Law on the Market? Evaluating the Securities Market Impact of Supreme Court Decisions*

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Abstract

Do judicial decisions affect the securities markets in discernible and perhaps predictable ways? In other words, is there "law on the market" (LOTM)? This is a question that has been raised by commentators, but answered by very few in a systematic and financially rigorous manner. Using intraday data and a multiday event window, this large scale event study seeks to determine the existence, frequency and magnitude of equity market impacts flowing from Supreme Court decisions.

We demonstrate that, while certainly not present in every case, "law on the market" events are fairly common. Across all cases decided by the Supreme Court of the United States between the 1999-2013 terms, we identify 79 cases where the share price of one or more publicly traded company moved in direct response to a Supreme Court decision. In the aggregate, over fifteen years, Supreme Court decisions were responsible for more than 140 billion dollars in absolute changes in wealth. Our analysis not only contributes to our understanding of the political economy of judicial decision making, but also links to the broader set of research exploring the performance in financial markets using event study methods.

We conclude by exploring the informational efficiency of *law as a market* by highlighting the speed at which information from Supreme Court decisions is assimilated by the market. Relatively speaking, LOTM events have historically exhibited slow rates of information incorporation for affected securities. This implies a market ripe for arbitrage where an event-based trading strategy could be successful.

1 Introduction

On June 13th, 2013, the United States Supreme Court delivered its opinion in the highly anticipated biopatent case of *Association for Molecular Pathology v. Myriad Genetics Inc.*, 133 S. Ct. 2107 (2013). Through this case, the Court considered the important question of whether human genes could be subjected to patent claims. The party to the litigation, Myriad Genetics, was sued over its patent claims relating to two types of biological material — BRCA1 and BRCA2, whose mutations are linked to increased risk for breast and ovarian cancer. Under the cover of its patent claim, Myriad Genetics had sought to be the exclusive provider of "BRAC analysis" and "BART analysis" tests used to screen patients for cancer.

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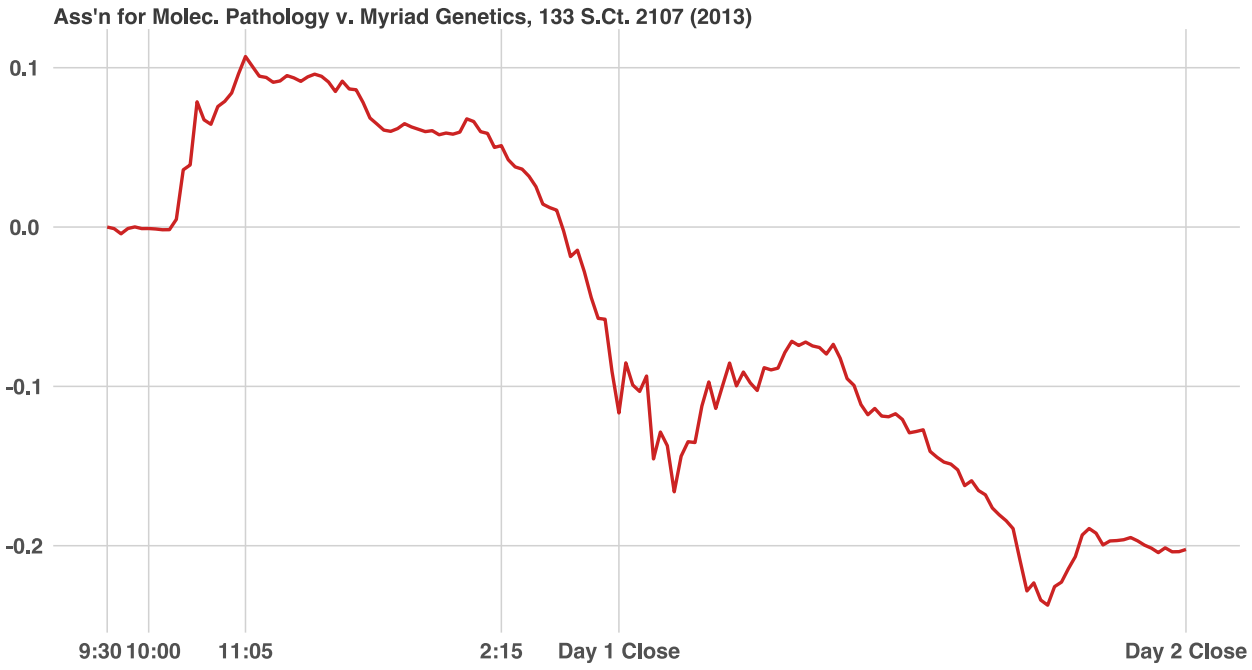

Figure 1: *Myraid Genetics* (MYGN) - Two Day Cumulative Abnormal Returns

The Court's ultimate decision was seen as a compromise that held that DNA sequences fall outside the definition of patentable subject matter under 35 U.S.C. §101, but cDNA (complementary DNA) sequences, which do not occur in nature absent human intervention, may indeed be patented. Ultimately, the Court's decision was significant not only for its contribution to overall patent law doctrine but also to the value of Myriad as a company.

As displayed in *Figure 1*, the Court's compromise decision initially confused the equity market. Fueled in part by media reports, would-be arbitrageurs interpreted the Court's decision as positive to Myriad in the initial hours of trading. However, this view was ultimately displaced as more careful reading and subsequent understanding revealed that the decision was *highly unfavorable* to Myriad's business interests. As a result, the stock began to trade down in the second half of the session. Media coverage following the initial trading day called it a "wild ride" and a "market whipsaw."

As the dust settled, the Court's decision was indeed detrimental to Myriad's long-term financial value. Even after controlling for overall market trends, Myriad's stock lost in excess of 20% of value over the two-day trading window. Attendant to this change in price, there was also a significant increase in volume as traders sought to shift their positions in light the Court's decision. Specifically, on the date of decision, there was roughly a thirteen-fold increase in trading volume of the stock. The day thereafter witnessed an eighteen-fold increase in trading volume.

Do judicial decisions affect financial markets in discernible manner? This question has been raised by commentators, but has been evaluated by very few, let alone in a financially rigorous manner. In *Myriad*, the case is relatively clear. However, *Myriad* is in many ways a unique case. It is not clear whether market behavior in response to the Court's decision is a rare or common event. What is the frequency and extent of movement attached to the wider set of events? While scholars have studied the securities market impacts of individual cases or have engaged in limited explorations into particular substantive areas of law, to date, there

has been no systematic, long-term analysis of an entire court such as the Supreme Court of the United States.

In this paper, we consider the frequency and extent to which the decisions of the Supreme Court affect equity markets. We comprehensively review every decision of the Supreme Court of the United States from the 1999-2000 term through the conclusion of the 2013-2014 term and identify the subset of case space where there is any plausible belief that the Court's decision could have an impact on one or more publicly traded companies. The Supreme Court considers a wide range of questions that are unlikely to affect the securities market. In addition, there are a number of decisions of the high court that do impact markets, but do so on time scales that prevent conclusive identification using available data and statistical methods. As a result, the analysis presented herein should be considered a conservative or lower bound estimate of the frequency and extent of impacts flowing from the Court's decisions.

Using our expert-coded subset of cases and applying event study methods developed in finance, we conduct abnormal returns analysis using intraday data at five minute intervals over a multiday event window (the day of decision and the immediate trading day after the decision). Controlling for overall market trends, we identify over seventy five instances (approximately five cases per year) where the share price of one or more publicly traded companies moved in direct response to a Supreme Court decision.

In total, over the past fifteen years, decisions of the Supreme Court of United States are collectively responsible more than 140 billion dollars of changes in wealth in the relevant equity markets. Our analysis not only contributes to the political economy of judicial decision-making, but also links to the broader research on information processing in financial markets. In that spirit, we conclude by exploring the informational efficiency of *law as a market*.

To our knowledge, this is the first intraday study to systemically explore the relationship between judicial decision making and equity markets. Using our event study framework, our analysis indicates that law indeed is *on the market*. As this is an initial inquiry into the much broader question of legal decision making in shaping the behavior of equity markets, we believe our *intraday* analysis can be meaningfully extended to several other domains of applied legal decision-making, including but not limited to jury verdicts, party settlements, dispositive motions, and administrative actions.

2 Event Studies in Economics, Finance & Law

Economists and financiers alike have long been interested documenting the manner in which markets respond to and incorporate new information. In finance, as well as in law, event study methods are used to evaluate the securities market consequences of various changes in the information environment.

Building upon early work of {Bachelier [1900]} and {Cootner [1964]}, the highly cited {Fama [1970]} article outlines the efficient market hypothesis (EMH). EMH argues that the stock market is informationally efficient and thus the price of a security reflects the information available at any given moment. A review of the literature reveals that there are stronger and weaker versions of EMH, but overall EMH is a characterization of the manner in which the stock market incorporates information into securities prices.[1] Under normal circumstances, individual stocks are expected to move in a manner consistent with their risk factors and the overall market. Thus, in the absence of new information, EMH proponents argue that it is not possible for the risk-adjusted return of an individual security to outpace the overall market return over a given period.

[1] Our paper has implications for the semi-strong version of the EMH. Supreme Court decisions, once announced, add to the universe of knowledge about the overall market as well as about individual securities. The semi-strong version of the EMH posits that the market should assimilate new information in the form of Supreme Court decisions, immediately and accurately.

