health consequences of eating particular foods over time.

However, this previous research has shown “that food safety information is relatively ineffective in changing consumers' behavior,” (Downs, 2009, Cao 2015). It was hypothesized that this may be due to lack of self control, limited capacity to process information, or people overestimating health risks when they do not know the true risk, and thus being more willing to take the risks when they know the true value (Downs, 2009). While this research was done on caloric intake, these same factors could be at play in the IARC announcement, and could diminish the effect of the announcement on stock prices.

While it is currently too early to determine if the IARC announcement has affected how meat companies operate, the initial stock market reactions are likely to be important indicators for the future. This study uses a similar event study methodology to Hamilton to examine how the announcement affected the stock performance of the meat companies. Like the TRI announcement, this paper assumes that the IARC announcement will come as news to consumers, and therefore could not have been previously incorporated into the stock market value of the meat companies. This paper builds off of the works of these authors, and applies proven techniques to study one of the most recent information based approaches to influencing public behavior.

3. Data

The ideal data to test the hypotheses would be to have all the financial information for all of the largest companies in the United States food industry. There are a few large players in the meat industry that control, according to some sources, up to 85% of the meat industry in the US (Bernice, 2014) Unfortunately, some of these massive companies, like Cargill, are private and thus their financial information is not available to the public, and they are not traded on a stock exchange. Therefore, the data on these companies are missing. In addition, stock data looks at the valuations of entire companies. Ideally, we could look at the individual sectors within the companies, such as the beef and processed meat sectors, however stock market data do not capture these subtleties. The stock of the entire company however should capture disruptions in these sectors of companies, as it is likely that if one sector of a company were to suffer the company as a whole would also suffer.

The closing stock market price for the top meat producers in the US, the top fast food companies and the top health food companies, along with the Russell 3000 Index provided the raw data for this experiment. This data was found online using Yahoo finance. The companies that were used for meat producers were Hormel, Tyson, Seaboard, JBS and Pilgrim's Pride. The fast food companies used in the study were McDonalds, Yum Brands, which owns Taco Bell, KFC, Pizza Hut, and

WingStreet, and Wendy's. The healthy food companies that were examined were Hain Celestial and White Wave Foods.

To track the general motion of the market, the Russell 3000 Index was used. The Russell 3000 Index, as described on the Russell website, "measures the performance of the largest 3,000 U.S. companies representing approximately 98% of the investable U.S. equity market." A market benchmark is needed in the calculation of abnormal returns, so the Russell 3000 was identified as the most representative benchmark.

Daily returns were calculated as the percent change in the closing stock price over each day. Percent Change was calculated using the formula below,

$$\text{Percent Change in Stock Price} = \frac{P(t) - P(t-1)}{P(t-1)}$$

Where $P(t)$ is stock price at closing on day t and $P(t-1)$ is stock price at closing on the previous day. Percent change was used as the metric for daily returns as it is an easy metric to interpret. The returns over periods of time were calculated by summing the daily returns over the given time period. The summary statistics for daily returns over the periods examined in the study are shown below in Table 1.

Table 1: Percent Change in Stock Prices Near Announcement

	Russell 3000	Health Food Companies	Meat Producers	Fast Food Companies
260 - 10 days prior (control)	-1.4455	7.6188	7.4148	-2.0227
5 days before	1.7122	-4.9820	3.1929	1.5835
Day of announcement	-0.2086	-1.7303	-1.5434	1.0712
5 days after	1.7053	0.5864	-1.4419	1.5875

4. Model / Results

To test whether or not the announcement had a significant effect on the valuation of each company, it was first necessary to separate the movement in stock prices caused by the announcement from the movement in stock prices caused by movements in the market. An event study was used to do this. The event study uses stock prices and market data from before the announcement to predict how the company would have performed if the announcement had never been made, and compares this to the observed data around the time of the announcement. Using the empirical framework from Dodd and Warner, Hamilton, Konar and Cohen, among others, the following model was fit to the data for a given company i at time t :

$$R_{it} = a_i + b_i R_{mt}, t \in (-10, -260)$$

where R_{it} is the daily return for a given company, a_i is a constant term, b_i is a parameter which reflects how the company reacts to market fluctuations, and R_{mt} is the daily return of the market, which in this case is the Russell 3000 Index. Data from 260 days prior to the event up to 10 days before the event were used to fit the returns of each company with the returns of the market, and a and b for each company were calculated. The following model was then used to calculate the abnormal returns for each company for 10 days surrounding the event:

$$R_{it} = \hat{a}_i + \hat{b}_i R_{mt} + AR_{it}$$

where AR_{it} is the abnormal returns for company i at time t . These abnormal returns around the time of the announcement formed the basis of the study. This method and the equation notation draw heavily from Konar and Cohen. See Table 2 for a summary of the abnormal returns for each group of companies.

