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The Need for Weed:

Role of Investor Attention in The North American Cannabis Industry

By

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A Thesis Submitted to

Department of Economics

Skidmore College

In Partial Fulfillment of the Requirement for the B.A. Degree

Thesis Advisor: Qi Ge

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Abstract

My paper analyzes the role that investor attention plays in the North American cannabis industry by conducting an OLS regression with time fixed effects. I use the North American Marijuana Index, comprised of 44 US- and Canada-based companies operating in the industry, as well as individual company stock performance for my dependent variables as a measure of industry performance. Over a period of 221 weeks, starting in January, 2015, I utilize Google Trends data on search frequency of marijuana-related terms as a proxy for information demand and investor attention towards the marijuana industry. I find that certain search terms are significantly related to index and stock performance, correlating with increases and decreases in prices, indicating the heightened role that investor attention plays in this recently legalized and fast growing industry. Politicians, businesses, consumers, and investors alike are all gradually bound by a common trait: the need for weed.

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1. Introduction

On October 17, 2018, Canada became the second country worldwide to legalize the recreational use of marijuana after Uruguay did in 2013 (Cox, 2018). Its only neighboring country, the United States of America, views marijuana as an illegal substance on a federal level; however, several states have adopted legislation permitting the use of marijuana. While marijuana has been grown and consumed for thousands of years, it has consistently been viewed as an illicit product, thus making it a good exchanged on the black market. The increased willingness of legislators in North America to permit marijuana to enter the legal market opens an avenue for data on production and consumption to become public and analyzed. In general, Americans' opinions towards marijuana will continue to liberalize as cannabis becomes legal in more places (Felson et al., 2019). With the potential of capturing market share and augmented revenue streams, companies involved in the marijuana business have already emerged as industry leaders and will likely continue to strategically interact with each other in the near future. Marijuana proved itself as a profitable cash crop in legalized US states, in which it remains a multibillion-dollar industry sanctioned by the respective state for a new wave of entrepreneurs (Harvard Law Review, 2018). Pursuing additional capital, a logical step for companies is to go public and spread the risk of ownership amongst their shareholders (Ding and Hou, 2015).

The top three cannabis firms in North America began the fiscal year of 2019 with a combined market capitalization of over $20 billion.[1] With a rising amount of strategic

[1] Retrieved from: https://www.fool.com/investing/2019/04/03/why-aurora-cannabis-outperformed-canopy-growth-and.aspx, Access date: April 4, 2019.

partnerships between marijuana-related companies and big conglomerates like Constellation Brands, Altria, or Anheuser-Busch, a trend becomes evident in which much of the cannabis industry will be relayed to public stock exchanges in North America. In an industry as vertically integrated as this one, an increasing amount of mergers, acquisitions, and partnerships will occur (Chakrabarti et al., 2017). The rise in the use of the Internet has contributed to the way that retail investors can gain access to financial information regarding these market movements and subsequently invest their money into tradable securities (Moussa et al., 2017). Although institutional investors have privatized platforms and research capabilities, retail investors search online for investment advice on companies to entrust their money with.

This study aims to combine the newly legalized marijuana industry and investor attention. To measure industry performance, I utilize an index that tracks major companies traded on leading exchanges in Canada and the US that concentrate the majority of their operations on cannabis. The choice of a stock market index as a measurement tool instead of the conventional statistics on a firm and industry level is due to data limitations on cannabis-related stocks, but existing literature has previously used general indexes like the S&P 500 or the CAC40 index, its French equivalent (Ding and Hou, 2015; Moussa et al., 2017). In addition to the index, two individual stocks - traded on a Canadian and American stock exchange, respectively - are examined and their performance is related to investor attention. Investor attention is captured by Google Trends, which provides search frequencies in specific regions over a given period of time for any terms that are searched on Google's platform. The study uses fixed effects regressions that include cannabis-related search terms to explore the possibility of correlation between an increase in investor attention and stock market performance of companies involved in the marijuana business.

Four main regressions are conducted. Two regressions employ the index performance as the dependent variables - here, independent variables are firstly comprised of generic keywords associated with marijuana in Canada and the US, and secondly comprised of search terms directly related to the politicization of marijuana legalization in selected states. The third regression uses selected key terms from Google Trends in the US to help explain the stock performance of GW Pharmaceuticals, a biopharmaceutical company involved with natural cannabis. Lastly, the final regression similarly uses Canadian Google search frequency to analyze the stock of the world's largest cannabis company, namely Canopy Growth Corporation. I then add lagged search terms to the regressions described above and run four additional regressions to assess the effect of delayed search intensity. Lastly, I conduct an additional placebo test to manifest the robustness of my model.

Findings show that investor attention is significantly correlated with stock market performance. It remains crucial to acknowledge that this project embodies an exploratory nature. A priori, the coefficients of variables in the model could have been either positive or negative. Concrete results indicate that different language regarding cannabis might be used across the countries. Simultaneously, prior research is confirmed that Google search intensity for specific companies positively correlate with that company's stock performance, further highlighting the importance of investor attention (Moussa et al., 2017; Ding and Wou, 2015; Ranjan and Bhattachharyya, 2018; Joseph et al., 2011). My results indicate that heightened search frequency specifically for either the marijuana index or the two companies is significantly correlated with increased stock prices. Search terms involving "cannabis" and "weed" differ in positive and negative impact, depending on the country. While "marijuana legalization" on a state-level has no significant impact on the index, more precise Google searches including politicians associated

with legalization portray significant results. When search frequencies are lagged by one week, the coefficients lose most of their significance and become weaker. Finally, the placebo regression containing impartial US states towards marijuana solidify the robustness and strength of my model.

This research fills a gap within existing literature. Using Google Trends as a proxy for consumer attention has been extensively perpetuated by academics (Carriere-Swallow and Labbe, 2013; Curtis et al., 2015; Bijl et al., 2016), yet seldom is Google search data applied to a specific industry. Here, this specific industry is the North American market space for firms involved in medicinal and recreational marijuana. The current data limitations only allow for future estimations of market growth, because cannabis has just recently transitioned from a good exchanged on the black market to a good produced and sold legally (in partiality). I attempt to fill this gap with my study and also dive into the political nature that legalization carries by investigating consumer attention towards significant politicians that play a role in legalization efforts. Prime motivators include the fact that one rarely has the opportunity to conduct an analysis on a market that has had consumer demand in the past, but never a demand that was immediately measurable due to its illicit nature. Similarly, several US states are currently considering or have already implemented bills to legalize sports betting. Formerly an underground economy, it is projected that legal sports betting enhances the growth of professional sports attracting broader audiences and enriching the fan experience (Burkhart and Welsh, 2014). Gamblers across the spectrum will likely use Google as a search engine to their advantage, further highlighting the potential insight that Google Trends data can shine on growing industries that have transitioned from the underground economy into legality.

The paper's remaining structure is as follows: Section 2 reviews literature pertaining to my topic, focusing on legalization efforts in Canada and the US, as well as Google Trends data. Section 3 outlines and describes the data collected for this study. Section 4 discusses the empirical analysis and its results. Section 5 issues concluding remarks, depicts the limitations of the study, and offers suggestions for future research.

2. Literature Review

Relevant literature to my specific topic of study is rather limited. Notwithstanding, literature exists that researches index performance, similar to the North American Marijuana Index, as well as Google Trends data, and investor attention and sentiment. To assist the reader through her understanding of my research topic, the first section of my literature review focuses on the institutional features of cannabis in the US and Canada. The second section analyzes the strand of literature with an emphasis on stock market performance. The literature review concludes with a section regarding the Internet's effect on cannabis-related companies and investor attention.

2.1 Institutional Background

There are three main words that often get used interchangeably, namely cannabis, marijuana, and hemp. Cannabis is a family of plants that produces two different strains - *sativa* and *indica.* Marijuana can be produced from both strains, but mostly from cannabis *sativa*, and is one of the oldest occurring psychoactive substances (Downer et al., 2018). According to Anderson (2017), marijuana's usage dates back to 1611 in the United States, albeit consumption was medicinal instead of recreational. While medical marijuana attempts to alleviate certain health concerns outlined below, backed up by scientific research and studies, recreational

marijuana is generally considered an everyday leisure activity. The companies I will be investigating focus on either consumption, and sometimes offer products and services for both medicinal and recreational purposes.

There are over 100 different cannabinoids, which are active chemical ingredients produced by a marijuana plant, but only two are seriously focused on when discussing medical and recreational marijuana: delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD). Whereas THC causes the psychoactive effects - the high - associated from cannabis, CBD lacks those effects and rather makes the high caused by THC more manageable, reducing the likelihood of paranoia or anxiety caused by THC (Downer et al., 2018). For the purpose of this study, the two psychoactive effects will not further be differentiated, but instead a focus remains on marijuana as a whole. Hemp, on the other hand, is historically important to the United States in particular, especially during the two World Wars, as it was and still is used for everyday product like fabrics, twine, paper, fiber, and oil (Coit, 2018). Simultaneously, it remains a low-cost source of marijuana as it stems from the cannabis plant family and is thus often grouped with marijuana.

There is an ongoing debate between medical experts on the health benefits of marijuana - my study is not predominantly concentrated on the health effects of marijuana's legalization, but the industrial organization component of cannabis-related firms.[2] Notwithstanding, the health debate should be briefly investigated as it plays into the consumer sentiment that my data attempts to capture. Main arguments of anti-legalization efforts include that the harm to marijuana consumers will rise, e.g. dependence, vehicular accidents, respiratory issues, or mental health problems and that the youth will be increasingly exposed to marijuana (Subritzky et al.,

[2] In the past decades, industrial organization has evolved towards the analysis of individual industries in which empirical analysis is framed in terms of economic theory (Einav and Levin, 2010).

2016). Vitiello and Deck (2018) describe how the consumption of marijuana during adolescence can have adverse effects on brain development. Furthermore, regular consumption of marijuana can lead to mental illnesses, like schizophrenia, or lung cancer (Vitiello and Deck, 2018). Here, it is important to note that it is not the cannabinoids themselves that cause negative effects on the lungs and respiratory system, but the combustion of cannabis when smoking it. Subritzky et al. (2016) outline how vaporization is a process in which marijuana is heated instead of burned in order to transmit cannabinoids and is more commonly referred to as "vaping". Another way of circumventing the actual smoking of marijuana is through edibles - these are cannabis-infused products, such as baked goods or candies (Subritzky et al., 2016).

Overall, Subritzky et al. (2016) find there to be a tension between industry profit and public health concerns. The political debate about the legalization of recreational marijuana is characterized by the opposition of public health arguments competing with arguments emphasizing economic and criminal justice benefits of legalization (McGinty et al., 2017). Since the youth and high frequency users seem vulnerable to legal marijuana, public health initiatives attempt to decrease their consumption. Gettman and Kennedy (2014) argue that teenagers should rather have access to marijuana in a legal climate to avoid confrontation with more dangerous illegal drugs such as opiates or methamphetamines. Cannabis companies driven by an imperative to grow and strike a profit will want to take a similar approach to Big Tobacco in the 20th century and capture exactly those consumers in the market. The public health perspective put forward by Barry and Glantz (2018) depicts how corporate domination of the market can be detrimental because the private sector will attempt to counter public health policies that could diminish sales and profits.

Notwithstanding, the health benefits of cannabis often outweigh the negative effects, ultimately driving Canada and several states in the US towards legalization. Vitiello and Deck (2018) contend that marijuana is effective in treating chronic pain, curbing opioid abuse, or as an alternative to chemotherapy when treating cancer. There also remain other positive economic externalities of cannabis' legalization, like employment opportunities, investment, and tax revenues (Downer et al., 2018). Vice versa, local and state law enforcement's punitive approach to marijuana has caused low-income and minority communities to suffer economic consequences (Harvard Law Review, 2018). Data has portrayed how a criminal record, specifically for minorities, leads to negative employment and wage effects (Harvard Law Review, 2018). These are trends on a macro-level that are unambiguously detrimental to economic prosperity. Additionally, the legalization of recreational marijuana carries potential spillover effects into other industries. Cheng et al. (2018) derive how the legalization of retail marijuana has led to a 6 percent increase in housing value appreciation in Colorado, mainly because the state's cannabis-related laws restrict housing supply, while also causing stronger housing demand. However, their paper fails to include other time-varying factors like employment or crime rates that could equally affect the value of houses.

The next section of my literature review focuses on the legalization process in firstly the United States, and then Canada.

2.2 Legalization Procedure in the US

To date, ten American states have fully legalized recreational marijuana and medicinal marijuana usage is allowed in 33 states (Cox, 2018). The first governmental intervention into the cannabis arena occurred following the Great Depression. Due to shifting societal attitudes

towards drugs in general, driven by opium abuse, Congress passed the Marijuana Tax Act in 1937, effectively prohibiting individual possession and sale of cannabis by implementing exponentially high taxation on marijuana (Coit, 2018). This tax-based approach remained questionable until the Supreme Court deemed it legal (Anderson, 2017). Marijuana's legal status stayed ambiguous until a major ruling in 1970, namely the Controlled Substances Act of 1970. In accordance with this Act of US Congress, marijuana was considered a Schedule I drug, implying that it is in the group with the most dangerous drugs classified by the Drug Enforcement Agency (DEA) (Coit, 2018). To understand the historical and political perspective of this Act and its effects on current legalization efforts, Vitiello and Deck (2018) provide valuable insight.

Vitiello and Deck (2018) use the Italian government's consideration of marijuana legalization as motivation to assess the American experience with marijuana. They give a general overview of how certain US states have come to adopt marijuana legislation as they delve into America's complicated interplay between state and federal laws on this sensitive subject. Vitiello and Deck (2018) observe a general trend that support for legalization of marijuana will increase. In their research on attitude change towards legalization, Felson et al. (2016) echo this notion that Americans' opinion towards marijuana will continue to liberalize as cannabis becomes legal in more places. However, Vitiello and Deck (2018) also point out how majoritarian preferences amongst a population will not always lead to legislative change, as demonstrated by the National Rifle Association's ability to lobby against stricter gun laws. Marijuana legalization faced major hurdles in the 20th century that have transpired into today. The Act of 1970 conditions that any minor possession of marijuana results in a violation of federal law (Vitiello and Deck, 2018). Aggressive anti-drug campaigns of Presidents like Ronald Reagan have not only deterred business investors from entering the industry throughout the past, but also created a certain

stigma around the subject. In 1996, California passed Proposition 215, the first medical marijuana law in the United States in an effort to essentially legalize it (Vitiello and Deck, 2018).

