UNIVERSITY OF CALIFORNIA
SANTA CRUZ

ESSAYS IN APPLIED MICROECONOMICS

A dissertation submitted in partial satisfaction of the
requirements for the degree of

DOCTOR OF PHILOSOPHY

in

ECONOMICS

by

Luka Kocic

June 2022

The Dissertation of Luka Kocic
is approved:

Professor Carlos Dobkin, Chair

Professor George Bulman

Professor Justin Marion

Peter Biehl
Vice Provost and Dean of Graduate Studies

Table of Contents

List of Figures

List of Tables

Abstract

Essays in Applied Microeconomics

by

Luka Kocic

This dissertation uses reduced form techniques to causally answer questions of direct importance in the fields of health economics, underage alcohol enforcement, and education. The first chapter tests whether Randomized Control Trial evidence showing a procedure to be ineffective substantially changes doctors' treatment decisions. Leveraging differential timing of publication of clinical trials that show a currently used procedure is ineffective or potentially harmful, I implement an event-study design to estimate how doctors respond to said evidence. I find that the use of the procedures in question only declines modestly by 10% within two years of publication and 30% within four years. Furthermore, focusing on a subset of publications with more definitive findings, I find an effect size of similar magnitude. The slow adoption of new evidence is similar between privately and government insured patients, and there is only weak evidence that non-profit hospitals abandon procedures at a higher rate than medical-school affiliated and for-profit ones. That medical procedures are still commonly performed long after the publication of evidence revealing they are ineffective or harmful suggests the need for greater integration between research and practice.

The second chapter examines the impact of Minor Decoy (MD) citations (a law enforcement strategy targeting liquor license holders rather than underage consumers) in curbing underage alcohol-related crimes. Leveraging spatial variation in when and where citations occur, I use an event-study analysis to study the impact of these citations on arrest rates per 10,000 people for 18-20 year olds,

21-24 year olds and all adults 18 and over. I find suggestive evidence that there is an increase in overall alcohol-related arrests on the day of citation across age groups, mostly driven by liquor law violations. All other arrest categories show no detectable impact of MD citations in curbing underage alcohol-related crime. This suggests that the presence of police in licensed establishments greatly increases likelihood of arrest across all age groups, but does not provide any evidence that the MD programs curb underage alcohol-related arrests. This may be due to the scope of the treatment itself rather than a true null effect.

The final chapter studies the interaction between for-profit college profitability and partisan elections. Identification based on policy announcements is hindered by market anticipation, whereas elections provide well-quantified shocks to the policy environment. For-profit college stocks experienced large and immediate abnormal returns after the 2012 and 2016 presidential elections, but little change after presidential elections or midterm elections before 2016. Private student loan stocks have been sensitive to presidential and congressional results over the last four election cycles. The pattern of estimates is consistent with an important role for recent gainful employment rules, greater data availability, and the expansion of direct federal loans. The effects are largest for colleges with poor debt-to-earnings ratios and high veteran enrollment rates, but abnormal returns are evident across nearly all firms, suggesting that federal policies pose a threat to the profitability and viability of a significant fraction of the industry.

To my parents Aleksandar Kocic, Vesna Radanovic, and my brother and sister Marko and Aleks

Acknowledgments

Throughout my Ph.D. journey countless people have helped get me over the finish line and without their help I would not have been able to become the researcher and person I am today. I would like to first thank my advisor professor Carlos Dobkin, whose generosity, patience, and sharp intellect were instrumental in my research path. Willing to meet with me every week, helping me through each twist, turn, and topic I went through, and providing both encouraging and thoughtful guidance made my Ph.D. and job market as fulfilling and pain-free as possible. He cleared paths for me without which I would not have been able to write this dissertation.

I would also like to thank my other committee members professors George Bulman and Justin Marion. Professor George Bulman's passion for applied microeconomics helped guide my interests through his coursework and as he worked with me on my second year paper that eventually turned into a co-authored working paper that makes up the third chapter of this dissertation, entitled "The Effect of Federal Policy on For-Profit Higher Education: Evidence From National Elections." Being able to work alongside him was an invaluable experience that gave me a front-row seat to the process of paper writing and research design, teaching me lessons that I still use to this day. Additionally, both he and professor Justin Marion were incredible resources to bounce ideas off of as I started developing the papers that would eventually culminate in my dissertation. Their keen eyes and experience helped sharpen my research design and guide me through the peaks and valleys of empirical research. Furthermore, they were generous with their time at all stages of my career at UCSC, always willing to take time out of their days to talk research or professional development.

Lastly, I would like to thank the many other faculty members that contributed

to growing my curiosity and expertise in economics throughout my stay at Santa Cruz. Professors Dan Friedman and Kristian Lopez Vargas gave me the opportunity to experience the world of experimental economics and develop an understanding of all the components and considerations that go into experimental design. Professor Natalia Lazzatti, Sandra Reebie, and professor Jon Robinson helped me coordinate the Ph.D. program at each step, translating an arduous system into much more manageable steps. Professors Ajay Shenoy, Jeremy West, Robert Fairlie, Nirvikar Singh, and Laura Guilliano helped me hone my presentation and research skills in the field of economics both at the applied micro level and in microeconomic theory through their teachings and constructive comments during seminar presentations. They made me a better and more well-rounded economist, broadening my interests and scope from just one sub-field.

Outside of lectures and school settings, I have had the luck to make amazing friends who without which I would not have been able to survive these last seven years. I want to thank my cohort David Zink, Fernando Chertman, Andrew Barber, Jiayi Xu, Zijing Zhu, Ruizhi Zhang, Kelsey Pilch, and Yifei Shang. Working alongside each other through the first two years of coursework was a major reason I was able to finish my Ph.D. Without them I would not have made it to where I am today. I would also like to thank Sophie, Joey, Dan Solecki, Alberto, Zach, Julian, Johnny, Jane, Drew, Rosie, Amanda, Sarah, Taylor, Niky and Kristina. Making life outside of school exciting, fun, and a pleasure made the stresses of grad school pale in comparison.

Lastly, I would like to thank my family. My parents Vesna and Aleksandar for being the shining examples of people both morally and intellectually that allowed me to even think pursuing a Ph.D. was achievable and my brother and sister Marko and Aleks for being my best friends, therapists, and confidants during my

whole life.

Earning a Ph.D. has been the single greatest achievement of my life. It has taken many twists, turns, pot-holes, dead ends, and any other obstacle analogy one can think of. However, every day and every challenge has brought a new lesson and I have constantly grown as a researcher, as an economist, and as an intellectual as a result. I look forward to continuing to learn in the next chapter of my career.

Chapter 1

The Impact of Negative Experimental Evidence on the Continued Use of Medical Procedures

1.1 Introduction

Healthcare spending per capita in the U.S. is higher than in any other country, having reached $3.8 trillion and $11,582 per person annually in 2019 (Martin et al., 2020). Cost due to the continued use of low value care or overtreatment of patients has been estimated to be over $100 billion annually (Shrank et al., 2019). Procedures that are ineffective or harmful hurt patients financially and physically. Every procedure comes with a financial burden either paid directly or indirectly by the patient or employer in the form of the price of surgical procedures, forgone wages, or hospital stays. These costs are often a barrier to care, with 25%

of Americans in 2019 saying they or a family member avoided medical care for a serious condition due to cost alone (Saad, 2019). Furthermore, surgeries often require long recovery periods and can have complications that result in disability or death. These risks are usually balanced against the benefit of an operation and therefore justified. However, when care is ineffective patients suffer without receiving the treatment they need for their condition. Thus, the continuing practice of procedures that are ineffective adds to wasteful spending in healthcare, subjects patients to risks with little or no potential benefit, and may undermine trust in the healthcare system.

The persistence of low-value treatments despite the burden it imposes may be due to an incomplete evidence base on efficacy of care. As a 2012 study done by the British Medical Journal: Clinical Evidence revealed, only one third of 3,000 treatments examined had empirical evidence showing that they were likely to be beneficial and 50% were of unknown efficacy (Street et al., 2012). Treatments may be adopted based on evidence from mechanistic models, observational studies, or analysis focused on surrogate outcomes rather than clinically meaningful endpoints. Additionally, surgical procedures do not go through a federal or state agency approval process. Rather, they are passed down by teaching hospitals. As a result, it is not uncommon for physicians to use treatments with limited knowledge of their true efficacy.

Given the lack of empirical support for many treatments, and surgical procedures in particular, and with the goal to combat wasteful care, there has been an emphasis on evidence-based practices since the 1980s. A core tenet of evidence-based medicine is the use of randomized control trials (RCT)'s to inform practice. However, in order for evidence-based medicine to be effective, the trials done need to impact doctors' decisions. This paper examines how physicians incorporate

evidence of efficacy when choosing a course of treatment by studying how the publication of evidence showing a procedure is ineffective impacts the usage of it in inpatient settings. I focus on 25 RCT's published between 2002 and 2015 in three of the top international medical journals. Each journal imposes significant penalties for posting final results prior to publication, allowing me to treat the release of each article as a negative information shock regarding a procedure. I employ both an event-study framework in the years before and after publication, and a staggered difference-in-differences design that exploits the differential timing of each publication. With these strategies, I am able to observe the dynamics of procedure abandonment over time as well as implicitly test for any anticipatory effects prior to publication. I separately consider a subset of 15 RCT's with the most definitive results to see if stronger conclusions lead to greater adherence.

This analysis is based on the universe of inpatient hospitalizations from Arizona, Florida, California, Maryland, New Jersey, New York and Washington between 2000 and 2017, covering one third of the U.S. population. I observe both the diagnosis and procedure for a patient throughout their hospital stay, allowing me to track whether a patient received both the procedure found ineffective in an article and the diagnosis it was meant to treat. I measure utilization of a procedure as the natural log of the rate at which it is performed[1]. The intersection of both the diagnosis and procedure is the most targeted outcome from each negative RCT, making a near 100% decrease the likely outcome if there was full adherence to the implicit recommendation of each article. The primary analysis examines the magnitude and timing of the deadoption of procedures in the years after definitive research against their usage is published. I estimate both the short and long-term trajectory of abandonment for all procedures and for those with

[1]I converted the count of patients who received the procedure and diagnosis it was meant to treat into the rate per million people by dividing the quarterly count by the overall population and multiplying by 1 million.

strongest negative findings separately.

I find that the usage of procedures falls modestly by 10% in the first two years after publication, with the decline starting in the first quarter and growing over time. The reduction reaches 30% four years post-publication. Even when focusing on events with the most definitive findings, I find a trajectory that is not significantly different. These findings are consistent with far from a majority of medical professionals failing to incorporate the results of these trials into practice in inpatient settings.

To better understand to what extent these procedures persist in a variety of medical settings, I analyze differential abandonment post-publication across two channels, patient insurance provider and hospital ownership/medical-school affiliation. Hospitals are possible actors for implementing guidelines to better inform physicians and protocols for insuring uniform practice across surgeries. However, procedures are a significant source of revenue and reputation for hospitals, making the incentives for abandonment complex. In addition, hospitals have different levels of integration with research and therefore may also have a different degree of connection to the medical literature and protocols for its dissemination and incorporation. This paper compares non-profit hospitals, for-profit hospitals, and medical-school affiliated centers to shed light on the role financial compensation structures and research intensity may play in abandonment. For-profit hospitals are investor-owned and have no built-in incentives to conduct medical research. On the other hand, non-profit hospitals receive a federal tax break on the condition that any profit earned will be used towards community benefit. One acceptable form of this is to conduct health research within the hospital. Similarly, Medical-school affiliated hospitals are teaching institutions meant to train physicians, and therefore should be the most aware of the current evidence base in medicine.

I find suggestive evidence that non-profit hospitals abandon at the fastest rate, with effect sizes similar to the overall impact observed in the event-study. For-profit hospitals do not react to the literature, remaining at the same usage levels in post-publication relative to pre, and medical schools are noticeably flatter in their response relative to non-profit hospitals, although estimates are noisy and not statistically distinguishable from each other. All three categories do not suggest substantially greater abandonment than what was found in the primary results.

Insurers can drop coverage for ineffective procedures and therefore decrease demand for their continued use by increasing the effective price patients pay. Thus, they present a strong avenue for the translation of evidence to practice through coverage determinations. The determination process, however, may be subject to outside pressure from lobbyists, public interest groups, and other parties that can slow down and weaken the efficacy of a determination. These issues are more present in government insurance providers such as Medicare and Medicaid, where determinations are often year long processes and open to public opinion and input. Therefore, I compare deadoption of procedures between patients with private vs. government insurance coverage to understand the magnitude of these frictions in limiting coverage determination efforts.

The pattern of abandonment across insurance carrier is virtually identical and does not depend on the strength of the finding in the underlying RCT. The event-study coefficients are nearly identical, suggesting that the difference in coverage determination processes does not explain the modest overall reaction to evidence of the inefficacy of a procedure.

Each of the articles I've used shows inefficacy or harm of a procedure relative to a less invasive treatment, a treatment with lower risk of complication, or relative to no treatment. Despite this, even in cases with the strongest evidence, the

procedures are still in use long after publication. The lack of a substantial response highlights fundamental inefficiencies in the translation of medical evidence to practice and suggests there is significant room for cost reductions and improved medical outcomes through greater oversight from government agencies.

This paper contributes to the literature on doctor decision making by systematically evaluating the role negative evidence has on medical practice. I introduce a new source of variation on information by exploiting the publication of a large list of RCT's whose results are likely unanticipated to the general public and medical community before release. Most literature in economics exploiting the impact of the publication of a negative trial on physician practice has focused on an individual treatment and specific dimensions of heterogeneity. For example, studies have differentiated the effects of negative information shocks on the use of individual treatments across hospitals (Greenwood et al., 2016; Howard et al., 2017; Howard and Shen, 2011; Duffey and Farley, 1992), physicians (Gardner and Vishwasrao,2018), due to peer interactions (Berez et al., 2018; Huesch, 2011), and by patient characteristics (Smith et al., 2020). These show that peer interactions are positively correlated with abandonment rates, and board certified physicians and those from higher rank residency programs are slower to abandon. The effect is mixed for hospital ownership, with some studies finding evidence of greater abandonment in academic medical centers and others finding no discernible impact, suggesting that the reasons for abandonment are multi-faceted across agents. The medical literature includes numerous analyses of individual procedures, ranging from single-center to national trend studies, and sometimes incorporating foreign countries. The results are mixed across procedures in terms of whether there was a decrease as a result of the publication of a given trial and its magnitude. These studies are limited in their ability to infer the causal impact of publication on

practice since they don't have a good measure of a procedure's trajectory absent of publication. There have also been several studies on the impact of clinical guideline information interventions such as Choosing Wisely and UK's National Institute for Health and Care Excellence's (NICE) appraisal releases. These have found the influence of information interventions to be mixed at best, with some finding virtually no impact (Dietrich, 2009). This study builds on this literature by using a large list of RCT's to examine the overarching pattern of deadoption in response to publication. This also allows me to use a new identification strategy in the event-study and staggered difference-in-differences designs, which take advantage of the differential timing of article releases to obtain a causal estimate of the overall impact of negative evidence on practices. Additionally, this paper uses events that have not had the chance to be synthesized into clinical practice, unlike other information interventions that are based on clinical guidelines. I strengthen this contribution by examining the role insurance provider and hospital ownership may play in abandonment across procedures.

The paper is organized as follows: section 2 covers defining the randomized trial events and how these procedures came to exist, the journal publication process, and the literature up to date on the topic; section 3 provides an overview of the data; section 4 details the empirical design; section 5 describes results; and section 6 discusses potential explanations for the pattern of evidence seen.

1.2 Background

1.2.1 Ineffective Care

Each RCT examined in this paper was identified by doctors Adam Cifu and Vinay Prasad, who have been at the forefront of identifying ineffective treatment

in the medical literature. In their paper published in the Mayo Clinic Proceedings, they and coauthors went through 1,344 original articles published in the New England Journal of Medicine (NEJM) and identified 146 different papers where a currently used practice was found, through RCT, to be ineffective or potentially harmful relative to no therapy, as an addition to optimal treatment, compared to a placebo, or compared to a previously obsolete/less-invasive therapy(Prasad et al., 2013) [2]. The RCT's they observe span the range of medical treatments, from surgical procedures to prescription drugs, diagnostic testing, and systems in hospitals. They discover that greater than 10% of the original articles from their sample resulted in the finding of a currently used procedure as harmful or ineffective.

In order to understand why the use of ineffective treatment persists, it is important to keep in mind why these treatments were used in the first place. First, treatments are often adopted based on flawed evidence that relies on relationships that may not prove to be empirically causal. One major contributor in this process has been creating treatments that target surrogate rather than clinical outcomes. Goals like survival and comorbidity are harder to directly assess since they are often less frequent events, and as a result a large amount of energy has been put towards targeting measures that are correlated with them but do not necessarily causally impact them. This creates cases where a therapy may treat a surrogate outcome to the detriment of a clinical one. For example, consider the case of flecainide in the early 1990's. Flecainide was an anti-arrhythmic medication meant to stabilize irregular heartbeats and prevent premature ventricular contractions, which have a strong correlation with sudden death. In 1992 an RCT sought to test the efficacy of medicine like flecainide to reduce risk of death. The study found

[2]They have since extended their work, writing a book entitled *Ending Medical Reversals* published in 2015.

that relative to a placebo, anti-arrhythmic drugs did indeed decrease premature ventricular contractions. However, they also led to a higher risk of death (Prasad and Cifu, 2015). Focusing on surrogate measures and assuming they have a causal channel to the health outcome of interest can lead to practices that become common place but do not actually benefit, or in the worst cases, directly harm their patients.

Second, medical practices are often assessed based on a mechanistic framework rather than empirical evidence. These procedures are not adopted randomly, but rather based on a theoretical framework, and are often taken as fact rather than rigorously tested before usage. For example, the practice of vertebroplasty was created in the late 1990's as a way to treat osteoporotic spine fractures in older patients. The procedure, where a physician injects medical grade cement into the fractured vertebrae, was thought to create space for nerves to reduce pressure caused by fractured bones. The procedure was quickly adopted in the early 2000's, lobbied heavily to be covered by Medicare, and since has become an industry worth a billion dollars a year. In 2009 an article published in the NEJM examined vertebroplasty against a saline solution in a 200 person blind placebo trial. They found that vertebroplasty was no better than a placebo treatment, despite the theoretical reasoning behind its acceptance.

Finally, the evidence base for currently used practices can be problematic as well, with observational studies, rather than randomized trials, used to document efficacy. One of the most famous instances of the downside of such studies was the prescribing of estrogen and progestin in post-menopausal women. Post-menopausal hormone therapy was common practice in the 80s and 90's due to the belief that it would decrease the risk of heart attack in women. This belief came from the release of the Nurse's Health Study (NHS), a large cohort study started

in 1976 that followed 127,000 nurses every two years, filling out questionnaires on their medical histories and major life events. The NHS found that estrogen users had 40% fewer heart attacks than those who took no hormones, leading to the widespread use of hormone therapy. In 1991, the Women's Health Initiative experimentally tested this relationship by implementing a large RCT meant to span 15 years. The WHI published their results early in 2002 after they had to discontinue the trial because women in the treated arms had higher risk of not only heart attacks, but breast cancer and stroke as well.

The persistence of the evidence processes above that lead to the adoption and continued practice of flawed therapies have direct financial and physical costs to patients. Hospital stays, recovery costs, and forgone wages from time missed at work can be substantial. For example, vertebroplasty is estimated to cost on average $14,585 within the first quarter of treatment and close to $45,000 after two years post surgery(Ong et al., 2013). Additionally, there is an opportunity cost to ineffective treatment in terms of time that could be better used pursuing empirically proven methods. The sustained use of ineffective care erodes trust between patients and doctors, which can lead to worse health outcomes, as patients may avoid seeking care even when beneficial treatments are available.

1.2.2 Publication Process of Clinical Trials

Two key factors in the publication process are crucial for there to be a large and sudden response to newly released RCT's showing a currently used practice is ineffective. The first is that the information published in each journal article will plausibly reach doctors. If the viewership of the medical journals in question is low, new evidence will not impact doctor behavior because of a lack of awareness rather than because physicians dismiss the results. The three journals I analyze

are the NEJM, the Journal of the American Medical Association (JAMA), and the Lancet. They are three of the four highest impact journals in the field and have millions of readers weekly, with JAMA's online viewership averaging 57 million annually and the Lancet's 84 million. The NEJM has a million readers weekly. These are the most prominent journals in the field. Therefore, not only are their results most likely to reach doctors, but articles in these journals are considered the highest quality in the field, adding credibility to their findings.

The other important factor is that the results from the RCT's are not anticipated pre-publication. If the information was available and fully integrated into practice before release of the article, then it would be hard to conclude that any change in doctor behavior is directly attributable to the results of the clinical trials themselves. While the event-study design tests this implicitly by examining trends prior to publication, it is also important to validate the assumption based on the publication policies of the three medical journals in question.

At each journal, early release of the final results by the authors prior to publication is grounds for denial of publication. There are three main exceptions. The first is the presentation of data at a scientific meeting. Authors are allowed to present slides, an abstract, or a poster at conferences. However, authors should not send out reports or finalized results to participants at conferences.

Authors are also allowed to post non-peer-reviewed manuscripts in non-profit pre-print servers prior to the peer review process at both the NEJM and the Lancet. These are meant to be viewed with the same amount of information validity as an abstract and are not meant to be used for clinical decision making. For JAMA, if there was a scientific meeting or previous pre-publication version of the paper available, the article indicates this at the end of the text. None of the articles originating in JAMA used in this paper have a pre-publication manuscript

posted. Unfortunately, for the NEJM and the Lancet it is not possible to directly check whether there was a pre-published manuscript. However, given the event-study design, if the pre-print manuscript posting represented the true information shock to the medical community, the impact should be visible in the pre-period coefficients. Lastly, in times of public health crisis or for information related to government agencies, the authors can release reports directly to the corresponding authorities.

Each journal also has a media embargo pre-publication. Media journalists receive access for the upcoming issue of each journal and are allowed to conduct interviews with authors and prepare stories. In order to have this access, journalists must agree not to publish any story pertaining to the article until a set time, usually the day before the journal is published. Similarly, during the pre-publication process, authors are strongly discouraged from producing news releases. For instance, JAMA states that "direct release of information through press releases or news media briefings may preclude consideration of the manuscript by this journal." (JAMA, 2016)

In summary, there are strong disincentives against publishing or making the final peer-reviewed results widely known prior to publication. Additionally, journalists enter into agreements not to print stories about results prior to publication. Scientific conferences may result in some anticipatory behavior within the first year prior to publication, but given the strong penalties for release, treating each publication as an unanticipated information shock to the medical community is justified.

1.2.3 Literature Review

Economics has a large literature examining technological diffusion in several different settings, including in medicine. However, relatively little has focused on the abandonment of technology in the medical setting. There is reason to believe that there would be asymmetry between technology diffusion and abandonment due to sunk costs, habit, and education and training. Medicine provides an interesting lens by which to look at abandonment for several reasons. One is that there are strong financial incentives for maintaining the practice of procedures in lieu of less invasive alternatives. Unlike typical models where abandonment may be due to a more profitable alternative being present, this is not necessarily the case. Additionally, there is a level of subjectivity to interpretation of results, since doctors can argue that their skill outranks the results they find. This makes the impact of information potentially weaker than in a setting where skill does not play a role. On the other hand, there are direct human costs to the continued usage of a procedure that should factor strongly into a typical doctor's objective function.

In terms of the suspension of medical procedures due to the publication of negative findings, the economics literature has largely been focused on examining the dissemination of negative RCT's to practice through individual case studies. These have taken the form of an analysis of the dissemination of evidence into practice and differential abandonment based on a dimension of heterogeneity, such as hospital ownership, physician certification, and physician peer effects. These analyses have considered procedures such as percutaneous coronary intervention (PCI), stenting, arthroscopic knee surgery, pulmonary artery catheter (PAC) usage, intermittent positive pressure breathing, and drugs such as fenofibrate and

dronedarone.

The most common procedure studied in the literature has been coronary stenting. (Huesch, 2011) and (Gardner and Vishwasrao, 2018)both examine the adoption of bare metal stent utilization, the substitution of bare metal stents for drug-eluting stents in 2003 and the subsequent abandonment of drug-eluting stents after March 2006 once their efficacy was called into question when results from the BASKET-LATE clinical trial showed that compared to bare metal stents, drug-eluting stents had higher rates of death due to cardiac complications, non-fatal heart attacks and thrombosis in the stent area. (Greenwood et al., 2016) examines stenting more generally using a guideline published by the American Hospital Association in 2005 calling into question the use of stents in general for stable, low-risk coronary artery dissection patients. All three of these studies use data from the Florida Agency of Health Care Administration's (FLAHCA) inpatient files. (Gardner and Vishwasrao, 2018) identifies differential discontinuation rates of drug-eluting stents post-publication based on whether the physician was board-certified or came from a top ranked residency program. (Greenwood et al., 2016) analyzes the role hospital ownership plays in the abandonment of procedures and (Huesch, 2011) examines if partner's and competitor's usage patterns positively or negatively impact a physician's continued use of drug-eluting stents. In aggregate, the papers find that board-certified physicians and doctors from top-ranked residency programs were slower to change their behavior after the event, that academic medical centers abandon stent usage faster than non-profit and for-profit hospitals, and that one's usage of drug-eluting stents is negatively correlated with competitor's continued usage of the procedure and positively correlated with partner's usage. (Howard and Shen, 2011) also extended this analysis by examining the impact of the publication of the COURAGE Trial, which showed that

PCI performed the same as medical therapy for stable angina patients, on relative usage of PCI for stable versus unstable angina. They compare U.S. community hospital deadoption to English hospital and Veteran hospital deadoption, finding the results larger for U.S. community hospitals, despite the payment structure following a fee-for-service schedule. They found no convincing evidence of differential abandonment across hospital ownership, whether a hospital was part of a joint venture system, or whether the hospital offered cardiac surgery. They did find a decline overall, but far from full adherence to COURAGE trial guidelines.

In addition to the papers that have examined coronary stenting, there are several papers looking at other procedures. The first, (Duffy and Farley, 1992), looked at the utilization of intermittent positive pressure breathing from 1980 to 1987, in a period where much of the evidence coming out was warning clinicians against the usage of it, including a large RCT done by the National Heart, Lung, and Blood Institute. They examined differential cross-sectional practice in the procedure across a variety of different hospital and patient characteristics, finding no strong evidence of determinants of total abandonment. They concluded that the issue of technological abandonment is multi-faceted, rather than being driven by one set of incentives. They also found that the procedure persists to a significant degree even four years after the publication of the trial.