Working from this premise, abnormal returns, by contrast, represent the difference between the expected return of a security and the actual return associated with a particular security. Abnormal returns may be triggered by availability of information and the subsequent actions of traders. Arbitrage may exist when parties possess new information or a novel insight that is not already priced into a particular stock or series of stocks.{Ross [1976]} As this information becomes known, traders buy or sell securities until a new price equilibrium is reached, thus removing the arbitrage opportunity. As noted above, there are stronger and weaker versions of the efficient market hypothesis (EMH) {Fama [1970]}, {Summers [1986]}, {Fama [1991]}. In addition, there have been a number of important and valid critiques of EMH including {Sornette et al. [1996]}, {Farmer and Lo [1999]}, {Lo and MacKinlay [2002]}, {Malkiel [2003]}, {Jiang et al. [2010]}, {Shiller [2015]}. That said, EMH still represents a defensible first-order description of how markets price information into securities and other financial instruments.

Event study methods are the typical approach used to explore how markets respond to new information. The event study methodology pioneered in {Fama et al. [1969]} and further outlined in {Brown and Warner [1985]}, {Campbell et al. [1997]}, {MacKinlay [1997]} and {Bhagat and Romano [2002]} is designed to test for the presence of abnormal returns associated with a change in the broader information environment. Event studies have become a staple of economics and finance with hundreds (if not thousands) of studies leveraging various forms of the event study methodology. Classic studies include the exploration of market reactions to information updating events including announcements of earnings {Firth [1976]}, {Patell and Wolfson [1981]}, dividends {Kalay and Loewenstein [1985]}, {Kalay and Loewenstein [1986]}, stock splits {Charest [1978]}, {Lamoureux and Poon [1987]}, mergers {Asquith [1983]} and tender offers {Dodd and Ruback [1977]}.

Beyond its traditional application, the analysis of abnormal return events also includes the exploration of market impacts of decisions of third-party actors, including documentation of market reactions to decisions of the federal reserve {Bomfim [2003]}, {Bernanke and Kuttner [2005]}, of administrative agencies {Bosch and Lee [1994]}, {Sarkar and de Jong [2006]}, {Lax and McCubbins [2006]} of legislatures {Ellert [1976]}, {Gilligan and Krehbiel [1988]}, {Cutler [1988]}, and the market response to the outcomes of various elections {Roberts [1990]}, {Herron et al. [1999]}, {Knight [2006]}.

Event study methods have also been applied in the context of litigation generally and judicial decision-making more specifically in areas including corporate law {Bhagat et al. [1998]} {Ryngaert [1988]}, tax law {Key and Adkins [2011]} {Dhaliwal and Erickson [1998]}, patent law {Marco and Vishnubhakat [2013]}, environmental law {Sun and Liao [2011]}, communications law {Chen et al. [2013]}, products liability {Prince and Rubin [2002]} {Viscusi and Hersch [1990]}, antitrust {Huth and MacDonald [1989]} {Bizjak and Coles [1995]} and property rights {Keay and Metcalf [2011]}.

Collectively, these studies offer initial evidence regarding the impact of various legal events on the collective behavior of the securities market. However, there are some serious limitation in these prior papers and the effort we present herein is designed to materially improve the state of the literature across several dimensions. In this paper, we present a *granular*, *systematic* and *long-term* exploration of the impact of judicial decisions in relevant securities markets. Our analysis uses *granular* intraday data to *systemically* evaluate an entire body of judicial decisions over a *long-term* window (1999-2014). While this is far from the final word on the question, we believe that we have undertaken the most extensive exploration to date of the impact of judicial decisions on the equity market.

3 Data Collection and Event Identification Framework

3.1 (a) Qualitative Event Filtering and Stock Identification

As we define it, law on the market exists when a judicial decision creates a statistically significant change in the market price one or more publicly traded companies. In order to reduce the number of cases in question, we reduce the set of cases to only those for which we can posit at least some reasonable theory regarding how the share price of publicly traded company might move in light of the Court's decision.

For the purposes of our study, we engage in a qualitative review of the entire corpus of decisions of the Supreme Court of the United States (1999-2014). Over the fifteen year period considered in this study, the Supreme Court decided 1,363 cases covering a wide range of social, political, and economic matters including topics such as tax, criminal procedure, civil rights, antitrust, employee benefits, environment protection, civil procedure and freedom of speech. While in many cases the Court's decision is meaningful both to the individual litigants as well as the society as a whole, there are only a subset of decided cases which might potentially move markets. In reviewing all cases from 1999-2014, we isolate any case for which we can construct a plausible explanation as to how the Court's decision would move the securities market. In so doing, we were required to consider two major questions: (1) Could this decision of the Supreme Court of the United States plausibly affect a publicly traded company? (2) If so, then which companies and/or sectors? Given the importance of this initial filtering step, we relied on subject matter experts in order to undertake this coding.[2]

We recognize that our coding process misses a range of economic consequences that might flow from the Court's decision. For example, an affected party might be privately held or non-profit institution or the economic consequences might be diffuse or long-term, such that our measurement strategy would fail to identify the case as significant. In these instances, we would not be able to directly link our analysis to the Court's decision. Also, despite our best efforts to be over-inclusive, we acknowledge that over the more than 1,300 cases considered, we may have failed to identify a decision and/or publicly traded stock for which there was a securities market impact. If anything, we believe that this implies that results presented herein are lower-bound estimates of the economic impact of the Supreme Court's jurisprudence.

Among the 1,363 total decisions evaluated in this study, we identify 211 candidate LOTM cases. These are cases where we believe at least one (sometimes many) publicly traded companies were potentially affected. Having identified our candidate LOTM cases, we collected intraday price, volume and market cap information at five minute intervals for the period immediately surrounding the Court decision. This provides us with a reasonably sized pre-event and post-event estimation window in order to support the analysis we present herein. For each stock, our event window relies upon five minute interval data starting at the 9:30am opening bell on the day of the Court's decision through 4:00pm close on the following trading day. In addition, we also collected a range of other interday data in order to support some of the other analysis offered in the balance of this paper.

3.2 (b) Causality and the Benefits of Intraday Event Studies

Causal inference is a significant issue in event studies. From a cause and effect standpoint, the goal for any researcher is to link the treatment (in this case, the potential change in the informational environment) to the effect (i.e., the price difference in a publicly traded company). In order to undertake this effort, scholars have typically conducted event based analysis using daily, weekly, or monthly price data. Virtually every event study in law and the vast majority of analysis in finance leverages such interday market data. Indeed, there

[2]Given the importance of this filtering step, we rely on subject matter experts in order to undertake this coding. The reviewers are both law professors. One has is a J.D. with a Ph.D. in Political Science & Public Policy with more nearly a decade of relevant academic work. The other reviewer is a law professor and former Supreme Court law clerk with more than two decades of legal experience). As a bonus robustness check, each decision was then also reviewed by another one of the authors of this paper.

is a significant methodological and applied literature devoted to the question of how to estimate interday abnormal returns.

Notwithstanding its popularity as a methodological approach, interday studies face a difficult and unavoidable tradeoff. Either a researcher must rely upon relatively few data points or must collect data over many time periods in order to generate sufficient statistical power. In relying upon large estimation windows, it is difficult from a causality standpoint to ensure that the cause and effect relationship is properly estimated. With every passing day, the likelihood of a confounding event grows. Whether it is an earnings announcement, a change in senior management, updates in the status of a regulatory approval, a merger announcement or some other important change, the potential for misidentification or measurement error looms large. While researchers undertaking interday studies typically attempt to control for a range of confounds that might plausibly impact the price of traded security, those controls do not always correct the issue.

At its core, we believe the problem is not one of method but rather one of data; scholars in the literature agree. As noted in {Kothari and Warner [2007]} "short-horizon methods are quite reliable (and) while long-horizon methods have improved, serious limitations remain." In order to support better assessments of the market impact flowing from a potential event, we believe granular intraday data is the key. There has been significant growth in access to highly granular securities data (including tick data). We believe that intraday event studies using fairly granular intervals (such as fifteen minutes or five minutes) are preferable to their interday alternative because they provide large number of data points and help avoid or at least limit the possibility of a joint response problem. With respect to the event window and the size of data interval, our effort compares very favorably to most other studies in finance and virtually every event study conducted to date in law.

As noted above, for our estimation window, we leverage stock price information over the period starting at 9:30am on the date of the Court's decision for each five-minute trading period concluding at the 4:00pm the day after the decision. From an information incorporation standpoint, we believe this window provides sufficient post-event incorporation time while also limiting the potential of a joint response flowing from a simultaneous event. While our two day intraday window could also be impacted by the problem joint causality,[3] it is far less likely given the limited duration window.

4 Testing for *Law on the Market* in the Decisions of the Supreme Court of the United States

4.1 Model Formalization

In order to test for significantly *abnormal* events, we must first choose a model of *normal* returns. While there is a wide range of asset pricing and, in particular, stock return models,[4] our model must allow for: 1) stable estimation for samples with $N \leq 175$, as dictated by our five-minute bar event interval size; 2) simple comparison and communication of results, including degree of uncertainty or belief; and 3) simple application across a wide range of industries and time periods. Conditions 1 and 2 preclude models requiring higher-order moments or more sensitive, asymmetric distributions, for example, those including skewness, kurtosis, or the Variance-Gamma family. Condition 3 also counsels against models such as multifactor models, which require industry and period-specific factors and calibration.

[3] We conducted a qualitative investigation attempting to search for other corresponding events that occurred in tandem with the Court's decision. While it is impossible to completely eliminate, we failed to find significant evidence of joint responses over the two day windows in question

[4] See {Nadarajah [2012]} for an overview of the set of potential return specifications.