Table 2: Abnormal Returns around release of IARC report

	Health Food Companies	Meat Producers	Fast Food
Five day span before	-7.5589***	0.9798	0.2673
October 26th	-1.5963***	-1.1684*	0.7640
Five day span after	-2.1679**	-2.7810**	0.1370

Abnormal returns reported in percent change in closing stock price

* 10% level of statistical significance

** 5% level of statistical significance

*** 1% level of statistical significance

The results shown in Table 2 show that meat producers saw a mild negative impact from the announcement, fast food companies were not affected, and no conclusion can be drawn about the effect of announcement on the health food companies. This supports the hypothesis that meat producers would see a drop in their valuations, but does not support the same hypothesis for fast food companies. The hypothesis that health food companies would see an increase in valuations was inconclusive.

The five-day span before the announcement is included in the table to check that the model for abnormal returns is accurate. Before the announcement is made, if there is no leaking of the announcement, there should be no abnormal returns due to the announcement. Thus, if there are abnormal returns, the model is not doing a good enough job of capturing the fluctuations in the market, or there are other events taking place in the market that are affecting stock prices. Both of these

scenarios are problematic. Therefore there should be no statistically significant abnormal returns in the five days before the announcement. As seen in Table 2, this is the case for the meat producers and the fast food companies, but not the case for the health food companies.

This result for the health food companies shows that the abnormal returns are likely being affected by forces other than the IARC announcement, and therefore the abnormal returns do not reflect the reactions to the IARC announcement. The returns for the health food companies are negative and statistically significant, throughout the five days before, the day of, and the five days after the study. This is likely due to the very small sample size of only two companies, as there are very few public health food companies that focus on plant-based products.

Figure 1: Abnormal Returns around release of IARC report

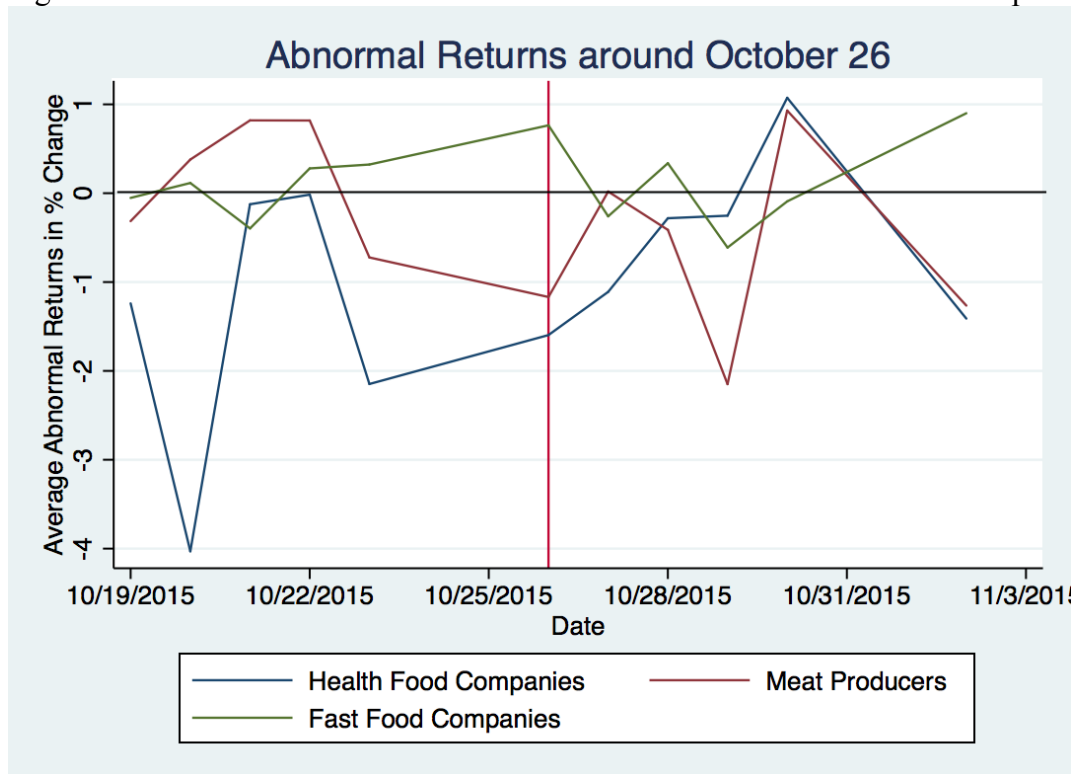


Figure 1 shows the average abnormal returns for the health food companies, meat producers and fast food companies. The red vertical line shows October 26 2015, the date of the announcement

The negative and statistically significant abnormal returns for meat producers and the positive and statistically insignificant abnormal returns for fast food companies suggest that only the meat producers were affected by the

announcement. In order for the announcement to have a significant effect on a company's stock price, the announcement must provide new information that is going to affect the future profitability of the company. If the information is not new, then it should have already been incorporated into the company valuation, as stated under the efficient markets hypothesis.