(Howard et al., 2017) investigated the impact of the publication of two different clinical trials showing that arthroscopic knee surgery is ineffective relative to a sham procedure or as an addition to optimal therapy. The dimension of heterogeneity they exploit is physician oversight by looking at the differential usage of hospital versus physician-owned outpatient centers in Florida. They find that the decline in usage is slower for physician-owned service centers, in line with the idea that doctors may face strong financial disincentives to abandonment.

(Berez et al., 2018) studies the impact of a 1996 observational study that found that PAC's had a high association with mortality. In particular, they study how the the entry of a new physician within hospital post-publication affected doctors already working at a hospital. They break up the new entrants into ones who have a high, medium or low PAC prescribing volume to see how it influences the volume of PAC usage among longer tenured physicians. They find that newly trained entrants do influence incumbent doctors' use of PAC's. Additionally, the effect seems larger in deadoption rather than continued usage of PAC, although both are statistically significant. This highlights the role experience may play in the decision to abandon a procedure.

Pivoting to prescribing patterns for drugs rather than procedures, (Smith et al., 2020) studies how the publication of the ACCORD trial, which found fenofibrate to be ineffective when used with statins, and the PALLAS trial, which found dronedarone to be unsafe for patients with permanent atrial fibrillation, impacted the prescription of fenofibrate and dronedarone, respectively, in Medicare fee-for-service claims data between 2008 and 2013. They find that there was a decrease post-publication for both prescription drugs and suggestive evidence of a greater decline in dually enrolled patients in Medicare and Medicaid relative to Medicare-only patients.

Medical Literature

The medical literature on ineffective care falls into two broad categories, one meant to identify the prevalence such publications, and the other the effect of individual studies on trends in usage of the procedure in question. The first paper to identify the existence and persistence of treatment that have been shown to be ineffective through clinical trial was (Tatsioni et al., 2007). In this paper, the

authors study how evidence against a commonly cited and once-held claim impacts how that claim is discussed in the medical literature overall. They analyze the citations in 1997, 2001 and 2005 for two highly-cited articles that, based on observational evidence, found that vitamin E supplements decrease risk of cardiovascular disease. They track whether the research citing the work was favorable, unfavorable, or equivocal towards the original work after three separate follow-up studies. The first, in 1996, was an RCT that showed some effects consistent with the original papers. The second, in 2000, was a large scale RCT that showed no signs of effectiveness of vitamin E supplements on cardiovascular risk. The third, in 2004, was a meta-analysis that showed that vitamin E supplements increased risks of death. They found that the proportion of favorable citations decreased after the two negative events, while the proportion of unfavorable citations increased. However, surprisingly, the largest percentage of citations in all periods remained favorable.

Following this work, (Prasad et al., 2011) reviewed one year of publication in the NEJM (2009) and identified how many of the articles published identified a currently used therapy as ineffective. The paper found that of the 124 original articles that concern a medical practice published in the NEJM, 16 showed a currently used practice to be of no benefit or potentially harmful. (Prasad et al., 2013) extended this analysis to all the original articles published in the NEJM from 2001 to 2010, and (Herrera-Perez et al., 2019) extended it to JAMA and the Lancet from 2001 to 2017, and in the NEJM from 2011 to 2017. The frequency of occurrence, as outlined in the background section, is remarkably consistent, with each review revealing that greater than 10% of the published studies found that a currently used practice is not beneficial. While this literature is important for understanding the frequency of these findings across the medical field, it does not

analyze the empirical consequences of the publication of these findings on practice.

Empirical evaluations of the impact of publications of negative evidence on utilization of procedures has been done in a case-by-case basis in the medical literature. These studies for the most part consist of a pre-post analysis of an individual procedure in terms of annual or quarterly rates to see if the publication of the negative finding influenced rates of practice. The procedures examined have been carotid stenting and angioplasty (Bekelis et al., 2017 ; Hussain et al., 2016), corticosteroid injections (Fujihara et al., 2018), humeral fracture surgery (Reeves et al., 2020), PCI (Deyell et al., 2011; Bangalore et al., 2015; Atwater et al., 2009; Howard and Shen, 2014), manual aspiration thrombectomy (Secemsky et al., 2019; Buccheri et al., 2019), arthroscopic knee surgery (Adern et al., 2020; Kawata et al., 2018; Mattila et al., 2016; Ghomrawi et al., 2017), vertebroplasty (Goz et al., 2015; Leutmer and Kallmes, 2011; Smieliauskas et al., 2014), lymphandenectomy for endometrial cancer (Melamed et al., 2015), PAC's (Gershengorn and Wunsch, 2013; Wiener and Welch, 2007), and endovascular aneurysm repair for abdominal aortic aneurysms (Jetty and Husereau, 2012). These papers range from single-center analyses to national trends from within the U.S. to Japan, U.K. or Finland and Sweden. The results are mixed across different procedures in terms of the extent to which abandonment is observed.

Information Dissemination Literature

An important question to understand the probable impact that a publication can have on the practice of a procedure is how that information is disseminated to doctors and practitioners. Is the issue of continued usage of an ineffective procedure due to a lack of knowledge of the evidence itself, or are there other incentives that create inertia in the medical field? Two initiatives that publish

clinical guidelines in the hopes of decreasing low-value care help provide insight on this subject. Launched in the U.S. in 2012, Choosing Wisely was started by the American Board of Internal Medicine (ABIM) in order to decrease overused and low value care by having medical specialty organizations create their own top-5 lists of practices that are inappropriate or provide low value. The National Institute for Health and Care Excellence (NICE) in the U.K. publishes recommendations for effective uses of clinical practices based on periodic analyses of the literature by a committee of experts.

Evaluations of the effectiveness of these two programs have focused on individual guidelines, with three exceptions. (Rosenberg et al., 2015) studied the effect of Choosing Wisely recommendations on seven low value services. Using claims data from Anthem-affiliated commercial health plans, they find that there is a decline in two of the services, increases in two, and three seeing no change post-Choosing Wisely. (Sheldon et al., 2004) examines how appraisals published by NICE impacted the use of prescription drugs and procedures as a function of whether the appraisals were positive or negative. They found some evidence of adherence, concentrated mainly in prescription drugs, with little evidence of changes to procedure counts. In the third paper,(Dietrich, 2009) reported how the publication of 14 negative NICE evaluations concerning 34 prescription drugs from 2000 to 2004 influenced the number of prescriptions issued in NHS ambulatory settings. They find no evidence of change for 33 of the drugs. The other literature on these two settings concerning individual recommendations find mixed evidence, with some having quite a bite and others not. The literature suggests that information dissemination has at best a mixed impact on decreasing utilization of low-value care. However, it is important to note that these interventions are based on years of medical evidence, possibly already integrated into the field before the guidelines

are created. As a result, lack of information may not be a primary driver in the continued practice of ineffective procedures.

This project contributes to the literature on doctor decision making in light of negative experimental evidence by examining a new source of variation. As outlined above, there have, to my knowledge, only been case studies examining either overall trends or heterogeneous effects within the publication of individual RCT's. I extend this analysis by looking at usage across 25 RCT's to better understand the role of information in abandonment more generally. I also exploit the variation in publication date to employ a new identification strategy in the literature in the event-study and staggered difference-in-differences designs. These provide empirical advantages over the individual procedure analysis by estimating the counterfactual trajectory of usage without publication. The event-study design in particular also estimates the dynamics of abandonment across procedures over time and tests for the empirical validity of the design through pre-trend analysis. Additionally, using the publication of the results of a RCT as my event allows me to leverage an information shock in the medical literature that is likely unanticipated, leading to a stronger impact than the informational interventions that have been covered in the Choosing Wisely and NICE literature. This project adds to the understanding of sources of wasteful medical spending by empirically analyzing the persistence of a rich set of procedures found to be ineffective. Studying the response to the publication of these RCT's within inpatient settings and how this may differ across agents in the healthcare decision making process, such as insurers and hospitals, helps motivate possible next steps for policy targeted at decreasing a major source of medical waste. I then extend this analysis by investigating the role bureaucratic frictions have in abandonment by comparing private versus government insured patients, and the impact different organizational mod-

els may have by comparing hospital ownership groups' differential abandonment post-publication.

1.3 Data

1.3.1 Randomized Control Trials

I have sourced the publication of RCT's for procedures from two meta-analyses by doctors Adam Cifu, Vinay Prasad and their coauthors. The first,(Prasad et al., 2013), sought to identify articles in the NEJM from 2001 to 2010 whose findings found a treatment to be ineffective or potentially harmful. They examined 2,044 original articles and isolated 1,344 which pertained to a medical practice. They then identified whether these examined new or existing practices and separated out the methodology of the papers into RCT, prospective controlled intervention, observational, or case-controlled studies. These were then given four designations: replacement, reversal, back to the drawing board, and reaffirmation, with each article reviewed by two separate authors to confirm findings. The authors found 146 instances of ineffective care out of the 1,344 original articles they examined.

(Herrera-Perez et al., 2019) extends the work that ,(Prasad et al., 2013) did to the Lancet and JAMA articles from 2001 to 2017, as well as the NEJM from 2011 to 2017. They repeated the same process as above and also searched the Cochrane Library's database of systematic reviews to see if they refuted the claims of the studies they identified. After excluding 19 articles due to this, they found 396 articles revealing a medical practice to be ineffective out of 3,000 RCT-based publications.

From this combined list I identified 83 articles pertaining to a surgery or procedure published between 2003 to 2017. Of these, four were excluded because they

were based on observational studies, nine were not the first publication concerning that procedure-diagnosis combination, 11 had procedures or diagnoses that could not be identified or separated from their comparison group with the current International Classification of Diseases-9/10-CM coding system (ICD-9/10), two were based on timing of a procedure, and nine pertained to procedure-diagnosis combinations that in my sample happened too infrequently to be able to identify their impact[3]. Additionally, endovascular therapy for acute ischemic stroke was found to be effective after publication of the two articles identified in,(Prasad et al., 2013), so they were excluded. For the articles examining PCI and coronary revascularization for stable coronary artery disease, the time series almost mapped 1-for-1 on the decline with drug-eluting stents for stable coronary artery disease. Given that the drug-eluting stents case has been well identified in the literature, I therefore replaced the three articles pertaining to PCI and coronary revascularization for stable coronary artery disease with the identified event in the literature for drug-eluting stents. I additionally excluded 19 papers published after 2015 in order to allow for at least two years of post-publication data for each event. Table A1 in the supplemental files shows the list of the 25 unique procedure-diagnosis combinations used for my subsequent analysis.

After reading each of the the original papers, I cross-checked each of the 25 RCT's considered in this study against the Cochrane Library's Database of Systematic Reviews. The Cochrane Library is meant to summarize the current results of medical research from clinical trials to better inform medical practices. At the core of its work are systematic reviews and meta-analyses for medical practices that assess the level of evidence on efficacy for a treatment arm. The reviews are a well-regarded source in medicine for synthesizing clinical research and are

[3]Specifically, the procedure is excluded if the pre-publication max procedure-diagnosis count by quarter was less than 100 patients.

peer-reviewed. As a result, these provide strong evidence for the assessment of current knowledge on an intervention and when available are a good source by which to check the quality of the findings from each paper assessed.

If there existed a systematic review for the procedure and it found that there was no evidence to currently support the usage of that procedure for the diagnosis it was meant to treat, I classified it as a strong event. If a Cochrane review did not exist, I reread the original paper and categorized their findings into several categories from strongest to weakest. If the paper's findings were that the procedure was no better than a placebo, potentially harmful, or of no additional benefit when added to medical or standard treatment I considered it a strong event, since all three of these entail the procedure should not be currently practiced. In table A1 in the appendix, for each event I include the Cochrane Review conclusion and the conclusion of the original study as well as the control group comparison.

1.3.2 State Inpatient Discharges

Procedures, diagnosis, and procedure-for-diagnosis counts were sourced from the Healthcare Utilization Project's (H-CUP) State Inpatient Databases (SID) from 2000 to 2015 in New York and from 2000 to 2017 in Arizona, California, Florida, Maryland, New Jersey, and Washington. The SID contains the universe of inpatient hospitalizations for community hospitals within each participating state and contains patient information on which diagnoses and procedures they had during their stay as well as demographic characteristics such as race, gender, and age, and expected payer information. The combined population of these seven states makes up about one third of the total U.S. population, providing a large sample for the identification of national trends in usage (HCUP. 2000-2017).

An important caveat to the data is that they only include inpatient discharges.

According to the Agency for Healthcare Quality and Research, as of 2014 a majority of surgeries are done in outpatient settings (47.3 versus 52.7%) (Steiner et al., 2014). Therefore, any conclusions drawn from this analysis only pertain to inpatient cases. However, there is reason to believe the effects would be muted in outpatient settings due to differential physician financial incentives in physician-owned outpatient centers. Another important note is that all states covered here have large metropolitan centers. Thus, the representation of rural hospitals is potentially smaller and these results do not necessarily translate to that setting.

1.3.3 AHA Annual Survey

In order to examine deadoption heterogeneity across hospital ownership and other hospital characteristics, I link SID hospitals from every state in my sample except California to hospital information from the American Hospital Association's (AHA) Annual survey of hospitals, a voluntary questionnaire that covers nearly 6,300 hospitals in the U.S. The response rate for the AHA annual survey is 80%, making it a strong source for understanding hospital characteristics. From this, I use information on hospital ownership group (non-profit or for-profit) and medical school affiliation in order to better understand how information integration and organizational structure may play a role in abandonment of a procedure.

1.3.4 Outcome Variable

The primary outcome is derived from the intersection of the procedure in question and the diagnosis that the procedure was meant to treat in the original article. I identify procedures and diagnoses using ICD-9/10 coding, sourced from insurance coverage determinations, medical literature or government reports to ensure

their accuracy[4]. Each patient in a given year and state can have multiple procedures and diagnoses during their inpatient stay. As a result, I define a patient as receiving the procedure if they have gotten the procedure at any point before discharge and similarly for the diagnosis. The raw outcome is therefore defined as a patient who received the reverse procedure as well as had the matching diagnosis at any point before discharge. In light of this, the interaction is not a direct 1-to-1 diagnosis and procedure pairing, and therefore may label certain patients who had the diagnosis, received the procedure, but did not get treated for the given diagnosis with the procedure as part of that outcome. Along the same lines, each state varies in the number of unique procedure and diagnoses they record for a patient from year to year, potentially leading to an upward trend in identifiability between states in later years as more unique procedure categories become available.[5]

I aggregate procedure-diagnosis intersections for each article up to the discharge quarter-state level. I then map annual population estimates for each state from the Surveillance, Epidemiology, and End Results Program (SEER) and aggregate them up to the quarter level and divide the sum of the procedure-diagnosis combination by the total population for my sample of states for a given year. I then convert these into a rate per million and take logs of the rate. This is to take into account the fact that some procedures are done more frequently than others and to reduce noise in the outcome variable.

[4]In the fourth quarter of 2015, the SID switched from ICD-9 to ICD-10. I used the General Equivalency Mapping from the U.S. Department of Health and Human Services to best identify which ICD-10 codes matched the ICD-9 sourced codes. Table A2 in the supplemental files lists the ICD-9 codes for each diagnosis and procedure for each event as well as the original documents the codes were sourced from.

[5]For procedures where the ICD-9 code was created from 2000-2015, pre-publication their values were marked as missing until the code became commonly used.

1.4 Identification Strategy

1.4.1 Event Study Design

I implement an event-study design around the first publication of an RCT showing a procedure to be ineffective or potentially harmful for treating a given diagnosis. I leverage the staggered timing of publication as well as the strict information embargo in medical journals to treat each paper as an information shock to the practice of that procedure. The event-study framework not only tests whether there is deadoption of the procedure post-publication, but additionally maps out the dynamics of abandonment. For policy, it is not only important to assess the degree but the pace of uptake in order to potentially target frictions in the dissemination of these results.

The underlying assumption in my design is that the timing of publication is uncorrelated with other unobservable factors that vary over time and influence the use of a treatment. The event-study framework directly tests if there are differential trends of abandonment before publication, to account for pre-trends. Additionally, given the nature of the information embargo, it is important to assess if article releases are unanticipated. The event-study design allows direct tests of the pre-trend that reveal if physicians were discontinuing usage of a procedure before publication.

The following specification is used in the event-study design:

$$
\begin{aligned}
Y_{mt} = & \sum_{e=-T,\neq -1}^{+T} \beta_e \; i[D_t - P_{mt} = e]_{mt} + \\
& \gamma_a \; i[D_t - P_{mt} > T]_{mt} + \gamma_b \; i[[D_t - P_{mt} < -T]_{mt} + \\
& \lambda_m + \theta_t + \epsilon_{mt}
\end{aligned}
$$

The outcome Y_{mt} is the log of the reversed procedure for diagnosis rate per million people for event m in discharge quarter t. β_e represents the impact of being e quarters away from publication and is the effect of interest. For all periods further out than two or four years I include one catch-all coefficient, γ_a for after two or four years and γ_b for the before period. I also include procedure for respective diagnosis fixed effects λ_m to account for inherent unobservable differences across procedure and diagnosis combinations, and time fixed effects θ_t to account for possible global shocks to the inpatient setting. Because SID data is available from 2000-2017, I cut off the publication dates P_{mt} after December 2015. This generates a balanced panel for two years pre- and post-publication as defined by the indicator variables $i[D_t - P_{mt} = e]_{mt}$. As I consider years further out in event time, the panel is no longer balanced, losing 20% after four years. Thus, I run two different time horizons for the event study, one with $T = 8$ quarters before and after publication and one with $T = 16$ quarters. The former is the most well defined specification with full balance, and the latter allowed me to trace out possible later dynamics of discontinuation to see if the effects seen in the first two years persist. Because of the modest number of events in my sample, my standard errors face a small cluster problem. Thus, if I were to use the standard clustering procedure it could lead to an underestimation of the bias from serial correlation within each procedure-diagnosis combination. To account for this, I calculate standard errors using a block bootstrap design at the procedure-diagnosis level.

I complement the event study with a staggered difference-in-differences design around publication. I exploit the differential timing of articles to estimate the impact of publication on the usage of procedures. Most of the literature has focused on individual publication analyses making deriving a causal estimate challenging because there is not a good sense of the counterfactual trajectory for the individ-

ual procedure. This makes the estimates they derive sensitive to global shocks or procedure-specific shocks in the post period. Both the difference-in-differences design and the event-study estimate the treatment relative to a counterfactual trajectory, and therefore are stronger strategies to causally estimate the impact of publication.

The specification for the difference-in-differences design is as follows:

$$Y_{mt} = \beta_0 + \beta_{2y}\text{Within Two years Post}_{mt} + \beta_{post}\text{Over Two years Post}_{mt} + \lambda_m + \theta_t + \epsilon_{mt}$$

β_{2y} measures the impact of article release on usage for the first two years after publication and β_{post} captures the effect over all the subsequent years after publication. I split the traditional post coefficient into two different time periods to map more closely with the two time horizons used in the event-study. I include quarter fixed-effects and procedure-diagnosis fixed effects in this specification as well.

I evaluate the impact of publication for all 25 events first and repeat the process for the subset of 15 events with strong conclusions. To explore sources of heterogeneity, the original procedure-diagnosis interaction is multiplied by indicator variables that identify whether the patient is paying with government-covered insurance or private insurance, as well as whether the hospital where the patient is staying is for-profit, not-for-profit and/or affiliated with a medical school[6].

[6]Other sources of heterogeneity such as uninsured patients, government-run hospitals, Medicare-certified institutions and metropolitan vs. rural hospitals have been examined, but were not particularly informative due to the lack of representation in the overall inpatient discharge sample.

1.5 Results

1.5.1 Overall Impact

Figure 1.1 captures the impact of publication of the RCT's on usage of procedures over the first two years before and after publication. When focusing on the pre-trend, within the first two years it is flat and centered around zero, giving credence to the idea that this information was not known before an article's release. This is further reinforced by the timing of abandonment post-publication, with the second quarter after beginning the statistically significant decline relative to pre-publication in the usage of reversed procedures. This trend flattens slightly after the first year but starts to grow again halfway through the second year, reaching a 10% decrease. When considering the four-year window before and after publication in Figure 1.2, the pre-trend is still relatively flat, the effect grows to between 20 and 30% after four years, and is statistically significant. The curve itself is fairly linear, suggesting a slow, steady deadoption over time rather than rapid uptake among some doctors. The abandonment of procedures is far from full even four years after publication, being bounded by 40%. The process is also slow, consistent with a large amount of inertia in changing behaviors for physicians after the release of negative evidence.

In Figures 1.3 and 1.4, I turn my attention to the subset of stronger events as discussed in the data section. The pre-trend in Figure 1.3 is not quite centered at 0, but is not statistically significant over the two years before publication, and when including all four years it exhibits no trend. The decline is similar post-publication when compared to Figures 1.1 and 1.2, although more pronounced and of greater statistical significance, reaching 20% after the first two years and 30-40% four years after publication. The estimates are less precise, as is to be

expected given the sample has been cut down significantly. Therefore, figures 1.3 and 1.4 that even in the RCT's with the most definitive evidence, medical practices are slow to change.

In addition to the pre-trend staying flat, the event-study estimates are stable with the inclusion of both fixed effects of procedure-diagnosis combinations, as well as when adding quarterly timed fixed effects, as seen in figures 1.5 and 1.6. All event-study coefficients across the two figures map remarkably close to the raw coefficients, even with the full specification implemented. Thus, when combined with a flat pre-trend in figures 1.1 through 1.4, it is likely that the event-study design is picking up the true causal path of the impact of publication on abandonment of a reversed procedure rather than other information shocks, global health shocks, or differences between procedure-diagnosis combinations.

When examining other possible outcomes, the impact of publication is essentially the same or more muted. Figures 1.7 and 1.8 show the effect of publication on three different possible alternative outcomes. Panel a covers only the impact of publication on procedures, rather than the intersection between procedure and diagnosis. It could be the case that article release has some spillover to other uses of a procedure and therefore looking at only the intersection may understate the true impact of publication. However, the effect size is much smaller than the overall effect seen in figure 1.2 and 1.4, reaching only about 10% after four years in the case of all events and 15-20% in the case of those events with the strongest evidence. This gives further credibility to the outcome of interest being the most targeted version of the outcome possible.

Panel b in both figures looks at the diagnosis rate per million of the diagnosis that the procedure was meant to treat. Given that some alternatives in these articles are medical or non-invasive therapies, it may be the case that the

publishing of the article decreases likelihood of appearing in an inpatient setting overall, decreasing diagnoses because people do not appear in the sample anymore. Looking at panel b in both figures, there is a slight decline post publication in all events and strong cases, but nothing that shows a clear pattern of people not being admitted for a diagnosis in response to publication.

The preferred outcome for this analysis has been, as outlined in the data section, the total patients who have received both the diagnosis and reversed procedure, normalized by population. One other possible metric is the percentage of each diagnosis that was treated with the reversed procedure. This normalizes the pool of recipients across procedures potentially more accurately, since who is eligible for a procedure is more likely to be captured by the overall diagnosis rate rather than population rates. However, as discussed in the previous paragraph, there is a possibility that likelihood of entering the sample under a given diagnosis may decrease as a result of publication, impacting not only the numerator of this measure but also the denominator, leading to an upward bias on the true impact of publication. When analyzing panel c of figures 1.7 and 1.8, the impact does in fact reach slightly smaller magnitudes relative to pre-publication means as what is captured in the main outcome of interest. The pre-trend still remains flat, furthering the idea that the true timing of the event is the release of the article itself. Furthermore, the overall impact after four years is about three percentage points and six percentage points for all events and strong events respectively. Relative to the mean value for the two years before publication (17.05% for all events, 21.02 for strong events), this translates to around a 17% and 28% decrease post-publication, which is slightly smaller than what is observed for the main specification. This consistency across both metrics further strengthens that the impact and magnitude estimated captures the true causal path of abandonment,

rather than operating as an artifact of outcome choice.

One possible reason for inertia in discontinuing use of a treatment is a need for the creation of a more robust evidence base before being fully convinced. While it is evident that there is partial abandonment post-publication, it could be the case that doctors do not want to react fully until the evidence base grows more substantially against a current practice. This level of evidence saturation is partially captured by focusing on events with greater medical consensus around them, as seen in the strong evidence sub-set. Additionally, figures 1.9 and 1.10 examine the impact of not just the first publication but a later publication time within this time frame [7]. If evidence saturation were the reason for this inertia, using the publication date for later results would likely then result in a greater decline post-publication than the initial article. However, it is evident across these two figures that if anything the response is more muted, with a post-trend much flatter than what is observed in figures 1.2 and 1.4. This evidence combined with the reaction to strong events suggests that it is unlikely that the primary driver of inertia seen in the original specification is entirely due to a need for reaching an evidence saturation point in the literature.

The RCT's examined here show inefficacy or harm of a procedure using strong experimental evidence and published in highly regarded journals. As is evident from the lack of pre-trends and consistency in results across several metrics, the findings of these trials are not widely known beforehand. However, post-publication we see modest declines of 10-20% two years out and 30-40% four years out. The process to abandonment is slow and even four years later procedures that have no evidence to support their use are still common practice.

[7]Several procedure-diagnosis combinations have additional articles in the sample showing negative results. This analysis converted event time for those to the second publication rather than the first article release

1.5.2 Insurance Coverage

An important agent involved in the decision to assign a treatment plan is the insurer. Given that they decide what is covered, insurance agencies have direct incentives to limit what they are willing to pay for. Thus, we may expect that insurance companies would respond most strongly to negative evidence. The main mechanism by which this is done is through coverage determinations. The determination process, however, can be subject to outside pressure from patients and other interests groups, potentially limiting the tool's ability to restrict coverage. This friction is likely more prominent in public insurance carriers such as Medicare and Medicaid, where the determination process is often longer and allows for public input. For example, a national coverage determination in Medicare has to be done through a process that lasts a year. These determinations are also fairly rare and can be appealed in their final phase by the public. However, private insurers may also be reluctant to abandon a procedure if patients and doctors no longer adopt their plan as a result of the insurer's coverage determination.