Vitiello and Deck (2018) argue that the success of state legislature has a lot to do with its alignment with Department of Justice stances on regulation of cannabis. President Obama's administration consistently demonstrated high tolerance of marijuana businesses, giving states room to experiment with recreational use of marijuana as well as encouraging industry investment. Unfortunately, the North American Marijuana Index only covers the last two years of Obama's Presidency; however, his initiatives have transpired into the current Trump administration. Vitiello and Deck (2018) accentuate the difficulty that while mainstream media publish abundant stories about potential cannabis industry growth, accurate market data is difficult to come by. Subritzky et al. (2016) argue that given the several years it will need for data to accumulate, current literature concentrates more on regulations and implementations rather than consumption outcomes of policy change.

Currently, more than half of Americans live in states where a form of marijuana is legal, albeit that these states are mostly Democratic (Vitiello and Deck, 2018). The benefits for the states due to tax revenues have been significant motivators for more elected officials to vote for marijuana deregulation. Vitiello and Deck (2018) assess that America's 20 plus years of experience with marijuana can help inform policy debates regarding cannabis regulation. Subritzky et al. (2016) highlight this notion in their study on Colorado's implementation of legalized recreational marijuana. The currently most structured laws regarding state marijuana laws are found in Proposition 64, adopted by Colorado and Washington (Vitiello and Deck, 2018). Broadly speaking, its goals are the elimination of the black market for marijuana and a structured regulation of business. Colorado legalized the commercial recreational cannabis

market in 2012 and has since then given out hundreds of recreational cannabis licenses to retail stores, cultivators, and product manufacturers (Subritzky et al., 2016). In 2014, Colorado itself reaped $70 million in tax revenue and licensing fees (Subritzky et al., 2016). Barry and Glantz (2018) put forward the idea that local action at the state and community levels will continue to determine the legislative and regulatory agendas until the federal government declassifies marijuana as a Schedule I drug and can involve itself effectively.

The mere passing of state legislature favoring cannabis legalization demonstrates the increasingly liberal public opinion towards the drug, but Felson et al. (2019) attempt to determine why opinion has shifted through national survey data. They use responses from the General Social Survey, the National Survey on Drug Use and Health, as well as a New York Times content analysis, yet they do not incorporate the largest, free source of data: Google. Felson et al. (2019) find that attitudes towards marijuana changed at the same rate across different regions in the country, implying that there is no evidence that legalized states have different perspectives than non-legalized states. Survey data like Felson et al. (2019) or McGinty et al. (2017) use to make inferences about public perception can definitely help with the differentiation of demographics by region towards consumer sentiment, but it fails to incorporate the investor attention that I am interested in. Also, self-reported survey data on such a relatively sensitive subject will not be comprehensively accurate and potentially skewed.

The most recent legislative hurdle was the December 2018 Farm Bill passed by Congress. This bill accentuates the importance of hemp in the cannabis debate. Since the aforementioned Controlled Substances Act of 1970, the DEA had jurisdiction over the cannabis plant; however, their guidelines had no clear distinction between marijuana and industrial hemp (Coit, 2018). The Farm Bill effectively took hemp off the list of illegal substances enforced by the DEA so

that hemp is no longer classified as cannabis (Coit, 2018). Coit (2018) depicts how American companies will not need to rely on imports of hemp from other countries, but will be able to cultivate their own farms, using it for CBD products or industrial products. This bill will remain of interest when hemp- and cannabis-related companies like Canopy Growth (CGC) are studied, who have invested in hemp farms to cultivate their produce. According to Coit (2018), companies involved in hemp will now be able to be traded on American stock exchanges given that hemp's federal nature has altered. Since the North American Marijuana Index also focuses on Canada-based companies, this literature review discusses legalization procedures in the country located on the United States' northern border next.

2.3 Legalization Procedure in Canada

Following Uruguay, Canada has become the second state in the world to federally legalize the recreational consumption of marijuana (Cox, 2018). This makes it the only country in the G20 to have implemented legalization on a federal level. While Canada officially added marijuana to its *Opium and Drugs Act* in 1923 to harshly go against drug offenders, the attitude towards drug usage in Canada has changed considerably throughout the past century (Downer et al., 2018). Downer et al. (2018) examine the selected state legalization in the United States in order to draw conclusions on what practices could be adopted into the Canadian context. The paper was written in the months leading up to Canada's recreational legalization in October 2018. Their assessment echoes that of Cox (2018), who claims that Canadian legislation within the past years has shifted from one of prohibitory nature to having more of a regulatory focus. Between the United States and Canada, a certain notion crystallizes in which governments see more benefits in a decriminalized and open market for cannabis that they can control, rather than

a strictly prohibited market that opens paths for illegal sales. Cox (2018) outlines how Canada's motivation to drive its policy change includes harm minimization, restriction of youth access, social education, and public health and safety. These notions stem from the country's initial legalization efforts almost twenty years ago. In 2001, Canada's Supreme Court declared the therapeutic use of marijuana (essentially medicinal marijuana) to be legal (Downer et al., 2018).

In October 2018, Canada's Parliament fully legalized recreational marijuana. Downer et al. (2018) assert that this measure is comparable to measures taken against other controlled substances - alcohol, tobacco, or fireworks - and paves the path for the government to regulate the sale, taxation, distribution, and use of the drug. In this regard, Cox (2018) depicts three main market models for the cannabis market in Canada: a public, private, or hybrid model. If states adopt a public model, the state government would have a monopoly; a private model would be a commercially free market system driven primarily by profit; and a hybrid model would combine the government and private industry (Cox, 2018). The implications of different market systems are vast, because most marijuana users remain resistant to a corporate oligopoly takeover of marijuana production and sales (Gettman and Kennedy, 2014). Barry and Glantz (2018) posit that a government monopoly over production and sales could reduce demand due to the prohibition of marketing and promotional activity and high taxation. An openly competitive market could reduce participation in the illicit market and provide a counterweight to oligopolistic commercial excess (Gettman and Kennedy, 2014). Meanwhile, lower prices in the hybrid model set forth by Cox (2018) can reallocate consumer savings and lead to a diversion of money being spent on marijuana to other forms of economic activity (Gettman and Kennedy, 2014).

In the early months since October 2018, Canada has taken the latter, hybrid approach. A major limitation of my study is this exact time constraint, namely that in the Spring Semester of 2019, sufficient literature and data to arrive at assertive conclusions does not exist. Interestingly, experts correctly predicted that there would be a shortage of recreational marijuana supply in the months after Canada's legalization finalized (Cox, 2018). This trend will, unfortunately, not be visible in available consumption data until after the completion of this thesis. Nonetheless, financial data of cannabis-related companies has existed for several years - therefore, the next section of the literature review focuses on stock market and index performance and their implications on market structure.

2.4 Why Use The Stock Market?

Due to a lack of producer and consumer data in a recently legalized market, financial market performance comes into play as a measure of market dynamics from an industrial organization and finance perspective. Lindenberg and Ross (1981) develop a comparison between companies' accounting data and financial data to examine the extent, distribution, and history of monopoly rents in the industrial sector. By analyzing the difference between the market value of a firm and a firm's replacement cost of capital based on its accounting data, they are able to arrive at useful conclusions of market power.

Lindenberg and Ross (1981) base their analysis on Tobin's variable q — the ratio of market value to replacement cost — and look at its cross-sectional value to measure monopoly power in particular. The Canadian and US governments are naturally striving to regulate the cannabis market in a competitive fashion, yet it remains inevitable that over time, marijuana-related companies will attempt to exercise oligopoly power. In his antitrust merger analysis,

Denis (1992) explains that if the gains from coordination with other firms exceed the gains from deviating from the market consensus, firms will rather coordinate with each other. Once the cannabis industry in North America will have reached its maturity stage, it is safe to assume that the market structures will shift. Chakrabarti et al. (2017) demonstrate how in a two-country model of oligopoly, competition on a local level matters for cross-border mergers and acquisitions in an industry that is vertically integrated. It is implied that Canadian and American companies will wrestle for market share on a local level, yet tend to look for strategic partnerships internationally.

The benefit of conducting my study at the current time is that the cannabis industry finds itself in its embryonic stage. The *q* ratio that Lindenberg and Ross (1981) calculate gives insight into the importance of barriers to entry: if there are low barriers to entry, firms will all purchase the same capital stock, which will be represented in their balance sheet. Their ratio of market value to replacement cost of assets would be close to 1. An oligopolist or monopolist on the other hand, with market power and less regulation, will earn rents that drive the firm's market value to exceed the replacement of its capital stock, and *q* will rise (Lindenberg and Ross, 1981). Incumbents in the cannabis industry will benefit from their economies of scale and attempt to raise barriers to entry in order to consolidate market power. These major companies will further be analyzed below - they are classified by trading volume within the index. While balance sheet data for the firms are widely available, investor attention trends in relation to market value are of more interest than Lindenberg and Ross' (1981) business-focused approach. They recognize that a firm's net revenue stream is what security markets tend to value most, because firms are ideally attempting to maximize their value subject to the constraints they face. Lindenberg and Ross (1981) adequately describe how the market value of a firm constitutes itself - essentially the

valuation of fixed factors of a firm, like technological, economic, and regulatory factors as well as intangible factors.

Their results of Tobin's *q* shed light onto the importance of capital investment of a firm and the corresponding market performance. With many cannabis companies expanding, buying production plants, and also investing in other firms, Lindenberg and Ross (1981) help explain this correlation. Naturally, if a dominant company in the market releases a press statement in which it outlines major capital investment, its stock price will fluctuate accordingly. Lindenberg and Ross (1981) predominantly use common stock of a firm and assume that year-end common stock market values represent true market values that unequivocally reflect the information used to value said firms by equity holders. Therefore, common stock will be utilized; however, the yearly data remains a clear limitation of their study, because it is not on a granular level. Instead, I will use a weekly time series extracted from the North American Marijuana Index. Likewise, individual companies, Canopy Growth and GW Pharmaceuticals, will be analyzed based on their high trading volume.

2.5 Implications of Stock Market Performance

When thinking about how to conduct this examination of individual stock performance, the available literature offers some guidance. Although Downer et al. (2018) focus primarily on accounting, taxation and auditing issues of marijuana as a legalized commodity, their paper investigates the already publicly traded firms in Canada that engage in the medical marijuana business. They go into detail about the accounting difficulties that cannabis-related firms face. Due to the “biological asset” rule, companies can pre-book income for crops that are still growing. This practice might be misleading because it carries the risk that the booked income

might not materialize - as a result of a bad crop, a drop in sales, or a decrease in market price (Downer et al., 2018). If this information is not properly passed on to retail investors who own equity in the publicly owned firms, these accounting problems might negatively affect the stock market, the investor, and the marijuana market itself. Downer et al. (2018) mention how Canopy Growth, Aurora Cannabis, and Aphria neglected to disclose their respective impact of biological assets and subsequently had to deal with negative reaction from investors. These three companies lead the group of companies that comprise the Marijuana Index.

A caveat to my study however remains not having a true definition of the value of a company and its product: the value could be based on sales price, the strength of the product, or the distribution and promotion method (Downer et al., 2018). The companies' valuation on the stock market will have to suffice to support the claims I will be making in regards to index and individual performance. Here, Downer et al. (2018) pose the question of how reliable and relevant the financial information of a cannabis-involved firm will be to investors who rely on financial statements if a consensus is not reached on the valuation of the cannabis. For example, in 2015, approximately $23 billion were lost by investors who fell for cannabis penny stock traps (Subritzky et al., 2016).

An example of approaching this concern is Anderson's (2017) paper on the American conglomerate DuPont between the two World Wars. His work ties back to the importance of hemp in the cannabis discussion. DuPont developed techniques to use synthetic fibers in the production of its products that had previously required hemp in the 1930s - Anderson (2017) investigates the popular theory that DuPont conspired with the government to implement a ban on marijuana, and also hemp, to eliminate its competition and reap the benefits. In this instance, the value of hemp predictably rose to unprecedented levels, but whether that value was mirrored

in DuPont's stock price remained up for debate. Given that Anderson (2017) delineates how stock prices are used for forensic economics, he uses stock data prior to the 1937 Supreme Court ruling and afterwards of DuPont. An approach like this to investigate significant occurrences on a specific date can be applicable to my study. To control for DuPont's stock volatility surrounding the marijuana ban, Anderson (2017) includes other conglomerates of comparable size and industry into his panel dataset. Interestingly, DuPont's stock performance in a time series dataset confirms the rent seeking theory, namely that its stock price improved directly after the criminalization of marijuana and hemp (Anderson, 2017). The inclusion of the other conglomerates in a panel dataset however demonstrates no relation to the ruling, questioning the robustness of his model. It becomes evident that individual stock prices of cannabis-related companies should be compared with other, similar companies. This is why I will look at two publicly traded companies in the marijuana industry.

Anderson (2017) offers unique policy insights for the controlled substances industry in terms of rent seeking. While alcoholic companies often lobby against marijuana legalization due to the threat of product substitution, profit prison companies, police unions, and pharmaceutical companies lobby because legalization would harm them economically (Anderson, 2017). It can only be assumed how much lobbying was involved in, for instance, the 2018 Farm Bill in the United States. For the purpose of this study, I will take the market's valuation of companies at face value however, disregarding any lobbying efforts. While this approach is a clear caveat to my study, it is supported by the efficient market hypothesis. Malkiel (2003) effectively describes how all stock market prices fully reflect all known information in the market. Subsequently, it can be argued that these aforementioned lobbying efforts are incorporated in the stock price of the companies in my analysis, justifying that there remains no hidden information in the cannabis

industry. Nonetheless, political power plays will be covered by the press and attract consumer sentiment and investor attention. Following the efficient market hypothesis, an increase in public information will spread quickly in the news and be incorporated into security prices without delay (Malkiel, 2003). The next section of my literature review will focus on how I can capture said consumer sentiment and investor attention and why it remains important to my study on the cannabis industry.