Given these conditions, we choose the most commonly used approach in the finance literature - the Capital Asset Pricing Model (CAPM). Furthermore, our analysis is short-term, focusing on intra-day timescales, allowing us to take the risk-free rate to be constant.[5] The end result is that CAPM, in our case, collapses to the simple market model of returns.

Estimating the impact of an event under the market model is detailed in a variety of paper in the literature. {MacKinlay [1997]} is widely cited across event study literature. For the convenience of the reader, we detail this estimation procedure in the *Appendix infra*.[6] However, the procedure can be characterized by the following pseudocode:

1. First, divide time into three windows: an estimation window $(T_0, T_1]$, an event window $(T_1, T_2]$ with event time τ s.t. $T_1 \leq \tau \leq T_2$, and a post-event window $(T_2, T_3]$.
2. Collect market and stock return data spanning these three periods.
3. Using ordinary least squares (OLS), fit parameters α and β of the market model during the estimation window. These parameters characterize *normal* return for the stock.
4. The *abnormal* return of the stock during the event window is calculated as the residual or error term of the *normal* model, as measured against the actual event return. In the words of MacKinlay [1997], "[t]he abnormal return is the disturbance term of the market model calculated on an out of sample basis."
5. The distribution of *abnormal* return, i.e., our characterization of uncertainty and significance, comes analytically from simple regression models.[7]

To perform this procedure, we rely on Sun's implementation, evReturn in the R package erer.[8]

4.2 Law on the Market: An Aggregate Perspective

Applying the estimation framework outlined above against our 211 candidate LOTM cases, our analysis reveals 79 cases and 118 securities that experienced a statistically significant change in response to a decision of the Supreme Court of the United States.[9] As displayed in *Figure 2*, over our nearly two day post event window, more than 37% of our candidate LOTM cases saw a statistically significant *law on the market movement*. Given some cases are likely to affect more than one publicly traded security, we also observe that 17.2% of candidate LOTM securities are statistically significant.

[5] Throughout the entirety of this study's history, the daily overnight rate of return has not exceeded 0.0002, i.e., 0.02%. Given this fact our approach is sufficiently proximate to CAPM as outlined in {Fama and French [2004]}.

[6] The interested reader is directed to {MacKinlay [1997]} for a full description of his protocol which summarizes the approach taken by many scholars in the literature.

[7] See Appendix or {MacKinlay [1997]} for details on conditional variance derivation.

[8] The Empirical Research in Economics with R (erer) package was developed for use in {Sun and Liao [2011]} based upon approaches previously outlined in work such as {Fama et al. [1969]}, {MacKinlay [1997]}, and others.

[9] There are at least twenty stocks which are significant against one or more ETF's but which are not significant against the S&P. All tables and figures are calculated using only ticker symbols for securities or exchange traded funds which are statistically significant with respect to the S&P 500 index.[10] While we could have very plausibly included the stock versus ETF analysis, we believe this is the most conservative presentation of our results.

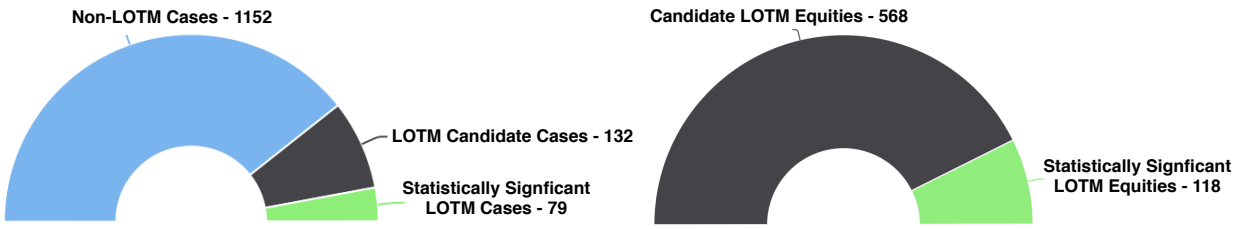

Figure 2: *Division of LOTM and Non-LOTM Cases and Equities (1999-2014)*

As displayed in *Figure 3* below, over the fifteen years starting with the 1999-2000 term and concluding with end of the 2013-2014 term, the frequency of both potential and realized LOTM events has been fairly steady. On an annual basis, there were an average of 5.3 LOTM cases per term and 7.8 statistically significant LOTM securities. While there was some yearly variation in the number of LOTM candidate and actual LOTM cases, *Figure 3* highlights that most years are fairly close to the average with the October 2009 term featuring only 1 LOTM case but with the immediately following year of 2010 serving as the largest year with 10 LOTM cases.

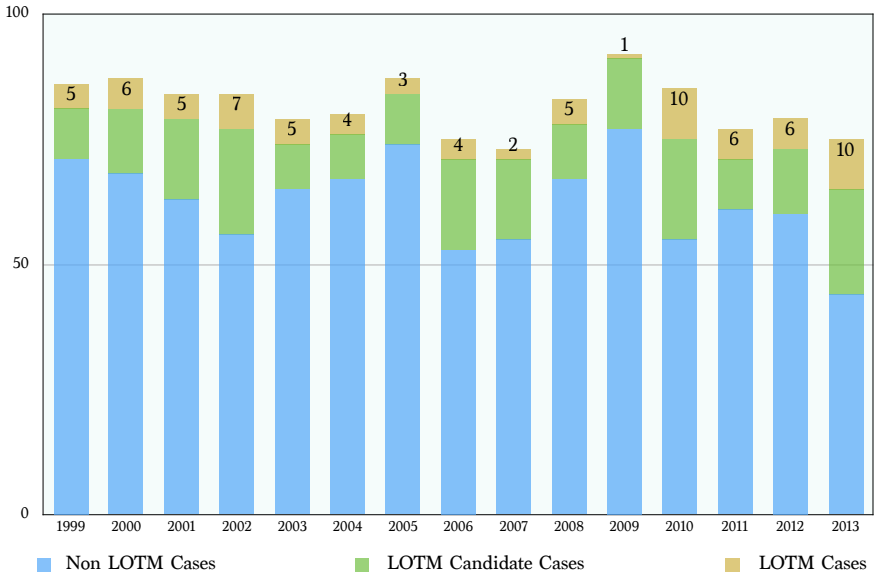

Figure 3: Yearly Distribution of *Law on Market* Cases 1999-2014

4.3 Calculating Wealth Effects using Change in Market Cap

Each time there is a statistically significant LOTM event, the corresponding abnormal returns have wealth implications for those who hold the underlying securities. While an individual or institution may or may not choose to sell the security and realize the gain or loss, the shares outstanding are made either more or less valuable as a result of the market's collective assessment. While subsequent events can either strengthen or lessen the financial impact experienced by shareholders, we are interested in directly estimating the absolute changes in wealth associated with the actions of the Court.

In this study, we observe a wide variety of companies as well as legal questions considered by the Court. There are significant differences in market cap among the companies in our study. These differences are both a function of company size and diversity of underlying business units.[11] In the case of a large and mature company, the Court's decision could represent a serious loss to a particular business unit, but that loss might be small compared to its variety of conglomerate business activities. In such a case, the total loss realized in subsequent trading might be relatively small. By contrast, for a smaller or less well diversified company, a decision by the Court could prove either extremely favorable or fatal.

Total *LOTM* Market Cap Change (1999-2014) Average Market Cap Change Per Year	*148.7 billion* *9.91 billion*
Average Market Cap Change (Per Case)	*1.88 billion*
Average Market Cap Change (Per Security) S.D. of Market Cap Change (Per Security)	*1.26 billion* *2.925 billion*

Table 1: LOTM Market Cap Change Summary Statistics (1999-2014)

Given these and other differences between companies, we believe that calculating abnormal returns alone does not provide a complete portrait of the impact of a given decision. A five percent change in the value of Sinclair Broadcast Group (SBGI) is not nearly as large as a similar change in the value of a company such as Bristol-Myers Squibb (BMY). In order to account for these differences, we calculate the change in equity for each of our statistically significant LOTM cases by calculating the market cap at the beginning of our event window and subtracting it from the market cap at the end of our event window.

Using this approach, we estimate the change in market cap for each statistically significant LOTM stock. In the aggregate, the *law on the market* phenomenon is responsible for wealth changes in excess of 148 billion dollars between 1999-2014 (an average of 9.91 billion dollars per year). As highlighted in *Table 1*, this represents an average of 1.88 billion per case and 1.26 billion per affected security (or exchange traded fund).

From a market cap position, the largest LOTM case is *United States v. Locke*, 120 S. Ct. 1135 (2000) a supremacy clause case from the October 1999 term, which held "regulations regarding general navigation watch procedures, crew English language skills and training, and maritime casualty reporting are preempted by the comprehensive federal regulatory scheme governing oil tankers." Among other things, this case was significant as it limited a set of state oil transport regulations passed in the wake of the Exxon Valdez oil spill. The decision, which relieved oil transporters from complying with certain state level regulations, increased the value of Exxon Mobil Corporation (XOM) by more than 23 billion dollars (9.1% change in market cap over the two day event window). Chevron (CVX) also experienced a positive market cap change in excess of 3 billion dollars.

[11] This size and diversity impacts the size of the observed change, as some are large and mature companies with a diverse set of business lines while other companies are small entities focused upon a very specific market vertical. In the case of exchange traded funds, differences are a function of the size of the fund and percentage of fund assets impacted by the Court's decision.