To shed light on this, Figures 1.11 and 12 present event-study estimates of the impact of publication on use of a reversed procedure for overall and strong events, respectively, by insurance status. The coefficients for government-insured and privately insured patients are overlaid on the overall impact captured in Figures 1.2 and 1.4. It can be seen that across insurance status the effects are virtually identical in magnitude and pattern over four years, with the size of the decline being slightly more pronounced for private insurers. This is true in both Figures 1.11 and 1.12, suggesting that stronger evidence is not being deferentially considered across insurance carrier and that frictions in the coverage determination process do not primarily drive the lack of adherence to evidence observed in Figures 1.2 and 1.4.

1.5.3 Hospital Ownership

Hospitals play a central role in the integration of evidence to practice. They can create programs meant to educate physicians, systems that automate guidelines for procedure practice, and generate greater oversight to ensure that the proper treatment is being done. On the other hand, hospitals can specialize in procedures or surgeries as well, making the cost to abandonment hard to absorb from a reputation and revenue perspective. Hospital ownership presents different mission statements for the role of financial incentives in clinical decision making as well as different levels of integration with medical research. For-profit hospitals are investor owned and as a result respond most directly to profit-maximizing incentives. Non-profit hospitals receive a federal tax exemption on the condition that they use any profits earned for community benefit. This mutes the profit incentives more than for-profit hospitals, and, additionally, one major category of community benefit is investment in healthcare research, providing incentives for non-profit healthcare centers to perform and integrate with current research. Similarly, medical school-affiliated hospitals are meant to train physicians, and as such should have the easiest access to current research on efficacy of practices, often conducting research themselves. Therefore, we might expect the largest abandonment to be among medical schools and then non-profit hospitals where there is greater connection to clinical research and weaker financial incentives to maintain ineffective care.

Figures 1.13 and 1.14 show the abandonment pattern of procedures in response to publication by hospital ownership and medical school affiliation overlaid on the overall impact. Non-profit and medical-school affiliated hospitals follow similar deadoption patterns to the overall effect. However, the trend post-publication is flatter and not statistically significant for medical schools, reaching only 20% after

four years from publication versus 30-40% for non-profit hospitals. This holds in the case of stronger events as well, as evidenced by Figure 1.14. Medical-school affiliated hospitals seem to be slower to abandon a procedure, despite the expectation that they would be more greatly integrated with current medical evidence. The hospital ownership group that most starkly deviates from the overall abandonment path seen in Figures 1.2 and 1.4 is for-profit hospitals. Across both strong and overall RCT's, the event study is virtually flat, although noisily measured, suggesting that stronger financial disincentives may play a role in abandonment. Non-profit hospitals have the largest response. None of these three exhibit paths that suggest larger effects than what was seen in Figures 1.2 and 1.4, implying that across these hospital types procedures are still common practice after publication.

1.5.4 Difference-in-Difference Estimates

Tables 1.1 and 1.2 represent the difference-in-differences equivalent of the event study for all events and those with stronger findings, respectively. The event-study trend we see translates to a 5.8% decrease in overall procedures relative to the pre-period within the first two years after article release and 19.3% for all years after, as seen in Table 1.1. When we compare across all events (Table 1.1) and those with definitive findings (Table 1.2), the effect sizes are of similar magnitude. However, the two-year window exhibits a smaller impact for more definitive findings (3.7% versus 5.8%) across each column relative to Table 1.1, and a larger impact further out (26.9 versus 19.3% decline), although the estimates are more noisily measured. All coefficients across these two tables are consistent in magnitude to what is shown in the event-study figures, but few of the coefficients are statistically significant. This is likely due to the different excluded category across the two models. The difference-in-differences model uses the whole pre-period as

the counterfactual comparison whereas only the quarter before publication is the reference in the event-study design. Consequently, although the effect is statistically significant and meaningfully larger in the event-study, including the whole pre-period, where some procedures may be getting adopted or have different pre-period lengths, the effect is of similar magnitude to the average of the event dummies and not statistically significant.

When comparing the heterogeneity analysis between the two models, in Tables 1.1 and 1.2 private and publicly insured procedures decline at a similar rate post-publication, just as in the event-study figures. Focusing on columns 4 to 6 in both tables, the greatest abandonment among hospitals occurs within non-profit hospitals, and for-profit hospitals show coefficients that are if anything positive within the first two years post-publication. The effects are also more muted for medical school affiliated hospitals relative to non-profit hospitals, consistent with the event-study analysis. This seems particularly true in the case of events with stronger findings, where the coefficient goes from negative (-5.5%) for the first two years in Table 1.1 to slightly postie in Table 1.2 (1.6%). However, the estimates are fairly noisy and all within one standard deviation of each other. All coefficient sizes do not suggest substantially larger abandonment in one group relative to the overall effect size, shown in column 1 in both tables, no matter the strength of the findings, consistent with the conclusions drawn from the event-study figures.

1.6 Conclusion

The U.S. has a healthcare spending problem that is exacerbated by the continued use of unnecessary practices. The acceptance of procedures that are ineffective increases the financial burden of healthcare for patients and exposes them to further harm without the usual benefit of care. Each of the medical RCT's considered

in this paper shows inefficacy or harm of the procedures in question relative to a previously thought-to-be obsolete procedure, a less invasive treatment, when added on to standard treatment, or relative to no treatment. Despite this, even in the RCT's with the strongest conclusions, the procedures sustain much longer than the evidence supports they should, and the process to deimplement them is slow. Additionally, there is no strong pattern of differential abandonment across hospital ownership or insurance status, suggesting the need for greater translation of research to practice across medicine. Future work can attempt to shed light on why these procedures continue to be used, whether the results generalize to outpatient settings, the role physician characteristics may play in the abandonment of procedures, and how this may differ in the prescription drug context.

Much of the focus in the popular press, medical editorials, and in work done by Dr. Prasad and Dr. Cifu has been on the role of physician bias and incentives in the continued practice of ineffective procedures. Hospitals and doctors face the highest financial and reputation cost from abandonment of a procedure. Surgeons often make a career specializing in a given procedure, making deadoption difficult professionally. Furthermore, doctors have their own experiences that may confirm their biases, such as patients who became healthy after procedures they performed, even if that response was unrelated to the procedure. There is also a subjective measure of skill in a surgeon that further amplifies this heuristic. Physicians can view themselves as more skillful than the surgeons in the trial, therefore justifying that the results do not generalize to them.

This study highlights the lack of federal infrastructure for assessing procedures and translating this information into practice. Unlike devices and drugs, the FDA does not regulate procedures. Rather, these are passed on through teaching institutes and other doctors before there is strong clinical evidence of their usage,

often allowing them to become entrenched in medical practice. The burden of information dissemination and implementation is then left up to local hospitals and physicians, creating room for significant heterogeneity in adherence.

Insurance providers are important decision makers in whether to cover treatment. As seen in the heterogeneity section, it does not seem that insurance carrier is a main driver of implementation, with a majority of procedures still sustaining across insurance carriers to a similar magnitude. This is puzzling considering that insurers foot the bill for the cost of the procedures in most cases in my sample, with uninsured patients only accounting for 3% of the overall procedure-diagnosis pairs.

One reason might be that determinations are not trivial to pass and enforce. For example, in Medicare the protocol for instituting a national coverage determination can be multi-year and subject to public input. Furthermore, national determinations are not common, only covering a few of the procedures involved in this study. Even where they are done, there is no evidence of these insurance determinations impacting the usage of a procedure (Howard et al., 2017).[8] Enforcement of coverage determination policies requires detailed clinical information that is not necessarily in claims files, giving physicians significant discretion in determining coverage. Furthermore, the restriction of coverage is often subject to strong public opposition, making it possibly politically infeasible to pursue (Garber, 2008).

Further research can examine how federal regulation may play a role in abandonment of a treatment by focusing on ineffective care in the case of prescription

[8]As (Howard et al., 2017) points out, insurance claims may not report whether a surgery is the primary method to treat a condition or a secondary treatment. This gets around some of the conditions of non-coverage and potentially allows the continued propagation of these procedures. This is further evidenced by (Foote et al., 2008), which examined eight different procedures subject to Medicare local coverage determinations and only found a 13% decline for one of the procedures.

drugs, where the FDA has stronger oversight. Likewise, additional research is needed studying the role of financial incentives and physician characteristics on differential abandonment. This can be achieved by comparing inpatient settings to the practice of ineffective procedures in outpatient settings where financial incentives are stronger.

1.7 References

Akhtar, Othman S., Vladimir Lakhter, Chad J. Zack, et al., "Contemporary Trends and Comparative Outcomes With Adjunctive Inferior Vena Cava Filter Placement in Patients Undergoing Catheter-Directed Thrombolysis for Deep Vein Thrombosis in the United States: Insights From the National Inpatient Sample," *JACC: Cardiovascular Interventions*, jul 2018, *11 (14)*, 1390?1397.

Alshekhlee, Amer, Win Kuang Shen, Judith Mackall, and Thomas C.Chelimsky, "Incidence and Mortality Rates of Syncope in the United States," *American Journal of Medicine*, feb 2009, *122 (2*), 181?188.

Ardern, Clare L, Teemu Paatela, Ville Mattila, et al., "When taking a step back is a veritable leap forward.Reversing decades of arthroscopy for managing joint pain: Five reasons that could explain declining rates of common arthroscopic surgeries," *British Journal of Sports Medicine*, nov 2020, *54 (22)*, 1312?1313.

Atwater, Brett D., James Oujiri, and Matthew R. Wolff, "The immediate impact of the clinical outcomes utilizing revascularization and aggressive drug evaluation (COURAGE) trial on the management of stable angina," *Clinical Cardiology*, aug 2009, *32 (8)*.

Bangalore, Sripal, Navdeep Gupta, Philippe Greux, et al.,"Trend in percutaneous coronary intervention volume following the COURAGE and BARI-2D trials: Insight from over 8.1 million percutaneous coronary interventions,"*International Journal of Cardiology*, mar 2015, *183*, 6?10.

Bekelis, Kimon, Jonathan Skinner, Daniel Gottlieb, and Philip Goodney,"De-adoption and exnovation in the use of carotid revascularization: retrospective cohort study," *BMJ (Clinical research ed.)*, oct 2017, *359*, j4695.

Benedetto, Umberto, Gianni D. Angelini, Massimo Caputo, et al.,"Off- vs. on-pump coronary artery bypass graft surgery on hospital outcomes in 134,117 octogenarians," *Journal of Thoracic Disease*, dec 2017, *9 (12)*, 5085?5092.

Berez, Julie, Guy David, David H. Howard, and Mark D. Neuman,"Does bad news travel faster? On the determinants of medical technology abandonment," *Journal of Human Capital*, nov 2018, *12 (4)*, 569?603.

Buccheri, Sergio, Giovanna Sarno, Ole Frbert, Thorarinn Gudnason, et al., "Assessing the nationwide impact of a registry-based randomized clinical trial on cardiovascular practice the TASTE trial in perspective,"*Circulation: Cardiovascular Interventions*, 2019, *12 (3)*.

Buchbinder, Rachelle, Renea V Johnston, Kobi J Rischin, et al.,"Percutaneous vertebroplasty for osteoporotic vertebral compression fracture,"*Cochrane Database of Systematic Reviews*, nov 2018, *2018 (11)*.

Buchbinder, Rachelle, Richard H. Osborne, Peter R. Ebeling, et al., "A Randomized Trial of Vertebroplasty for Painful Osteoporotic Vertebral Fractures,"*New England Journal of Medicine*, aug 2009, *361 (6)*, 557?568.

Chen, Huai Sheng, Jun Min Wen, Sheng Nan Wu, and Jian Ping Liu, "Catheter ablation for paroxysmal and persistent atrial fibrillation," *Cochrane Database of Systematic Reviews*, apr 2012, *(4)*.

Chen, Jersey, Kumar Dharmarajan, Yongfei Wang, and Harlan M.Krumholz, "National trends in heart failure hospital stay rates, 2001 to 2009,"*Journal of the American College of Cardiology*, 2013, *61 (10)*, 1078?1088.

Connolly, Stuart J., Robert Sheldon, Kevin E. Thorpe, et al., "Pacemaker Therapy for Prevention of Syncope in Patients with Recurrent Severe Vasovagal Syncope: Second Vasovagal Pacemaker Study (VPS 11): A Randomized Trial,"

Journal of the American Medical Association, may 2003, *289(17)*, 2224?2229.

Cooper, Christopher J., Timothy P. Murphy, Donald E. Cutlip, et al., "Stenting and Medical Therapy for Atherosclerotic Renal-Artery Stenosis," *New England Journal of Medicine*, jan 2014, *370 (1)*, 13?22.

Cooper, Christopher J., Timothy P. Murphy, Donald E. Cutlip, et al., "Stenting and Medical Therapy for Atherosclerotic Renal-Artery Stenosis," *New England Journal of Medicine*, jan2014, *370 (1)*, 13?22.

Cooper, D. James, Jeffrey V. Rosenfeld, Lynnette Murray, et al., "Decompressive Craniectomy in Diffuse Traumatic Brain Injury," *New England Journal of Medicine*, apr 2011, *364 (16)*, 1493?1502.

Cooper, D. James, Jeffrey V. Rosenfeld, Lynnette Murray, et al., "Patient Outcomes at Twelve Months after Early Decompressive Craniectomy for Diffuse Traumatic Brain Injury in the Randomized DECRA Clinical Trial," *Journal of Neurotrauma*, mar 2020, *37 (5)*, 810?816.

Cosedis-Nielsen, Jens, Arne Johannessen, Pekka Raatikainen, et al., "Radiofrequency Ablation as Initial Therapy in Paroxysmal Atrial Fibrillation,"*New England Journal of Medicine*, oct 2012, *367 (17)*, 1587?1595.

Dasenbrock, Hormuzdiyar H., David J. Cote, Yuri Pompeu, et al., "Validation of an International Classification of Disease, Ninth Revision coding algorithm to identify decompressive craniectomy for stroke," *BMC Neurology*, jun 2017, *17 (1)*.

De Bruin, Jorg L., Annette F. Baas, Jaap Buth, et al.,, "Long-Term Outcome of Open or Endovascular Repair of Abdominal Aortic Aneurysm," *New England Journal of Medicine*, may 2010, *362 (20)*, 1881?1889.

Deyell, Marc W., Christopher E. Buller, Louis H. Miller, et al., "Impact of national clinical guideline recommendations for revascularization of persistently occluded infarct-related arteries on clinical practice in the United States," *Archives of Internal Medicine*, oct 2011, *171 (18)*, 1636?1643.

Dietrich, Eva Susanne, "Effects of the National Institute for Health and Clinical Excellence?s technology appraisals on prescribing and net ingredient costs of drugs in the National Health Service in England," *International Journal of Technology Assessment in Health Care*, jul 2009, *25 (3)*, 262?271.

Duffy, Sarah Q. and Dean E. Farley, "The protracted demise of medical technology: The case of intermittent positive pressure breathing," *Medical Care*,1992, *30 (8)*, 718?736.

Ederle, Jrg, Joanna Dobson, Roland L. Featherstone, et al.,"Carotid artery stenting compared with endarterectomy in patients with symptomatic carotid stenosis (International Carotid Stenting Study): an interim analysis of a randomised controlled trial," *The Lancet*, may 2010, *375 (9719)*,985?997.

Elbadawi, Ayman, Amgad Mentias, Islam Y. Elgendy, et al., "National trends and outcomes for extra-corporeal membrane oxygenation use in high-risk pulmonary embolism," *Vascular Medicine (United Kingdom)*, jun 2019, *24 (3)*, 230?233.

Esposito, D. B., G. Banerjee, R. Yin, et al., "Development and Validation of an Algorithm to Identify Endometrial Adenocarcinoma in US Administrative Claims Data," *Journal of Cancer Epidemiology*, 2019, *2019.*

Fader, Amanda N., R. Matsuno Weise, Abdulrahman K. Sinno, et al., "Utilization of minimally invasive surgery in endometrial cancer care: A Quality and cost disparity," *Obstet Gynecol,* 2016, *127 (1),* 91?100.

Foote, Susan Bartlett, Beth A Virnig, Robert J Town, and Lacey Hartman,"The impact of medicare coverage policies on health care utilization,"*Health Services Research*, aug 2008, *43 (4),* 1285?1301.

Friedly, Janna L., Bryan A. Comstock, Judith A. Turner, et al., "A Randomized Trial of Epidural Glucocorticoid Injections for Spinal Stenosis,"*New England Journal of Medicine*, jul 2014, *371 (1)*, 11?21.

Frost, Jonathan A., Katie E. Webster, Andrew Bryant, and Jo Morri-

son,"Lymphadenectomy for the management of endometrial cancer," *Cochrane Database of Systematic Reviews*, oct 2017, *2017 (10).*

Fujihara, Yuki, Helen E. Huetteman, Ting Ting Chung, et al., "The Effect of Impactful Articles on Clinical Practice in the United States:Corticosteroid Injection for Patients with Lateral Epicondylitis," *Plastic and Reconstructive Surgery,* may 2018, *141 (5),* 1183?1191

Garber, Alan M, "Commentary: The Impact of Medicare Coverage Policies on Health Care Utilization," *Health Services Research*, aug 2008, *43 (4)*, 1302.

Gardner, Lara and Sharmila Vishwasrao, "Physicians? use of medical technology:an analysis of the introduction and subsequent failure of drug-eluting stents," *Applied Economics,* may 2018, *50 (24),* 2733?2745.

Gershengorn, Hayley B. and Hannah Wunsch, "Understanding changes in established practice: Pulmonary artery catheter use in critically iii patients," *Critical Care Medicine*, dec 2013, *41 (12),* 2667?2676.

Ghomrawi, Hassan M.K., Robert G. Marx, Ting Jung Pan, et al.,"The effect of negative randomized trials and surgeon volume on the rates of arthroscopy for patients with knee OA," *Contemporary Clinical Trials Communications*,mar 2018, *9*, 40?44.

Goz, Vadim, Thomas J. Errico, Jeffrey H. Weinreb, et al., "Vertebroplasty and kyphoplasty: National outcomes and trends in utilization from2005 through 2010," *Spine Journal,* may 2015, *15 (5),* 959?965.

Greenhalgh, R. M., "Endovascular aneurysm repair and outcome in patients unfit for open repair of abdominal aortic aneurysm (EVAR trial 2): Randomised controlled trial," *Lancet*, jun 2005, *365 (9478)*, 2187?2192.

Greenhalgh, R. M. , L.C. Brown, D. Epstein, et al., "Endovascular aneurysm repair versus open repair in patients with abdominal aortic aneurysm (EVAR trial 1):Randomized controlled trial," *The Lancet*, jun 2005, *365 (9478)*, 2179?2186.

Greenspon, Arnold J., Jasmine D. Patel, Edmund Lau, et al.,"Trends in

permanent pacemaker implantation in the United States from 1993to 2009: Increasing complexity of patients and procedures," *Journal of the American College of Cardiology*, oct 2012, *60 (16)*, 1540?1545.

Greenwood, Brad N., Ritu Agarwal, Rajshree Agarwal, and Anandasivam Gopal, "The When and Why of Abandonment: The Role of Organizational Differences In Medical Technology Life Cycles," *Management Science*,aug 2016, *63 (9)*, 2948?2966.

H., A., "Coding for Arthroscopic Knee Surgery," *For The Record*, 2012, *24 (3)*, 28.

Hacke, Werner, A. Ringleb P. A. Kunze, et al., "30 day results from the SPACE trial of stent-protected angioplasty versus carotid endarterectomy in symptomatic patients: A randomised non-inferiority trial," *Lancet*, oct 2006, *368 (9543),* 1239?1247.

Handoll, Helen Hg and Stig Brorson, "Interventions for treating proximal humeral fractures in adults," *Cochrane Database of Systematic Reviews*, nov 2015, *2015 (11).*

Harvey, Sheila, David A. Harrison, Mervyn Singer, et al., "Assessment of the clinical effectiveness of pulmonary artery catheters in management of patients in intensive care (PAC-Man): a randomised controlled trial," *Lancet,* aug 2005, *366 (9484)*, 472?477.

Healthcare Utilization Project, "HCUP State Inpatient Databases," Agency for Healthcare Research and Quality, Rockville, MD 2000-2017.

Health Partners, "Epidural Steroid Injections for Lower Back," Technical Report 2019.

Herrera-Perez, Diana, Alyson Haslam, Tyler Crain, et al., "A comprehensive review of randomized clinical trials in three medical journals reveals396 medical reversals," *eLife*, jun 2019, *8.*

Hill, James A., Daniel F. Pauly, Debra R. Olitsky, et al., "Evaluation study of congestive heart failure and pulmonary artery catheterization effectiveness," *Journal of the American Medical Association,* oct 2005, *294 (13),*1625?1633.

Hochman, Judith S., Gervasio A. Lamas, Christopher E. Buller, et al., "Coronary Intervention for Persistent Occlusion after Myocardial Infarction,"*New England Journal of Medicine*, dec 2006, *355 (23),* 2395?2407.

Hosseini, Seyed Mohammadreza, Guy Rozen, Ahmed Saleh, et al.,"Catheter Ablation for Cardiac Arrhythmias: Utilization and In-Hospital Complications,2000 to 2013," *JACC: Clinical Electrophysiology,* nov 2017, *3 (11),*1240?1248.

Howard, David H. and Yu-Chu Shen, "Comparative Effectiveness Research, COURAGE, and Technological Abandonment," *NBER Working Paper Series,* aug 2011, p. 17371.

Howard, David H. and Yu Chu Shen, "Trends in PCI volume after negative results from the COURAGE trial," *Health Services Research,* feb 2014, *49 (1),* 153?170.

Howard, David H., Guy David, and Jason Hockenberry, "Selective Hearing: Physician-Ownership and Physicians? Response to New Evidence," *Journal of Economics and Management Strategy*, feb 2017, *26 (1)*, 152?168.

Huesch, Marco D., "Is blood thicker than water? Peer effects in stent utilization among Floridian cardiologists," *Social Science and Medicine*, dec 2011, *73 (12),*1756?1765.

Hussain, Mohamad A., Muhammad Mamdani, Jack V. Tu, et al., "Impact of Clinical Trial Results on the Temporal Trends of Carotid Endarterectomy and Stenting from 2002 to 2014," *Stroke*, dec 2016, *47 (12),* 2923?2930.

Ikuta, Kevin, Yun Wang, Austin Robinson, Tariq Ahmad, et al., "National trends in use and outcomes of pulmonary artery catheters among medicare beneficiaries, 1999-2013," *JAMA Cardiology,* aug 2017, *2 (8),*908?913.

Inamdar, Sumant, Eoin Slattery, Ramandeep Bhalla, et al., "Comparison of adverse events for endoscopic vs percutaneous biliary drainage in the treatment of malignant biliary tract obstruction in an inpatient national cohort," J*AMA Oncology,* jan 2016, *2 (1),* 112?117.

Journal of American Medical Association. Instructions For Authors. *JAMA Network*, 2016.

Jain, Nitin B. and Ken Yamaguchi, "The contribution of reverse shoulder arthroplasty to utilization of primary shoulder arthroplasty," *Journal of Shoulder and Elbow Surgery,* dec 2014, *23 (12)*, 1905?1912.

Jenks, Sara, Su Ern Yeoh, and Bryan R. Conway, "Balloon angioplasty,with and without stenting, versus medical therapy for hypertensive patients with renal artery stenosis," *Cochrane Database of Systematic Reviews,* dec 2014, *2014 (12).*

Jetty, Prasad and Don Husereau, "Trends in the utilization of endovascular therapy for elective and ruptured abdominal aortic aneurysm procedures in Canada," *Journal of Vascular Surgery*, 2012, *56 (6).*

Jones, Nathaniel L., Ling Chen, Sudeshna Chatterjee, et al., "National trends in extended procedures for ovarian cancer debulking surgery," *International Journal of Gynecological Cancer,* jan 2018, *28 (1),* 19?25.

Katz, Jeffrey N., Robert H. Brophy, Christine E. Chaisson, et al.,"Surgery versus Physical Therapy for a Meniscal Tear and Osteoarthritis," *New England Journal of Medicine,* may 2013, *368 (18),* 1675?1684.

Kawata, Manabu, Yusuke Sasabuchi, Shuji Taketomi, et al., "Annual trends in arthroscopic meniscus surgery: Analysis of a national database in Japan," *PLoS ONE,* apr 2018, *13 (4).*

Kilic, Arman, Joshua C. Grimm, J. Trent Magruder, et al., "Trends, clinical outcomes, and cost implications of mitral valve repair versus replacement,concomitant with aortic valve replacement," *Journal of Thoracic and Cardiovascular Surgery*, 2015, *149 (6)*, 1614?1619.

Kim, Sunny H., Robert M. Szabo, and Richard A. Marder, "Epidemiology of humerus fractures in the United States: Nationwide emergency department sample, 2008," *Arthritis Care and Research,* mar 2012, *64 (3),* 407?414

Kirkley, Alexandra, Trevor B. Birmingham, Robert B. Litchfield, et al.,

"A Randomized Trial of Arthroscopic Surgery for Osteoarthritis of the Knee," *New England Journal of Medicine*, sep 2008, *359 (11),* 1097?1107.

Kitchener, H., A.M. Swart, Q. Qian, C. Amos, and M.K Parmar, "Efficacy of systematic pelvic lymphadenectomy in endometrial cancer (MRC ASTEC trial): a randomised study," *The Lancet,* 2009, *373 (9658)*, 125?136.

Krishnamoorthy, Vijay, Catherine L. Hough, Monica S. Vavilala, et al., "Tracheostomy After Severe Acute Brain Injury: Trends and Variability in the USA," *Neurocritical Care,* jun 2019, *30 (3)*, 546?554.

Kwan, Gene F., Danielle M. Enserro, Emelia J. Benjamin, et al., "Racial Differences in Hospital Death for Atrial Fibrillation: The National Inpatient Sample 2001-2012," *ProClinS cardiology*, 2018, *1 (1),* 1005.

Lamy, Andr.J. Devereaux, Dorairaj Prabhakaran, et al, "Off-Pump or On-Pump Coronary-Artery Bypass Grafting at 30 Days," *New England Journal of Medicine,* apr 2012, *366 (16)*, 1489?1497.

Laupattarakasem, Wiroon, M. Laopaiboon, P. Laupattarakasem,and C. Sumananont, "Arthroscopic debridement for knee osteoarthritis," *Cochrane Database of Systematic Reviews*, 2008, *(1).*

Liang, Patric, Rob Hurks, Rodney P. Bensley, et al., "The rise and fall of renal artery angioplasty and stenting in the United States, 1988-2009," *Journal of Vascular Surgery*, 2013, *58 (5).*

Lichtman, Judith H., Michael R. Jones, Erica C. Leifheit, et al., "Carotid endarterectomy and carotid artery stenting in the US Medicare population,1999-2014," *Journal of the American Medical Association*, sep 2017, *318 (11),* 1035?1046.