2.6 Google Trends Data

In an effort to gauge consumer sentiment and retail investor attention towards the cannabis industry in North America, Google Trends data will be used to complement the stock performances of cannabis-related companies. This is not a novel approach, as several academics have conducted similar research in the past validating that Google Trends data is a valid proxy (Bijl et al., 2016; Joseph et al., 2011; Vlastakis and Markellos, 2012). Given that information is hard to quantify as it is not directly observable, researchers have previously used Google Trends as a proxy for information flow. Google remains an adequate choice for my study because of the continued prevalence of the Internet and its accessibility online. Typing the name of a company into Google and looking at the data for its search popularity can serve as a proxy for the demand of idiosyncratic (distinctive) information and consumer search behavior (Vlastakis and Markellos, 2012; Joseph et al.,2011). Google records data for all terms that are searched once the terms reach a certain level and this historical data is available for download (Bijl et al., 2016). Before diving into the more financial applications of Google data, a general overview of previous academic applications of Google Trends data is provided.

The most applicable study in terms of topic was conducted by Curtis et al. (2015) who use Google Trends to track the search volume of "herbal incense" and correlate it with Internet websites providing synthetic cannabinoids. Curtis et al. (2015) conclude that Google provides a technique to identify emerging drug markets. Their study highlights the real-time data of Google and shows its feasibility to follow public health trends and develop policies to complement them. Curtis et al. (2015) however only focus on increased search volume and retail websites selling synthetic CBD. Their initial motivation, to track increased substance use, serves as a basis for me to expand on Google Trends literature related to cannabis by connecting it to financial performance and markets.

The attractiveness of Google data lies within the following: it is derived directly from micro user data; the proportion of Internet users is larger than that of surveying agencies; and data are released at regular intervals with high frequency (Carriere-Swallow and Labbe, 2013). Carriere-Swallow and Labbe (2013) use the Chilean automobile market to assert that Google search habits can inform stakeholders about consumer behavior in an emerging market. They introduce the concept of "nowcasting" for emerging markets to make more informed real-time decisions. A study that equally looks at a specific industry is by Ranjan and Bhattachharyya (2018), who use Google Trends to quantify investor attention for a particular stock within the top 20 performing global energy companies. They use market capitalization on the NYSE to help select those stocks, implicating that my selection of individual stock based on their market capitalization remains valid. The authors conclude that investor attention is of paramount importance in determining market movements and is correlated to market performance at high and low frequencies (Ranjan and Bhattachharyya, 2018).

Hence the question arises how to search for cannabis-related companies on Google Trends. Vlastakis and Markellos (2012) use the company name and stock ticker as their search queries for the companies. By using the company name, one encapsulates the information demand for everything regarding the company and its industry rather than just information related to the stock (Vlastakis and Markellos, 2012). Individuals who search for a company stock using Google bypass information asymmetry issues because Google will provide relevant information to the stock (Ding and Hou, 2015). On the other hand, Joseph et al. (2011) focus solely on company ticker abbreviations because people will only search the ticker if they are seriously considering an investment decision. These people are primarily average retail investors, because institutional investors will have in-house information sources that are more sophisticated than Google. For the purpose of my study, only search volume of company names and buzzwords associated with the cannabis industry are relevant.

For Joseph et al. (2011), ticker searches can be utilized as a valid proxy for investor sentiment, which essentially is a set of beliefs by the retail investor about investment risks that are not immediately based on available facts. Investor attention can subsequently be used to forecast stock returns and volumes, as their research affirms that online search intensity reliably predicts stock returns. A shortcoming of their work is that they "put" high search intensity stocks and "short" low search intensity stocks in their forecasting model, which leads to an unbalanced portfolio within the pursuant empirical analysis. The fact that they only use ticker abbreviations also limits the possible scope of their data. Overall, search data serve as a database of intentions and contain information that might predict future outcomes (Joseph et al., 2011). The consensus amongst financial experts is that market activity, such as trading volume or volatility of return, is correlated with the availability of new information (Vlastakis and Markellos, 2012). Meanwhile,

Vlastakis and Markellos (2012) contend that demand for information has a positive effect on market activity. Joseph et al. (2011) conceptualize how online search volume can forecast abnormal stock return and trading volume. Moussa et al. (2017) adopt a similar research frame and investigate the impact of online information, drawn from the Google Trends database, on the stock market return and volatility of the 25 largest stocks in the CAC40 index, the French equivalent of the S&P 500. Equally, they conclude that the demand for public information has an impact on stock returns as well as an impact on volatility (Moussa et al., 2017). By only focusing on high-performing stocks though, their results are less likely to be generalizable to all publicly listed companies.

For the purpose of my study, interest in higher or lower returns remains peripheral, but focus on correlation and noticeable trends over time will rather be emphasized. This is because according to Bijl et al. (2016), Google search volumes can predict stock returns, but their relationship changes over time. Increased search volume might lead to short-term higher returns for a company on the stock market, but tends to associate with negative long-run returns (Joseph et al., 2011). Regarding overall trends in the market economy, Vlastakis and Markellos (2012) derive that the relationship between information demand - as proxied by Google search volume - and market activity heightens during market states of high return. Looking at the performance of cannabis-related companies over the past years, the market was overwhelmingly bullish, offering implications for individual stock performance and potential applicability to my results.

Next, previous literature provides guidance on what kind of a dataset to use. Vlastakis and Markellos (2012) comprise a dataset consisting of the 30 largest stocks on the NYSE, NASDAQ, and S&P 500, as they investigate the effects of information demand on an individual stock as well as overall market level. Just as they do, I use weekly closing stock prices (Friday's

closing values) from the index and from the individual companies. Meanwhile, Joseph et al. (2011) analyze all stocks in the S&P 500, as they sort the 500 firms into quintiles at the beginning of every week based on the search volume of ticker labels from the previous week. In terms of Google Trends data, they use Google's normalized search data, in which entries greater than 1 indicate a search volume that is above average and entries lower than 1 represent search volume below average. Ding and Hou (2015) likewise use S&P 500 stocks in their research that demonstrates how retail investor attention improves stock liquidity for companies included in the index and enlarges the shareholder base. Interestingly, they find that if a firm's investor base increases, the cost of capital will be reduced and the market value of the firm will increase (Ding and Hou, 2015). However, this approach excludes middle- and small-sized companies without the economies of scale that large S&P 500 firms enjoy.

Vlastakis and Markellos (2012) offer a complex regression function to study the relationship between realized volatility and the demand of information that also controls for the effect of market returns. I base my regression function on theirs. Likewise, Bijl et al. (2016) utilize a panel data regression with fixed effects to arrive at their conclusions - I will instead use a time series because I want to follow the index and stocks over time and not cross-sectional. All their results are robust implicating that I will need to test for robustness as well.

Stephens-Davidowitz (2014) uses the Barack Obama candidacy for President of the United States as an occasion to analyze racial prejudice in contemporary America. In 2008 and 2012, the years where Obama initially ran for President and for re-election respectively, Stephens-Davidowitz (2014) looks at Google Trends data that includes racially charged language and compares it as a proxy to Obama's vote shares in specific geographic areas. He comes to the conclusion that the search rate for racially charged language on Google is a significant and

negative predictor of the vote shares that Obama garnered in 2008 and 2012, using Kerry's 2004 election results when he was the Democratic candidate for President and lost against George W. Bush to control for his results. It manifests itself that Google gives better data and opens new research questions on already studied socially sensitive topics. Stephens-Davidowitz (2014) justifies his use of Google data because it serves as a proxy for socially sensitive attitude in America, where nearly 70 percent of the population had access to the Internet in 2007. A shortcoming of the racial amicus study is that voter share could have altered due to factors that are not racially charged.

Stephens-Davidowitz' geographic and demographic conclusions are widely interesting and insightful; thus, search results in US states where recreational marijuana is fully legalized, like Colorado, versus states that have a complete ban will be incorporated into my study. His politically motivated research approach gave rise to my idea of incorporating politicians associated with marijuana legalization into my regression analysis. Stephens-Davidowitz (2014) also focuses on race, which is a factor hardly attributable to the study of marijuana. He looks at the vote percentages by Obama and other Democratic candidates that they receive from African American voters compared to white voters. Generally speaking, I have chosen to focus only on geographical regions in North America for the Google Trends data as it aligns with Bijl et al.'s (2016) assumption that investors will be located in those areas who have the highest interest in the North American companies in my dataset.

In terms of methodology, Stephens-Davidowitz (2014) finds that the effects of using Google Trends data are larger than effects that can be found using survey-based methodologies. This is because individual-level surveys rely exclusively on voters who self-report for whom they voted where misreporting might be an issue (Stephens-Davidowitz, 2014). Google data is an

unambiguous measure of racial animus on the other hand. Since marijuana is also a socially sensitive topic in some areas, survey data might be skewed; however, Google data can show the full extent to which certain demographics are at least interested in the cannabis market. What cannot be controlled for is whether the searches will be by people invested in or partakers in the cannabis industry – searches could be made by individuals who are against cannabis legalization but might just be interested. Here, Vlastakis and Markellos (2012) ascertain that Google has disrupted the production, distribution, and consumption of information due to its low cost and availability. Particularly investors increasingly rely on search engines to make their decisions. It can be assumed that small-scale investors without the financial means to hire an advisory service will use Google to educate themselves whether they want to invest on investment platforms like Robinhood Markets Inc. that cater to all socioeconomic classes. Not only will the search volume of cannabis-related companies be explored, but also buzzwords associated with the consumption of marijuana. Downer et al. (2018) offer alternate, more commonly known "street" terms for marijuana, namely pot, weed, grass, or dope.

While literature exists on the utilization of Google Trends to capture general consumer sentiment and investor attention, this technique has not been used to assess the development of the cannabis industry. Several scholars track the returns of companies traded on a general index in relation to Google Trends, or use the search engine data to make conclusions about political trends. Besides the oil industry, no papers remain that take a specific industry under investigation. Meanwhile, researchers have analyzed the potential externalities of cannabis legalization. In Canada, Troudeau's administration concluded that the benefits of legalization outweigh the negatives, as have several US states as well. My study bridges the gap between relevant prior research on investor attention within Google Trends data and the emerging

cannabis market in North America. Not only is the North American Marijuana Index examined, but also individual stock companies in Canada and the US to further fill gaps within the existing literature. Next, I will focus on the process of acquiring data, the summary of my data, and methodology of the study.

3. Data & Methodology

3.1 North American Marijuana Index

Stock data for the North American Marijuana Index was extracted from its website.[3] The company that runs the website offers three types of indices: the North American Index; the United States Index; and the Canadian Index. While the US and the Canadian indices are essentially sub-indices that focus on stock market performance of cannabis-related companies whose business operations are based primarily in either of the two countries, respectively, the North American Index tracks leading securities in the legal cannabis industry in both countries. In order to be eligible for the index - which is managed by the company MIJC, Inc. - a company must have more than half of its operations concentrated on the legal marijuana industry. Hence, each firm tracked by the index is related to any form or application of the cannabis plant, including hemp and other forms of cannabinoids - both CBD and THC. Their business activities regarding cannabis can take the form of direct revenue streams, partnerships with other companies, or assets related to the cannabis industry. Companies might be involved in the immediate handling of producing, processing, or retailing marijuana, or serve as a subservient that aids with product packaging, information technology, or business services.[4]

[3] Retrieved from: https://www.marijuanaindex.com, Access date: March 20, 2019.
[4] The most notable companies in the North American Marijuana Index with a market capitalization over $1 billion are: Canopy Growth Corporation (Can); Aurora Cannabis (Can); GW Pharmaceuticals (US); Tilray (Can); Curaleaf Holdings (US); Cronos Group (Can); Aphria (Can); Trulieve Cannabis (US); HEXO (Can); Green Thumb Industries (US); OrganiGram Holdings (Can); The Green Organic Dutchman

These companies simultaneously need to meet certain trading requirements. They must either display over $10 million in revenue over the prior year or achieve a minimum market capitalization of $80 million, a share price of at least $1, and $2 million in daily trading volume. The companies included in the North American Marijuana Index are traded on seven of the main security exchanges in the US and Canada. It remains important to note that the index is not a tradable security; rather, it serves for informational purposes and its management guidelines strive for transparency of the North American industrial landscape pertaining to the cannabis.

The index started tracking firms in the first week of January 2015. Subsequently, I use data from Saturday, January 3, 2015 up until the present day. For reasons that will be further explained in regards to Google Trends data, only end-of-week values are used from the index. As the index strives to portray the broad diaspora of publicly traded cannabis companies across North America, it is equally weighted. This means that it attributes the same importance to each member of the index. Each quarter, the index is rebalanced to ensure that all companies still meet the requirements and that the weights are redistributed equally. As of April 2019, there were 44 companies that met the requirements and are tracked by the index. Naturally, the companies based in the US are traded in USD on the United States sub-Index; likewise, the North American Marijuana Index are based in USD, so that the values of Canadian constituents are converted daily from CAD to USD in accordance with the foreign exchange rate. Therefore, the index captures partial effects of the volatile daily exchange rates; however, these effects should not be detrimental to my study.

Holdings (Can). They are listed in order in terms of market capitalization, and the country abbreviation in parentheses indicates whether the company belongs to the American or Canadian sub-Index. This data was retrieved on April 15, 2019.

3.2. Stock Data of Cannabis-Related Companies

Besides the North American Marijuana Index, individual cannabis-related stocks were also analyzed. In the interest of equality and heterogeneity, one major company was selected from Canada and the US, respectively: Canopy Growth Corporation (TSX ticker: WEED) and GW Pharmaceuticals (NASDAQ ticker: GWPH). These two firms are amongst those constituents of the North American Index with the highest market capitalization, signifying their positioning as major players in the cannabis industry. If multiple years of data on industry performance - including revenue and assets - were available to conduct a thorough industrial organization study, I would use that data. For the purpose of my study, using stock market performance in accordance with market capitalization suffices as a proxy for competitive positioning and performance.