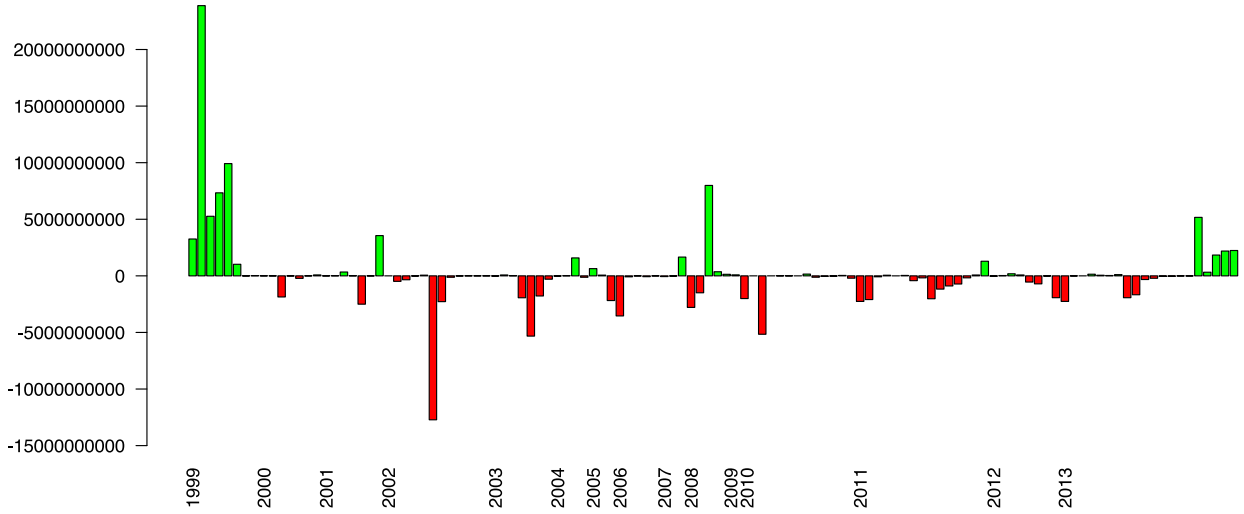

Figure 4: Timeline of Market Cap Changes (By Security) 1999-2014

Figure 4 highlights the time ordered distribution of all cases, starting with the first LOTM case in the October 1999 term and concluding with the final LOTM case decided during the October 2013 term. A review of *Figure 4* highlights that there are slightly more negative market moves as opposed to positive changes in market capitalization. Overall, both positive and negative market cap changes occur throughout the fifteen year period of study.

4.4 Measuring Dollar Volume Traded

Each of the statistics that we present in *Table 2* offers a different perspective on the *law on the market* phenomena. The point estimate of cumulative abnormal returns identifies the size of gain or loss experienced by investors. Our market cap analysis highlights the size of macroeconomic impact experienced by each of the securities, a number that might be interesting to executives at the given company or policy makers more generally. Market makers and "high-frequency" traders, however, are often more interested in understanding the size of abnormal dollar volume traded around each of these specific events. Thus, in *Table 2*, we also provide an analysis of the individual and aggregate dollar volume traded (DVT). Dollar volume traded provides a price-weighted perspective on the changes in volume associated with a potential market event; furthermore, unlike volume as measured by shares, volume as measured by dollars allows for apples-to-apples economic comparison across time and stocks, as price-per-share varies due to both.

Consistent with the standard practice, we calculate dollar volume traded as follows: for each of the thirty trading days immediately following the Court's decision, we calculate the daily price of our given stock using the closing price for the trading day. Next, we multiply this closing price by the volume traded over that day. [12] We then calculate the average dollar volume traded over the entire thirty day pre-event estimation window by averaging the daily dollar volumes traded. Using the same methodology, we estimate the average dollar volume traded for each the two trading days in our event window (the day of the decision and the trading day immediately thereafter). Using the LOTM cases previously identified using the abnormal returns framework, we focus primarily on differences in dollar volume traded between a representative day and the

[12]While we recognize that prices may change over a given day, we believe the average of the daily closing prices offers a reasonable estimation of price (and is better than alternatives such as the daily high or low).

event period.

DVT is a conception of volume as measured in dollars. In a nominal sense, ignoring margin trading or shorting, it represents the gross dollars involved in trading activities. This number is critical, for example, to market makers or traders who might wish to understand the size of their positions relative to liquidity. In the case of market makers, these events may result in significant directional risk given the spreads that that they are contractually compelled to maintain. In the case of higher-frequency traders, these events may provide a compelling source of event-driven alpha, but it is critical to understand how large a bet may be placed. DVT and, more subtly, abnormal DVT, allow sophisticated market participants to better quantify their potential risk and reward.

4.5 Law on the Market: A Case Level Perspective

Given the wide scope of this paper and the ongoing possibility of joint causality, it is certainly possible that one or more of the results presented herein is driven by another contemporaneous event. It is also possible that the statistical significance of one or more of the LOTM cases or stocks is an artifact of our significance threshold. That said, across the 118 LOTM securities or exchange traded funds, over 85 of the 118 stocks in question experienced at least a 2% movement against the market model. 55 stocks experienced 4% or greater cumulative abnormal returns over the two-day window. *Table 2* offers our case-by-case estimation of the market cap, dollar volume traded, and cumulative abnormal returns for all LOTM cases and all LOTM securities.

Table 2: Statistically Significant Law on the Market (LOTM) Events

Case Name	Symbol	Abnormal DVT	Market Cap Impact	Point Estimate
United States v. Locke	CVX	3,646,474	3,256,382,212	0.066548 **
120 S.Ct. 1135 (2000)	XOM	215,593,471	23,876,128,996	0.091131 ***
Robin Free v. Abbott Labs	ABT	88,840,463	5,263,999,131	0.096659 **
120 S.Ct. 1578 (2000)	BMY	147,475,499	9,918,240,336	0.086523 ***
	JNJ	182,151,624	7,334,942,460	0.07512 ***
Norfolk Southern v. Shanklin	KSU	−7,486,732	1,022,028,891	0.151437 ***
120 S.Ct. 1467 (2000)				
United States v. Playboy	PLA	169,753	−4,891,438	-0.083455 ***
120 S.Ct. 1878 (2000)				
Harris Trust v. Smith Barney	XLF	1,319,209	22,891,473	0.053329 **
120 S.Ct. 2180 (2000)				
Bush v. Palm Beach County Canvassing Bd.	XLE	−5,530,622	3,527,938	0.054412 ***
121 S.Ct. 471 (2000)				

Continued on next page

Table 2 : Statistically Significant Law on the Market (LOTM) Events

Case Name	Symbol	Abnormal DVT	Market Cap Impact	Point Estimate
Whitman v. American Trucking Ass'n	GM	$-73,932,185$	$-1,864,716,761$	-0.059418 **
121 S.Ct. 903 (2001)	HMC	$875,624$	$-4,685,824$	-0.012076 **
Buckman Co. v. Plaintiffs' Legal Comm.	XLV	$-856,355$	$-689,586$	-0.015257 **
121 S.Ct. 1012 (2001)				
Circuit City v. Saint Clair Adams	CC	$-6,949,873$	$-222,022,297$	-0.091445 **
121 S.Ct. 1302 (2001)				
Pollard v. DuPont	XLI	$322,629$	$1,378,359$	0.01947 **
121 S.Ct. 1946 (2001)				
Lorillard Tobacco v. Reilly	VGR	$2,119,582$	$81,246,666$	0.106526 **
121 S.Ct. 2404 (2001)				
J.E.M. Ag Supply v. Pioneer	XLI	$-496,890$	$-1,198,772$	-0.015203 ***
122 S.Ct. 593 (2001)	XLP	$-41,088$	$13,918,090$	0.03823 **
Great-West Life Ins. v. Knudson	GWO	**NA**	$338,249,181$	0.027505 **
122 S.Ct. 708 (2002)				
Sec'y of Labor v. Mallard Bay Drilling	XLE	$-3,294,122$	$10,186,773$	0.038277 **
122 S.Ct. 738 (2002)				
Verizon Communications v. FCC	T	$-936,376$	$-2,502,709,242$	-0.05149 **
122 S.Ct. 1646 (2002)				
Verizon v. Public Serv. Comm. of MD	T	$-76,263,017$	$3,557,090,030$	0.077959 ***
122 S.Ct. 1753 (2002)	XLY	$1,648,171$	$-1,799,346$	-0.007931 **
Barnhart v. Peabody Coal	WLB	$105,135$	$76,082$	0.000834 ***
123 S.Ct. 748 (2003)				
Norfolk & Western Railway v. Ayers	NSC	4,206,575	-343,561,746	-0.046355 ***
123 S.Ct. 1210 (2003)	XLI	-1,822,253	-11,305,140	-0.041693 ***
	UNP	4,121,348	-484,343,680	-0.034756 **
Pacificare Health Sys. v. Book	PHS	$674,951$	$61,027,462$	0.066783 **
123 S.Ct. 1531 (2003)				
Pharm. Research & Mfr's v. Walsh	PFE	573,835,306	-12,718,219,763	-0.04597 ***
123 S.Ct. 1855 (2003)	BMY	266,960,866	-2,277,791,424	-0.045528 **
	XLV	3,154,307	-6,300,685	-0.025572 ***
	AZN	20,526,068	-124,851,323	-0.029752 **