Livaudais-Toman, Jennifer, Natalia Egorova, Rebeca Franco, et al., "A Validation Study of Administrative Claims Data to Measure Ovarian Cancer Recurrence and Secondary Debulking Surgery," *eGEMs* , nov 2016, *4 (1),* 22.

Luetmer, M. T. and David F. Kallmes, "Have referral patterns for vertebroplasty changed since publication of the placebo-controlled trials?," *American Journal of*

Neuroradiology, apr 2011, *32 (4),* 647?648.

Martin, Anne B., Micah Hartman, David Lassman, et al., "National Health Care Spending In 2019: Steady Growth For The Fourth Consecutive Year," *Health Affairs*, dec 2020, *40 (1),* 14?24.

Martin, Brook I., Jon D. Lurie, Anna N.A. Tosteson, et al., "Indications for Spine surgery: Validation of an administrative coding algorithm to classify degenerative diagnoses," *Spine*, apr 2014, *39 (9)*, 769?779.

Mattila, Ville M., Raine Sihvonen, Juha Paloneva, and Li Feller-Tsai, "Changes in rates of arthroscopy due to degenerative knee disease andtraumatic meniscal tears in Finland and Sweden," *Acta Orthopaedica*, jan 2016,*87 (1),* 5?11.

Melamed, Alexander, Jose A. Rauh-Hain, Joel T. Clemmer, et al., "Changing trends in lymphadenectomy for endometrioid adenocarcinoma of the endometrium," *Obstetrics and Gynecology*, oct 2015, *26*, 815?822.

Mendes, Elizabeth, "More Than Three in 10 in U.S. Put Off Treatment Due to Cost," *Gallup poll,* 2012, 1?3.

Mismetti, Patrick, Silvy Laporte, Olivier Pellerin, et al., "Effect of a retrievable inferior vena cava filter plus anticoagulation vs anticoagulation alone on risk of recurrent pulmonary embolism: A randomized clinical trial," *Journal of the American Medical Association*, apr 2015, *313 (16)*, 1627?1635.

Mohan, Arun V., Reza Fazel, Pei Hsiu Huang, et al., "Changes in Geographic Variation in the Use of Percutaneous Coronary Intervention for Stable Ischemic Heart Disease after Publication of the Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation(COURAGE) Trial," *Circulation: Cardiovascular Quality and Outcomes*, 2014, *7 (1)*, 125?130.

Moller, Christian H, Luit Penninga, Jrn Wetterslev, et al., "Off-pump versus on-pump coronary artery bypass grafting for ischaemic heart disease," *Cochrane Database of Systematic Reviews*, mar 2012, *(3).*

Moseley, J. Bruce, Kimberly O?Malley, Nancy J. Petersen, et al., "A con-

trolled trial of arthroscopic surgery for osteoarthritis of the knee," *New England Journal of Medicine,* 2002, *347 (2),* 683?687.

Muller, Mandy D., Philippe Lyrer, Martin M. Brown, and Leo H. Bonati, "Carotid artery stenting versus endarterectomy for treatment of carotid artery stenosis," *Cochrane Database of Systematic Reviews*, feb 2020, *2020 (2).*

Ojemolon, Pius E, Hafeez Shaka, Ehizogie Edigin, et al., "Impact of Diabetes Mellitus on Outcomes of Patients With Knee Osteoarthritis Who Underwent Knee Arthroplasty: An Analysis of the Nationwide Inpatient Sample," *Cureus,* jun 2020, *12 (6).*

Ong, K. L., E. Lau, J. E. Kemner, and S. M. Kurtz, "Two-year cost comparison of vertebroplasty and kyphoplasty for the treatment of vertebral compression fractures: Are initial surgical costs misleading?," *Osteoporosis International,* apr 2013, *24 (4)*, 1437?1445.

Orhurhu, Vwaire, Emeka Agudile, Robert Chu, et al., "Socioeconomic disparities in the utilization of spine augmentation for patients with osteoporotic fractures: an analysis of National Inpatient Sample from 2011 to 2015," *Spine Journal,* apr 2020, *20 (4),* 547?555.

Paravastu, Sharath Chandra Vikram, Rubaraj Jayarajasingam, et al., "Endovascular repair of abdominal aortic aneurysm," *Cochrane Database of Systematic Reviews,* jan 2014, *2014 (1).*

Parker, Benjamin R., Shepard Hurwitz, Jeffrey Spang, et al., "Surgical Trends in the Treatment of Meniscal Tears," *American Journal of Sports Medicine*, jul 2016, *44 (7)*, 1717?1723.

Perera, Divaka, Rodney Stables, Martyn Thomas, et al., "Elective intra-aortic balloon counter pulsation during high-risk percutaneous coronary intervention: A randomized controlled trial," *Journal of the American Medical Association,* aug 2010, *304 (8),* 867?874.

Prasad, Vinay, Andrae Vandross, Caitlin Toomey, et al., "A decade of reversal:

An analysis of 146 contradicted medical practices," *Mayo Clinic Proceedings,* 2013, *88 (8),* 790?798.

Prasad, Vinay, Victor Gall, and Adam Cifu, "The frequency of medical reversal," *Archives of Internal Medicine,* oct 2011, *171 (18),* 1675?1676.

Prasad, Vinay and Adam S. Cifu, Ending medical reversal : improving outcomes, saving lives, *Johns Hopkins University Press.* Baltimore, MD, 2015.

Rajaram, Sujanthy S., Nayan K. Desai, Ankur Kalra, et al., "Pulmonary artery catheters for adult patients in intensive care," *Cochrane Database of Systematic Reviews,* feb 2013, *2013 (2).*

Rangan, Amar, Helen Handoll, Stephen Brealey, et al., "Surgical vs nonsurgical treatment of adults with displaced fractures of the proximal humerus the PROFHER randomized clinical trial," *Journal of the American Medical Association,* mar 2015, *313 (10),* 1037?1047.

Reeves, Katharine, Samuel Chan, Alastair Marsh, et al., "Implementation of research evidence in orthopaedics: A tale of three trials," *BMJ Quality and Safety,* may 2020, *29 (5),* 374?381.

Reichenbach, Stephan, Anne WS Rutjes, Eveline Nu?esch, et al., "Joint lavage for osteoarthritis of the knee," *Cochrane Database of Systematic Reviews,* may 2010, *(5).*

Romme, Jacobus J.C.M., Johannes B. Reitsma, Catherine N. Black, et al., "Drugs and pacemakers for vasovagal, carotid sinus and situational syncope," *Cochrane Database of Systematic Reviews,* oct 2011, *2011 (10).* **Rose, Peter G., Stacy Nerenstone, Mark F. Brady, et al..,** "Secondary Surgical Cytoreduction for Advanced Ovarian Carcinoma," *New England Journal of Medicine*, oct 2004, *351 (24)*, 2489?2497.

Rosenberg, Alan, Abiy Agiro, Marc Gottlieb, et al., "Early trends among seven recommendations from the choosing wisely campaign," *JAMA Internal Medicine,* dec 2015, *175 (12),* 1913?1920.

Saad, Lydia, "More Americans Delaying Medical Treatment Due to Cost," *Gallup,* 2019.

Sahuquillo, Juan and Jane A. Dennis, "Decompressive craniectomy for the treatment of high intracranial pressure in closed traumatic brain injury," *Cochrane Database of Systematic Reviews,* dec 2019, *2019 (12).*

Sandham, James Dean, Russell Douglas Hull, Rollin Frederick Brant, et al., "A Randomized, Controlled Trial of the Use of Pulmonary-Artery Catheters in High-Risk Surgical Patients," *New England Journal of Medicine,* jan 2003, *348 (1),* 5?14.

Schoch, Bradley S., Eric M. Padegimas, Mitchell Maltenfort, et al., "Humeral shaft fractures: national trends in management," *Journal of Orthopaedics and Traumatology,* sep 2017, *18 (3)*, 259?263.

Scott, John W., Olubode A. Olufajo, Gabriel A. Brat, et al., "Use of national burden to define operative emergency general surgery," *JAMA Surgery*, jun 2016, *151 (6).*

Secemsky, Eric A., Enrico G. Ferro, Sunil V. Rao, et al., "Association of Physician Variation in Use of Manual Aspiration Thrombectomy with Outcomes Following Primary Percutaneous Coronary Intervention for ST-Elevation Myocardial Infarction: The National Cardiovascular Data Registry CathPCIRegistry," *JAMA Cardiology,* feb 2019, *4 (2),* 110?118.

Sheldon, Trevor A., Nicky Cullum, Diane Dawson, et al., "What?s the evidence that NICE guidance has been implemented? Results from a national evaluation using time series analysis, audit of patients? notes, and interviews," *BMJ,* oct 2004, *329 (7473)*, 999.

Shrank, William H., Teresa L. Rogstad, and Natasha Parekh, "Waste in the US Health Care System: Estimated Costs and Potential for Savings,"*Journal of the American Medical Association,* oct 2019, *322 (15)*, 1501?1509.

Sihvonen, Raine, Mika Paavola, Antti Malmivaara, et al., "Arthroscopic Par-

tial Meniscectomy versus Sham Surgery for a Degenerative Meniscal Tear," *New England Journal of Medicine*, dec 2013, *369 (26),* 2515?2524.

Sikirica, Vanja, Bela Bapat, Sean D. Candrilli, et al., "The inpatient burden of abdominal and gynecological adhesiolysis in the US," *BMC Surgery,*2011, 11.

Smieliauskas, Fabrice, Sandi Lam, and David H. Howard, "Impact of negative clinical trial results for vertebroplasty on vertebral augmentation procedure rates," *Journal of the American College of Surgeons,* 2014, *219 (3),* 525?533.

Smith, Laura Barrie, Nihar R. Desai, Bryan Dowd, et al., "Patient and provider-level factors associated with changes in utilization of treatments in response to evidence on ineffectiveness or harm," *International Journal of Health Economics and Management,* sep 2020, *20 (3),* 299?317.

Smith, Peter K., John D. Puskas, Deborah D. Ascheim, et al., "Surgical treatment of moderate ischemic mitral regurgitation," *New England Journal of Medicine,* dec 2014, *371 (23),* 2178?2188.

Steiner, Claudia A., Zeynal Karaca, Brian J. Moore, et al., "Surgeries in Hospital-Based Ambulatory Surgery and Hospital Inpatient Settings,2014: Statistical Brief 223," Technical Report, *Agency for Healthcare Research and Quality,* Rockville, MD 2014.

Street, Richard L, Quentin W Smith, Robert J Volk, and Michael Fordis, "Differing Levels of Clinical Evidence: Exploring Communication Challenges in Shared Decision Making," *Medical Care Research and Review*, 2012,*70 (1),* 3?13.

Suckow, Bjoern D., Philip P. Goodney, Jesse A. Columbo, et al., "National trends in open surgical, endovascular,and branched-fenestrated endovascular aortic aneurysm repair in Medicare patients," *Journal of Vascular Surgery,* jun 2018, *67 (6),* 1690?1697.

Swank, D. J., S. C.G. Swank-Bordewijk, W. C.J. Hop, et al., "Laparoscopic adhesiolysis in patients with chronic abdominal pain: A blinded randomised controlled multi-centre trial," *The Lancet*, apr 2003, *361 (9365)*, 1247?1251.

Tatsioni, Athina, Nikolaos G. Bonitsis, and John P.A. Ioannidis, "Persistence of contradicted claims in the literature," *Journal of the American Medical Association,* dec 2007, *298 (21),* 2517?2526.

Thiele, Holger, Uwe Zeymer, Franz-Josef Neumann, et al., "Intra-aortic Balloon Support for Myocardial Infarction with Cardiogenic Shock," *New England Journal of Medicine,* oct 2012, *367 (14),* 1287?1296.

Thiele, Holger, Uwe Zeymer, Franz-Josef Neumann, et al., "Intra-aortic balloon counterpulsation in acute myocardial infarction complicated by cardiogenic shock (IABPSHOCKII): Final 12 month results of a randomised, open-label trial," *Lancet,* 2013, *382 (9905),* 1638?1645.

Unverzagt, Susanne, Michael Buerke, Antoinette de Waha, et al., "Intra-aortic balloon pump counterpulsation (IABP) for myocardial infarction complicated by cardiogenic shock," *Cochrane Database of Systematic Reviews*,mar 2015, *2015 (3).*

Vallabhajosyula, Saraschandra, V. Subramaniam, Dennis H. Murphree, et al., "Complications from percutaneous-left ventricular assist devices versus intra-aortic balloon pump in acute myocardial infarction-cardiogenic shock," *PLoS ONE*, aug 2020, *15 (8 August).*

Van Der Gaag, N. A., E. A.J. Rauws, C. H.J. Van Eijck, et al., "Preoperative biliary drainage for cancer of the head of the pancreas," *New England Journal of Medicine* may 2010, *362*, 129 - 137.

Van Dijk, Diederik, Monique Spoor, Ron Hijman, et al., "Cognitive and cardiac outcomes 5 years after off-pump vs on-pump coronary artery bypass graft surgery," *Journal of the American Medical Association,* feb 2007, *297 (7),* 701?708.

VM, Mattila, Sihvonen R, Paloneva J, and Feller-Tsai L, "Changes in rates of arthroscopy due to degenerative knee disease and traumatic meniscal tears in Finland and Sweden," *Acta Orthopaedica*, jan 2016, *87 (1),* 5?11.

Ward, Bryan K., Howard W. Francis, Simon R. Best, et al., "National preva-

lence and impact of perioperative vagus nerve injury in vestibular schwannoma," *Laryngoscope,* dec 2012, 122 (12), 2824?2831.

Wheatley, K., N. Ives, R. Gray, et al., "Revascularization versus Medical Therapy for Renal-Artery Stenosis," *New England Journal of Medicine,* nov2009, *361 (20)*, 1953?1962.

Wheeler, Arthur P., Gordon B. Bernard, B Taylor Thompson, et al., "Pulmonary-Artery versus Central Venous Catheter to Guide Treatment of Acute Lung Injury," *New England Journal of Medicine,* may 2006, *354 (21)*, 2213?2224.

Wiener, Renda Soylemez and H. Gilbert Welch, "Trends in the use of the pulmonary artery catheter in the United States, 1993-2004," *Journal of the American Medical Association,* jul 2007, *298 (4)*, 423?429.

Yang, Jianji and Judith Logan, "A data mining and survey study on diseases associated with paraesophageal hernia," *Annual Symposium proceedings,* 2006, 829?833.

Young, Tim and Krishna Bajee Sriram, "Vena caval filters for the prevention of pulmonary embolism," *Cochrane Database of Systematic Reviews,* oct 2020,*2020 (10).*

Zhou, Selena, Natalia Egorova, Gil Moskowitz, et al., "Trends in Mitra Clip,mitral valve repair, and mitral valve replacement from 2000 to 2016," *Journal of Thoracic and Cardiovascular Surgery,* aug 2021, *162 (2),* 551?562.

1.8 Figures

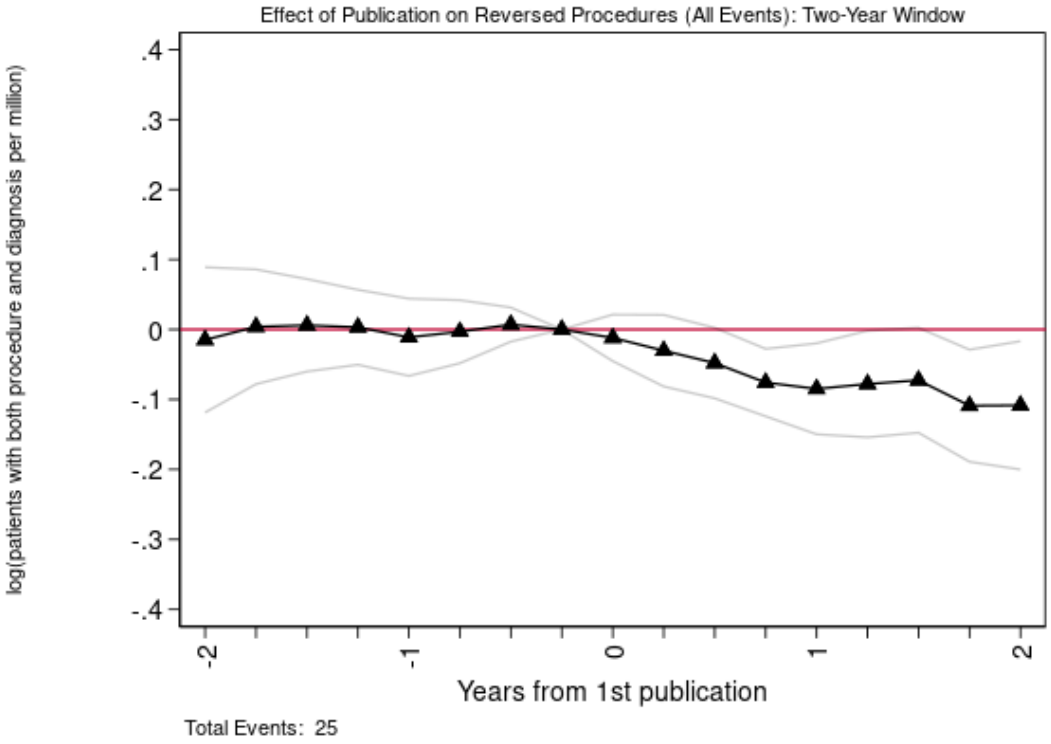


Figure 1.1 Event-Study: Impact of Publication of on Reversed Procedures (All-Events 2 Year Window)

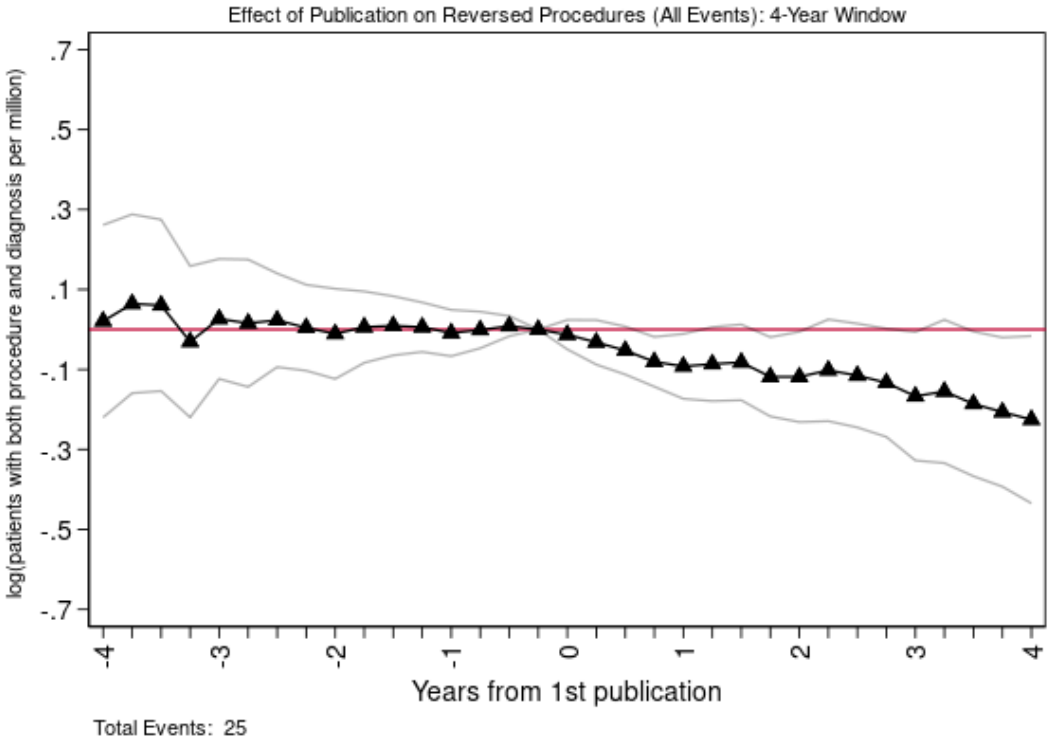


Figure 1.2 Event-Study: Impact of Publication of on Reversed Procedures (All-Events 4-Year Window)

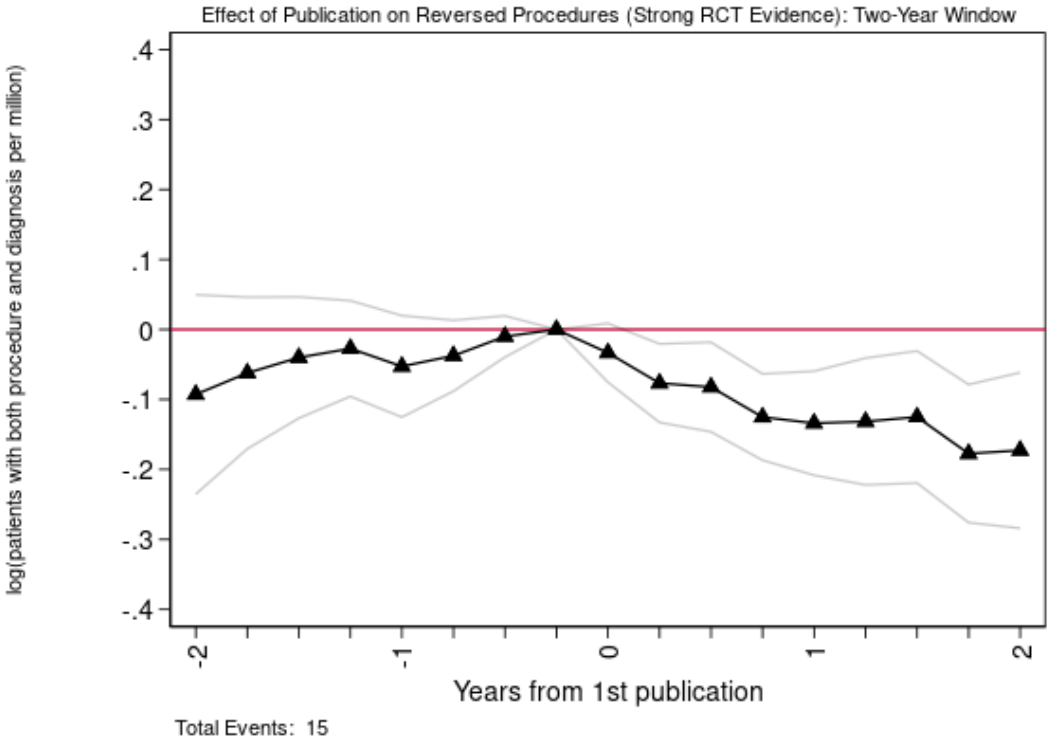


Figure 1.3 Event-Study: Impact of Publication of on Reversed Procedures (Strong Evidence 2 Year Window)

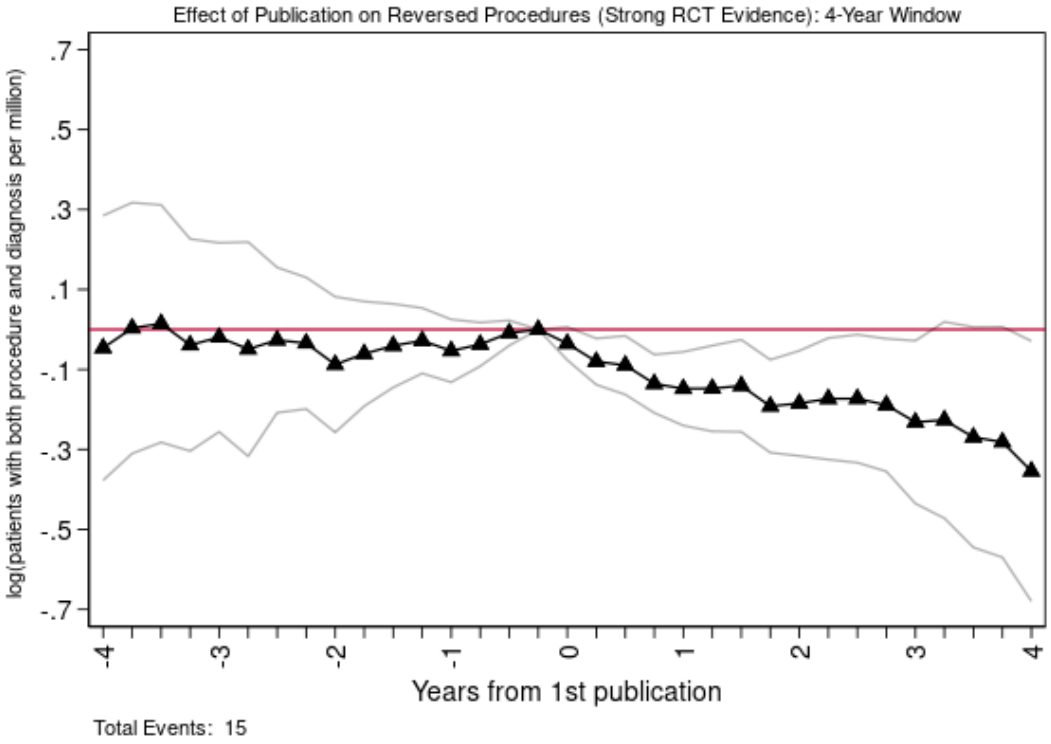


Figure 1.4 Event-Study: Impact of Publication of on Reversed Procedures (Strong Evidence 4 Year Window)