Canopy Growth remains one of the cannabis-related companies in North America that has enjoyed significant media attention in the past years. Based out of Ontario, Canada, the company is traded on the Toronto Stock Exchange (TSX) as well as the New York Stock Exchange (NYSE) and operates in twelve different countries. It was selected from the index members to serve as a Canadian case study because it has been traded the longest in Canada and is a major player in the industry. The closing stock price on Fridays was extracted in weekly intervals from Yahoo Finance along with the corresponding trading volume. The values are naturally in CAD. As an additional control variable, the S&P/TSX Composite Index was extracted from Yahoo Finance - it is the equivalent of the American S&P 500 and captures about two-thirds of the total market capitalization of the TSX.

Up until 2018, many companies invested in the marijuana industry were unable to list themselves on public exchanges in the US due to the federal prohibitory nature of marijuana.

While major companies, like Canopy Growth, Aurora Cannabis, Cronos or Tilray had all been trading in Canada for some years, it took time for them to be able to do the same on the NYSE. Time and data limitations prevent me from using most US cannabis-related stocks in my analysis; therefore, I chose the company GW Pharmaceuticals, which is a biopharmaceutical company primarily focused on producing therapeutic cannabinoids. Firstly, it is the top company in the US sub-Index in terms of market capitalization, making it the largest operator in the United States related to marijuana. Secondly, it has been traded on the NASDAQ for a sufficient amount of years to incorporate into my analysis. In future years, researchers wishing to analyze the stock market performance of cannabis companies on American stock exchanges will be able to do so with the more conventional and popular companies in the marijuana industry because the stock data will have adequately accumulated. The firm itself is British, but it runs vast amounts of its business in the US and can thus be considered as an indicator for American individual marijuana stock performance. I extracted its weekly stock price data, its respective trading volume, as well as the weekly closing data of the S&P 500 composite index to use as a control variable from Yahoo Finance.

In terms of stock market data, I utilize the values of the North American Marijuana Index, Canopy Growth on the TSX, Canopy Growth's trading volume, GW Pharmaceutical on the NASDAQ, GW Pharmaceutical's trading volume, the Canadian S&P/ TSX composite index, and the American S&P 500. Even though daily stock data is available, I use data in weekly intervals so that it aligns with the Google Trends data, which is available on a weekly basis and will be discussed in the next section.

3.3. Google Trends Data

Google's analytic service Google Trends offers a means of capturing and measuring online tendencies of consumers and retail investors by providing data for specific search terms. For the purpose of my study, it serves a proxy for investor attention and consumer sentiment towards the marijuana industry. Over a given period of time, Google Trends measures the frequency with which certain terms were searched using the Google search engine relative to the total number of Google searches in a selected region. The amount of searches is scaled on a spectrum from zero to 100, where 100 indicates the highest search frequency and zero the lowest. Google tracks and scales these frequencies on a weekly basis and allows for a comparison of search intensity over the same time period in different regions. Data for search queries is available on a national and state level; however, due to Google's method of scaling data of individual search terms relative to total number of searches in a selected region, comparisons across states are not ideal because the total number of searches might differ across states. Notwithstanding, the inferences that can be made on a national level remain insightful and useful to my study.

Each search term's scaled frequency is reported individually by Google Trends for the specified region. I mainly look at keywords related to cannabis on a national level in the US and Canada, respectively. In some cases, I extract data from states that have recently passed marijuana laws. For each keyword, Google provides a separate dataset with the weekly scaled frequency of searches; thus, datasets were gathered individually and then compiled into one Microsoft Excel spreadsheet.

In total, I incorporate 23 different search terms in my dataset, providing 221 weekly observations from the first week of January 2015 up until March 2019. I chose the first week of

January as a universal start date because that is the same week in which the North American Marijuana Index began tracking companies. Because of their association with the marijuana industry, I specifically extracted data for the search terms "cannabis", "cannabis legalization", "hemp", "CBD", and "weed". For each of these terms, I separate between US-based search frequency and Canadian search frequency. I also aim to capture the politicization of the cannabis industry by analyzing data for the keywords "cannabis + legalization" and “marijuana + legalization”. I do this once again by differentiating between the US and Canada, but also include the state level searches in states that have passed extensive cannabis legislation, namely Colorado, Massachusetts, Michigan, and Vermont. In this regard, I extracted data for the search terms “Phil Scott + marijuana legalization” for the region of Vermont and “Rick Snyder + marijuana legalization” for the region of Michigan. Scott was the Governor of Vermont and Snyder the Governor of Michigan at the time that these states both legalized recreational marijuana, effective January 1, 2018. A final political figure that I analyze is the Attorney General by using data for the search frequency of “Jeff Sessions + marijuana legalization”.

Not just marijuana-related Google queries are investigated, but also stock-related Google search frequencies. For my regression model that has the index as its dependent variable, I include the data for the search term “marijuana index” in the US and Canada. I do the same for the search term “cannabis stocks” in the hope of capturing retail investors interested in cannabis-related stocks that the index tracks. For the regression of Canopy Growth’s stock performance on the TSX as the dependent variable, I use Google Trends data for the search term “Canopy Growth Corporation” limited to the region of Canada. Likewise, “GW Pharmaceuticals” as a search term in the US is used when regressing the biopharmaceutical company’s Nasdaq

performance. Before beginning the regression analysis, this next section will focus on the concrete description of the data.

3.4. Data Summary

As seen in Table 1, all Google Trends variables have a maximum value of 100, indicating the top search frequency in the time period from 2015 until present day. Each search term listed in the table is followed by _US or _CAN to indicate whether the search region is the US or Canada. Several variables are labeled with "MJ_leg" which stands for "marijuana legalization"; these search terms are further broken down by state. In some instances, the minimum value of search terms is zero, indicating that there are some weeks in the time frame in which that keyword was not searched at all. While the mean search frequencies of the search terms is only tangentially notable, the standard deviations are of greater interest. Search terms with a relatively high standard deviation, like "CBD" in the US, "Canopy Growth" in Canada, or "Marijuana Index" in Canada (MJ_Index), indicate that over time, the search frequency varied a great deal. On the contrary, search terms with a relatively low standard deviation, like the "marijuana legalization" terms across states, and "cannabis" or "weed" in both US and Canada, demonstrate a certain consistency within the search frequency.

To help visualize the frequencies for Google search terms regarding cannabis, time trends were created using Microsoft Excel. Either the trend line for the index, the GWPH stock performance, or Canopy Growth's stock performance is portrayed in a bold blue line in the various figures because those are dependent variables of interest. Figures 1 through 4 all represent the Marijuana Index in bold, scaled to the y-axis on the left of the graph. The figures are grouped by category of the Google Trends search. Generic search terms associated with the

cannabis industry for the US region are reported in Figure 1. Notable are the spikes of "marijuana index", "cannabis", and "weed" at the beginning of 2018, when the index values reach their peak. The Google Trends data is scaled from zero to 100 on the right y-axis. Equally notable is how "hemp" reaches its highest search volume when the index dips significantly at the beginning of 2019.

Figure 2 focuses on the same search terms as Figure 1, however Canada is the region of interest. I consistently differentiate the US and Canada, because the index is comprised of both US and Canadian based companies. There exists a heterogeneity between the two countries as well, because of marijuana's prohibitory nature on a federal level in the US, while it is legal on a federal level in Canada. Google searches for "marijuana index" and the index peak at the same time around the beginning of 2018. The frequency of searches for "cannabis", "CBD", "hemp", and "weed" all increase the week after Canada legalized recreational marijuana in mid-October of 2018. This trend demonstrates how consumer attention to cannabis increased with the passed legislation. Overall, as time passes, not only does the index increase, but the search frequencies as well.

Figure 3 highlights the differences across state searches regarding marijuana. While trends for Colorado, Massachusetts, Michigan, and Vermont are all similar to each other, they do not immediately correspond with the volatility of the index. Notwithstanding, one clearly observes the cyclicality of politics within the trends. In the second week of November 2016, the week of the Presidential election, all searches spike. The same happens for the election week of November 2018. This feat is further accentuated in Figure 4, where the names of governors and politicians in combination with "marijuana legalization" increase during election season. The yellow line representing Jeff Sessions experiences consistent volatility, portraying how the

interest of Americans is possibly based on certain press conferences or releases of him regarding his point-of-view on marijuana legalization as the Attorney General.

Attention shifts towards the individual stock performances of the two chosen stocks in Figures 5 and 6. In Figure 5, GW Pharmaceutical is tracked in bold, and is compared to search intensity for "GW Pharmaceutical", "cannabis", and "cannabis stocks" in the US. The term "cannabis stocks" is included in my model to capture those retail investors interested in investing in marijuana companies as they increasingly hear about their popularity in addition with progressive overall tendencies towards the drug's legalization. The "cannabis" search term in itself closely compares to the stock's movements (the axes are scaled), and the company's search frequency experiences stark increases at similar times as the stock price. The overall increase of frequency for "cannabis stocks" as of 2018 remains interesting, because many marijuana laws across US states went into effect on January 1, 2018. Likewise, several Canadian companies associated with the cannabis industry completed their Initial Public Offerings (IPOs) on American stock exchanges throughout 2018.

Of all graphs, Figure 6 embodies the most overlap of Google Trends with stock performance. In bold is Canopy Growth's stock growth on the TSX - it reached a high throughout September of 2018, which coincides with peaks of search frequency for "Canopy Growth Corporation", "cannabis stocks", and "cannabis" in Canada. At the beginning of 2019, the stock increases again after a significant dip, which can be attributed to the company's acquisition of a licensing agreement with New York State for hemp production. Interestingly, "hemp" in the US and Canada undergo surges in frequency around the same time (Figures 1 and 2).

Overall, the index experiences times of intense growth, but also reoccurring decline. The fact that the index reaches its two peaks at the beginning of 2018 (new US Congress with a Democratic majority) and in the fall of 2018 (leading up to Canadian legalization) indicates the political nature of the cannabis market. Canopy Growth equally experiences its peak at the time around Canadian legalization. This politicization of the industry is complemented by the Google Trends data, which is inherently noisy as shown by the relatively high standard deviations of some variables. The majority of search terms reach their maximum frequency during the weeks of elections in the US, while some search terms do not immediately indicate any relation to politics. The overall takeaway remains that the investor attention measured by Google Trends partially overlaps with the index or stock performance. With the visualization of the trends in relation to stock performance in mind, the next section will turn to my regression analysis in which significant results will specify what type of attention truly matters in the North American cannabis industry.

4. Regression Results and Discussion

4.1. Regression 1: Index and Generic Cannabis-Related Search Terms

Using a simplified version of Vlastakis and Markellos (2012), I performed my empirical analysis by conducting four separate fixed effect regressions that correlate either the index or individual stock price to Google Trends data, while controlling either with S&P/ TSX performance or stock volume. Regression 1 tests for generic search terms in Canada and the US; Regression 2 tests for political search queries; Regression 3 tests for searches associated with GW Pharmaceuticals; and Regression 4 tests for searches in Canada regarding Canopy Growth. Due to my sample size of 221 weeks in my time series, any coefficient with a p-value of under

10 percent will be classified as significant. An overview of all regression results can be found in Table 3.

Regression 1 is represented as:

$$(1)\ Index_t = \beta_0 + \beta_1 * SP500_t + \beta_2 * MJ_{Index_{CAN}t} + \beta_3 * MJ_{Index_{US}t} + \beta_4 * cannabis_{CAN}t + \beta_5 * cannabis_{US}t + \beta_6 * cannabis_{st_{CAN}t} + \beta_7 * cannabis_{st_{US}t} + \beta_8 * can_{leg_{CAN}t} + \beta_9 * can_{leg_{US}t} + \beta_{10} * CBD_{CAN}t + \beta_{11} * CBD_{US}t + \beta_{12} * hemp_{CAN}t + \beta_{13} * hemp_{US}t + \beta_{14} * weed_{CAN}t + \beta_{15} * weed_{US}t + \tau_t + \epsilon_t$$

This first regression is comprised of seven search terms across Canada and the US that aim to explain the dependent variable, namely the performance of the index (Table 3, Column 1). The τ_t variable represents the time fixed effects in my model that aims to eliminate omitted variable bias of unobserved variables that affect index performance over time. The control variable for the S&P 500 is positively and significantly related to the index, mainly because some companies on the index mimic the general performance of the 500 firms on the S&P. The most interesting results of Regression 1 lie with the search terms "cannabis" and "weed". While a one-unit weekly increase of "cannabis" searches in Canada results in a significant increase of $3.58 in the weekly index, a one-unit weekly increase of "weed" in Canadian searches results in a significant decrease of $5.41 in the index, holding all else constant (Table 3, Column 1). To put these coefficients into perspective, I divided them by the overall mean of the index to arrive at percentage gains or losses. "Cannabis" in Canada responds to a 2.45% weekly increase in the index, whereas "weed" in Canada correlates with a 3.72% decrease in index value.[5] Here, it

[5] The mean of the index is $145.30 (Table 1, Column 1). The "cannabis" in Canada percentage was calculated in the following manner: $\frac{coefficienct}{index\ mean} * 100\% = \frac{3.58}{145.3} * 100\% = 2.45\%$. The remaining percentages were calculated similarly.

remains crucial to recognize that these are weekly increases and decreases; in order to draw conclusions on daily change, these percentage values must be divided by five. Subsequently, "cannabis" in Canada achieves a 0.5% daily increase and "weed" a 0.74% decrease in the index - these daily percentage changes, albeit an averaged and thus imprecise ratio, are not unrealistic.

In the US, the coefficient for “cannabis” is negative (yet not significant), but a one-unit increase of “weed” search frequency results in a significant positive $0.98 (0.67%) increase in the index. This differentiation gives insight into the way that Americans use terminology regarding marijuana differently than Canadians. It can be interpreted that Canadians prefer to use the word "cannabis" and Americans prefer "weed" regarding the marijuana market; future research could be conducted on the importance of linguistics and word choice of consumers or investors when it comes to the development of a new industry in general (not just the cannabis industry). It crystallizes that the term "cannabis" might be region-specific. With the increased public attention that "cannabis" as a technical and politicized word has reached in Canada, it can be supposed that Canadians will use a different terminology in their search terms than Americans, specifically because of the federal legalization of cannabis in Canada. This notion manifests itself when looking at the coefficient for "cannabis legalization": it is negative and insignificant in the US, but amounts to $1.40 (0.96%) weekly index price increase in Canada. Based on the index performance, investor attention in Canada rests upon the search term "cannabis" instead of "weed", while it is vice versa in the US.