Continued on next page

Table 2 : Statistically Significant Law on the Market (LOTM) Events

Case Name	Symbol	Abnormal DVT	Market Cap Impact	Point Estimate
Hillside Dairy v. Lyons 123 S.Ct. 2142 (2003)	XLP	117,569	6,872,931	0.027277 **
American Ins. Ass'n. v. Garamendi 123 S.Ct. 2374 (2003)	TRV	−3,667	4,318,783	0.043488 ***
Nike v. Kasky 123 S.Ct. 2554 (2003)	XLY	2,726,027	4,346,891	0.022002 **
Raytheon v. Hernandez 124 S.Ct. 513 (2003)	XLF	8,527,934	−13,934,987	-0.020726 ***
Household Credit Serv's v. Pfennig 124 S.Ct. 1741 (2004)	V	18,483,469	77,569,064	0.036286 ***
Jones v. R. R. Donnelley & Sons 124 S.Ct. 1836 (2004)	XLI	2,682,288	17,041,794	0.036887 ***
Aetna Health v. Davila 124 S.Ct. 2576 (2004)	UNH	63,491,519	−1,935,283,576	-0.049103 ***
Cheney v. U.S. District Court of Columbia 124 S.Ct. 2576 (2004)	HES	-7,368,730	-295,702,482	-0.041697 ***
	XOM	255,309,962	-5,322,749,723	-0.017903 **
	CVX	-14,194,848	-1,777,020,581	-0.017503 **
Cooper Indus. v. Aviall Services 125 S.Ct. 577 (2004)	XLI	−396,390	−12,570,067	-0.0176 **
Granholm v. Heald 125 S.Ct. 1885 (2005)	XLP	−6,898,679	17,208,867	0.022182 **
Merck KGAA v. Integra Lifesciences 125 S.Ct. 2372 (2005)	MRK	−69,773,070	1,584,991,390	0.022919 **
American Trucking Assn v. Mich. Pub. Serv. Comm 125 S.Ct. 2419 (2005)	YRCW	13,326,461	-124,899,527	-0.041491 **
Illinois Tool Works v. Indep. Ink 126 S.Ct. 1281 (2006)	ITW	63,797,034	638,010,513	0.026458 ***
Merrill Lynch v. Dabit 126 S.Ct. 1503 (2006)	MER	97,997,931	64,157,312	0.000868 ***
Ebay v. Mercexchange 126 S.Ct. 1837 (2006)	EBAY	−124,988,874	-2,182,028,895	-0.04914 **

Continued on next page

Table 2 : Statistically Significant Law on the Market (LOTM) Events

Case Name	Symbol	Abnormal DVT	Market Cap Impact	Point Estimate
Philip Morris USA v. Williams 127 S.Ct. 1057 (2007)	MO	−173,515,300	-3,539,948,877	-0.019594 **
Global Crossing v. Metrophones Telecomm. 127 S.Ct. 1513 (2007)	GLBC VOX	−5,886,533 −39,918	−85,219,835 −1,671,997	-0.076904 ** -0.007325 ***
Microsoft v. AT&T 127 S.Ct. 1746 (2007)	TFX VOX	18,606,506 1,451,894	−72,018,497 −1,436,853	-0.025642 ** -0.006344 ***
Riegel v. Medtronic 128 S.Ct. 999 (2007)	XLV	−68,240,280	-64,242,423	-0.026054 ***
Sprint Communs. v. APCC Servs. 128 S.Ct. 2531 (2008)	S XLY	−52,322,613 −14,158,082	1,658,603,780 −16,288,111	0.07553 ** -0.022495 **
Altria Group v. Good 129 S.Ct. 538 (2008)	MO	181,028,512	-2,788,958,029	-0.08824 ***
Kennedy v. DuPont Sav. and Inv. Plan 129 S.Ct. 865 (2009)	DD	70,606,899	-1,495,878,480	-0.068615 **
Wyeth v. Levine 129 S. Ct. 1187 (2009)	PFE	120,933,789	7,988,860,759	0.099778 ***
Travelers Indem. v. Bailey 129 S.Ct. 2195 (2009)	CNA	327,099	362,020,289	0.094833 ***
Coeur Alaska v. SE. Alaska Conserv. Council 129 S.Ct. 2458 (2009)	CDE	43,813,479	136,501,142	0.184156 ***
Conkright v. Frommert 130 S.Ct. 1640 (2010)	XLI	535,275,832	86,419,494	0.027994 ***
Chase Bank v. McCoy 131 S.Ct. 871 (2011)	AXP WEX	180,941,296 −4,650	-2,006,556,619 −109,947	-0.036237 ** 0.038107 **
Williamson v. Mazda 1131 S.Ct. 1131 (2011)	GM	1,054,372,974	-5,160,913,066	-0.091799 ***
FCC v. AT&T 131 S.Ct. 1177 (2011)	VOX XTL	51,959 6,156	4,842,596 −74,623	0.014943 *** -0.013904 ***
Astra v. Santa Clara County 131 S.Ct. 1342 (2011)	XPH	−704,199	2,053,797	0.027994 ***
AT&T v. Conception 131 S.Ct. 1740 (2011)	XTL	−1,096,713	-25,018	-0.001867 ***

Continued on next page

Table 2 : Statistically Significant Law on the Market (LOTM) Events

Case Name	Symbol	Abnormal DVT	Market Cap Impact	Point Estimate
Cigna v. Amara 131 S.Ct. 1866 (2011)	XLF	270,224,495	154,930,279	0.020594 ***
Global-Tech Appliances v. SEB S.A.	JAH	2,128,890	-121,474,410	-0.037876 ***
131 S.Ct. 2060 (2011)	XLY	97,794,273	−50,361,572	-0.021473 ***
Erica P. John Fund v. Halliburton 131 S.Ct. 2179 (2011)	XES	−4,817,231	-21,685,050	-0.04211 **
Wal-Mart v. Dukes 131 S.Ct. 2541 (2011)	XLY	44,229,006	37,879,034	0.01715 **
Goodyear Dunlop v. Brown 131 S.Ct. 2846 (2011)	GT	−24,495,312	-205,776,009	-0.053076 **
Credit Suisse Sec. (USA) v. Simmonds	CS	742,515	-82,419,345	–0.049502 ***
132 S.Ct. 1414 (2012)	DB	-24,792,290	-2,258,053,830	-0.049312 ***
	UBS	-3,748,416	-2,094,152,582	-0.039246 ***
Caraco Pharm. Lab. v. Nordisk 132 S.Ct. 1670 (2012)	XLV	−46,768,546	54,789,344	0.013476 **
Christopher v. GlaxoSmithKline 132 S.Ct. 2156 (2012)	XHE	−358,792	-69,372	-0.003151 **
Match-E-Be-Nash-She-Wish Indians v. Patchak 132 S.Ct. 2199 (2012)	STN	−84,176	37,154,875	-0.003151 **
Southern Union v. U.S.	XLE	155,947,385	-177,581,706	-0.027598 **
132 S.Ct. 2344 (2012)	KMI	−141,891,692	−424,510,695	-0.024491 **
Fed'n of Indep. Bus. v. Sebelius	HCA	352,267,822	1,290,237,867	0.110501 ***
132 S.Ct. 2566 (2012)	WLP	648,710,314	-2,023,088,139	-0.088001 ***
	HNT	28,599,889	-174,685,398	-0.083329 ***
	AET	290,631,223	-1,169,750,606	-0.082206 ***
	CI	256,343,576	-890,588,913	-0.068037 ***
	MGLN	3,800,843	74,843,356	0.0638 ***
	HUM	185,683,104	-719,907,505	-0.055466 ***
FTC v. Actavis	ACT	−134,578,415	-706,755,862	-0.041928 ***
133 S.Ct. 1310 (2013)	XPH	1,415,895	−11,427,365	-0.02761 ***
Bluechristine99 v. John Wiley & Sons 133 S.Ct. 1351 (2013)	PSO	3,180,279	-30,436,928	-0.043339 **

Continued on next page

Table 2 : Statistically Significant Law on the Market (LOTM) Events

Case Name	Symbol	Abnormal DVT	Market Cap Impact	Point Estimate
Kiobel v. Royal Dutch Petroleum	XOP	110,488,370	28,104,796	0.038507 ***
133 S.Ct. 1659 (2013)	XLE	710,014,228	182,893,261	0.024786 **
Bowman v. Monsanto	XLP	−91,615,389	78,039,996	0.011022 **
133 S.Ct. 1761 (2013)				
Ass'n for Molec. Pathology v. Myriad Genetics	MYGN	524,916,512	-546,731,681	-0.202351 ***
133 S.Ct. 2107 (2013)				
American Express v. Italian Colors Rest.	MA	304,551,875	-1,928,963,539	-0.028151 **
133 S.Ct. 2304 (2013)				
Ford v. U.S.	F	247,407,528	-2,256,812,134	-0.034111 **
134 S.Ct. 510 (2013)				
Sprint v. Jacobs	VOX	−1,277,305	-6,049,050	-0.010294 **
134 S.Ct. 584 (2013)	XTL	210,511	−24,448	-0.002309 **
Miss. Ex Rel. Hood v. AU Optronics	XLK	65,120,225	144,872,935	0.011264 **
134 S.Ct. 736 (2014)				
Limelight Networks v. Akamai Tech.	LLNW	1,968,662	54,743,617	0.254996 ***
134 S.Ct. 2111 (2014)				
CTS Co. v. Waldburger	SANM	648,686	109,115,185	0.06294 ***
134 S.Ct. 2175 (2014)	CTS	−723,343	30,381,569	0.049658 **
Loughrin v. U.S.	C	112,532,350	5,168,198,566	0.035938 ***
134 S.Ct. 2384 (2014)				
Halliburton v. Erica P. John Fund	BHI	59,639,713	-1,669,471,598	-0.05131 ***
134 S.Ct. 2398 (2014)	XOP	138,460,187	-44,373,777	-0.035632 ***
	HAL	70,818,570	-1,931,073,487	-0.032554 ***
	XES	-1,147,800	-5,625,465	-0.017953 ***
	XLE	567,630,228	-212,068,651	-0.017594 ***
Util. Air Regulatory Group v. EPA	XOP	138,460,187	-44,373,777	-0.035632 ***
134 S.Ct. 2427 (2014)	XES	−1,147,800	−5,625,465	-0.017953 ***
	XLE	567,630,228	−212,068,651	-0.017594 ***
Riley v. CA	S	−33,402,008	2,190,360,983	0.067397 ***
134 S.Ct. 2473 (2014)				
ABC v. Aereo	SBGI	188,473,724	321,197,891	0.153921 ***
134 S.Ct. 2498 (2014)	CBS	908,286,100	1,837,835,165	0.059017 ***
	FOXA	288,154,424	2,240,337,291	0.045865 ***