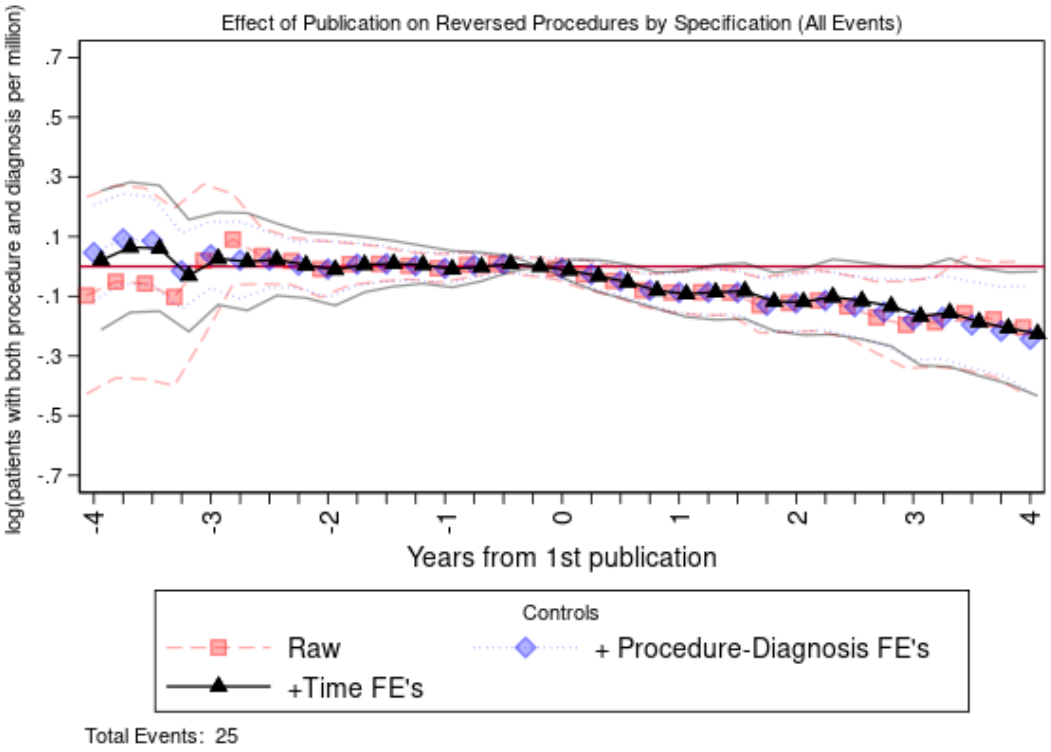


Figure 1.5 Event-Study: Robustness to Controls (All Events)

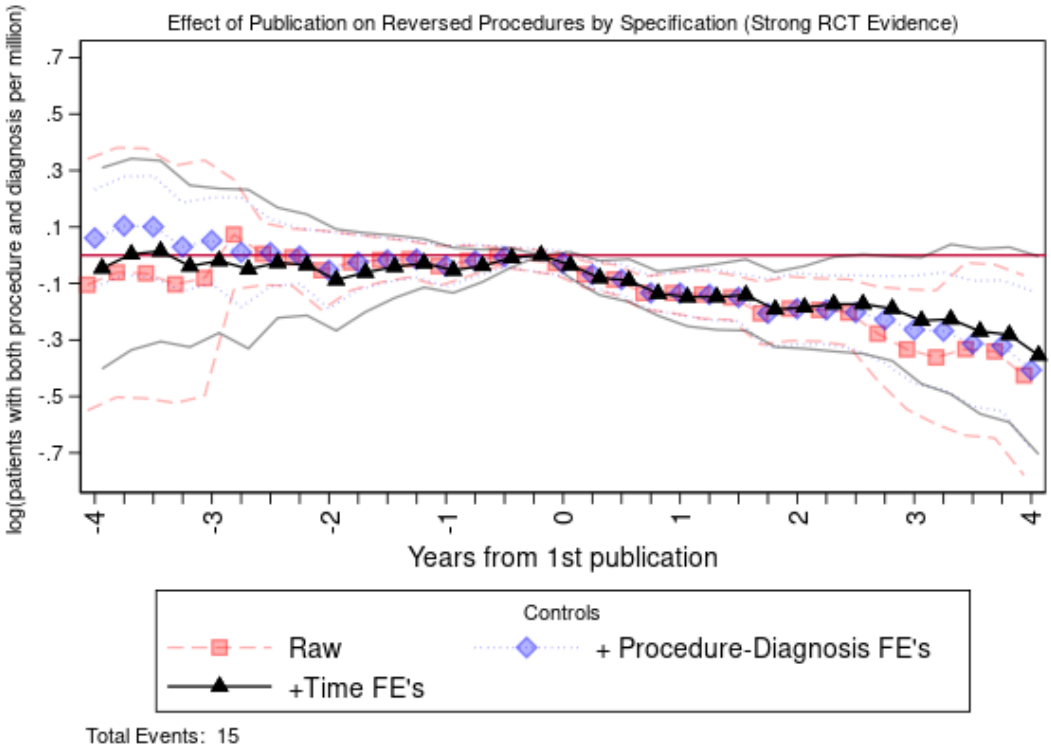
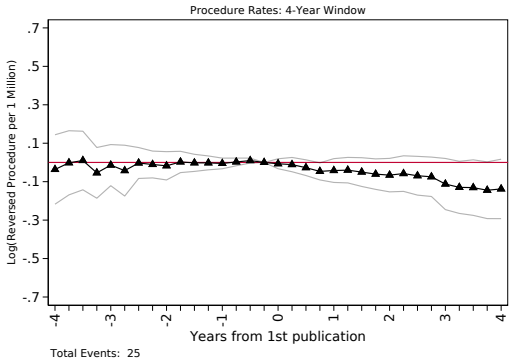
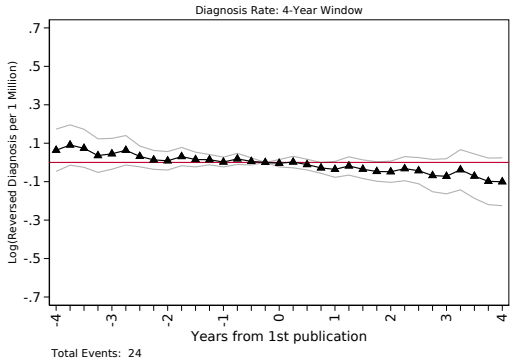


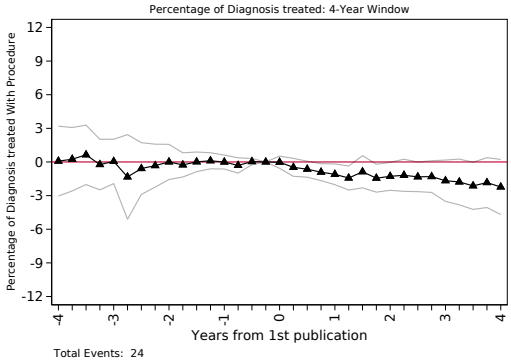
Figure 1.6 Event-Study: Robustness to Controls (Strong Evidence)



(a) Procedures per Million People

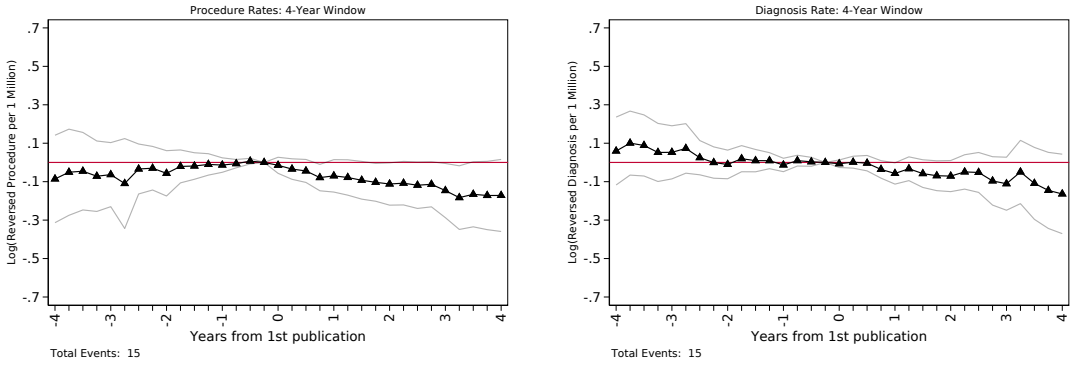


(b) Diagnoses per Million People

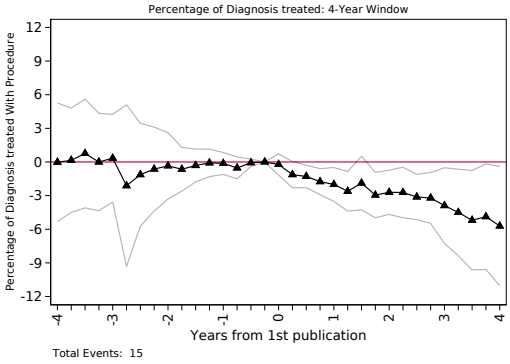


(c) Percentage of Diagnoses treated with Procedure

Figure 1.7 Robustness Tests: Impact of Publication on Other Outcomes (All Events)



(a) Procedures per Million People **(b)** Diagnoses per Million People



(c) Percentage of Diagnoses treated with Procedure

Figure 1.8 Robustness Tests: Impact of Publication on Other Outcomes (Stronger Evidence)

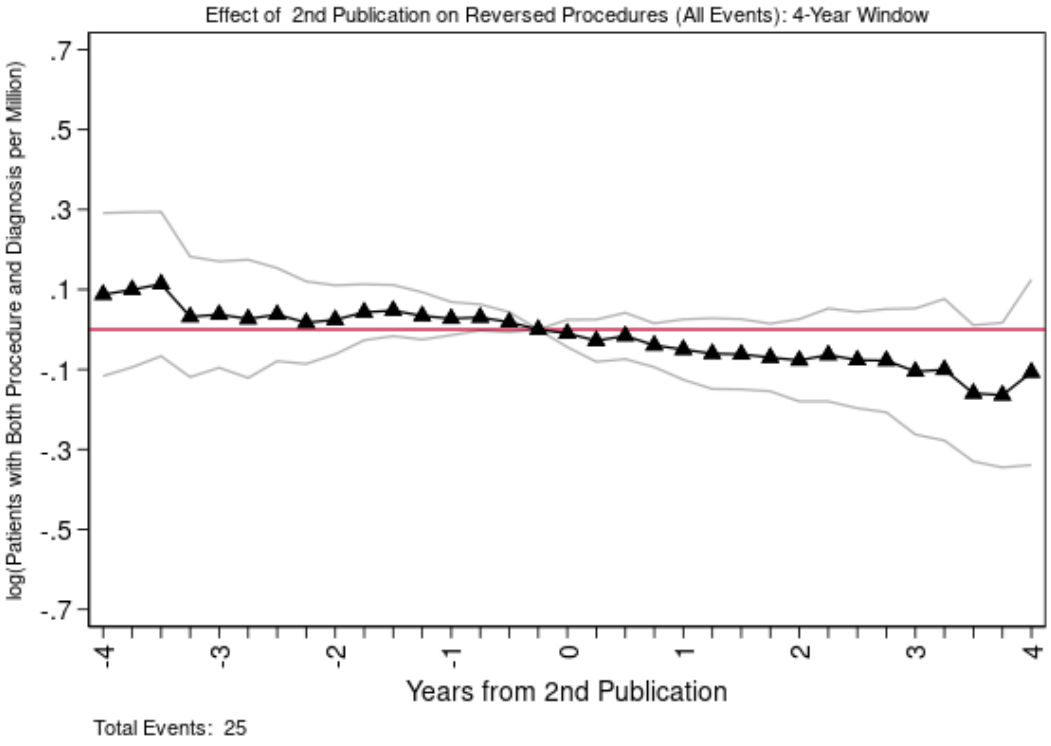


Figure 1.9 Robustness Test: Impact of 2nd Publication on Reversed Procedures (All Events)

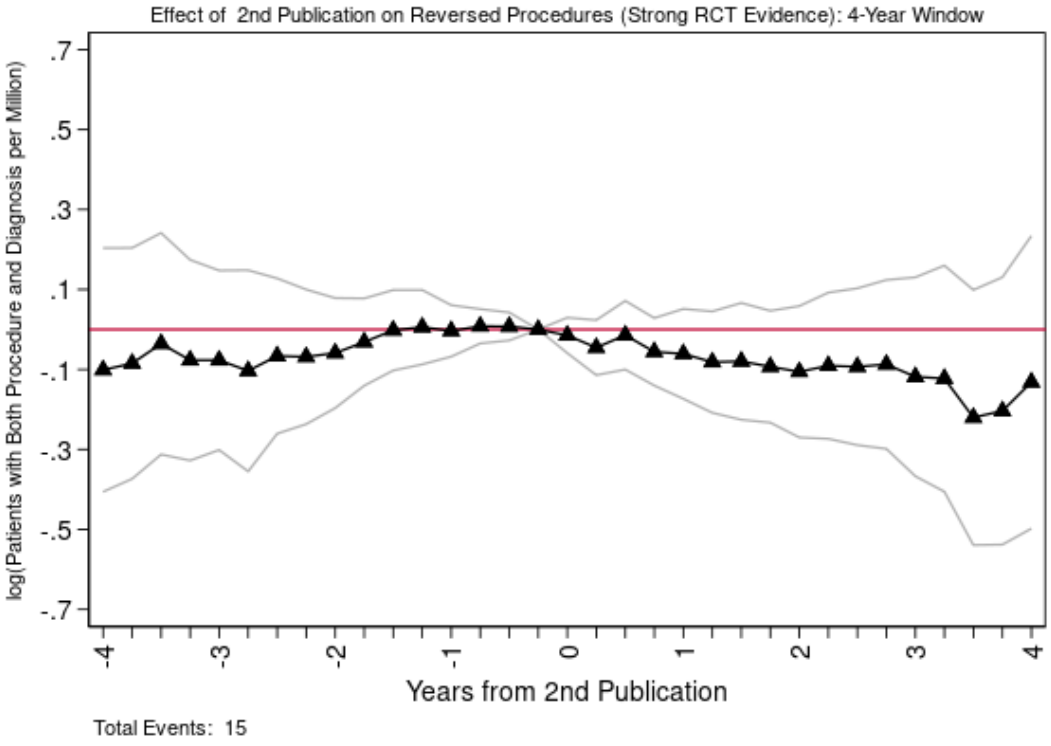


Figure 1.10 Robustness Test: Impact of 2nd Publication on Reversed Procedures (Strong Evidence)

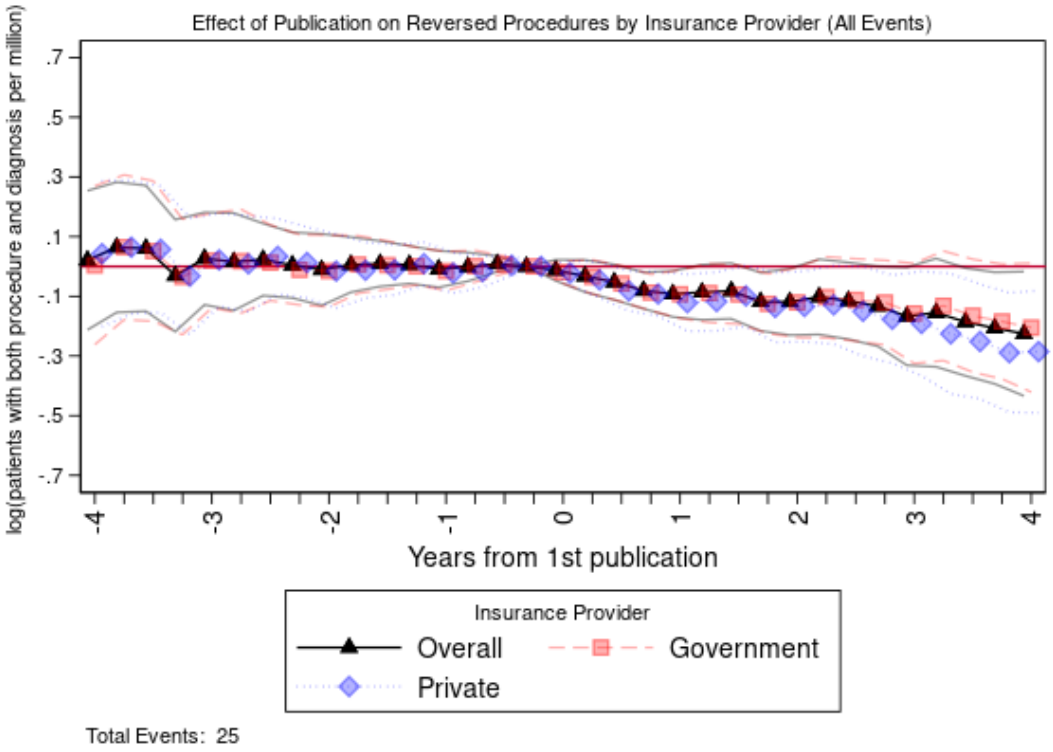


Figure 1.11 Event-Study: Heterogeneity by Insurance Provider (All Events)

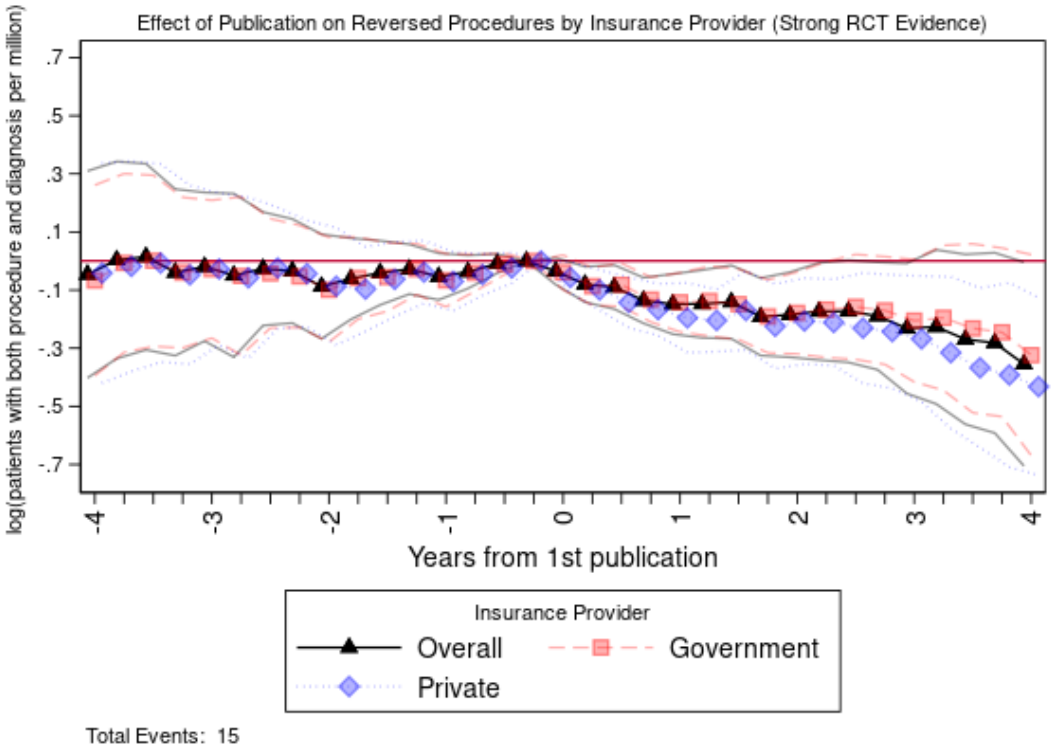


Figure 1.12 Event-Study: Heterogeneity by Insurance Provider (Strong Evidence)

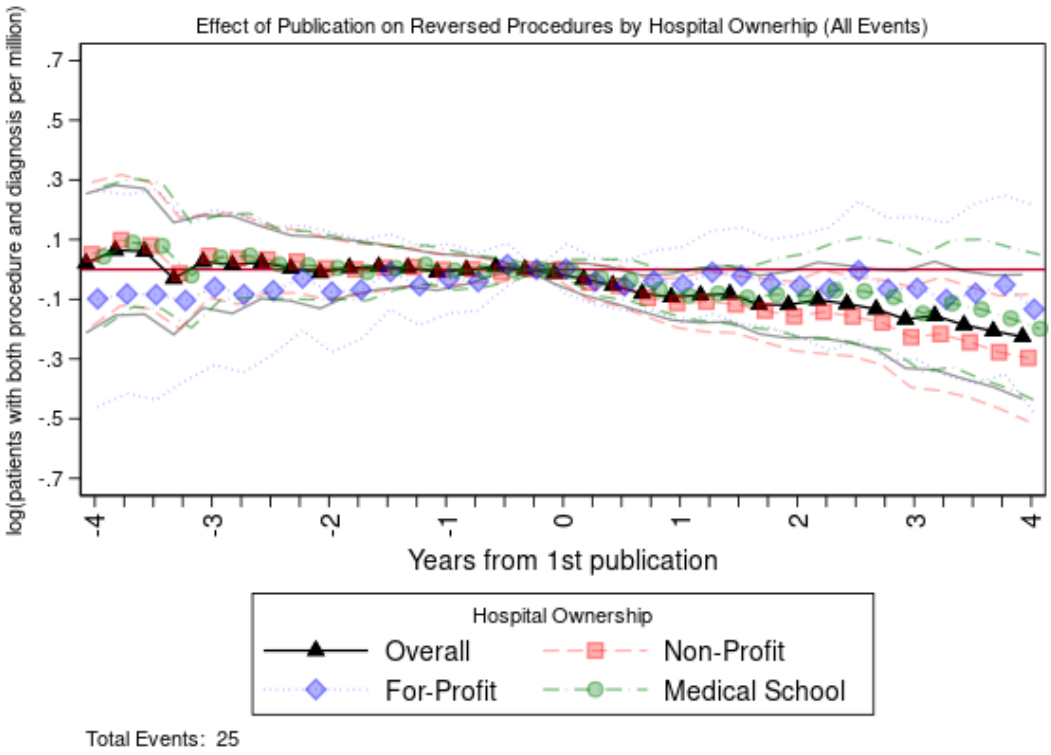


Figure 1.13 Event-Study: Heterogeneity by Hospital Ownership (All Events)

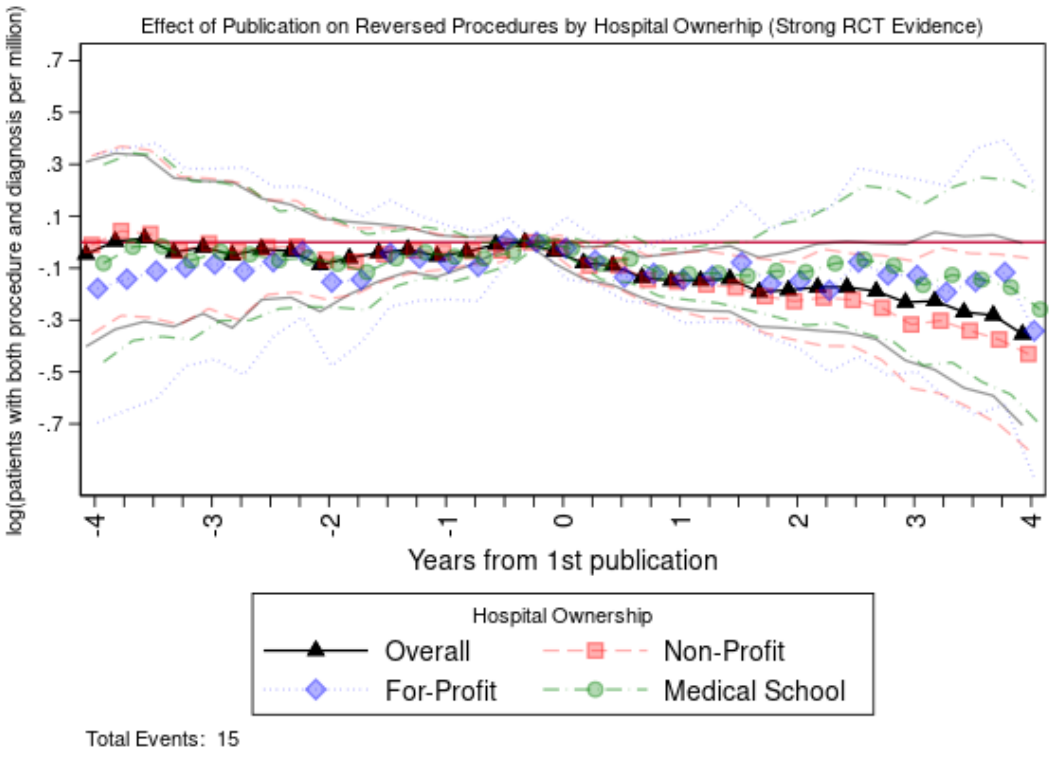


Figure 1.14 Event-Study: Heterogeneity by Hospital Ownership (Strong Evidence)

1.9 Tables

		Insurance Carrier		Hospital Ownership		
	Total	Government	Private	Non-Profit	Medical School	For-Profit
Within 2 Years After	-0.058	-0.057	-0.069	-0.085	-0.055	0.061
	(0.076)	(0.076)	(0.079)	(0.072)	(0.077)	(0.116)
Over 2 Years After	-0.193	-0.179	-0.238*	-0.245*	-0.157	-0.101
	(0.121)	(0.119)	(0.132)	(0.129)	(0.132)	(0.170)
% of Procedures :	100	62.8	32.8	55.9	45.4	10.3
P-D FE's:	X	X	X	X	X	X
Q FE's:	X	X	X	X	X	X
States:	7	7	7	6	6	6
Obs:	1746	1746	1746	1746	1746	1746
Events:	25	25	25	25	25	25

Note: Standard errors are calculated using a block bootstrap method clustered at the procedure diagnosis combination level. All outcomes are measured in log(patients who received both the procedure and the diagnosis it was meant to treat per 1 million people). The percentage of procedures for each category of heterogeneity is measured prior to publication. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 1.1: Effect of Publication on Inpatient Reversed Procedure Usage (All Events)

		Insurance Carrier		Hospital Ownership		
	Total	Government	Private	Non-Profit	Medical School	For-Profit
Within 2 Years After	-0.037	-0.026	-0.048	-0.062	0.016	0.039
	(0.101)	(0.095)	(0.106)	(0.100)	(0.115)	(0.174)
Over 2 Years After	-0.269	-0.242	-0.337*	-0.325*	-0.163	-0.191
	(0.170)	(0.164)	(0.175)	(0.171)	(0.218)	(0.242)
% of Procedures :	100	66	30.5	58	45.5	10.4
P-D FE's:	X	X	X	X	X	X
Q FE's:	X	X	X	X	X	X
States:	7	7	7	6	6	6
Obs:	1029	1029	1029	1029	1029	1029
Events:	15	15	15	15	15	15

Note: Standard errors are calculated using a block bootstrap method clustered at the procedure diagnosis combination level. All outcomes are measured in log(patients who received both the procedure and the diagnosis it was meant to treat per 1 million people). The percentage of procedures for each category of heterogeneity is measured prior to publication. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 1.2: Effect of Publication on Inpatient Reversed Procedure Usage (Strong RCT Evidence)

Chapter 2

The Effect of Point-of-Sale Law Enforcement Efforts on Underage Drinking: Evidence from Minor Decoy Citations

2.1 Introduction

According to the U.S. National Institute of Health, people between the ages of 12 to 20 account for 11% of all the alcohol consumed domestically. Additionally, this age group makes up 90% of all binge drinking nationally. This dangerous amount and pattern of consumption has both short and long term consequences, from hurting brain development to increasing the risk of injury and risky behavior, resulting in over 188,000 alcohol-related emergency room visits for people under 21 (NIAAA, 2022).Thus, underage drinking has become a major public health concern in the U.S.