As expected, in accordance with Moussa et al. (2016), the search frequency for “marijuana index” is positively and significantly correlated to index price. In Canada, a one unit increase in weekly search frequency leads to a $0.26 rise in index value, while an increase in Google searches in the US results in a $0.38 index hike. Although the index is not immediately

tradeable, retail investors might conduct an online search on the index, examine the top individual performers, invest in those, and then the index grows as well. This is why Regressions 3 and 4 focus on individual top companies from both countries to capture said sentiment and thought process. Since the index is informational in nature, this examination of specific stocks with respective stock volume is conducted.

Still, Regression 1 gives insight into the increasing importance of cannabis-related stocks. The search term "cannabis stocks" embodies those individuals who seek to reap the benefits of a marijuana boom by investing in stocks of cannabis firms. While Canadian searches for this term have a negative and insignificant coefficient, a one unit increase in weekly US searches leads to a $1.20 (0.83%) significant gain for the index. At first glance, this stands in contrast to the negative coefficient associated with "cannabis" in the US; however, that coefficient was not significant. The coupling of the two words "cannabis + stocks" rather indicates that Americans might prefer the more scientific word cannabis when it comes to financial queries instead of the conventional words "weed + stocks". One must acknowledge the possibility that some searches might be related to curiosity regarding harvest stocks of the cannabis plants. This is where the search term "hemp" was intended to come into play as a relatively technical term in the realm of marijuana production. In both Canada and the US, the coefficient for "hemp" is negative and insignificant.[6] Similarly, increased search frequency for "CBD" has weak and insignificant explanatory power.

[6] "Hemp" is not reported in the regression tables.

4.2. Regression 2: Index and Marijuana Legalization

Regression 2 is represented as:

$$(2)\ Index_t = \beta_0 + \beta_1 * SP500_t + \beta_2 * MJ_{leg_{CAN}t} + \beta_3 * MJ_{leg_{US}t} + \beta_4 * MJ_{leg_{CO}t} + \beta_5 * MJ_{leg_{MA}t} + \beta_6 * MJ_{leg_{MI}t} + \beta_7 * MJ_{leg_{VT}t} + \beta_8 * Scott_{MJ_{leg_{VT}}t} + \beta_9 * Snyder_{MJ_{leg_{MI}}t} + \beta_{10} * Sess_{MJ_{leg_{US}}t} + \tau_t + \epsilon_t$$

This regression is more political in nature, as it abandons the generic terms for cannabis in Regression 1 and focuses on the legalization of marijuana across countries, states, and specific politicians. Once again, the S&P 500 is positively and significantly correlated with the dependent variable: the index. The query “marijuana legalization” in Canada has a positive significant effect on index price, while the same query in the US has a marginally negative and insignificant effect on index price. It can be hypothesized that the federal legalization of marijuana in October 2018 impacts the Canadian coefficient: a one unit increase of weekly search frequency for this term results in a $0.90 (0.6%) surge in index value (Table 3, Column 2). Looking at the raw data set, this makes sense. The index achieves one of its peak values in late September and early October in anticipation of Canada's federal law being passed; likewise, search intensity for "marijuana legalization" in Canada climaxes at 100 for the week of October 20. The fact that Canada's search coefficient differs from America's in sign and significance indicates the heterogeneity of politics between the two countries regarding legalization. Even though the English word "legalization" has the same meaning in both Canada and the US, adding the word "marijuana" to the search term indicates how different terminology is used between the two nations.

Most notably, none of the state-level searches for “marijuana legalization” are significant, except for Vermont. A one unit increase of searches in Vermont on this term leads to a $0.35

(0.2%) reduction in index value. Meanwhile, all searches that include a politicians name are significant, implying that index price is affected by these types of searches. Governor Scott of Vermont has a positive coefficient, standing in contrast with Vermont's negative coefficient, and Governor Snyder of Michigan posits a negative coefficient. Questions can be raised about Vermont as a notorious blue state in elections and Michigan as a swing state and the further effects of a state's political nature on the development of the industry. The fact that the coefficients vary so much in this regression infers that these search terms might not be the ideal explicates for index performance, especially because they are on a state-level, but the final variable in Regression 2 is of the utmost interest.

A one unit increase in search frequency for "Jeff Sessions + marijuana legalization" results in a $0.50 (0.4%) boost in index value. This search remains insightful, because shortly after the 2018 elections, Jeff Sessions was asked to resign as Attorney General.[7] Previously, he was known for a prohibitory stance on marijuana's legalization; with him out the picture, American advocates for legalization were inclined to conduct searches on him and possibly invest into the stock market in a hopeful manner. Nonetheless, the results concerning Sessions should be taken with caution. Looking back at Figure 4, a trend becomes evident in which search intensity for Sessions increases sporadically; but those spikes are extensive. Notable peaks are in mid-June 2017 and mid-November 2018 (the week he had to resign). In June 2017, Sessions received media attention for directly asking Congress to be able to prosecute medical marijuana states; simultaneously, the index decreased in value in the late spring and summer of 2017.[8] The week of the 10th of November 2018 marks Sessions' resignation - the Google search intensity for

[7] Retrieved from: https://www.forbes.com/sites/jordanwaldrep/2018/11/13/what-replacing-jeff-sessions-as-ag-means-for-marijuana-legalization/#703ed14c103f, Access date: April 4, 2019.
[8] Retrieved from: https://www.forbes.com/sites/trevorburrus/2017/06/16/jeff-sessionss-reefer-madness/#5e2f9cc1f950. Access date: April 4, 2019.

"marijuana legalization + Jeff Sessions" reaches its peak of 100, while the index also undergoes a surge that week. However, the index falls into decline the following weeks. While one could have expected the Sessions coefficient to be positive or negative a priori, the given trends solidify the conclusive positive effect on the index. Time will tell what stock market reactions the new acting Attorney General William Barr will have on the cannabis industry. Overall, it becomes evident that increased search intensity - in this case, political in nature - is related to investor attention. This feat can be applied to other industries as well, where specific key search terms related to the market product combined with a regional search sphere can indicate the extent of consumer or investor attention and ensuing outcomes of the industry. Here, my paper demonstrates how its concentration is two-fold: there is a direct relation to the cannabis industry, but also a focus on stock market performance. The latter will be explored within the next two regressions.

4.3. Regression 3: GW Pharmaceuticals

Regression 3 is represented as:

(3) $GWPH_t = \beta_0 + \beta_1 * SP500_t + \beta_2 * GWPH_{VOL_t} + \beta_3 * GWPH_{US_t} + \beta_4 * cannabis_{US_t} + \beta_5 * cannabis_{st_{US_t}} + \beta_6 * can_{leg_{US_t}} + \beta_7 * CBD_{US_t} + \beta_8 * weed_{US_t} + \tau_t + \epsilon_t$

The regression focuses on search terms exclusively in the US regions as it utilizes the NASDAQ performance of GW Pharmaceuticals as its dependent variable. Predictions are confirmed that search frequency for the company's name is positively correlated with the stock price: a one unit increase of weekly searches results in a $0.39 increase in stock price, holding all else constant (Table 3, Column 3). Once again, I divide the coefficient by the mean of GWPH's stock price to express my results in percentages. Search frequency for "GW Pharmaceuticals"

correlates with a 0.35% weekly stock price increase, which is a 0.07% daily increase.[9] This outcome indicates that increased consumer attention towards the company corresponds (weakly) to its performance on the NASDAQ. The S&P 500 as a control variable is significant and positive as well. Similarly, a one unit increase in “cannabis stocks” corresponds with a $0.38 increase in stock price. Here, it remains important to recall that "cannabis stocks" in the US were strongly positively correlated to index in Regression 1. A trend on American stock markets can be inferred in which Google Trends searches positively affect stock market return of the index or more generally, individual stocks, like Moussa et al. (2017) posit in their research. Equally consistent with Regression 1 is the negative coefficient of "CBD" (-$0.56), which is now significant. This result remains interesting, because GW Pharmaceuticals is known for its pioneer research on CBD products to combat epilepsy.[10] One must keep in mind, though, the large standard deviation of CBD across all 221 weeks of Google searches (Table 1). This volatility might result in a coefficient that contradicts logical reasoning and hypotheses. The search term for "cannabis" is positively correlated, yet insignificant, while the search frequency for "cannabis legalization" is associated with a $0.32 weekly index increase. Cannabis by itself might not own any explanatory power for the GWPH stock performance, but in combination with a search for legalization, it has a significant effect. The differentiation between search terms found in Regression 1 remain intriguing when investigating a single company's performance instead of the index.

[9] Instead of using the mean price of the index (like in Regressions 1 and 2), I use the mean stock price of GWPH in the denominator of my percentage calculation (Table 1, Column 1). The weekly percentage was then divided by 5 to obtain average daily percentages. The same procedure is utilized in Regression 4 with the mean stock price of CGC in the denominator of my percentage calculation.
[10] Retrieved from: https://www.gwpharm.com/about, Access Date: April 4, 2019.

4.4. Regression 4: Canopy Growth Corporation

Regression 4 is represented as:

$$(4)\ WEED_t = \beta_0 + \beta_1 * TSX_t + \beta_2 * WEED_{VOL_t} + \beta_3 * CGC_{CAN_t} + \beta_4 * cannabis_{CAN_t} + \beta_5 * cannabis_{st_{CAN_t}} + \beta_6 * can_{leg_{CAN_t}} + \beta_7 * CBD_{CAN_t} + \beta_8 * weed_{CAN_t} + \tau_t + \epsilon_t$$

To ensure consistency between fixed effects models, this regression concentrates on search terms exclusively in the Canadian region as it employs the TSX performance of Canopy Growth as the dependent variable. The performance of the S&P/ TSX composite index, the Canadian equivalent to the S&P 500, is positive and significant. Similar to Regression 3, search frequency for the company's name is positive and significantly correlated to stock price. A one unit increase in searches for "Canopy Growth Corporation" leads to a C$ 0.30 increment of the firm's stock price (Table 3, Column 4). This is a 1.8% weekly increase and a 0.36% daily surge in stock price, on average.

The search term for "cannabis" is significant and negative: a one unit increase in weekly Google searches leads to a C$ 1.26 CAD (7.31% weekly) devaluation of Canopy Growth's stock price. When comparing this result to Regressions 1 and 3, a trend becomes evident, in which the signs for "cannabis" in the US and Canada flip when the regression changes from index to individual stocks. The "cannabis" coefficient for the US was negative in Regression 1 and then turned positive when regressed on GWPH in Regression 3. Contrarily, the "cannabis" coefficient in Canada was strongly positive in Regression 1 (3.58) and is now negative in Regression 4. Once again, questions for further research arise in which the usage and impact of specific words differ across regions. Regarding "CBD", significant results are displayed. In Canada, a one unit upsurge of Google searches for "CBD" leads to a C$ 0.90 increase in stock price. The variables "cannabis stocks" and "cannabis legalization" are both significant coefficients, although weak.

Notwithstanding, it becomes apparent that investor attention, as measured by search intensity, is related to the individual stock market performance of companies. These findings complement previous literature as they are generalizable to other firms, regardless of the industry that they operate in.

4.5. Lag Regressions

To explore whether the index or individual stock performance might be affected by delayed investor attention, I conducted regressions with lagged search terms. For each Google Trends search term utilized in Regressions 1 - 4, I created a new variable that lags the data by one time unit, namely one week. This means that for every given week of stock market performance, the corresponding search intensity for a search term is that of the following week. While relevant news for investors spreads in real-time via the Internet and other media outlets, the possibility remains that retail investors might not make their decisions immediately, but rather after multiple days. The regressions are run together with the respective concurrent terms, but only the lagged coefficients are reported in Table 4. As done previously, I control for time fixed effects to prevent omitted variable bias.

Overall, it becomes evident that search frequency on cannabis-related terms is noisy. The concurrent coefficients partially lose significance and magnitude when regressed together with the lagged terms. For instance, "marijuana index" in Canada does not remain significant and the coefficients for "cannabis" and "weed" in Canada decrease in strength. For US search queries, the term "weed" loses its significance and "marijuana index" is less of a predictor for index performance. Shifting focus to the coefficients of the lagged terms, one notices that they took away some of the explanatory power of the concurrent terms; however, there is only modest

evidence of a lagged effect. The only significant lagged terms are "marijuana index" in the US and "cannabis" and "weed" in Canada (Table 4, Column 5). Compared to a $3.56 weekly index price increase from the regression using only concurrent terms (Table 3, Column 1), the lagged "cannabis" term now only correlates with a $2.08 weekly increase in index price (Table 4, Column 5). Similarly, the coefficient for "weed" in Canada loses some of its magnitude, going from a $5.41 decrease in index price in the original regression (Table 3, Column 1) to a $2.22 decrease within the lagged regression (Table 4, Column 1). The fact that this discrepancy continues to exist between the terms "cannabis" and "weed", even with a lag of one week, highlights the linguistic aspect of investor attention.

After adding lagged terms to the second regression, which focuses on "marijuana legalization" and politicians on a state level, almost all lagged coefficients lose their significance (Table 4, Column 6). The only remaining significant variables, "Rick Snyder + marijuana legalization" and "Jeff Sessions + marijuana legalization", both become weaker. Similar trends appear in the lagged regression of GWPH stock performance. Whereas the search for "GWPH" in the US originally corresponded to a $0.39 weekly increase in stock price (Table 3, Column 3), a one week search lag results in only a $0.24 increase (Table 4, Column 7). Interestingly, the previously insignificant coefficient "cannabis" reaches a 10% significance level in the lagged regression and correlates with a $0.78 GWPH stock increase (Table 4, Column 7). This surge is a 0.7% weekly rise in stock price and indicates the potential delayed investor reaction after conducting research on cannabis, potentially medicinal because of GWPH business emphasis, on the Internet before making an investment decision.