Each case has a story and it would be impossible to do complete justice to each of the events we present in *Table 2*. Thus, while *Table 2* offers our case by case-by-case analysis, *Figure 5* provides a more detailed treatment of four specific LOTM cases covering topics including preemption, tort law, environmental law, administrative law, and patent law. In *Figure 5*, we track the two-day time series of cumulative abnormal returns along the x-axis, starting at the 9:30pm open and concluding at 4:00pm on the day immediately following the Court's decision. Although there are a variety of forms of premarket trading, a typical trading day begins at 9:30am Eastern and concludes at 4:00pm. On a day when the Court sits, the Supreme Court announces its decisions at the beginning of its session, starting just after 10:00am Eastern time. The second gray vertical line denotes the beginning of the 10:00am Supreme Court session and the y-axis (scaled for each individual stock) tracks the change in returns experienced by the stock in question.

Reading from top to bottom, *Figure 5* begins with the time series of cumulative abnormal returns for *Altria Group, Inc. v. Good*, 129 S. Ct. 538 (2008), a case originating when "smokers of 'light cigarettes, filed suit, alleging that cigarette manufacturers violated the Maine Unfair Trade Practices Act (MUTPA) by fraudulently advertising that their 'light' cigarettes delivered less tar and nicotine than regular brands." The Supreme Court considered whether Maine's statute allowing plaintiffs to pursue a fraud claim was preempted by federal law. The Court ultimately "held that a state law prohibiting deceptive tobacco advertising was *not* preempted by a federal law regulating cigarette advertising," thus allowing the state tort claim to proceed. As displayed in *Figure 5*, following this Court announcement, Altria's (MO) stock immediately trended down, followed by lateral trading for much of the balance of the date of decision. In the following day, Altria's continued to decline relative to the S&P as the financial implications of the Court's decision began to become more widely understood. Ultimately, at the close of the two-day window, the stock had experienced a negative cumulative abnormal return of nearly 9%.

In *Whitman v. American Trucking Ass'ns, Inc.*, 121 S.Ct. 903 (2001), the Court considered a challenge to the Environmental Protection Agency's National Ambient Air Quality Standard (NAAQS). Among other things, the NAAQS is responsible for regulating the permissible amount of ozone and particulate matter. In response to revision in national ambient air quality standards, a series of organizations including the American Trucking Association challenged the EPA, arguing the enabling statute had impermissibly delegated legislative power to EPA. While the Court's decision was somewhat mixed, *Figure 5* reveals what appears to be a clear negative market reaction to the Court's decision. The then largest automaker General Motors (GM) traded down over the next two sessions.[13]

While the previous cases yielded downward movements for relevant stocks, *Coeur Alaska, Inc. v. Southeast Alaska Conservation Council*, 129 S.Ct. 2458 (2009) represented a substantial gain for Coeur Mining, Inc. (CDE). In *Coeur Alaska*, the Supreme Court considered a challenge brought by a series of environmental groups who sought to block the the disposal of tailings from a former gold mine. Coeur Alaska had obtained a permit to dispose of 4.5 million tons of tailings in a local lake located inside a national park. Environmental organizations challenged the permit, arguing it violated the Clean Water Act. The Supreme Court rejected the challenge, upholding the permit and thereby enriching its parent company. As displayed in *Figure 5*, within hours, the Coeur stock (CDE) traded up 10% and finished the day by posting S&P adjusted cumulative abnormal returns around 15%. The following day saw some small additional gains, but most of the returns had been established in the first trading day.

Limelight Networks v. Akamai Tech, 134 S.Ct. 2111 (2014) represented the largest two-day cumulative abnormal return with LLNW posting a S&P 500 adjusted gain in excess of 25%. The patent infringement case considered whether, under the specific circumstances present in the case, an infringement claim could be sustained even if no direct party had committed patent infringement. The Court held the answer was no and that decision was highly beneficial to Limelight Networks (LLNW). As displayed in *Figure 5*, the stock

[13] Although not displayed in *Figure 5*, Honda Motors (HMC) also traded down slightly over the two day window.

experienced an almost immediate gain of 5%, finishing the day up nearly 15%. The second day of trading saw LLNW continue to steadily rise into the afternoon of the session.

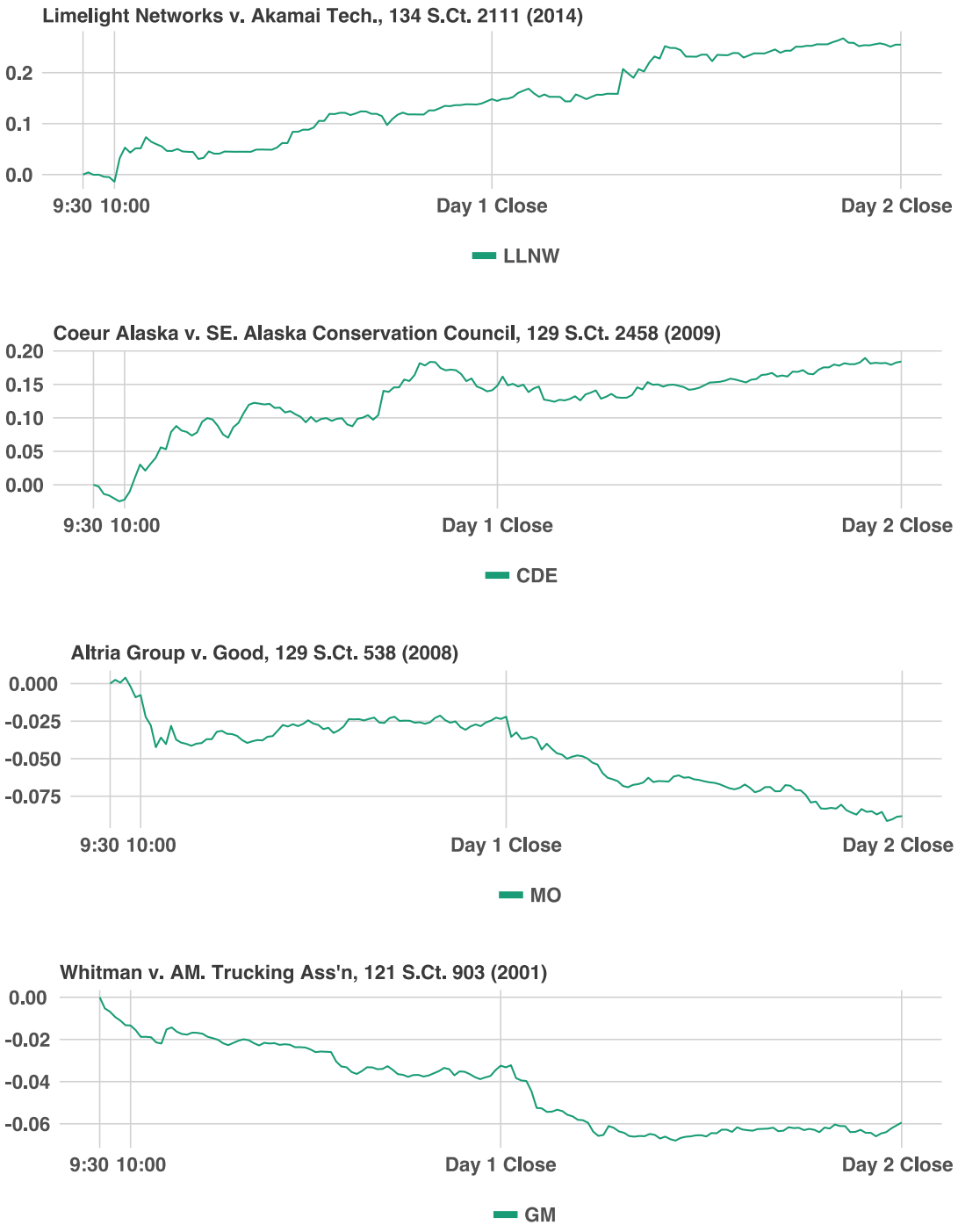

Figure 5: Two-Day Cumulative Abnormal Returns for Several LOTM Cases

Figure 6 highlights the market's response to the Court's high profile decision in *National Federation of Independent Business v. Sebelius*. In this case, the Court considered a variety of distinct questions surrounding the validity of the Affordable Care Act (often known as "Obamacare"). The Act made substantial changes to America's health care system and thus the Court's ruling was well understood to have significant financial implications for relevant health care stocks. In *Figure 6*, we plot cumulative abnormal returns for a significant number of healthcare related stocks including Aetna (AET), Cigna (CI), Hospital Corporation of America (HCA), Health Net (HNT), Humana (HUM), Magellan Health (MGLN) and Anthem / Well Point (WLP). Over the two-day trading window, the Court's decision drove down the price of a variety of health insurance companies while simultaneously increasing the value of one large hospital conglomerate (HCA) and a healthcare management business (MGLN).