Policies targeting curbing underage alcohol consumption are often oriented towards making its procurement more difficult for consumers. Minimum legal drinking age restrictions (MLDA), stricter identification laws, and zero-tolerance alcohol driving penalties have all been implemented to make it more difficult for an individual to purchase alcohol if they are not of age. While there is a rich literature tackling these laws, relatively little has been studied about the efficacy of programs that target alcohol furnishers. Targeting the supply of underage alcohol sellers may decrease consumption through a minor's ability to purchase from a previously selling establishment. However, people under 21 may substitute to another supply channel, such as parental access or from peers, potentially mitigating any measurable impact these interventions would have on drinking. This makes the impact of these policies ambiguous. Thus, this paper estimates the impact of minor decoy citations, a policy focused on the point-of-sale, on alcohol-related crime in order to better understand how a reduction of one channel of supply works to curb illicit behavior directly related to alcohol.

Minor decoy operations implemented by local law enforcement agencies consist of sending a minor to attempt to purchase alcohol from a liquor licensed establishment. If the minor is able to successfully purchase alcohol, the establishment is hit with heavy penalties that include fines in the thousands, multi-week suspensions, and even the revoking of licenses. This paper takes advantage of the fact that these fines are large and therefore likely to be a strong deterrent to alcohol furnishing as well as spatial variation in citations across California to examine the impact of an establishment in a jurisdiction getting cited on the local crime rate for 18 to 20 year olds, 21 to 24 year olds, and all adults over the age of 18 separately. Minor Decoy citation events are sourced from the universe of successful liquor license citations in California through California's Alcohol Beverage Control (ABC) from

2000 to 2006 and the near universe of arrests for California from the California Department of Justice's Monthly Arrest and Citation Registry (MACR). I use an event study design around the day of citation within a 14 day window before and after to capture the immediate impact of said supply shock and implicitly test through pre-period trend analysis if any decline estimated in arrests is directly tied to the citation itself.Furthermore, I separately consider several categories of alcohol-related and alcohol-adjacent crimes as well as look for spillovers across illicit drug, violent, and property crimes. I compliment this analysis with a staggered difference-in-differences estimation strategy to get the average impact of a minor decoy on underage arrests the first month after the citation occurred.

I find evidence that alcohol-related crimes greatly increase the day of citation across all three groups, and seem to persistently increase for a week after for 18 to 20 year olds. This is primarily driven by liquor law violations,likely capturing a monitoring effect in local jurisdictions. Having law enforcement present in these establishments increases the likelihood of discovery of other violations. The persistence for minors within the first week also suggests that minor decoy citations are part of a greater initiative to crack down on minor underage alcohol access, focusing on enforcing laws such as false identification violations. When studying other alcohol-related and alcohol adjacent outcomes, I find no evidence of a decrease in arrests across jurisdictions as a result of a potential decrease in underage alcohol supply. This may be due to the nature of the treatment itself, as outlined in the conclusion, rather than evidence of no impact.

This paper adds to the literature on underage alcohol enforcement efforts by systematically studying the impact of minor decoy laws. Most of the literature on underage alcohol policy has studied laws targeting underage consumers, such as MLDA laws (Carpenter and Dobkin, 2009a; 2009b; 2015; 2017; Crost and Guer-

rero, 2012), and other ID restriction laws(Bellou and Bhatt, 2013, Yoruk, 2014; 2018; Zheng, 2018). These papers generally find that minimum legal drinking age is effective in curbing crime, mortality, and morbidity among underage people. The efficacy of ID orientation laws is mixed, with (Zheng, 2018) finding no evidence of a decline as a result of the policy intervention and (Yoruk, 2014; 2018) finding a decline in average days of drinking. The literature examining supply interventions is relatively more scarce and has followed mostly pre-post analyses of local community coalitions that are not uniform policies, but rather tailored to specific communities (Lewis et al, 1996; Wagenaar et al 1999; 2000a; 2000b;). These papers have found some evidence of reduction in alcohol consumption as a result of the intervention, but are mixed to the size of effect and whether the impact is statistically significant. This paper takes advantage of spatial variation in citations across jurisdictions to examine the impact of a similar policy on a larger scale, furthering to our understanding of the efficacy of penalty-based underage alcohol policies. The paper is organized as follows: section 2 covers the minor decoy program policy instituted by the California ABC; section 3 provides an overview of the data and outcomes used to measure alcohol-related crime; section 4 details the empirical strategy; section 5 describes results; and section 6 discusses why the minor decoy policy resulted in no significant reduction in underage crime.

2.2 Background: Minor Decoy Program

The minor decoy program has been a large component of ABC's strategy to combat underage alcohol behavior, with the organization issuing grants to local law enforcement agencies of $10.7 million in funding toward projects related to and including Minor Decoy operations, as well as $2.1 million specifically for Minor Decoy initiatives between 2000 and 2006. It has been used in California since 1987

and from 2002 to 2007 an average of 4,000 to 6,000 establishments were visited by a minor decoy operation (CA ABC, 2007).

In a minor decoy program, local law enforcement or ABC agents send in a person under 20 years of age in order to purchase alcohol from a liquor licensed establishment. If the licensee is caught selling they receive three penalties of varying degrees of severity depending on whether this instance was their first, second, or third offense within three years. For the first offense licensees pay a fine from $750 - $3000 and potentially face up to 15 days of liquor license suspension. Their second infraction institutes a mandatory 25 day suspension of an establishment's license and license holders get their license revoked for the third instance. For places where alcohol is a major source of revenue this can lead to a strong financial blow to their profits, making the penalty of being caught quite harsh.

It's important to note that the stated goals of the program are to reduce alcohol consumption and access of minors, not to target license holders specifically. Critics of the program have painted these as "sting operations" meant to trick a license holder to sell alcohol to a minor. This view was prominent enough that the decoy program was assessed by California's Supreme Court on the grounds of whether it was considered entrapment in 1994. In light of this, there has been regulation put in place to ensure that the decoys participating are in no way meant to trick establishments into assuming they are of age. Under California Law, they must be under 20 years old, they can't lie about their age, they must present their correct ID if asked for it, and must display an appearance which could generally be expected of a person under 21 years old. For example, they are not able to wear college apparel or have facial hair. Additionally, jurisdictions announce in a local paper the time-frame when they are planning to start performing minor decoy

visits. This is issued with the hope that it will restrict alcohol supply without the need to penalize license holders.

The percentage of license holders who received a violation decreased over time,with a 29.4 % hit-rate of all cited establishments in 1994 that has dropped steadily to less that 16 % by the end of the 2006-2007 fiscal year. In parallel, the number of citation visits has increased from 4,262 in 2002 to between 6,000 and 8,000 from 2004-2007. As such this program seems to deter license holders from at minimum being detected by law enforcement agencies. Therefore understanding how this translates to the curbing of alcohol consumption itself and downstream outcomes such as crime is key toward understanding the true efficacy of this program in regards to its primary goals.

2.3 Data

2.3.1 California Alcohol Beverage Control Citations

Minor Decoy citations are sourced from California's ABC Citation registry, consisting of the universe of all liquor license citations from 1996 to 2006 in the state. Included in this information is the name of the establishment cited, the date the successful citation was issued, and the police department or jurisdiction under which the citation was issued. It's important to note that some of these citations are not only done by local police departments, but by ABC officers themselves. In these instances, jurisdictions were marked by the location of the premises that were targeted by citation, since the treatment is a reduction of supply of underage alcohol for the surrounding area.

I collapsed individual citations to the citation date/jurisdiction level to account for cases where multiple stores in the same jurisdiction were hit on the same

day. For the purpose of events, I treated the first citation within a 7 day period in the same jurisdiction as the start of any minor decoy program, since it is unlikely that events within the same week and area can be considered separate treatments. Rather, these probably make up a larger scale effort towards curbing underage alcohol furnishing. Given the potential network effects and likely interconnectivity of local stores, I did not differentiate by number of successful citations within a 7 day period. Local store owners likely know when another store is cited within their own district, therefore adding an information shock component to a successful citation that may have spillover effects to other stores within a jurisdiction.

2.3.2 Arrest Records

Arrest rates are constructed using arrest data from the California's department of Justice's Monthly Arrest and Citation registry from 1996 to 2006. The MACR consists of the near universe of all arrests for both misdemeanor and felony charges in the state during this time period. Of direct importance, we also have for each arrest the date of birth of the perpetrator, date of arrest and arresting organization jurisdiction code. This allows us to map one to one between MACR and minor decoy citations date/locations.

For each arrest observe the level of crime and code for arrest category. A breakdown of each arrest code is available upon request. In the main analysis, I distinguish between alcohol-related arrests, alcohol-adjacent arrest, and summary crimes for illicit drugs (such as use and sale), property crimes (such as theft), and violent crimes (such as assault). Alcohol related crimes include liquor law violations(LLV)[1], public intoxication, vagrancy, driving under the influence (DUI), and

[1]These include sale to minors as well as minor possession

disorderly conduct. Alcohol-adjacent crimes include county ordinances (typically include public urination, open container laws), traffic violations, hit-and-run's, vandalism, and weapons possession. Once these are identified, they are collapsed to the daily level by jurisdiction for each of the three age groups examined, and then converted into arrest rates per 10,000 people ([2]).

2.4 Identification Strategy

As the main identification strategy for this paper, I implemented an event study around the first citation within a seven-day span. I leverage spatial variation in the number and frequency of citations in order to map out the path of arrests in response to a supply shock from the suspension or penalty of a liquor license holder as a result of said citation. The staggered event study approach estimates the impact of the citation relative to a counterfactual jurisdiction with no citation, creating a more plausible causal estimate than a pure pre-post analysis. Furthermore, the advantage of the event-study design over a standard difference-in-differences estimate is its ability to not only determine the average impact post-citation, but also the trajectory pre and post. This is particularly important in this case because Minor Decoy programs often release newspaper warnings in local press prior to implementation. Given one major channel by which citations may curb underage alcohol is through spread of information, it is important to empirically test whether the true event is the citation itself or any warning prior. Having a sufficient enough pre-period that covers this allows the event-study design implicitly tests for this. Furthermore, it also important to understand not only the average impact post-citation but how persistent any change in arrests is

[2]Population estimates by age at the jurisdiction level from California's 2000 Census(U.S. Census Bureau, 2002)

across the time period in question. Breaking up the post-period into multiple time periods allows an estimation of not only the overall impact but also the trend, which is of direct interest for policy analysis. The main specification is as follows:

$$\begin{aligned} Arrests_{jt} = \sum_{e=-14,\neq -1}^{14} \beta_e i[D_t - C_{jt} = e]_{jt} + \\ \beta_{pre} i[-30 \leq D_t - C_{jt} < -14]_{jt} + \\ \beta_{post} i[14 < D_t - C_{jt} \leq 30]_{jt} + \\ \lambda_j + \theta_t + \epsilon_{jt} \end{aligned}$$

The outcome $Arrests_{jt}$ captures arrests rates per 10,000 people for each arrest category mentioned in the data section for individuals 18-20 years old, 21 to 24 years old, and 18 and older, respectively. If the arrest impact is operating through the channel of underage alcohol, the group that is most affected are those underage, making the 18 to 20 year olds the most likely group to be impacted by the mechanism of interest. In contrast, 21 to 24 year olds present a natural placebo group considering that the age range covered is similar, but individuals within it are not directly under the minimum legal drinking age and therefore the supply effects of the citations would unlikely have a strong spillover effect to them. Lastly, I examine everyone over 18 to see whether the impact of a decline in underage alcohol consumption translates to a measurable decline in arrest for all adults.

The main effect of interest is captured by the β_e coefficients, which represent being e number of days away from a citation in jurisdiction j in time t. The excluded period is the day immediately before citation. Given the fact that each jurisdiction receives treatment multiple times from 2000 to 2006, treating the entire pre period or post period as after or before an individual citation runs the

risk of contamination of coefficients from other previous minor decoy programs. Given this constraint, I defined the event window as one month before and one month after citation. Two months gives enough time to capture the general trend of arrests over this period, important for identifying any pre-period effects, as well as capturing how transitory the impact of supply is in the post period over this window. I break up this event window into indicator variables for each day 14 days before and after citation, since the causal claim of the impact of these events on arrests is stronger the closer to the citation date the estimation is. I then allow for a catch all impact of being greater than two weeks before or after citation within the month, whose effect is captured by β_{pre} and β_{post}. I include jurisdiction fixed effects to account for general arrest rate levels and non-time varying differences between jurisdictions as well as day fixed effects to account for any California global shocks that might bias my estimates. I cluster standard errors at the jurisdiction level to account for possible intra-serial correlation that might cause an underestimation of the true standard errors.

I further compliment this analysis with a staggered difference-in-differences design to get an estimate of the average impact of minor decoy citations within the first 30 days post citation. The specification is as follows:

$$Arrests_{jt} = \beta_0 + \beta_1 \, i[0 \leq D_t - Pjt \leq 30]_{jt} + \lambda_j + \theta_t + \eta_{jt}$$

The main effect is captured by β_1, which measures the impact of being within the first month after a minor decoy citation on jurisdiction level arrest rates. This model also includes fixed effects at the jurisdiction and time level, as captured by λ_j and θ_t, and standard errors are clustered at the jurisdiction level.

The sample of jurisdictions only includes ones who received at least one minor

decoy citation from 2000 to 2006. Additionally, I exclude any big cities such as Los Angeles, San Francisco and San Jose, since crime rates there are not representative of the average jurisdiction within the state. The primary assumption within this model is that, conditional on having received at least one citation between 2000 and 2006, timing of successful citations are uncorrelated with other unobservable time varying factors that could bias our estimates. By conditioning on having received a minor decoy operation, the counterfactual control groups are more plausibly similar in their need for the program. Additionally, by zooming in on the immediate impact within the first two weeks to a month, it becomes more reasonable to assume any change seen in the post period in highly targeted outcomes is likely due to that event. Lastly, by including 21 to 24 year olds as placebo, we have a comparable counterfactual that would likely pick up any time varying differences that are unrelated to underage access but correlated with arrests and timing of citation.

2.5 Results

2.5.1 Primary Results: Alcohol Related Crimes

Figure 2.1 presents] the event-study estimates of the impact of minor decoy citations on all alcohol-related arrests split between the three age groups of interest. Across all three it is evident that pre-citation trends are flat and centered at 0, adding validity to the idea that true event is the day of citation, rather than any earlier announcements. In contrast to what one would expect, 18 to 20 years see a large increase in arrests Starting in the day the citation occurred, reaching 0.4 arrests per 10,000 underage individuals and steadily declining back down to 0 within a week. This constitutes an increase of about 40% relative to the mean.

This increased arrest rate is also present in the 21-24 year old and all adults, but only on the day of citation.

If the primary channel by which the citations impacted arrests was a reduction of supply of underage alcohol to minors, it should result in a decline post-citation. However, if anything the event-study illustrates an increase across age groups. This is in line with an increased overall law enforcement presence due to citations, particularly in the case of the of-age groups. Minor decoy citations bring officers into a jurisdiction and setting where underage alcohol supply is present, increasing the likelihood that any other alcohol violations will be discovered as well. The persistence of arrest increase for underage individuals within the first week post-citation also highlights that minor decoy citations may not just be a standalone program, but part of a greater police force initiative to target underage drinking.

This increase in alcohol-related crimes is driven primarily by liquor law violations increasing the day of and week after citations. As figure 2.2 highlights, the impact of citations on liquor law violations follows the same trend across age groups seen in figure 2.1, although less pronounced in the week after citation in the case of 18 to 20 year olds. The transitory nature of the impact across 21 to 24 year olds and all adults is particularly stark in panels b and c, where there is a large pronounced increase the day of, but virtually flat trends pre and post citation day.

This pattern does not persist across any of the other alcohol-related arrest sub-categories, as captured in figures 2.3 to 2.7. illustrate. Each event study for underage groups and of-age groups is noisy, with no distinct pattern that could be tied to the day of citation, and is virtually flat when looked at the arrest rate for all adults within the jurisdiction, highlighting that the primary driver behind the increases seen in overall arrests related to alcohol is liquor law violations.

These violations include sale to minors, fake id laws, underage drinking, and furnishing of alcohol to minors. Given the concentration of these events so strongly among this category, it's likely that the arrests are occurring at the liquor license holding premises themselves, rather than throughout the whole jurisdiction. The persistence throughout the week for minors may also be capturing the impact of other establishments that were targeted by a minor decoy program in the following days, or ones where there was presence of an officer but the citation itself was not successful.

2.5.2 Difference-in-Differences Estimates

The difference-in-difference estimates follow a similar pattern to what is shown in the event-study figures. Tables 2.1 to 2.3 show how the minor population is impacted by citations within the first 30 days after a citation occurs. Looking at Table 2.1, we see no statistically significant impacts on alcohol-related arrests. Interestingly, the coefficient corresponding to the impact on liquor law violations is the only effect that is positive, although most of the coefficients are close to zero. Given that most other categories are negative, this is suggestive of a potential supply side decrease resulting in less crime among underage people, but the impact is not large enough to be detectable. This is further enforced by the first column of table 2.3, which shows that there is a negative, but not statistically significant impact on overall alcohol-related arrests. When focusing in on table 2.2 that covers alcohol-adjacent crimes, the signs are less consistently negative and all not statistically significant, reiterating that there is no detectable impact of minor decoy citations on crime through a reduction of underage alcohol supply. There is also no detectable spillover or pattern across other crime categories, as seen in columns 2 to 4 in table 2.3.

When focusing on the other two age groups, 21 to 24 year olds and all adults over 18, the difference-in-difference estimate corroborates clearly the analysis found in the event study. In both columns 1 in tables 2.4 and 2.7 there is a statistically significant impact of citation on liquor law violations. For 21 to 24 year olds arrests increase in jurisdictions where a minor decoy citation occurred by 0.015 arrests per 10,000 people, about a 50 % increase relative to the mean. When focusing on all adults, the impact is 0.0083 arrests per 10,000 people, which is also corresponds to an over 33 % increase. Furthering this narrative, there is virtually no measurable impact on any other outcomes across each of the six tables for these two groups. For alcohol-related arrests, besides liquor law violations, there is a marginally statistically significant decrease in vagrancy arrests for 21 to 24 year olds. However, considering the lack of statistical significance seen in any of the other arrest categories, this is like a spuriously statistically significant coefficient rather than a truly measured impact of citations on vagrancy.

As seen in tables 2.5 and 2.6, there are no statistically significant impacts on the 21 to 24 year old groups in alcohol-adjacent crimes or when looking at summary crime categories. This pattern holds when looking at the impact for all adults as well. Additionally, in separate analysis that is available upon request, each sub-category of illicit drugs, property crime, and violent crimes has been examined and there has been no meaningful decrease or increases measured in jurisdictions post-minor decoy citations across each of the three age groups in question. For 21 to 24 year olds this is not surprising considering they act as placebo tests for the channel of interest. For the underage population, this is in line with the results seen in those arrests most related to alcohol. Given the primary mechanism by which this policy operates is by decreasing supply of alcohol to those under 21, it would be unlikely to see an impact other types of arrests without also

seeing a measurable effect in arrests directly tied to alcohol consumption.

2.6 Conclusion

Through the event-study and difference-in-differences analysis, it is clear that arrests rates for liquor law violations increase as a result of minor decoy citations. In the event-study design there is a clear increase the day of citation across all age groups that dissipates almost immediately for adults and people of age. This translates to a statistically significant increase of 0.0153 arrests per 10,000 21 to 24 year olds and 0.0083 arrests per 10,000 adults within a jurisdiction the first month after a citation. The increase estimated is likely due to police presence within establishments that are successfully cited. Law enforcement entering the vicinity of a licensed establishment increased the likelihood of detection of not just selling to minors but other liquor law violations as well.

When examining whether a decrease in underage supply of alcohol had a measurable impact on alcohol consumption for minors and therefore crime as a result, there is no clear sign of reduction. Each event-study for alcohol-related crimes of underage people is noisily measured and shows no clean pattern of reduction within the first month of citation. Furthermore, when there is no statistically significant estimates post-citation for minors in the difference-in-differences design, although all alcohol-related arrests and sub-categories show a decline post-citation. These findings may be due to the size of the treatment rather than the inefficacy of the treatment itself. In order to find a detectable effect of citation for each sub-category of arrest, the reduction in each category relative to its mean would have to range from 4 to 15 %. However, as illustrated by Figure 2.7, for the majority of jurisdictions hit by a minor decoy citation, less than 1% of all liquor license holders are hit with a citation. Furthermore, according to the National

Survey of Drug Use and Health, 11.1% of 18-20 year old alcohol users get their alcohol from a liquor-licensed establishment(SAMSHA, 2019). This bounds the first stage impact of citation on underage alcohol supply between 0.11%(If every licensed establishment sold alcohol to minors) to 11.1% (if the one cited was the only source of underage alcohol within a jurisdiction) , unlikely large enough to translate into a reduction in crime that can be observable.

Furthermore, there are also compounding factors that may muddy the estimate. The first, clearly seen in liquor law violations, is a monitoring effect that might increase the likelihood of police observing a crime compared to a counterfactual where there was not a successful citation. This increase would attenuate any impact a reduction of supply may have as result. Secondly, the potential spillovers to other stores may result in a larger or smaller shock to supply depending on the reaction of store owners. Underage alcohol furnishers may hear from local networks and information channels of a fellow store in their jurisdiction being hit and as a result also could cut back their sales to minors, causing the supply to decrease further than within one store and therefore likely leading to a greater decrease in crime. On the other hand, these suppliers may be competitors for underage alcohol demand, resulting in a substitution away from one store that was hit into another supplier, mitigating any supply effects.

Further research is needed to evaluate the cost-effectiveness of minor decoy operations as a result of the information above. There is no discernible impact of citation on underage alcohol-related arrests that would result from a reduction in alcohol access. This is likely due to the scope of the treatment itself, and therefore minor decoy operations may simply be operating through a channel that has only a small possible impact on alcohol access for minors. Understanding how this balances with the costs of operations is paramount to helping local

jurisdictions more effectively curb underage drinking in their area and its negative consequences. Additionally, focusing on other metrics related to alcohol may reveal downstream outcomes besides crime by which a reduction in supply may operate. Studying morbidity and mortality as a result of citation could be a more targeted outcome, particularly considering the binge-drinking nature of underage alcohol consumption.

2.7 References

Bellou, Andriana and Rachana Bhatt. "Reducing underage alcohol and tobacco use: Evidence from the introduction of vertical identification cards," *Journal of Health Economics*, 2013, *32(2)*, 353-366.

California Alcohol and Beverage Control. 2007. "Fact Sheet: Minor Decoy Program." ABC-511.

Carpenter, Christopher and Carlos Dobkin."The Effect of Alcohol Consumption on Mortality: Regression Discontinuity Evidence from the Minimum Drinking Age," *American Economics Journal: Applied Economics, 2009, 1 (1)*, 164-182.

Carpenter, Christopher and Carlos Dobkin. "The Minimum Legal Drinking Age and Public Health," *Journal of Economic Perspectives, 2009, 25 (2)*, 133-156.

Carpenter, Christopher and Carlos Dobkin. "The Minimum Legal Drinking Age and Crime," *The Review of Economics and Statistics, 2015, 97 (2)* , 521-524.

Carpenter, Christopher and Carlos Dobkin. "*The minimum legal drinking age and morbidity in the United States,*" *The Review of Economics and Statistics, 2017, 99 (1)*, 95-104.

Crost, Benjamin and Santiago Guerrero. "The effect of alcohol availability on marijuana use: evidence from the minimum legal drinking age," *Journal of Health Economics, 2012, 31 (1)*, 112-121.

Dent, Clyde W., Joel W. Grube and Anthony Biglan. ''Community Level

Alcohol Availability and Enforcement of Possession Laws as Predictors of Youth Drinking," *Preventative medicine*, *2005, 40 (3),* 355-362.

Lewis, Rhonda K., Adrienne Paine-Andrews, Stephen B. Fawcett and et al. "Evaluating the effects of a community coalition's efforts to reduce illegal sales of alcohol and tobacco products to minors," *Journal of Community Health, 1996 21 (6)*, 429-436.

National Institute on Alcohol Abuse and Addiction. 2022. Underage Drinking. Retrieved from www.niaaa.nih.gov/publications/brochures-and-fact-sheets/underage-drinking.

Saltz, Robert F, Mallie Paschall, Richard P. McGaffigan and et al. ''Alcohol Risk Management in College Settings: The Safer California Universities Randomized Trial," *American journal of preventive medicine , 2010 39(6)*, 491-499.

Substance Abuse and Mental Health Services Administration. 2019. Results from the 2018 National Survey on Drug Use and Health: Detailed tables. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. Retrieved from https://www.samhsa.gov/data/.

U.S. Census Bureau.2000 Census of Population and Housing, Summary Population and Housing Characteristics, PHC-1-6, California. Washington, DC, 2002.

Wagenaar, Alexander C., John P. Gehan, Rhonda Jones-Webb and et al. "Communities Mobilizing for Change on Alcohol (CMCA): Lessons and Results From a 15-Community Randomized Trial," *Journal of Community Psychology , 1999, 27 (3),* 315-326.

Wagenaar, Alexander C., David M. Murray, and Traci L. Toomey. "Communities Mobilizing for Change on Alcohol (CMCA): effects of a randomized trial on arrests and traffic crashes," *Addiction, 2000, 95 (2),* 209-217.