The final regression with lagged search terms used Canopy Growth's stock as its dependent variable. When concurrent and lagged terms were run together in the same regression,

all concurrent coefficients compared to the original regression (Table 3, Column 4) stayed significant, yet their magnitude was weaker. Meanwhile, "cannabis stocks" and "cannabis legalization" are not significant anymore, and the remaining coefficients decrease in strength. The explanatory power of a "Canopy Growth Corporation" search query with a one week lag correlates with a C$ 0.20 increase in stock price (Table 4, Column 8) instead of a C$ 0.30 concurrent increase (Table 3, Column 4). In general, the lag terms do not provide a strong predicting power for the stock performance of the index or individual companies. The index or stock price in a given week portrays a weaker relationship with the search frequencies of the previous week (lagged) than the search intensity of the current week. Here, one must keep in mind that these lagged regressions continue to be on a weekly basis, thus preventing any conclusive statements on daily lagged effects.

4.6 Placebo Test

An additional regression was conducted with the purpose of testing the mechanism of my regression model and the strength of my original results (Table 3). To do so, three US states were selected, Idaho, Wyoming, and South Dakota, who are relatively neutral about marijuana legalization and currently do not have extensive legalization efforts or legislation.[11] The index served as the dependent variable and generic search frequencies within the three respective states were the independent variables. The fact that only two coefficients, "marijuana" in Idaho and "marijuana legalization" in Wyoming, showed any significance aligns with the expectation of running such a placebo test, in which one strives to not have many significant results (Table 5).

[11] I analyzed the existing legislation and bills currently being debated in all US states, and used this general overview by the National Conference of State Legislatures as a starting point. The three selected states have no broad laws concerning marijuana, e.g. decriminalization. Retrieved from: http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx. Access date: April 15, 2019.

The findings of this regression strengthen previous results and indicate that the investor attention seen in Regressions 1 and 2 (Table 3) matters and correlates with index price. Naturally, states in which cannabis legalization efforts are peripheral or non-existent should not display any notion of investor attention related to companies in the marijuana industry. On the other hand, the possibility remains that there are retail investors in these states that invest in a Canadian cannabis company because of its lucrative returns and not because they are interested in the locally illicit product. Generally though, the search frequency in these three states does not amount to a level at which it can significantly correlate with stock market prices because of the inherent nature and outlook of their population on marijuana. The final section of my paper will be dedicated to concluding remarks.

5. Conclusion

5.1 Summary Discussion

This study was exploratory in nature. Its premise was that due to the increasing legalization of medical and recreational marijuana, companies that operate within the cannabis industry will reap the benefits of improved stock market performance. Canada served as the country in which recreational cannabis is legal on a federal level, eliminating all barriers for cannabis-related firms to thrive and have their securities traded in the market. The United States is heterogeneous in the sense that more than half of its states permit medicinal marijuana, yet less than a dozen have legalized recreational marijuana use (Cox, 2018). With the lifting of federal sanctions, cannabis firms have successfully completed IPOs on American stock markets. Removing marijuana from the Controlled Substances Act would further reduce the hurdles that marijuana businesses face at the federal level like high taxation, slim access to banking services, or limited access to legal counsel (Harvard Law Review, 2018). In the near future, industry data

will exist that captures the recent transition from primarily black market operations to the legal sphere of business, thus providing valuable information on sales, costs, and consumption. Nearly every firm relies on said data that it collects on their customers, employees, and other aspects of the business (Einav and Levin, 2010). Currently, an analysis with an industrial organization approach is impossible because of these aforementioned data limitations. Nonetheless, the timing of this 2019 Senior Thesis remains ideal to capture the disruptive nature of the cannabis industry in recent months, like Canada's federal legalization in October 2018 or the December 2018 US Farm Bill.

The North American Marijuana Index provides an adequate representative of how companies within the Canadian and American marijuana business have performed since its inception in January 2015. It tracks companies that operate in both countries and are traded on the main stock exchanges of each nation, respectively. Naturally, many factors affect the performance of the index, but the fact that it is rebalanced quarterly aims to ensure parity across all of its constituents. Its 350% increase to-date corresponds to the mounting presence and strong financial performances of cannabis companies.

The heart of this project lies with consumer and investor attention towards these trends described above. In an effort to capture Americans' and Canadians' propensity to follow the developments of the cannabis industry, Google Trends data was utilized. As proven in their study on CBD, Curtis et al. (2015) conclude that Google provides a technique to identify emerging drug markets. I use fixed-effect regressions to estimate the correlation between investor attention, specifically using Google Trends as a proxy, and index performance and individual stock performance. Results depict that certain search terms are significantly correlated with the performance of the index and with individual cannabis stocks in Canada and the US. Not only is

prior literature confirmed that search frequency for company names (Moussa et al., 2017; Ding and Hou, 2015; Ranjan and Bhattachharyya, 2018; Joseph et al., 2011), or in this case also index name, corresponds with stock market returns, but insight is provided on the differentiation between search terms like "cannabis" or weed" between the two examined countries. Politicized results are also achieved, in which names of state governors combined with the search term "marijuana legalization" yield significant results. Here, the figures graphically depicting search frequency help pinpoint certain weeks in which politicians or key buzz words might be searched more on Google than usual. The work of Stephens-Davidowitz (2014) on racial amicus regarding Barack Obama's campaign remains the pinnacle of politicizing Google Trends and must be repeatedly acknowledged.

5.2 Limitations

While this paper's results remain intriguing, the design of the study comes with limitations. First and foremost, the fact that Google Trends data is scaled on a spectrum of zero to 100 essentially makes it incompatible to compute different search intensities. Since Google calculates its scales based on total search volumes within a specified region, a complication remains the comparison of search queries between the two countries and also across US states. The amount of searches will differ by region, causing the scaled values in one region to not immediately be applicable to a different region. Limiting the source of information demand to solely Google's search platform does not fully incorporate all possible avenues of measuring investor attention. Social media platforms like Twitter or Facebook are neglected, as well as query data from other informational databases like Morningstar or FactSet that are tailored more towards the financial industry. Retail investors will generally not have a remarkable effect on individual stock prices. Regarding my method of incorporating stock market data, major caveats

include the weekly intervals due to the nature of Google Trends data as well as the rather basic design that does not consider abnormal returns nor volatility of the stock performance. It goes without saying that the design of my study is not a sophisticated returns model like prior research that e.g. use volatility measures, the log of stock returns, and a differentiation between idiosyncratic, market-related, and firm-specific information demand (Vlastakis and Markellos, 2012; Bijl et al., 2016). The specific type of news is not taken into account, seeing that a negative news cycle concerning a firm or cannabis in general might increase the Google searches, but the index and stock might not see an improved performance. While my model takes time fixed effects into account, it does not capture exogenous trends or shifts that could impact investor attention. To help put the noisiness of my model into perspective, logarithms could have been used in the model. Finally, the index price only serves as a measure of market performance to a certain extent, as much of the marijuana business remains on the black market and thus, cannot be captured by general index performance over the years.

5.3 Future Research

These flaws open the opportunity for future research to be conducted. Especially in Canada I expect the literature to expand on the actual impact of marijuana's federal legalization. Currently, only estimates are available of the legal market's economic impact and potential performance. Those companies now capable of publically issuing their securities on stock exchanges will equally be required by law to publish their financial data which can lead to a more nuanced analysis of individual company performance. Economists will be able to evaluate concepts like price competition, Bertrand-Nash equilibria, strategic deterrence, or vertical integration within the companies that compete for marijuana market share. As Denis (1992)

outlines, competition takes on the form of present sales, but also innovation and technological process regarding future competition.

My study in a sense serves as pioneer in the realm of investigating and interpreting investor attention towards the rising cannabis industry. Overall, it adds additional evidence to the fact that Google search intensity is linked to investor attention on the stock market, and not just related to marijuana companies. It can be inferred that companies could intentionally increase their visibility on a search platform like Google to attract the attention of potential investors (Ding and Hou, 2015). With certain adjustments to make my model more robust and nuanced, other industries can adapt the concept of researching investor attention. As consumer behavior and behavioral economics becoming increasingly poignant towards business decisions, Google search frequencies will have applicable implications because Google's information is essentially free and readily available. Jun et al. (2018) delineate how Google Trends remains a prime candidate to depict the possibilities of big data, and how its applications are evolving. With big data, the quantification of demand and supply becomes possible, so that financial empiricists and practitioners can use Internet information in their stock market models (Moussa et al., 2017). More granular data could also encapsulate the tone of news regarding cannabis, i.e. if it is positive or negative. Daily search intensities could shine light on specific time trends between search intensity and stock price fluctuations. While Google Trends has been used to describe and diagnose research trends in past years, nowadays it is being used to forecast changes (Jun et al., 2018). These changes are bound to come to the cannabis industry.

5.4 Concluding Remarks and Outlook

The next decade will be perpetuated by public attention on the further legalization of cannabis in the US, with the 2020 election cycle serving as the culmination of consumer and investor attention focused on the market. Politicians who have declared their candidacy for the Democratic nomination overwhelmingly focus their platform on legalization efforts, shifting the way that society perceives this formerly illicit good and disrupting an entire industry of cannabis production and sale. Most prominently remains Cory Booker's Marijuana Justice Act of 2017 that aims to legalize marijuana at the federal level with an increased focus on punishing states that disproportionately arrest low-income and minority individuals (Harvard Law Review, 2018). Estimates for the legal cannabis market reach up to $18 billion in 2020 (Harvard Law Review, 2018). Such estimates are complemented by strategic partnerships and corporate strategies by the major players in the North American cannabis industry. On April 18, 2019, Canopy Growth agreed to purchase Acreage Holdings for $3.4 billion, one of the largest multistate cannabis operators in the US.[12] The crucial component to this deal is that it will not take effect until cannabis has been legalized on a federal level in the US, meaning that until then, the two companies will function independently. Canopy Growth's willingness to take on such high stakes and bet on the legislative future of marijuana resulted in an 8 percent stock price increase that day, as the deal naturally attracted increased investor attention. In this regard, there is one thing that unites politicians, businesses, consumers, and investors alike: The Need for Weed.

[12] Retrieved from: https://www.cnbc.com/2019/04/18/canadian-weed-giant-canopy-growth-strikes-deal-to-buy-acreage.html. Access date: April 28, 2019.

Table 1. Summary Statistics.

VARIABLES	(1) mean	(2) S.D.	(3) min	(4) max
Date	20,861	447.6	20,091	21,631
Index	145.3	89.04	38.24	352.3
SP500	2,360	301.7	1,852	2,926
TSX	14,958	989.2	11,843	16,477
GWPH	111.3	26.82	37.20	174.0
GWPH_VOL	2.106e+06	1.426e+06	718,300	1.549e+07
WEED	17.23	19.45	1.570	68.47
WEED_VOL	1.278e+07	1.468e+07	0	6.644e+07
MJ_Index_CAN	15.13	17.13	0	100
MJ_Index_US	21.33	15.21	0	100
CGC_CAN	19.89	19.72	0	100
GWPH_US	10.38	9.355	1	100
cannabis_CAN	7.683	8.273	2	100
cannabis_US	59.74	8.896	47	100
cannabis_st_CAN	10.65	14.81	0	100
cannabis_st_US	14.52	16.03	0	100
can_leg_CAN	3.357	7.657	0	100
can_leg_US	13.51	8.751	2	100
CBD_CAN	15.30	16.66	1	100
CBD_US	26.16	25.07	4	100
hemp_CAN	55.79	11.72	37	100
hemp_US	38.35	17.11	20	100
weed_CAN	15.85	7.980	9	100
weed_US	63.65	9.619	48	100
MJ_leg_CAN	14.14	7.287	7	100
MJ_leg_US	28.44	6.067	22	100
MJ_leg_CO	40.39	7.025	27	100
MJ_leg_MA	16.23	7.037	9	100
MJ_leg_MI	13.85	6.413	10	100
MJ_leg_VT	29.65	13.09	10	100
Scott_MJ_leg_VT	10.15	10.91	0	100
Snyder_MJ_leg_MI	8.204	9.161	1	100
Sess_MJ_leg_US	7.222	11.51	1	100
Number of Observations: 221				

Table 2. Explanation of Variables.

Variable	Explanation (on a weekly basis)
Date	Every Friday from 2015 - present
Stock Market Related Data	
Index	Index values
SP500	Closing values for S&P 500
TSX	Closing values for S&P/TSX composite index
GWPH	Stock values for GW Pharmaceuticals
GWPH_VOL	Trading volume for GWPH
WEED	Stock values for Canopy Growth
WEED_VOL	Trading volume for Canopy Growth
Google Trends Data	
MJ_Index_CAN	GT search frequency "marijuana index" in Canada
MJ_Index_US	GT search frequency "marijuana index" in US
CGC_CAN	GT search frequency "Canopy Growth Corporation" in Canada
GWPH_US	GT search frequency "GW Pharmaceuticals" in US
cannabis_CAN	GT search frequency "cannabis" in Canada
cannabis_US	GT search frequency "cannabis" in US
cannabis_st_CAN	GT search frequency "cannabis stocks" in Canada
cannabis_st_US	GT search frequency "cannabis stocks" in US
can_leg_CAN	GT search frequency "cannabis legalization" in Canada
can_leg_US	GT search frequency "cannabis legalization" in US
CBD_CAN	GT search frequency "CBD" in Canada
CBD_US	GT search frequency "CBD" in US
hemp_CAN	GT search frequency "hemp" in Canada
hemp_US	GT search frequency "hemp" in US
weed_CAN	GT search frequency "weed" in Canada
weed_US	GT search frequency "weed" in US
MJ_leg_CAN	GT search frequency "marijuana legalization" in Canada
MJ_leg_US	GT search frequency "marijuana legalization" in US
MJ_leg_CO	GT search frequency "marijuana legalization" in Colorado
MJ_leg_MA	GT search frequency "marijuana legalization" in Massachusetts
MJ_leg_MI	GT search frequency "marijuana legalization" in Michigan
MJ_leg_VT	GT search frequency "marijuana legalization" in Vermont
Scott_MJ_leg_VT	GT search frequency "Phil Scott + marijuana legalization" in Vermont
Snyder_MJ_leg_MI	GT search frequency "Rick Snyder + marijuana legalization" in Michigan
Sess_MJ_leg_US	GT search frequency "Jeff Sessions + marijuana legalization" in US

Table 3. Regression Results.