The strong valuations of the fast food companies in the face of the announcement could have been due to a variety of factors, including preconceptions about fast food, confusion as to what constitutes processed meat, or a lack of bad press related to fast food. Many people already associated the consumption of fast food as a health hazard, so this announcement that processed meat was unhealthy may not have been seen as news. Fast food restaurants serve a wide variety of products, not all of which contain meat, and thus investors may have assumed that these restaurants would be able to pivot if consumer preferences changed. The lack of bad press for fast food companies may also have been a factor. None of the major press releases in newspapers around the United States highlighted fast food products as processed meat in their announcements. Most of the articles focused their discussions of processed meat on deli-style sandwich meats, such as salami and pepperoni. The Boston Globe listed the following as examples of processed meats: "Hot dogs, ham, sausage, corned beef, beef jerky, canned meat, and meat-based sauces and preparations," (Rocheleau, 2015). However, in the IARC announcement, it is clearly stated that the report implicates any meat that "has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation," (WHO, 2015) Many chicken items at popular fast food restaurants such as McDonalds and KFC, contain ingredients such as sodium phosphate to transform the meat. Yet they remained outside of the headlines in the days following the announcement. The lack of articles linking the IARC announcement to the fast food companies may have played a role in the indifference of the stock prices to the announcement, and could have also reflected a more general lack of understanding as to what types of meat are considered processed meat.

The significant abnormal returns for the meat producers are the most supportive of the original hypothesis that the announcement had a negative effect on the valuation of meat producers. The statistically significant negative abnormal return for the five days after the announcement is exactly what was hypothesized, as well as the statistically significant negative abnormal return on the day of the announcement. However, these negative returns are fairly mild in the face of the announcement, only statistically significant at the five percent level, and only about a 2.7% negative return. In addition, as seen in Figure 1, the while there was a negative return over the five days, there was one day of positive abnormal returns. In the time since the announcement, many of the companies have since recovered, and are again trading higher than they were before the announcement. Similarly to

the fast food companies, this could be due to consumer and investor sentiments that it was already well known that processed meat was unhealthy. It could also be due to the belief that people will continue to consume red meat and processed meats despite the risks, as they are an important part of many diets and cultures.

Taken together, the results from the study show a fairly weak relationship between abnormal returns and the IARC announcement. This suggests that the IARC announcement likely did not have a major impact on the market valuations of large companies in the meat industry, or in related industries. This suggests that investors did not find the report to be of much importance to the meat industries, and are betting that people will not change their diets and consumption of meat. The indifference of investors may also help to reduce the attention paid to the announcement, and thus help reduce the effect of the announcement on consumers.

The IARC announcement is not the first report to condemn red meat and processed meat as a health risk, as the announcement was based on over 800 previously published studies. However, the prestige of the organization and the press it received are what made this announcement an especially important one. The mild reaction to it suggests that the public is perhaps desensitized to dietary advice from any organization, or that meat consumption is too deeply embedded in culture to be affected by revelations about the health risks. In order to successfully change the way people eat, a larger campaign may be needed to change the attitudes towards meat in America. Given the nature of the announcement as a one-time press release, the news quickly faded from the headlines, and has not been widely publicized since early November. The U.S. Department of Agriculture, which releases food and nutrition advice to the American public, reviews their dietary suggestions every five years, with the next report scheduled to be released in 2015. The agency did not respond strongly to the announcement, but if this research is reflected in the newest dietary guidelines for 2015, which have not yet been released, it could have a greater effect than the IARC announcement.

5. Conclusions

This study has found that the announcement from the IARC caused mild negative stock returns for United States meat producers, while fast food companies, which sell processed meat and red meat directly to consumers, saw no statistically significant effects from the announcement.

These results point to the ineffectiveness of one information based approach to affecting the American diet. The results could have a greater affect if they are incorporated by the United States government, but the announcement from the WHO, one of the largest health organizations in the world, did not shake investor confidence in the companies that rely on consumption of a product denounced as

carcinogenic. The deep-seated cultural ties and consumer preferences surrounding meat consumption may necessitate a greater cultural shift if a significant reduction in meat consumption is to be reached.

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