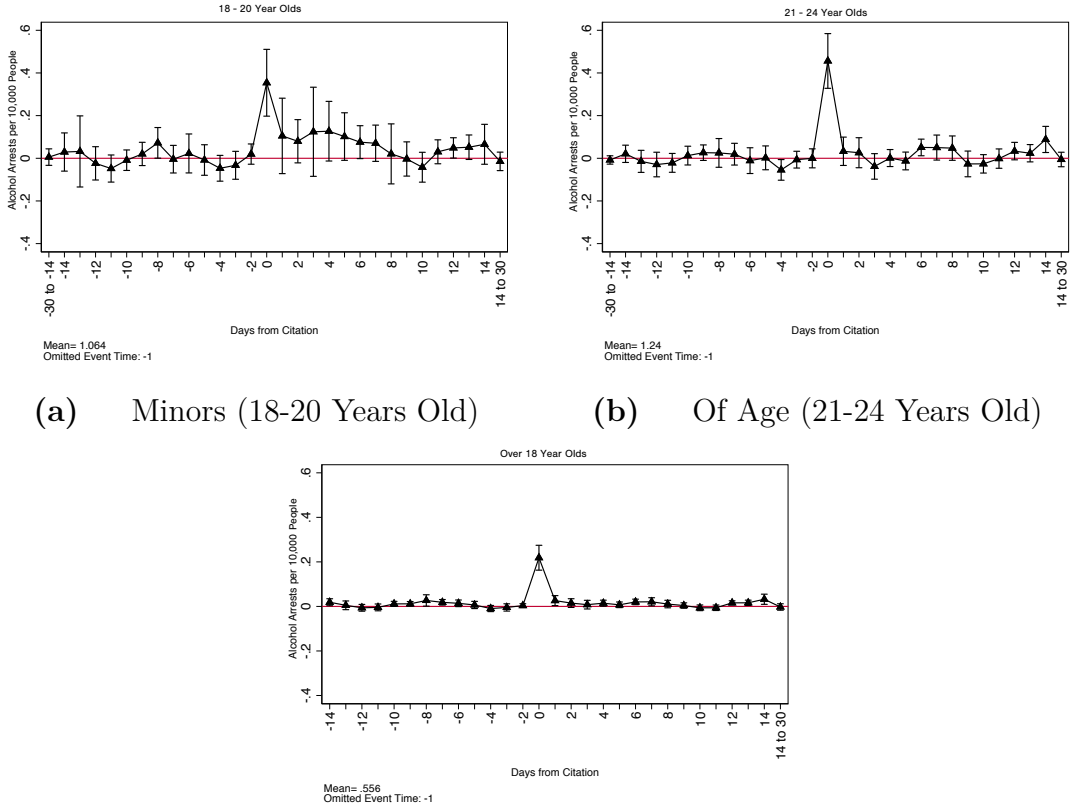
Wagenaar, Alexander C., David M. Murray, John P. Gehan and et al. "Communities mobilizing for change on alcohol: outcomes from a randomized community trial," *Journal of Studies on Alcohol, 2000, 61 (1),* 85-94.

Yoruk, Baris K. "Can technology help to reduce underage drinking? Evidence from the false ID laws with scanner provision," *Journal of Health Economics*, *2014, 36,* 33-46.

Yoruk, Baris K. "The impact of the false ID laws on alcohol consumption among young adults: New results from the NLSY97," *Journal of Health Economics , 2018, 57,* 191-194.

Zheng, Emily Y. "Can technology really help to reduce underage drinking? New evidence on the effects of false ID laws with scanner provisions," *Journal of Health Economics , 2018, 57,* 102-112.

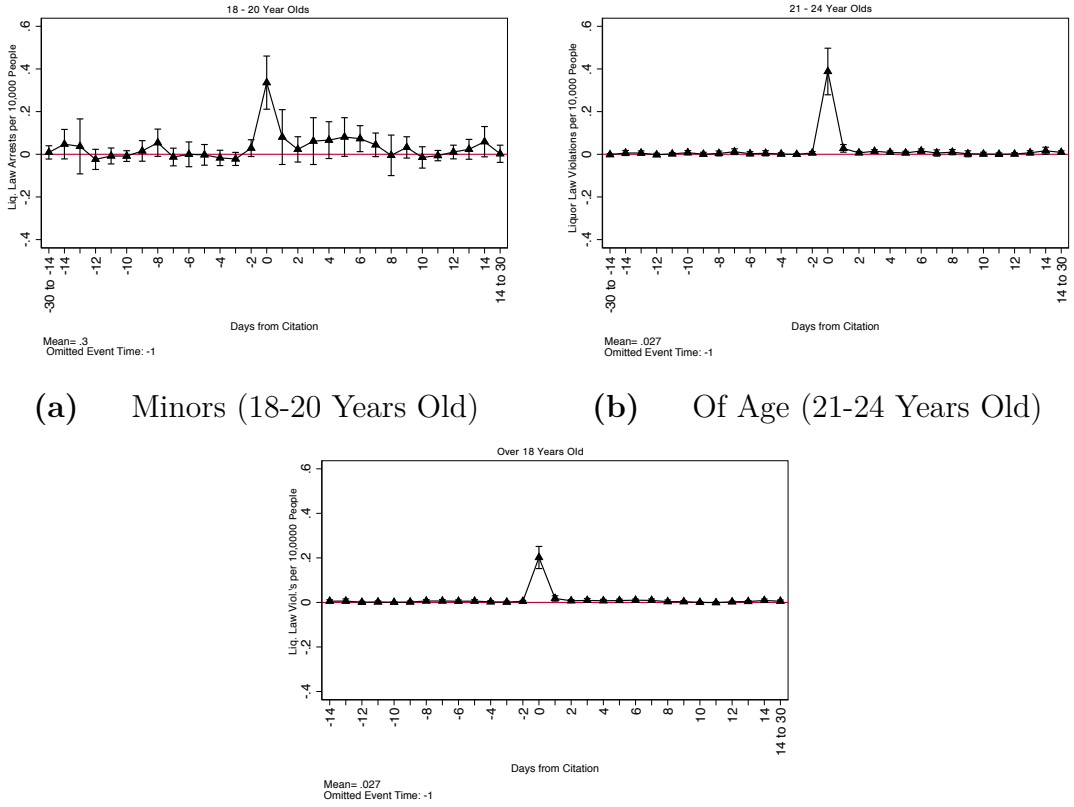
2.8 Figures



(a) Minors (18-20 Years Old) **(b)** Of Age (21-24 Years Old)

(c) Over 18 Years Old

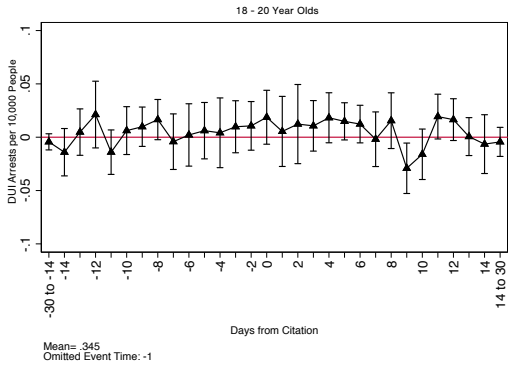
Figure 2.1 Event-Study: Impact of Minor Decoy Citations on Alcohol-Related Arrests



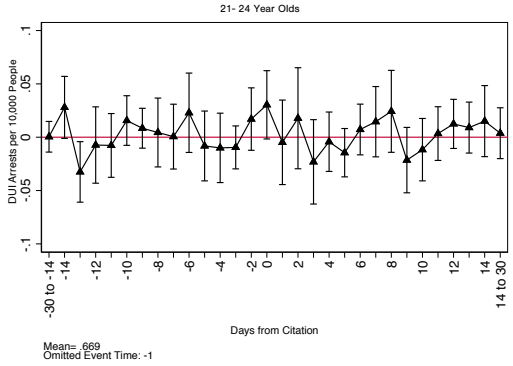
(a) Minors (18-20 Years Old) **(b)** Of Age (21-24 Years Old)

(c) Over 18 Years Old

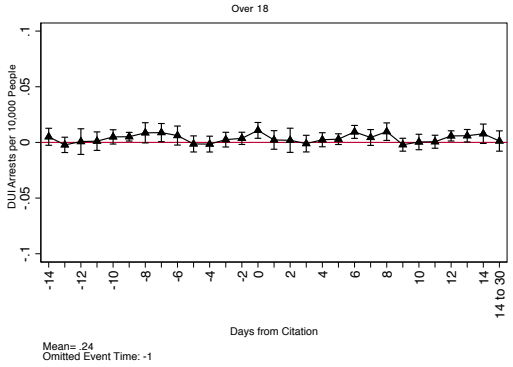
Figure 2.2 Event-Study: Impact of Minor Decoy Citations on Liquor Law Violation Arrests



(a) Minors (18-20 Years Old)

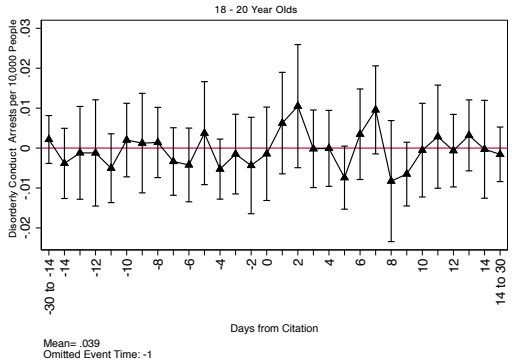


(b) Of Age (21-24 Years Old)

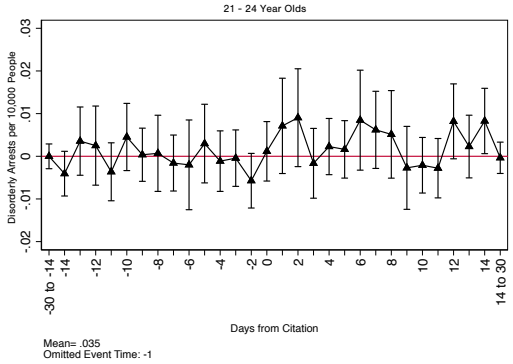


(c) Over 18 Years Old

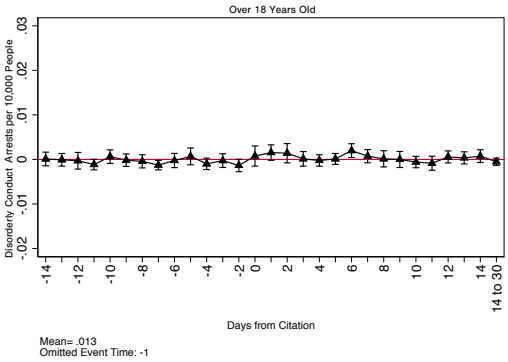
Figure 2.3 Event-Study: Impact of Minor Decoy Citations on DUI Arrests



(a) Minors (18-20 Years Old)

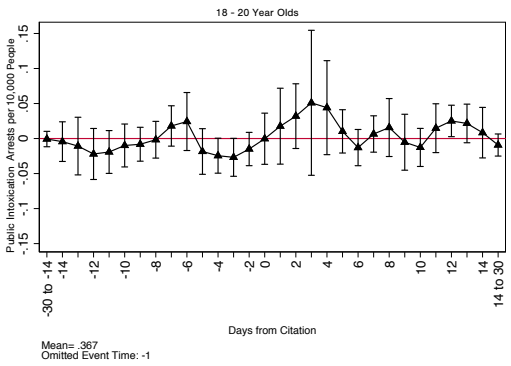


(b) Of Age (21-24 Years Old)

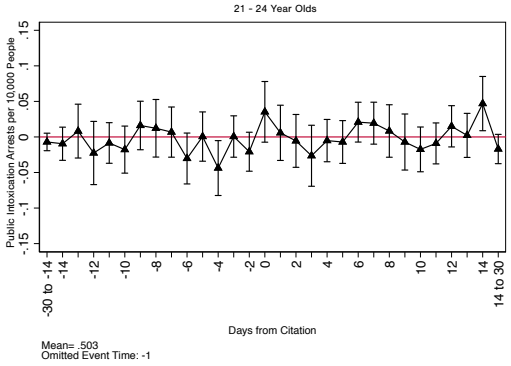


(c) Over 18 Years Old

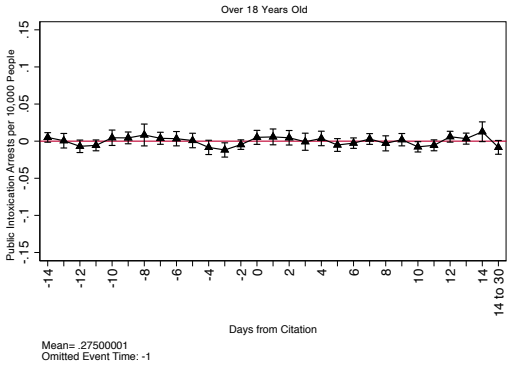
Figure 2.4 Event-Study: Impact of Minor Decoy Citations on Disorderly Conduct Arrests



(a) Minors (18-20 Years Old)

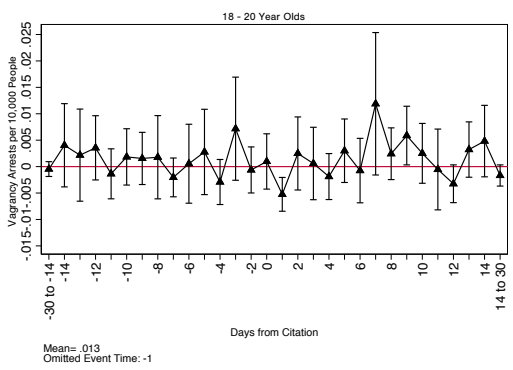


(b) Of Age (21-24 Years Old)

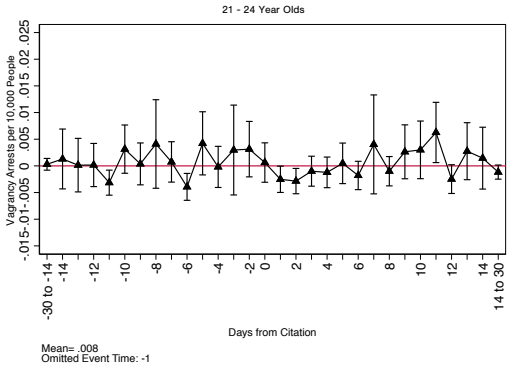


(c) Over 18 Years Old

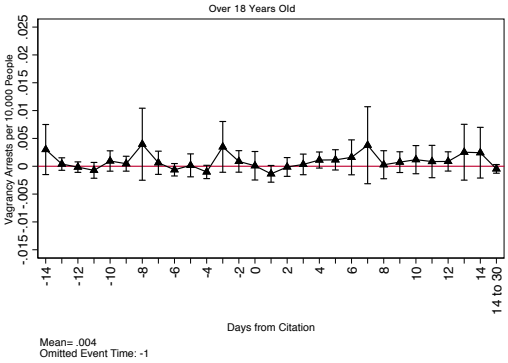
Figure 2.5 Event-Study: Impact of Minor Decoy Citations on Public Intoxication Arrests



(a) Minors (18-20 Years Old)



(b) Of Age (21-24 Years Old)



(c) Over 18 Years Old

Figure 2.6 Event-Study: Impact of Minor Decoy Citations on Vagrancy Arrests

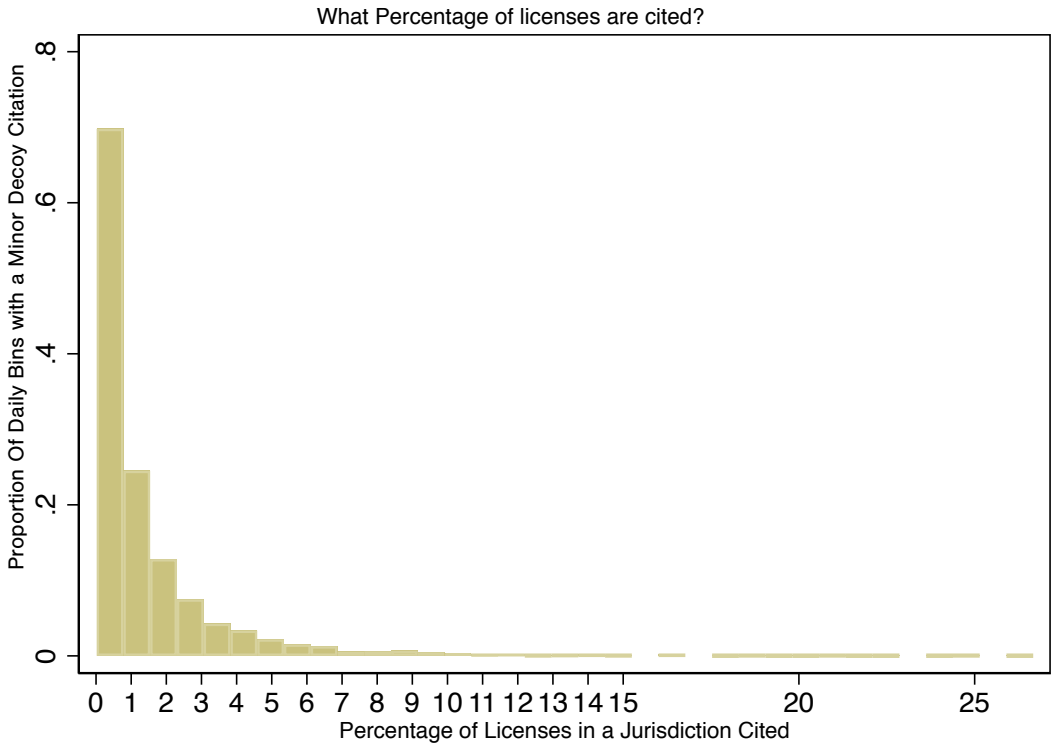


Figure 2.7 Percentage of Licenses Hit within Jurisdiction

2.9 Tables

	(1) Liquor Laws	(2) DUI	(3) Pub Intoxication	(4) Disorderly Conduct	(5) Vagrancy
Post Citation	0.0072	-0.0023	-0.0075	-0.0032	-0.0009
	(0.021)	(0.007)	(0.008)	(0.003)	(0.001)
Jur FE's:	X	X	X	X	X
Time FE's:	X	X	X	X	X
Jur's:	365	365	365	365	365
Obs:	933305	933305	933305	933305	933305
Mean:	0.300	0.345	0.367	0.0390	0.0133

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 18 to 20 year olds. Regressions are also weighted by the 18-20 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.1: D-in-D: Estimate of Impact of Minor Decoy Citations. on 18-20 year old Alcohol Arrests

	(1) County Ordinances	(2) Hit & Run	(3) Weapon Poss.	(4) Traffic Viol.	(5) Vandalism
Post Citation	0.0279	0.0020	-0.0004	-0.0008	-0.0024
	(0.019)	(0.005)	(0.004)	(0.004)	(0.003)
Jur FE's:	X	X	X	X	X
Time FE's:	X	X	X	X	X
Jur's:	365	365	365	365	365
Obs:	933305	933305	933305	933305	933305
Mean:	0.110	0.120	0.148	0.0662	0.120

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 18 to 20 year olds. Regressions are also weighted by the 18-20 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.2: D-in-D: Impact of Minor Decoy Cits. on 18-20 year old Alcohol-Adjacent Arrests

	(1) Alcohol	(2) Illicit Drugs	(3) Violent	(4) Property
Post Citation	-0.0068	0.0106	-0.0024	0.0111
	(0.023)	(0.021)	(0.009)	(0.016)
Jur FE's:	X	X	X	X
Time FE's:	X	X	X	X
Jur's:	365	365	365	365
Obs:	933305	933305	933305	933305
Mean:	1.064	1.128	0.676	1.107

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 18 to 20 year olds. Regressions are also weighted by the 18-20 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.3: D-in-D: Impact of Minor Decoy Cits. on 18-20 year old Summary Arrests

	(1) Liquor Laws	(2) DUI	(3) Pub Intoxication	(4) Disorderly Conduct	(5) Vagrancy
Post Citation	0.0153***	0.0035	-0.0124	-0.0002	-0.0011*
	(0.004)	(0.013)	(0.011)	(0.002)	(0.001)
Jur FE's:	X	X	X	X	X
Time FE's:	X	X	X	X	X
Jur's:	365	365	365	365	365
Obs:	933305	933305	933305	933305	933305
Mean:	0.0270	0.669	0.503	0.0349	0.00818

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 21 to 24 year olds. Regressions are also weighted by the 21 to 24 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.4: D-in-D: Impact of Minor Decoy Cits. on 21-24 year old Alcohol Arrests

	(1) County Ordinances	(2) Hit & Run	(3) Weapon Poss.	(4) Traffic Viol.	(5) Vandalism
Post Citation	0.0243	-0.0035	-0.0032	-0.0015	0.0007
	(0.020)	(0.003)	(0.003)	(0.006)	(0.002)
Jur FE's:	X	X	X	X	X
Time FE's:	X	X	X	X	X
Jur's:	365	365	365	365	365
Obs:	933305	933305	933305	933305	933305
Mean:	0.112	0.0720	0.125	0.137	0.0818

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 21 to 24 year olds. Regressions are also weighted by the 21 to 24 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.5: D-in-D: Impact of Minor Decoy Cits. on 21-24 year old Alcohol-Adjacent Arrests

	(1) Alcohol	(2) Illicit Drugs	(3) Violent	(4) Property
Post Citation	0.0052	-0.0132	0.0008	-0.0073
	(0.019)	(0.019)	(0.009)	(0.011)
Jur FE's:	X	X	X	X
Time FE's:	X	X	X	X
Jur's:	365	365	365	365
Obs:	933305	933305	933305	933305
Mean:	1.240	1.131	0.781	0.774

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 21 to 24 year olds. Regressions are also weighted by the 21 to 24 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.6: D-in-D: Impact of Minor Decoy Cits. on 21-24 year old Summary Arrests

	(1) Liquor Law	(2) DUI	(3) Pub. Intoxication	(4) Disorderly Conduct	(5) Vagrancy
Post Citation	0.0083***	0.0012	-0.0079	-0.0006	-0.0004
	(0.003)	(0.005)	(0.005)	(0.000)	(0.000)
Jur FE's:	X	X	X	X	X
Time FE's:	X	X	X	X	X
Jur's:	365	365	365	365	365
Obs:	933305	933305	933305	933305	933305
Mean:	0.0269	0.239	0.275	0.0127	0.00416

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 over 18 year olds. Regressions are also weighted by the over 18 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.7: D-in-D: Impact of Minor Decoy Cits. on Alcohol Arrests over 18 years old

	(1) County Ordinances	(2) Hit & Run	(3) Weapon Poss.	(4) Traffic Viol.	(5) Vandalism
Post Citation	0.0051	-0.0002	-0.0004	-0.0000	-0.0005
	(0.007)	(0.001)	(0.001)	(0.002)	(0.000)
Jur FE's:	X	X	X	X	X
Time FE's:	X	X	X	X	X
Jur's:	365	365	365	365	365
Obs:	933305	933305	933305	933305	933305
Mean:	0.0468	0.0219	0.0479	0.0372	0.0330

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 over 18 year olds. Regressions are also weighted by the over 18 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.8: D-in-D: Impact of Minor Decoy Cits. on Alcohol-Adjacent Arrests for Over 18 Year Olds

	(1) Alcohol	(2) Illicit Drugs	(3) Violent	(4) Propert
Post Citation	0.0006	-0.0058	0.0026	0.0005
	(0.008)	(0.008)	(0.003)	(0.004)
Jur FE's:	X	X	X	X
Time FE's:	X	X	X	X
Jur's:	365	365	365	365
Obs:	933305	933305	933305	933305
Mean:	0.556	0.534	0.387	0.298

Note: Standard errors are clustered at jurisdiction level. Each arrest category is measured as crime rate per 10,000 over 18 year olds. Regressions are also weighted by the over 18 year old population of a jurisdiction. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 2.9: D-in-D: Impact of Minor Decoy Cits. on Summary Category Arrests for People over 18 years old

Chapter 3

The Effect of Federal Policy on For-Profit Higher Education: Evidence From National Elections

3.1 Introduction

The for-profit sector plays a significant role in higher education through for-profit colleges and private student loan companies. As of 2016, for-profit colleges enrolled 1.4 million students and private lenders serviced the majority of student loans (U.S. DOE, 2017a). Policies introduced over the last three decades by the executive and legislative branches of government have significantly altered the role and oversight of these industries. Concerns that for-profit colleges saddle students with high levels of debt and poor employment prospects have prompted policy proposals to address recruiting practices, online classes, accreditation, debt and earnings of graduates, reliance on military aid, and borrower protections. Enacted policies typically carry the threat of losing eligibility for federal student

grant and loan aid, which accounts for more than 70 percent of revenue among for-profit colleges (U.S. DOE, 2017b). Likewise, the role of private loan companies has been fundamentally altered by the introduction of federal direct student loans, the elimination of federally guaranteed private loans, and legal action against servicers that provide fraudulent advice. Despite this active policy environment, there is limited direct empirical evidence about how these policies affect the profitability and viability of for-profit colleges and private student loan companies. This paper examines changes in the stock prices of publicly traded companies in the days immediately following the last four presidential and midterm congressional elections to shed light on several important questions.[1] Specifically, we examine: 1) the sign and magnitude of the stock price responses of for-profit colleges and student loan companies for each national election since 2004; 2) differences in the responses to the party controlling the executive and legislative branches; and 3) the distribution of effects for companies that are more or less exposed to federal policy. The abnormal returns after elections are compared to those generated by policy announcements and other major events.

Identification in this paper exploits three important factors. First, support for policies affecting for-profit colleges and private student lenders is largely divided on party lines. Democratic administrations and congresses have introduced the majority of rules and regulations concerning performance standards, recruiting practices, and dependence on federal revenue for colleges. Likewise, they have consistently pushed for increases in grant aid, direct federal loans, and oversight of private loan companies. Second, a number for-profit college and student loan

[1]While there was limited media attention given to postsecondary education stocks in prior elections, the 2016 election was followed by significant coverage. The effect on for-profit college stocks was noted by, for example, Barron's, CNN, Forbes, Fortune, and the Wall Street Journal. A New York Times piece discussed several policy factors that could be driving investor response (Dynarski, 2016). Likewise, the impact on private student loan companies was noted by Barron's, Time, and the Washington Post.

companies are publicly traded, making it possible to estimate responses using stock prices. Fourteen publicly traded companies account for approximately half of for-profit college enrollment during the period of interest, and three publicly traded student loan companies currently service half of all student loans.[2] Stock prices provide a measure of performance that captures expected future profitability and makes it possible to estimate the immediate effect of an election or other event. Observing immediate responses to shocks is crucial due to the large number of other factors that can affect stock prices over time and because there is no natural control group for publicly traded for-profit colleges or student loan companies.[3] Third, national election results represent a sudden and well-quantified shock. The timing of the shock is known and win probabilities are documented through online betting markets in the days leading up to the elections. This is in contrast to, for example, the announcements of rules and regulations that may be anticipated or known to the market or to insiders, and thus could be reflected in stock prices prior to the date of record.[4]

The analysis reveals several interesting results. Among for-profit colleges, the average change in stock prices is similar to that of the market as a whole after

[2]These statistics are based on data from the National Center for Education Statistics Integrated Postsecondary Education Data System and the quarterly reports published by private student loan companies (U.S. DOE, 2016; Navient, 2018; Nelnet, 2018; and Sallie Mae, 2018). The number of publicly traded for-profit college companies, the enrollment of the colleges and universities that they own, and the volume of student loans serviced by publicly traded companies vary over time, especially in response to the sales and acquisitions of new companies and institutions. For example, Apollo Education Group, which owns the University of Phoenix, went private in 2016, while the publicly traded lending company Nelnet acquired Great Lakes Higher Education Corporation, one of the largest student loan servicing companies, in 2017.