VARIABLES	(1) Index	(2) Index	(3) GWPH	(4) WEED
SP500	0.195***	0.218***	0.077***	
	(0.018)	(0.017)	(0.012)	
TSX				0.001**
				(0.001)
GWPH_VOL			0.000	
			(0.000)	
WEED_VOL				-0.000
				(0.000)
CGC_CAN				0.297***
				(0.058)
GWPH_US			0.388***	
			(0.116)	
MJ_Index_CAN	0.256**			
	(0.129)			
MJ_Index_US	0.384***			
	(0.132)			
cannabis_CAN	3.575***			-1.256***
	(1.087)			(0.269)
cannabis_US	-0.009		0.078	
	(0.466)		(0.371)	
cannabis_st_CAN	-0.183			0.146**
	(0.262)			(0.056)
cannabis_st_US	1.203***		0.375***	
	(0.227)		(0.136)	
can_leg_CAN	1.397***			0.407***
	(0.484)			(0.128)
can_leg_US	-0.360		0.322*	
	(0.249)		(0.190)	
CBD_CAN	0.032			0.903***
	(0.645)			(0.135)
CBD_US	-0.298		-0.553*	
	(0.492)		(0.299)	
weed_CAN	-5.413***			-0.064
	(0.876)			(0.239)
weed_US	0.979***		-0.031	
	(0.364)		(0.275)	
MJ_leg_CAN		0.900***		
		(0.225)		
MJ_leg_US		-0.011		
		(0.733)		
MJ_leg_CO		0.276		
		(0.457)		
MJ_leg_MA		0.268		
		(0.477)		
MJ_leg_MI		0.088		
		(0.425)		
MJ_leg_VT		-0.353**		
		(0.141)		
Scott_MJ_leg_VT		0.823***		
		(0.192)		
Snyder_MJ_leg_MI		-0.700***		
		(0.245)		
Sess_MJ_leg_US		0.496***		
		(0.161)		
Constant	-315.513***	-358.350***	-84.351***	-16.089
	(46.273)	(34.737)	(30.691)	(9.774)
Observations	221	221	221	221
R-squared	0.973	0.959	0.778	0.952
Time Fixed Effects	yes	yes	yes	yes

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Lag Regressions.

VARIABLES	(5) Index	(6) Index	(7) GWPH	(8) WEED
L_CGC_CAN				0.197***
				(0.055)
L_GWPH_US			0.243**	
			(0.117)	
L_MJ_Index_CAN	0.105			
	(0.130)			
L_MJ_Index_US	0.306**			
	(0.136)			
L_cannabis_CAN	2.082*			-0.827***
	(1.110)			(0.275)
L_cannabis_US	0.531		0.779*	
	(0.512)		(0.421)	
L_cannabis_st_CAN	-0.029			0.006
	(0.284)			(0.064)
L_cannabis_st_US	-0.166		-0.037	
	(0.245)		(0.168)	
L_can_leg_CAN	-0.083			0.133
	(0.497)			(0.130)
L_can_leg_US	0.153		0.189	
	(0.247)		(0.192)	
L_CBD_CAN	0.235			0.751***
	(0.685)			(0.167)
L_CBD_US	0.167		-0.319	
	(0.680)		(0.516)	
L_weed_CAN	-2.224**			0.025
	(0.967)			(0.257)
L_weed_US	0.119		-0.489	
	(0.441)		(0.345)	
L_MJ_leg_CAN		-0.067		
		(0.227)		
L_MJ_leg_US		0.760		
		(0.754)		
L_MJ_leg_CO		-0.405		
		(0.457)		
L_MJ_leg_MA		0.337		
		(0.507)		
L_MJ_leg_MI		0.339		
		(0.453)		
L_MJ_leg_VT		-0.222		
		(0.149)		
L_Scott_MJ_leg_VT		0.304		
		(0.233)		
L_Snyder_MJ_leg_MI		-0.517*		
		(0.263)		
L_Sess_MJ_leg_US		0.285*		
		(0.157)		
Constant	-328.865***	-367.476***	-102.884***	-7.593
	(45.473)	(36.665)	(30.621)	(9.499)
Observations	220	220	220	220
R-squared	0.976	0.963	0.793	0.959
Time Fixed Effects	yes	yes	yes	yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: These four regressions mimic those in Table 3. The lag terms (identifiable by the preceding L) are run together with the concurrent search terms from Table 3, but only the lag coefficients are reported in Table 4.

Table 5. Placebo Regression.

VARIABLES	(1) Index
SP500	0.231***
	(0.019)
cannabis_ID	0.174
	(0.128)
MJ_leg_ID	-0.089
	(0.147)
CBD_ID	-0.236
	(0.213)
weed_ID	0.118
	(0.154)
MJ_ID	0.442*
	(0.233)
cannabis_WY	-0.058
	(0.088)
MJ_leg_WY	0.292**
	(0.138)
CBD_WY	0.013
	(0.118)
weed_WY	0.036
	(0.151)
MJ_WY	0.156
	(0.160)
cannabis_SD	-0.070
	(0.095)
MJ_leg_SD	0.010
	(0.083)
CBD_SD	-0.192
	(0.173)
weed_SD	-0.033
	(0.150)
MJ_SD	-0.052
	(0.201)
Constant	-396.054***
	(38.875)
Observations	221
R-squared	0.946
Time Fixed Effects	yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

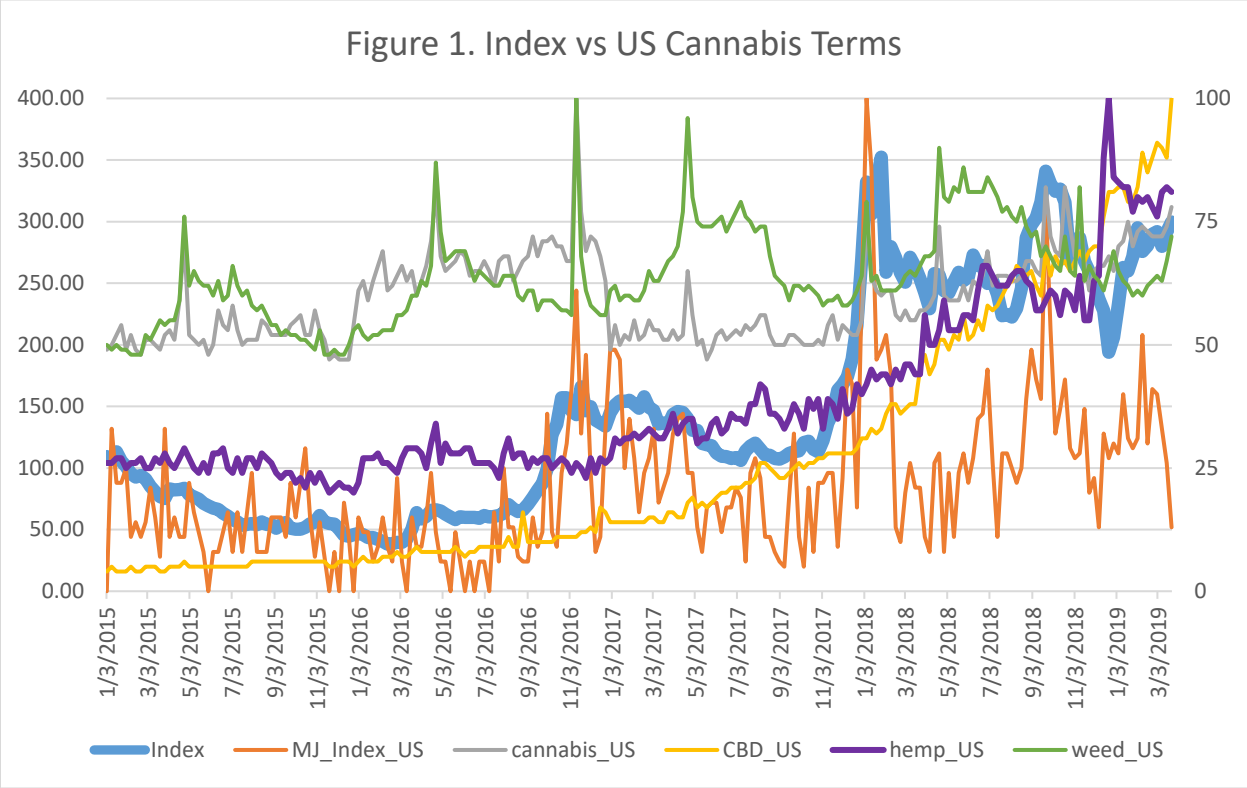
Figure 1. Index vs US Cannabis Terms
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
100
75
50
25
0
1/3/2015
3/3/2015
5/3/2015
7/3/2015
9/3/2015
11/3/2015
1/3/2016
3/3/2016
5/3/2016
7/3/2016
9/3/2016
11/3/2016
1/3/2017
3/3/2017
5/3/2017
7/3/2017
9/3/2017
11/3/2017
1/3/2018
3/3/2018
5/3/2018
7/3/2018
9/3/2018
11/3/2018
1/3/2019
3/3/2019
Index
MJ_Index_US
cannabis_US
CBD_US
hemp_US
weed_US

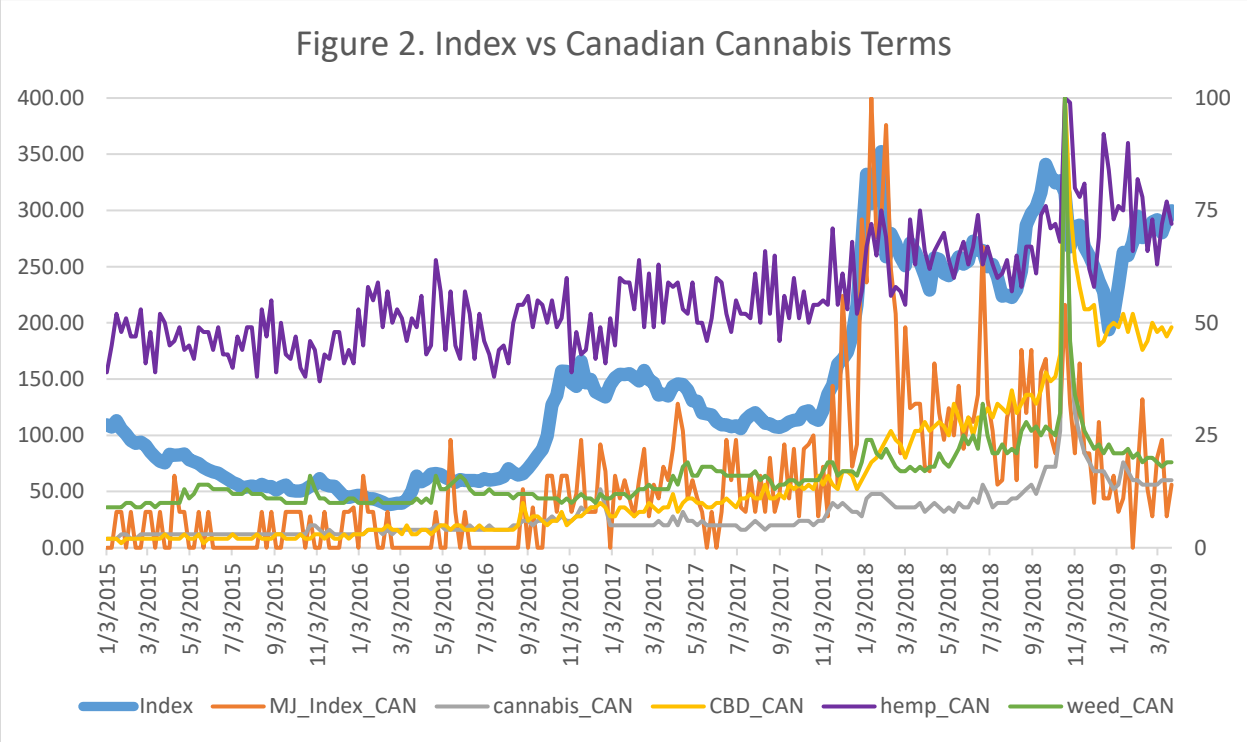
Figure 2. Index vs Canadian Cannabis Terms
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
100
75
50
25
0
1/3/2015
3/3/2015
5/3/2015
7/3/2015
9/3/2015
11/3/2015
1/3/2016
3/3/2016
5/3/2016
7/3/2016
9/3/2016
11/3/2016
1/3/2017
3/3/2017
5/3/2017
7/3/2017
9/3/2017
11/3/2017
1/3/2018
3/3/2018
5/3/2018
7/3/2018
9/3/2018
11/3/2018
1/3/2019
3/3/2019
Index
MJ_Index_CAN
cannabis_CAN
CBD_CAN
hemp_CAN
weed_CAN