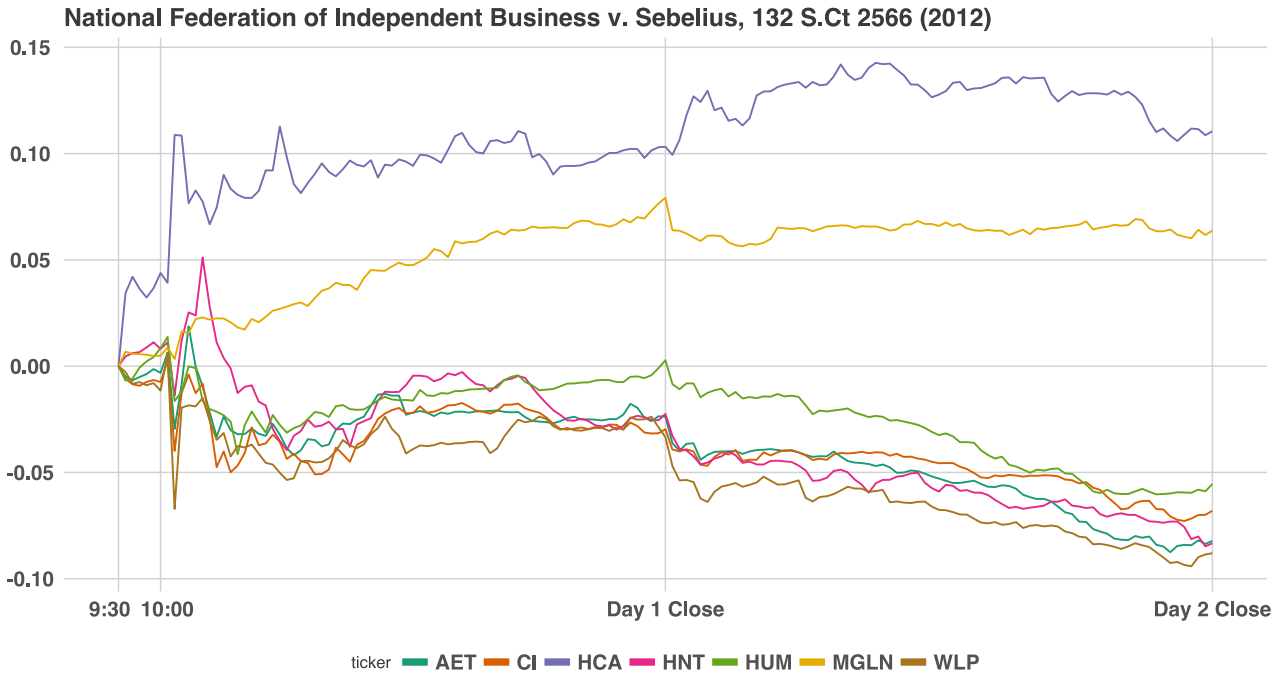

Figure 6: Two Day Cumulative Abnormal Returns for Obamacare Cases

Interestingly, each of the stocks of the health insurance companies that ultimately trended downward experienced a significant short term uptick in the immediately aftermath of the Court's decision. This is likely due to the widespread initial misreporting of the Court's decision, which appeared to engender market confusion in the immediate aftermath of the Court's ruling.[14] However, unlike the *Myriad* case discussed earlier, the market quickly corrected itself in response to the subsequent accurate reporting of the Court's decision. Collectively, among the stocks we evaluated in this study, the Obamacare decision was responsible for absolute changes in shareholder wealth in excess of 6.3 billion dollars.

[14]For some background on the misreporting *see* Katherine Fung & Jack Mirkinson, Supreme Court Health Care Ruling: CNN, Fox News Wrong On Individual Mandate, Huffington Post, June 28, 2012 available at `http://www.huffingtonpost.com/2012/06/28/cnn-supreme-court-health-care-individual-mandate_n_1633950.html`

5 Exploring the Signal Processing Environment Surrounding *Law as a Market*

Markets price information through the aggregation of decentralized decisions made by various actors. The efficient market hypothesis argues that at any given moment the price of a given security is reflective of the set of information available. The information state, however, is not constant, as new information periodically becomes available. In certain instances, new information leads to a change in prices. Using options (i.e. calls and puts), traders can seek to capitalize on these shifts. In this context, would-be arbitrageurs seek to determine the firm level economic impacts of a given Supreme Court decision and then appropriately position themselves in the relevant securities market. Speed is of the essence as arbitrage windows are finite and often fleeting. For those who are able to quickly and properly able to assess the direction and magnitude of the change in the information state, the rewards can be significant.

In *Section 4*, we demonstrated that law is indeed on the market, but there are a series of open questions that flow from this finding. We seek to determine the contours of the information processing environment. For example, what is the dynamic signature associated with LOTM signal incorporation? How rapidly and accurately does the equity market process new information of this type? *Figure 7* offers an overall portrait of signal incorporation across each of the 118 LOTM securities. Each statistically significant security-event pair is displayed on the y-axis while the x-axis displays each of the five minute intervals over our two day trading window. Each five-minute interval is colored using the classic heat map color scale, where 100% is the final two-day cumulative abnormal return. In all but a small number of cases, each the Court's decisions is rendered toward early part of the 10:00am Eastern hour. We denote this and other key time marks along the bottom of the x-axis.

Among the various LOTM cases, we observe substantial variation in the rate at which the market responds to the new information content. Given the complexity of its opinions and the differential timing of news reporting of its decisions, it is not surprising to observe a lag between the issuance of a Supreme Court decision and its ultimate incorporation into the price of a relevant security. In high salience cases such as *Sibelius* and *Myraid*, we observe rapid (albeit initially incorrect) signal processing. Across the overall set of cases, however, there is typically a significant delay between the release of the Court's decision and the ultimate price movement.[15] Indeed, *Figure 7* demonstrates that for all but a small number of securities in a small number of cases, there is a significant lag in the signal processing environment.

Although *law is on the market*, that market does not feature the same sort of high frequency response environment that is typically attendant to such event-based arbitrage mainstays such as central bank announcements {Bernanke and Kuttner [2005]}, {Jansen and De Haan [2007]} consumer sentiment data release {Akhtar et al. [2012]} and other meaningful news announcements {Gross-Klussmann and Hautsch [2011]} {Schumaker and Chen [2009]}. In extreme examples, the window for event-based trading has been reduced to mere milliseconds {Scholtus et al. [2014]}. Unlike these more well-known events that draw significant attention from traders, the typical LOTM security appears open to the development of an event-driven trading strategy.[16]

[15] *Figure 7* reveals that the movement of XLI 6/4/2001 and XHE 6/18/2012 predates the Court's decision. It is unclear whether this is driven by an independent event or is a function of the very low liquidity of the underlying securities.

[16] While *Figure 7* demonstrates that such rapid signal incorporation is not a property of *law as a market*, it is still worth exploring whether there has been an increase in the speed at which LOTM events are incorporated over the fifteen year window of study. Thus, we examined whether the pace of signal incorporation has changed over time. Namely, over the period on study (1999-2014) the financial services industry has seen substantial increase in the sophistication of traders and their ability to rapidly process new information. See {Brogaard [2010]} and {Scholtus et al. [2014]} as well as the references cited therein for a small slice of the growing literature on "high-frequency" trading. For well-known event based trading opportunities, the window of arbitrage has been substantially reduced by increasingly sophisticated trading strategies including the use of proprietary trading algorithms.