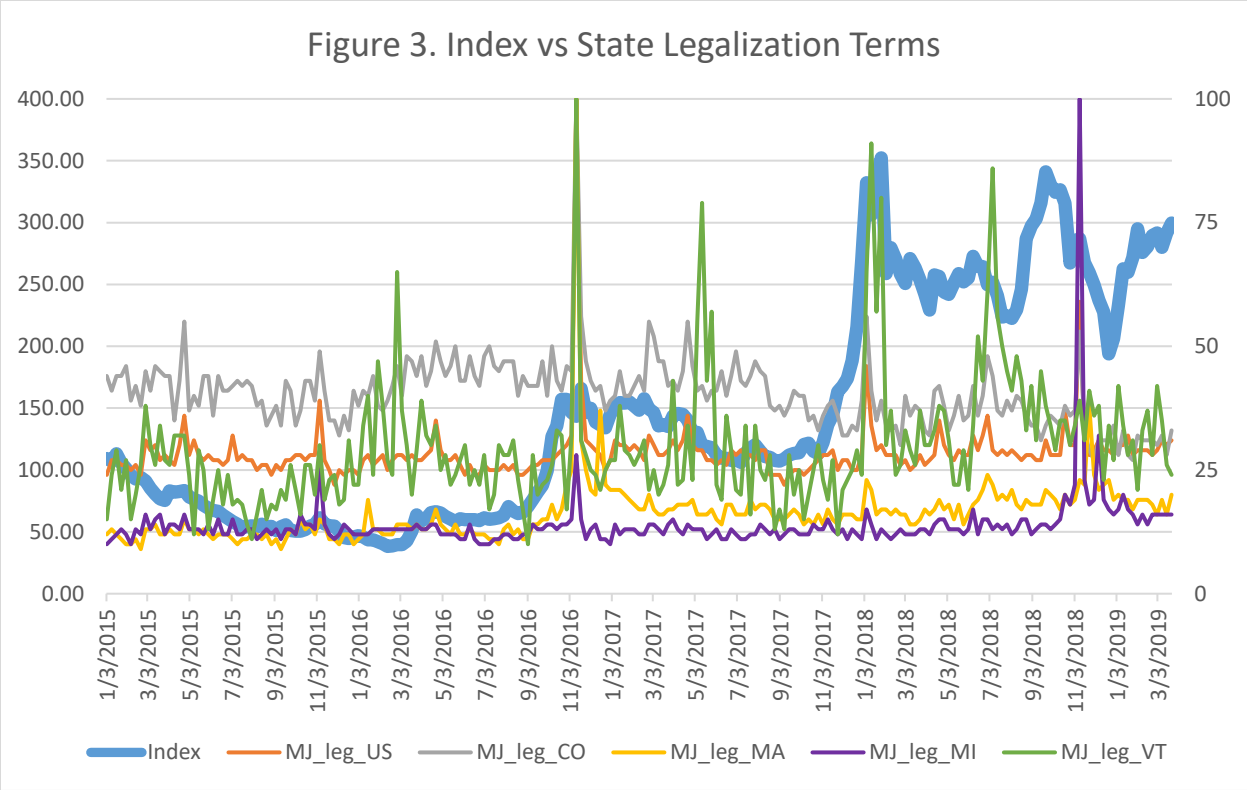
Figure 3. Index vs State Legalization Terms
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
100
75
50
25
0
1/3/2015
3/3/2015
5/3/2015
7/3/2015
9/3/2015
11/3/2015
1/3/2016
3/3/2016
5/3/2016
7/3/2016
9/3/2016
11/3/2016
1/3/2017
3/3/2017
5/3/2017
7/3/2017
9/3/2017
11/3/2017
1/3/2018
3/3/2018
5/3/2018
7/3/2018
9/3/2018
11/3/2018
1/3/2019
3/3/2019
Index
MJ_leg_US
MJ_leg_CO
MJ_leg_MA
MJ_leg_MI
MJ_leg_VT

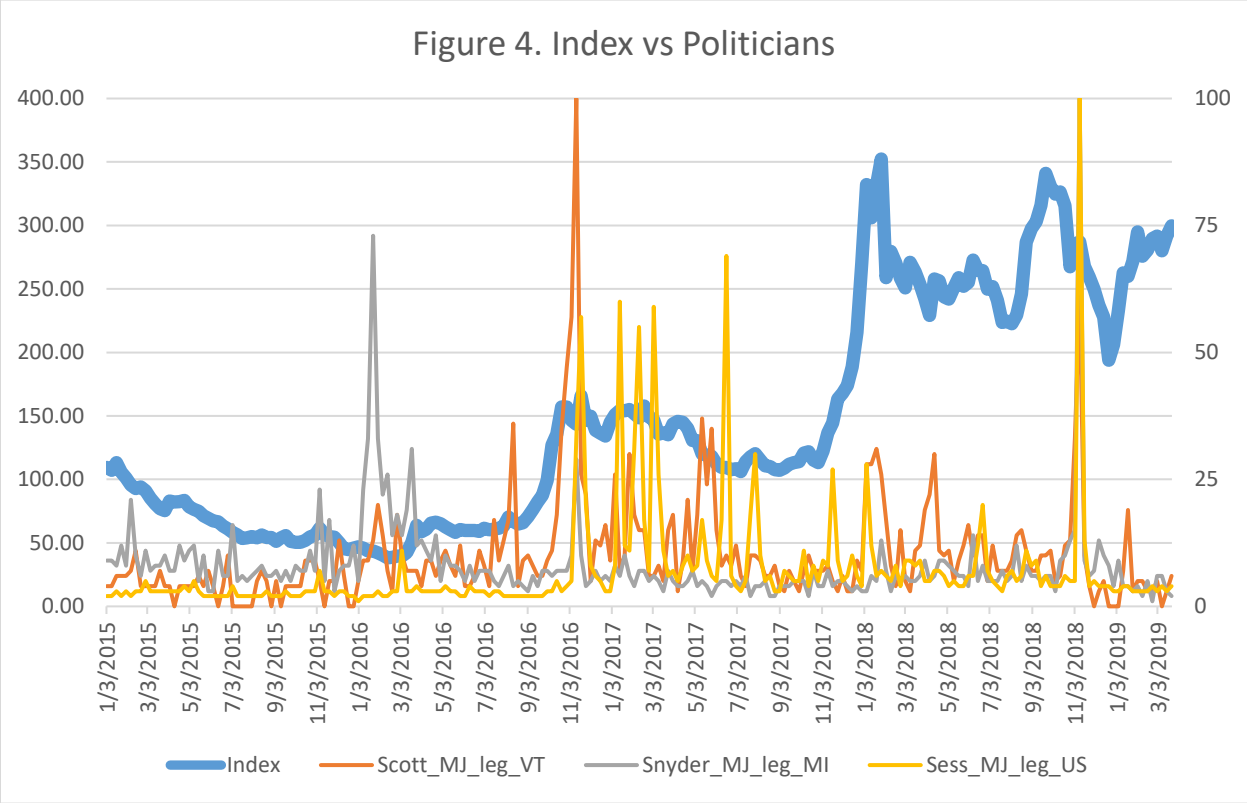
Figure 4. Index vs Politicians
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
100
75
50
25
0
1/3/2015
3/3/2015
5/3/2015
7/3/2015
9/3/2015
11/3/2015
1/3/2016
3/3/2016
5/3/2016
7/3/2016
9/3/2016
11/3/2016
1/3/2017
3/3/2017
5/3/2017
7/3/2017
9/3/2017
11/3/2017
1/3/2018
3/3/2018
5/3/2018
7/3/2018
9/3/2018
11/3/2018
1/3/2019
3/3/2019
Index
Scott_MJ_leg_VT
Snyder_MJ_leg_MI
Sess_MJ_leg_US

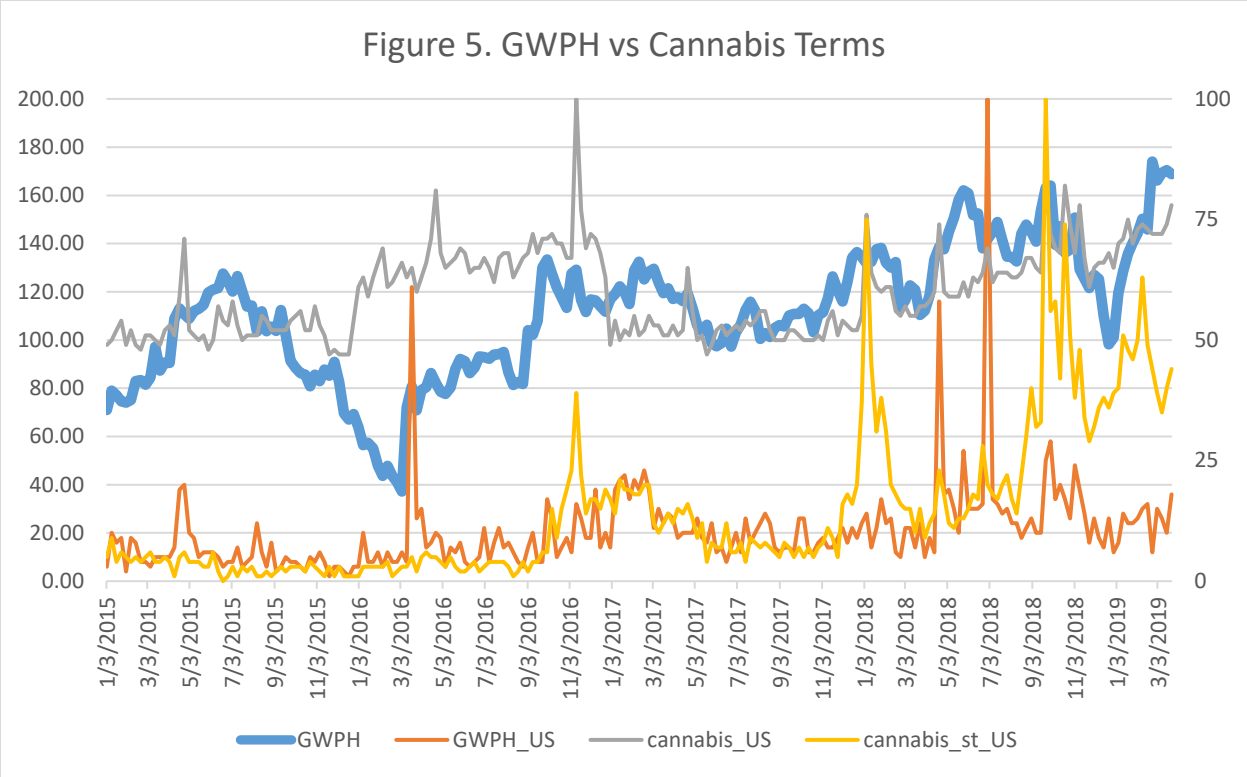
Figure 5. GWPH vs Cannabis Terms
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
100
75
50
25
0
1/3/2015
3/3/2015
5/3/2015
7/3/2015
9/3/2015
11/3/2015
1/3/2016
3/3/2016
5/3/2016
7/3/2016
9/3/2016
11/3/2016
1/3/2017
3/3/2017
5/3/2017
7/3/2017
9/3/2017
11/3/2017
1/3/2018
3/3/2018
5/3/2018
7/3/2018
9/3/2018
11/3/2018
1/3/2019
3/3/2019
GWPH
GWPH_US
cannabis_US
cannabis_st_US

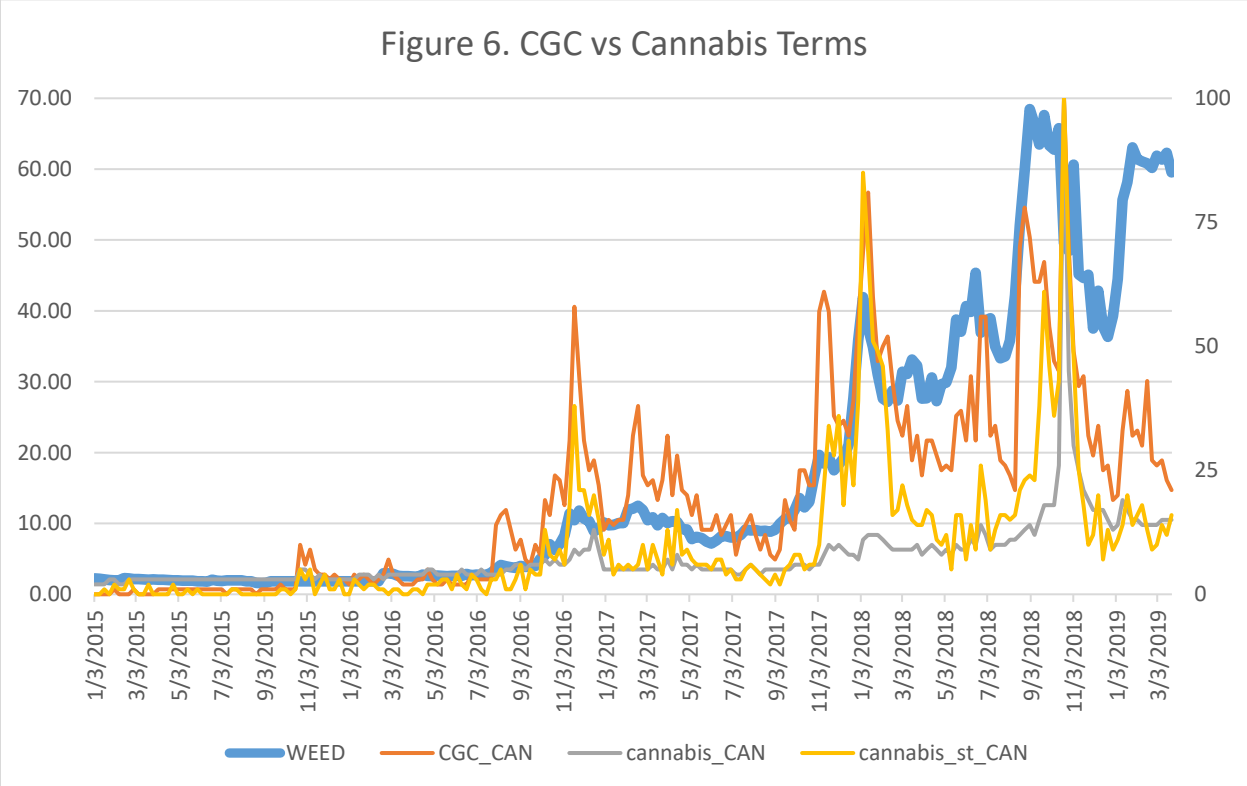
Figure 6. CGC vs Cannabis Terms
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
100
75
50
25
0
1/3/2015
3/3/2015
5/3/2015
7/3/2015
9/3/2015
11/3/2015
1/3/2016
3/3/2016
5/3/2016
7/3/2016
9/3/2016
11/3/2016
1/3/2017
3/3/2017
5/3/2017
7/3/2017
9/3/2017
11/3/2017
1/3/2018
3/3/2018
5/3/2018
7/3/2018
9/3/2018
11/3/2018
1/3/2019
3/3/2019
WEED
CGC_CAN
cannabis_CAN
cannabis_st_CAN

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