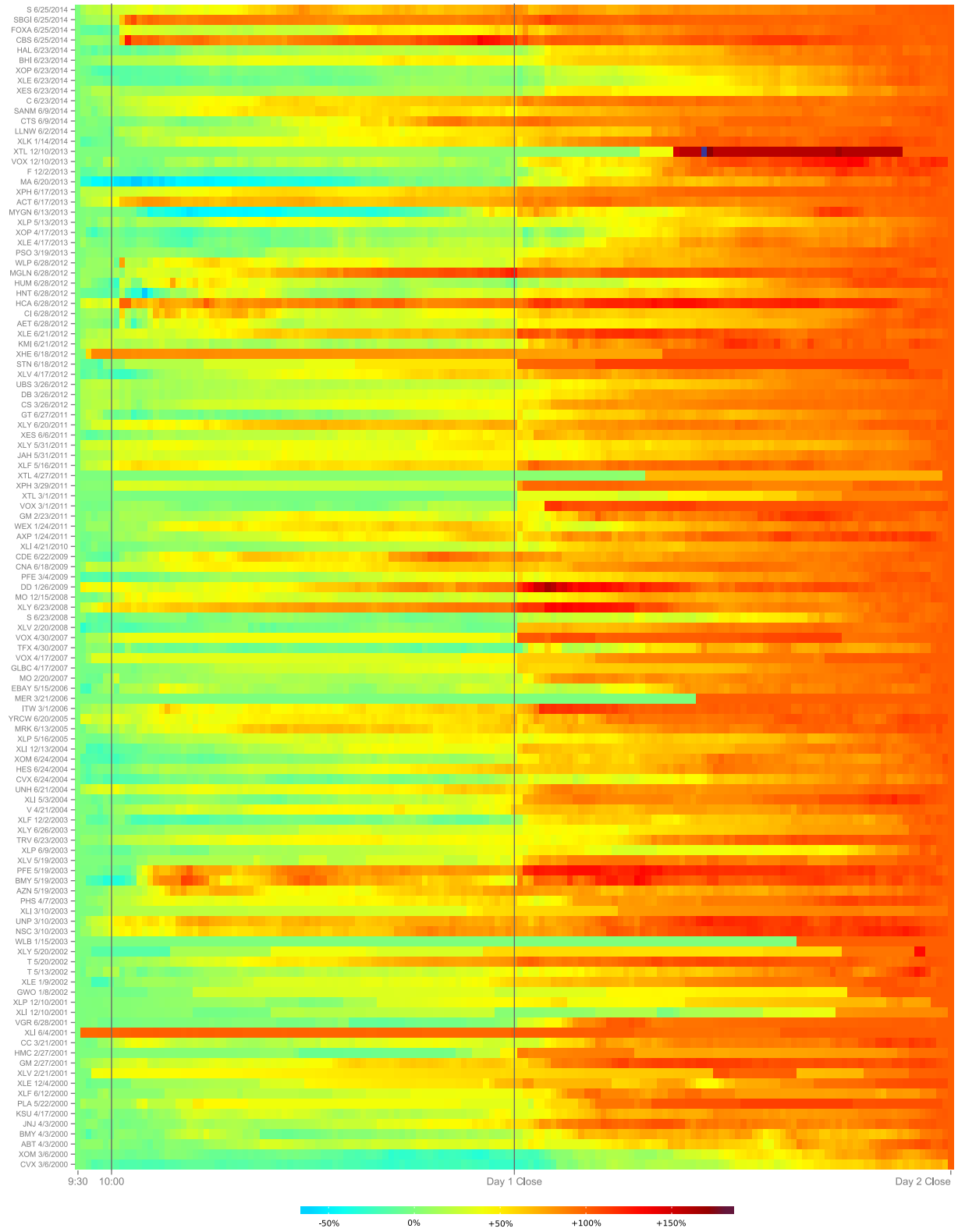

Figure 7: Cumulative Abnormal Returns as a Function of Time

6 Uncertainty, Prediction, and Some Concluding Thoughts

Even assuming one of the weaker forms of the efficient market hypothesis, from a theoretical perspective, we would only expect to observe statistically significant returns under a fairly limited set of conditions. For example, in some instances, new but otherwise independent information should have no impact on a given security.[17] By the same token, information that is unsurprising (i.e., does not update the information state) should not have an impact on a given stock. Under normal conditions, it is only relevant and otherwise surprising information that can significantly move the price of a given security.

Prior to release, there are many specific opportunities for the market to incorporate the potential impact of a Supreme Court's decision. These include but are not limited to the time of certiorari grant, information revealed through the interaction during oral argument and at each point up to the day of release of the Court's decision. Among other things, we believe our results are particularly interesting because a fairly high percentage (nearly forty percent) of our candidate LOTM events actually produced statistically significant cumulative abnormal returns. The presence of LOTM implies *ex ante* uncertainty regarding the Court's ultimate decision. Namely, it stands to reason that if the decision were not at least somewhat surprising then traders could have taken a position in relevant stocks and bid the stock up or down in anticipation of the final decision.

The predictability of this subset of Supreme Court decisions and its relation to the presence and magnitude of the observed LOTM is still very much an open and unexplored question. In related work, several of the authors of this study have examined the predictability of Supreme Court decisions using a variety of methods including algorithmic and crowd-sourced predictions.[18] Future work will explore the role of uncertainty as well as prior signal incorporation and its impact on the post-decision movement of the securities market.

This paper has presented a portrait of both *law on the market* and the contours of *law as a market*. Evaluating the population of cases decided in recent terms (1999-2014) of the Supreme Court of the United States, we have identified 118 securities across 79 cases (more than 5.5% of the docket) where the share price of one or more publicly traded companies moved in direct response to a Supreme Court decision. In the aggregate, over the past fifteen years, decisions of the Supreme Court of United States have been directly responsible for more than 140 billion dollars in absolute changes in wealth. As we have highlighted in *Section 5*, LOTM events have historically exhibited slow rates of information incorporation for affected securities. This implies a market ripe for arbitrage where an event-based trading strategy could potentially be successful.

[17] There is a significant amount of work in behavioral finance highlighting conditions where this statement does not hold. See generally {Shleifer [2000]}, {Barberis and Thaler [2003]}, {Lo [2005]}, {Hirshleifer et al. [2009]}, {Shiller [2015]}. That said, in general it is the case that independent information does not lead to a lasting change in the price of a particular security.

[18] For an algorithmic approach to Supreme Court prediction *see* {Katz et al. [2014]} and for the use of crowd-sourcing see generally `https://fantasyscotus.lexpredict.com/`. In ongoing work, we are exploring various forms of ensemble models that seek to optimally mix experts, crowds and algorithms. On this latter point, see generally `http://computationallegalstudies.com/2014/11/three-forms-legal-prediction-experts-crowds-algorithms/`.

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A Appendix

A model of normal returns (*i.e.*, expected returns unconditional on the event but conditional on other information) must be specified before an abnormal return can be defined. There are a variety of different approaches to establishing expected returns including the market model, constant expected returns model, etc.[19] We focus upon the simplest approach presented in the literature and for the reasons outlined in *supra Section 4.1.* Our data and implementing code are available on *Github* [20] and we encourage other researchers in future work to consider any alternative specification of their choosing.

In the literature, there have been various approaches used to estimate abnormal returns including {Sharpe [1964]} and {Brown and Warner [1985]}. We believe that {MacKinlay [1997]} presents the most useful summary of the formalization we leverage in this study. Therefore, for the ease of the reader we highlight that formalization below.

"For any security i the market model is:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$
$$\mathrm{E}(\varepsilon_{it} = 0) \qquad var(\varepsilon_{it}) = \sigma^2_{\varepsilon_i} \qquad (1)$$

where R_{it} and R_{mt} are the period-t returns on security i and the market portfolio, respectively, and ε_{it} is the zero mean disturbance term. α_i, β_i and $\sigma^2_{\varepsilon_i}$ are the parameters of the market model."

The market model is used to relate the return of a security to the return of some broader market portfolio. The market model is typically preferable to the constant mean return model because it partials out (controls for) the portion of the return that is attributable to broader market conditions. For our purposes, we follow the standard practice and use the S&P 500 index as our market portfolio.

As highlighted in *infra Section* 4.1, we divide time into three windows: an estimation window $(T_0, T_1]$, an event window $(T_1, T_2]$ with event time τ s.t. $T_1 \leq \tau \leq T_2$, and a post-event window $(T_2, T_3]$. In this specific implementation, our estimation window constitutes the two days prior to our event with price data aggregated to five minute intervals.

We use the simplest specification, ordinary least squares (OLS), to fit the parameters of the market model during the estimation window.[21] The properties of the OLS estimators are as follows:

$$\hat{\beta}_i = \frac{\sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\mu}_i)(R_{m\tau} - \hat{\mu}_m)}{\sum_{\tau=T_0+1}^{T_1} (R_{m\tau} - \hat{\mu}_m)^2} \qquad (2)$$

[19] See Nadarajah [2012] for an overview of sophisticated potential models of returns.

[20] See `https://github.com/LexPredict/law-on-the-market` for replication details. Given the terms of service associated with the stock data, we are unable to provide this data to other researchers but can direct any interested researchers to relevant third-party providers from whom they can purchase access.

[21] Far more complex specifications are certainly possible but the purposes of this project we pursue the simplest appropriate approach.

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \qquad (3)$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau = T_0 + 1}^{T_1} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2 \qquad (4)$$

R_{it} and R_{mt} are the return in the event period τ for the ith security and the market respectively. The properties of $\hat{\mu}_i$ and $\hat{\mu}_m$ are as follows:

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau = T_0 + 1}^{T_1} R_{i\tau} \qquad \hat{\mu}_m = \frac{1}{L_1} \sum_{\tau = T_0 + 1}^{T_1} R_{m\tau}$$

Using the parameter estimates outlined above we can now measure abnormal returns using the following approach:

$$\hat{AR}_{i\tau} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau} \qquad (5)$$

As noted in {MacKinlay [1997]} "the abnormal return is the disturbance term of the market model calculated on an out of sample basis. Under the null hypothesis, conditional on the event window market returns, the abnormal returns will be jointly normally distributed with a zero conditional mean and conditional variance $\sigma^2(\hat{AR}_{i\tau})$." The properties of $\sigma^2(\hat{AR}_{i\tau})$ are as follows:

$$\sigma^2(\hat{AR}_{i\tau}) = \sigma^2_{\varepsilon_i} + \frac{1}{L_1} \left[1 + \frac{(R_{m\tau} - \hat{\mu}_m)^2}{\hat{\sigma}^2_m} \right] \qquad (6)$$

Our null hypothesis H_0 is that the event in question (*i.e.*, a decision of the Supreme Court of the United States) does not impact the returns associated with our LOTM candidate stocks. Testing H_0 the distribution properties of the sample abnormal return of a given observation in the event window is given by:

$$\hat{AR}_{i\tau} \sim N(0, \sigma^2(\hat{AR}_{i\tau})) \qquad (7)$$

Finally, we must aggregate abnormal returns to create our overall point estimate of cumulative abnormal returns (CAR) during our event window. The CAR from τ_1 to τ_2 is the sum of the included abnormal returns:

$$\hat{CAR}_i(\tau_1, \tau_2) = \sum_{\tau = \tau_1}^{\tau_2} \hat{AR}_{i\tau} \qquad (8)$$