[3]The challenge of identifying a suitable control group for for-profit colleges is evident from the fact that their daily price fluctuations do not strongly covary with those of other consumer services or education stocks. Finding a suitable comparison index for student loan companies is somewhat less problematic, as their stock price changes have a stronger relationship with those of banks and other finance stocks.

[4]Binder (1985) found little effect of regulatory announcements on stock prices and noted that it is "extremely difficult to find announcements in the regulatory process that are unanticipated by the market," thus limiting the usefulness of stock returns for studying the effects of regulation when "the dates that market expectations change are not known exactly."

the 2004 and 2008 presidential elections, while the Democratic win in 2012 and the Republican win in 2016 generated significant negative and positive abnormal returns, respectively. The magnitudes of the changes in stock prices exceeds the volatility adjusted responses of the U.S. market, the consumer services sector, and other education companies. After adjusting for win probabilities, the effect of having one party win the executive branch rather than the other generated five-day cumulative abnormal returns among for-profit colleges of about 30 percent after both the 2012 and 2016 elections. There is not, however, evidence of meaningful responses to changes in the balance of power in Congress during midterm elections despite several unanticipated changes in the majority party. This suggests a limited role for the legislative branch relative to the executive branch for shaping policies relevant to the viability of for-profit colleges.

We find little evidence of changes in stock prices in the days immediately following the announcement of the proposed gainful employment rule in June 2010. There is also no response in the days following the publishing of the final rule in October 2010, but there is a large positive return when a revised version of the policy is released in June of 2011. These inconsistent results highlight the potentially important role of market anticipation and the challenges it poses for interpreting responses to formal announcements as a valid measure of policy importance. Estimating the response to the initial policy announcement is further complicated by the the release of a Government Accountability Office (GAO) report on for-profit college recruiting fraud seven days later, and the release of student debt repayment data by the Department of Education (DOE) fifteen days later. Each of these events generated large and immediate negative abnormal returns.[5] Heterogeneity analysis indicates that abnormal returns are highly correlated with the

[5]Thus, while changes in stock prices in the days immediately following the gainful employment announcement may be interpreted as stemming from the policy, changes observed in subsequent weeks will reflect these additional information shocks.

debt-to-earnings ratios of the colleges owned by a publicly traded company, as well as the fraction of students receiving financial aid from the military – two measures of policy exposure. However, nearly all post-secondary education companies experienced abnormal returns exceeding market averages in the last two elections, after the GAO report, and after the debt repayment data release, indicating concerns with the viability of the industry, rather than just those companies that appear most exposed to federal laws and regulations.

Republican presidential wins in 2004 and 2016 resulted in clear and immediate 20 percent positive abnormal returns for private student loan companies relative to other finance companies after adjusting for win probabilities. In contrast, the closely contested Democratic win in 2012 generated little or no abnormal return despite a Republican candidate who favored a greater role for private lenders. The modest effect in 2012 may have been a result of the mediating effects of a Republican controlled House of Representatives, whereas the Republicans controlled the executive branch and both chambers of the legislative branch in 2004 and 2016. An examination of midterm elections supports the hypothesis that the legislative branch plays an important role, as a narrow Democratic victory in the House and Senate in 2006 was followed by a 6 percent negative abnormal return one day after the election. The response of publicly traded student loan stocks to both presidential and congressional elections indicate that a policy environment that favors an expanded role for federal direct loans substantially decreases the value of private loan companies. This explanation is supported by an examination of the release of the 2010 proposed federal budget. The budget proposed eliminating federally guaranteed private loans in favor of direct loans, and resulted in an immediate 40 percent stock price decline. In contrast, we find no evidence of abnormal returns after the introduction of borrower defense rules or the announcement of a

lawsuit by the Consumer Federal Protection Bureau alleging fraud by one of the three lending companies. These results suggest that the viability of this sector may be most strongly tied to Republican support for reducing the role of direct federal student loans, rather than the stricter regulatory environment. Consistent with this, we find large election responses for each of the private student loan companies, not just those under the most regulatory scrutiny.

This paper provides systematic evidence of the importance of federal policies for the value of for-profit colleges and private student loan companies. The analysis reveals that: 1) the value of both for-profit colleges and student loan companies is strongly tied to the federal policy environment; 2) for-profit colleges have become more responsive to the party in control of the executive branch, indicating the importance of recent regulations, while private lenders have been consistently responsive to both executive and legislative control; 3) nearly all for-profit education company stocks respond to major shocks, indicating that investors believe that a significant fraction of players in the market are unlikely to meet the standards set out by federal policy. The sensitivity of for-profit colleges to national elections adds market-based evidence to the broader literature examining the quality of for-profit colleges and their effect on earnings and debt (Lang and Weinstein, 2013; Cellini and Chaudhary, 2014; Darolia, Koedel, Martorell, Wilson, and Perez-Arce, 2015; Denice, 2015; Cellini and Darolia, 2015; Cellini and Turner, 2016; Deming, Yuchtman, Abulafi, Goldin, and Katz, 2016; Goodell, 2016; Armona, Chakrabarti, and Lovenheim, 2017). The paper also contributes to studies examining the factors affecting the growth and viability of the for-profit postsecondary education sector (Cellini, 2010; Chung, 2012; Deming, Goldin, and Katz, 2012; Gilpina, Saunders, and Stoddard, 2015; Goodman and Henriques, 2015; Eaton, Howell, and Yannelis, 2018). The role of elections on for-profit postsecondary education

companies adds to the literature that examines the stock price implications of national elections and political parties (Wolfers and Zitzewitz, 2016; Born, Myers, and Clark, 2017; Kundu, 2018; Wagner, Zeckhauser, and Ziegler, 2018).

The paper proceeds as follows. Section 2 provides an overview of the for-profit, publicly traded education sector and the role of partisan politics in shaping regulation. Section 3 discusses how for-profit campuses are linked to their stocks and summarizes the national election winners and probabilities. Section 4 introduces the empirical design and challenges to interpretation. Sections 5 and 6 present evidence on the effects of presidential and congressional elections, and other major events, on for-profit colleges and student loan companies. Section 7 concludes.

3.2 Background

Enrollment in private for-profit institutions grew from 0.7 million students in 2000 to 2.4 million students in 2010, accounting for 40 percent of private postsecondary enrollment at its peak. The growth of the sector is likely to have stemmed from various factors, including the early adoption of fully online programs and the use of advertising and recruiting practices targeted to non-traditional students (Gilpina et al., 2015; Deming, Lovenheim, and Patterson, 2018). However, by 2016, enrollment had fallen to 1.4 million, a decline that may have stemmed from economic conditions, the greater availability of information about student debt and labor market outcomes, negative media coverage, increased oversight of recruiting practices, and expanded offerings from public and non-profit institutions. Research has found that attending for-profit colleges is generally associated with modest benefits when measured using outcomes such as interview call back rates and earnings (Lang and Weinstein, 2013; Cellini and Chaudhary, 2014; Darolia et al., 2015; Denice, 2015; Cellini and Turner, 2016; Deming et al., 2016; Armona et

al., 2017). Further, they generally charge higher tuition than their public college and university counterparts, resulting in greater debt accumulation and default rates (Cellini, 2012; Deming et al., 2012; Cellini and Darolia, 2015; Armona et al., 2017).

In the political realm, both the legislative and executive branches have played a significant role in shaping rules and regulations affecting for-profit colleges. In the early decades of for-profit institutions, Republican politicians often opposed the use of tax dollars to support students attending for-profit colleges (Rothman, 1988). Over the course of the 1990s, however, the current status quo of Republican support and Democratic opposition to for-profit colleges took shape. A Democratic Congress passed the Higher Education Amendments of 1992, which restricted commission-based recruiting practices by colleges and limited the share of an institution's students who could attend class online to 50 percent while maintaining eligibility for federal student aid (US Congress, 1992).[6] In contrast, the Republican majority in Congress in 1998 increased the fraction of college revenue that could come from federal sources from 85 to 90 percent (U.S. Congress, 1998). In 2002, the Deputy Secretary of Education in a Republican administration sent a widely reported memo stating that the department would not pursue colleges that compensated recruiters on a commission basis, thus undermining the 1992 law. Further, in 2005, a Republican administration proposed eliminating the 50 percent rule regarding online education, and this was introduced into law by a Republican controlled Congress in 2006 (Dillon, 2006).

The political division over for-profit colleges has continued over the last 10

[6]Specifically, with respect to recruiting, the law states that colleges "will not provide any commission, bonus, or other incentive payment based directly or indirectly on success in securing enrollments or financial aid." With respect to online education, the law states that a college "shall not be considered to meet the definition of an institution of higher education" if it "offers more than 50 percent of such institution's courses by correspondence" or if it "enrolls 50 percent or more of its students in correspondence courses."

years. A Democratic administration introduced the gainful employment rule in 2010 that restricts access to federal student aid for college programs whose graduates have low loan repayment rates or high debt-to-earnings ratios. Shortly after the announcement of the proposed gainful employment rule, the GAO released a report detailing widespread recruiting fraud among for-profit colleges, and the DOE released data on the debt repayment rates of college programs (U.S. GAO, 2010). Democratic legislators have introduced bills, unsuccessfully, to restore the 85 percent federal revenue maximum and have proposed including military aid (GI Bill and Department of Defense Tuition Assistance) in the total.[7] In June of 2016, the DOE chose not to renew recognition of the Accrediting Council for Independent Colleges and Schools (ACICS), which accredited many for-profit colleges. Most recently, in August of 2018, the DOE under a Republican president announced a proposal to rescind the gainful employment rule (U.S. DOE, 2018). This regulatory history reveals that: a) there is a clear division between the Republican and Democratic parties in terms of their support for policies that are likely to affect for-profit colleges; and b) the executive and legislative branches have both played a role in shaping policies that may affect the potential viability of the for-profit college industry.

The role of private student loan companies has varied significantly over time in response to federal rules and regulations. Currently, publicly traded student lenders service approximately one-half of all outstanding student loan debt and include the largest issuer of private student loans. Similar to for-profit colleges, there is a clear division between parties with respect to policies affecting this in-

[7]Specifically, a Democratic senators released a commissioned study detailing the pursuit of veterans by for-profit colleges in 2012, and introduced a bill that would close the loophole that treats military aid as non-federal for the purposes of the 90-10 calculation (U.S. Senate, 2012). Additionally, Barack Obama proposed closing the military aid loophole in his 2016 budget (Zillman, 2015).

dustry. Most notably, Republican politicians favor reducing the role of the federal government in the student loan market and expanding the role of private companies, while Democratic politicians favor an expanded role for direct federal loans. A Democratic administration introduced direct federal loans in 1994 that would compete with the privately issued federally guaranteed loans. The College Cost Reduction and Access Act of 2007 (CCRAA), which was introduced and passed by a Democratic Congress, increased Pell Grant levels, reduced and fixed the interest rates of private federally guaranteed loans, and reduced annual repayment minimums for these loans. Also in 2007, the Democratic Attorney General of New York announced an investigation into corruption in the private student loan market, including the publicly traded companies Sallie Mae and Nelnet.

Perhaps the most dramatic policy change occurred in 2010, when a Democratic administration and Congress eliminated federally guaranteed private student loans altogether in favor of direct federal loans, eliminating one of the primary components of the private student lending business. Thus, currently, the role of private loan companies is to service federal loans and to issue private loans. Under the same administration, the Consumer Financial Protection Bureau has investigated and sued private lenders for providing advice to students that increases company profits but is not in the best interests of the borrower (CFPB, 2017). In the summer of 2016, the DOE introduced a rule providing loan forgiveness for borrowers who attended (primarily for-profit) colleges that committed recruiting fraud. This history reveals that: a) there has been a sharp partisan divide about the role of private lenders for the past three decades; and b) both branches have played an active role in shaping relevant policies.

3.3 Data

The empirical analysis is based on three data sources. First, publicly traded for-profit college companies are identified and linked to the college and university campus brands they own and the branch campuses of each of these brands. Second, for-profit college and student loan companies, as well as all companies in potential control indices, are linked to their daily closing stock prices. Finally, we document the results and predicted win probabilities for each presidential election, the majority party and win margins for each congressional election, and the dates of major policy announcements and other notable events relating to for-profit postsecondary education. This section details several of the key steps in this process.

We begin by constructing the list of for-profit postsecondary education companies that are publicly traded as shown in Table 3.1. In some cases, for-profit college companies operate a single university brand, while in others they operate several for-profits colleges and universities with different names.[8] Each for-profit college or university brand is then linked to all branch campuses for which data is submitted to the National Center for Education Statistics Integrated Postsecondary Education Data System (NCES IPEDS). In total, this process reveals 14 publicly traded companies that own 40 college brands that range from small bricks and mortar institutions to regional networks of branch campuses and national online programs. During the peak of for-profit college attendance, these companies accounted for nearly 600 branch campuses and 50 percent of reported for-profit enrollment. Relative to other for-profit postsecondary institutions reporting data

[8]Table 3.1 lists the college brand with the highest enrollment for each publicly traded company. A complete list of college brands owned by each company is presented Appendix Table 3.8. Laureate Education is not included because it became publicly traded in 2017, after each event presented in this study.

to the NCES, campuses owned by publicly traded companies have, on average, larger enrollments, are more likely to be degree rather than certificate granting, and have slightly lower fractions of black and Hispanic students. Publicly traded for-profit colleges received approximately 76 percent of their revenue from non-military federal grants and loans in 2014 and 2015, which is slightly higher than the total for all reporting for-profit campuses.

There are three publicly traded companies whose primary business is issuing or servicing student loans: Sallie Mae, Navient, and Nelnet. Sallie Mae was a government sponsored private enterprise that issued and serviced federally guaranteed student loans for three decades. It gradually transitioned to being a private company between 1997 and 2004, and created Navient as a separate company in 2014. While a large number of major banks issue private student loans, these loans represent a small fraction of their overall revenue and thus shocks to this market are unlikely to be clearly reflected in their stock prices. The publicly traded student loan companies Nelnet and Navient service 700 billion dollars in loans, or approximately half of all outstanding student loan debt, while Sallie Mae is now the largest originator of private student loans.[9]

The closing stock prices of each company are measured at the end of each trading day. The majority of the companies are traded on the Nasdaq, so this is used as the market of interest for estimating abnormal returns. However, attention is restricted to U.S. companies on this exchange since we are interested in the effect of U.S. elections on U.S.-based postsecondary education companies. The closing stock prices are adjusted to account for stock splits and dividend payouts. Treatment of the day of the election is of particular importance. National elections are held on the first Tuesday after November 1st. Thus, the closing price on

[9]Note that the average market capitalization for Sallie Mae presented in Table 3.1 includes the period prior to the branching off of Navient, so the current market capitalization is much smaller.

Monday should reflect expectations about the election rather than realized results. While the closing prices on Tuesday could reflect election results (if exit polls or other information is known to investors), we do not observe such anticipation, and therefore use the closing price on Tuesday as the pre-shock baseline price.

Presidential election years included in the analysis are 2004, 2008, 2012, and 2016, while midterm congressional elections occur in each intervening even year.[10] Appendix Tables 3.9 and 3.10 present presidential results and probabilities and congressional election margins. The relevant shock of an election stems from the probability of the realized results. That is, an election result that is highly expected is likely to have already been capitalized into stock prices, so the response may be small, while an unexpected result may generate a much larger effect. Therefore, translating the stock price response into a comparable measure across elections requires an estimate of the probability of each event. Thus, in addition to presidential election results, we consider the probability of the realized election result in the days leading up to the election using betting markets including Betfair, PredictIt, and Intrade. For congressional elections, historical data on win probabilities is of lower quality and is complicated by the presence of multiple chambers. Thus, we aid interpretation by documenting whether each chamber experienced a change in the majority party and the margin of the win.

3.4 Empirical Strategy

The analysis examines the abnormal returns of student loan and for-profit college stocks in the days immediately following national elections. We present daily abnormal returns for the days before and after the election or event, as well as the

[10]We start the analysis with the 2004 election due to the fact that the 2000 presidential election generated an unclear shock, with a contested recount in Florida, and because there was only one publicly traded student loan company prior to 2004.

cumulative change relative to the time of the event. Focusing on short-run changes is possible due to the fact that markets appear, in practice, to quickly incorporate information shocks in a way that is consistent with the efficient market hypothesis. This is important due to the fact that, in the longer run, postsecondary education stocks may be affected by earnings reports, policy announcements, product announcements, mergers and acquisitions, and various other factors. That is, the longer the time horizon that is being considered, the greater is the concern that the observed price changes are not being driven by the shock of interest. Further, there is no natural control group or subgroup of colleges and loan companies that is unaffected by national elections, regulatory announcements, and other industry-specific factors. Thus, the most credible estimates of the effects of elections and other events are measured in the short run, while longer-run estimates require much stronger assumptions.

3.4.1 Abnormal Returns

A rich finance literature examines methods of using stock market returns to estimate the effects of presidential elections, regulatory announcements, and other events, as well as the challenges of considering longer-run returns (Schwert, 1981; Huang, 1985; Campbell, Lo, and MacKinley, 1997; Santa-Clara and Valkanov, 2003; Snowberg, Wolfers, and Zitzewitz, 2007). The Trump election of 2016 spawned a particularly large literature examining various market outcomes (Wolfers and Zitzewitz, 2016; Born et al., 2017; Fan, Talavera, and Tran, 2018; Kundu, 2018; Wagner et al., 2018). In the context of for-profit colleges, Eaton et al. (2018) estimate cumulative abnormal returns in the 60 days after the announcement of the gainful employment rule and attribute a 40 percent reduction to this policy.

The abnormal return of a stock is the change in price relative to a comparison

index after accounting for differences in volatility. If a stock is more volatile than its comparison index, then it would spuriously appear that the stock had experienced an excess return in response to an event. Thus scaling the returns of the index by a measure of the volatility of each stock of interest, beta, captures the abnormal return. We estimate this measure, β^{Ed}, for each student loan and for-profit college stock based on two years of daily returns prior to the election or event of interest, thus allowing the volatility of a company relative to the index to vary over time.[11] A value of beta exceeding one indicates that the education stock of interest is more volatile than the index, while a value of less than one indicates that it is less volatile. The abnormal daily return (DAR) can then be computed by adjusting the daily return of the index to reflect the volatility of the specific stock in question: $DAR_t^{Ed} = r_t^{Ed} - \hat{\beta}^{Ed} r_t^{Ind}$.[12]

The daily abnormal return is presented for student loan and for-profit college companies in the five days before and after each election or announcement. Stock prices will fully capitalize well-publicized shocks in the short-run under the semi-strong and strong forms of the efficient market hypothesis.[13] Estimates based on longer response windows are more likely to be biased by unobserved factors, as well as overlapping treatments. For example, the announcement of the gainful employment rule was followed by the widely publicized GAO report and DOE debt data release within a three week period, thus making it highly problematic

[11]The estimates are not sensitive to the number of trading days prior to the event used to estimate beta. This is due to the fact that the results in the short run are driven by changes in the stocks of interest and not by large fluctuations in the broader market, sector, or industry.

[12]The estimates are nearly identical when also adjusted for fixed differences in the daily return α^{Ed} between the stock of interest and the index (the constant term from the regression of stock daily returns on index daily returns), as this constant is generally close to 0. Further, the estimates are very similar when β^{Ed} is computed using the Fama-French three factor model that takes into account the differential returns of larger and smaller companies, measured using total market capitalization (Fama and French, 1993).

[13]The immediate capitalization of shocks into stock prices is observed in several presidential elections and after earning reports. That is, in cases where we know the timing of the shock, the evidence is consistent with stock prices adjusting rapidly to new information.

to interpret longer-run stock price changes as stemming from the policy. The cumulative return is the sum of the daily returns after the day of the election, announcement, or event. The resulting estimates reveal the additional return of postsecondary education stocks relative to the index of interest after accounting for differences in volatility. The standard errors are cluster at the stock and day levels to reflect the potential for significant variation in the distribution of stock returns after major events such as presidential elections.[14]

The index used to estimate the abnormal return essentially plays the role of the control group. For both student loan companies and for-profit colleges, the abnormal returns and estimates are computed using three different indices. First, we use the Nasdaq as the baseline comparison index due to the fact that the majority of the stocks of interest are listed on that index. Because we are interested only in domestic student loan and for-profit colleges and their response to national elections, we exclude non-U.S. based companies. A concern with using the market index to estimate abnormal returns is that these companies may belong to sectors and industries that are sensitive to other policies associated with political parties. Thus, as a second approach, we compute the abnormal returns at the sector level by comparing student loan companies to other finance stocks and for-profit colleges to other domestic consumer services companies. This exercise isolates the additional effect of an election or event beyond its impact on the sector as a whole. Finally, we compute the abnormal return of student loan companies relative to publicly traded banks, and for-profit colleges to other companies operating in the education sector, including those that produce educational software,

[14] An alternative method for conducting statistical inference is to empirically construct the distribution of returns for portfolios of the relevant size for each day. Comparing the returns of the for-profit college and student loan company stock portfolios to these empirically estimated distributions reveals statistical significance similar to that generated by the standard asymptotic approach.

publishing and services, and training services. However, abnormal returns relative to any of these three comparison indices are only likely to be credible in the short run. This is evident empirically, as no subset of stocks appears to provide a close counterfactual for the stocks returns of for-profit college and student loan companies.[15]

3.4.2 National Elections

The magnitude of the stock price response will depend on the extent to which the event, whether it be an election, policy announcement, or data release, is unexpected. That is, the estimated abnormal return should be scaled by the probability of an event in order for it to be easily interpreted and comparable across events. The probabilities associated with presidential elections are captured by betting markets as detailed in Appendix Table 3.9. Online markets reveal that, for example, the winners of the 2004, 2012, and 2018 elections had win probabilities ranging from 54 to 58 percent, 70 to 76 percent, and 21 to 22 percent, respectively. We note that in 2008, the election was not close, with online markets putting the probability of a Democratic win at 92 to 94 percent, limiting the usefulness of the shock.[16] The full effect of having the winning party in power rather than the alternative can be computed as the daily abnormal return divided by one minus the win probability, $DAR_t^{Ed}/(1 - WinProb)$, and likewise for the cumulative abnormal return. The extent to which a policy announcement or other event is anticipated by the market, and the day when such anticipation occurs, is

[15]This relationship is examined by regressing the daily price changes for student loan companies against other sector and industry stocks for all dates not included in the analysis, and similarly for for-profit colleges. The exercise reveals that for-profit college stock price changes are not strongly correlated with any sector or industry, while student loan stock price changes are only slightly more strongly correlated with banks and financial stock price changes.

[16]The 2008 election also occurred during a period of high volatility (which is evident graphically in the analysis) in the market due to the subprime mortgage crisis and Great Recession.

generally unknown. Thus the resulting stock price changes may be a lower bound effect. The empirical evidence in this study strongly suggests that many formal policy announcements generated little or no shock.

Examining which national elections generate effects sheds light on which rules and regulations are likely to be driving the estimates. In the case of for-profit colleges, the partisan divide over the 90-10 federal aid limit, college recruiting practices, and the 50 percent online rule existed prior to each of the presidential and congressional elections we examine. Thus, stock prices should reflect concerns about these policies in each national election estimate. By contrast, the introduction of the gainful employment rule and the release of debt and earnings data occurred in 2010 and subsequent years, and efforts to include military aid in the 90-10 rule gained traction in 2012. Thus the impact of these policies should only be reflected in later elections. In the case of student loan companies, the role of direct federal loans has been debated since the early 1990s and thus should be reflected in each election. More recent elections should reflect the elimination of private, federally guaranteed loans, borrower defense rules, and recent legal action against private lenders.

A second challenge for interpretation is that each presidential election is accompanied by a congressional election, so unexpected election results for the House or Senate could generate an additional treatment that amplifies or attenuates the presidential estimates. Two factors aid in addressing this issue. First, some presidential election years are not characterized by close congressional election results or changes in the majority party. For example, there was no change in the majority party, nor a close result, in either chamber in 2004 and 2012. Thus, the change in stock prices after these elections is likely to stem from the presidential election. Second, midterm election years shed light on whether control of the legislative

branch affects postsecondary education stocks without the confounding effect of presidential elections. For example, in 2006, the Democratic Party won a narrow 51-49 majority, generating a shock to the policy environment in Congress.

In addition to national elections, we consider several policy announcements and major events that put the magnitude of the election effects into context, and that highlight the challenge of identification when the timing and probability of a shock is not well known. For colleges, we examine the dates of the DOE announcements of the proposed, final, and revised gainful employment rule, the release of a GAO report detailing widespread recruiting fraud by for-profit colleges, and the release of student debt and earnings data for college programs.[17] For loan companies, we examine the announcement of an investigation into fraud by the New York Attorney General, the introduction of the CCRAA of 2007, the release of the President's Fiscal Year 2010 Budget, the announcement of a CFPB lawsuit against Navient, and the announcement of the borrower defense rule.

3.5 For-Profit Colleges

This section presents estimates of the effect of national elections on the daily and cumulative abnormal returns of publicly traded for-profit colleges. Estimates are also presented for announcements relating to the roll out of the gainful employment rule and several high profile events. The importance of the party winning control of the executive or legislative branch is shaped by the partisan nature of the policies affecting for-profit colleges. As detailed in Section 3.2, the Democratic Party has been systematically responsible for the introduction of policies increasing oversight

[17]We also examine the effect of two shocks to specific for-profit college companies that may have spillover effects on other companies. The first is the withdrawal of earnings estimates by Apollo Education Group shortly after the gainful employment announcement, GAO report, and debt repayment data release in 2010. The second is the announcement that ITT Tech has lost eligibility for federal aid in 2016.

of these colleges under the threat of lost eligibility for federal student aid.

While the 2004 presidential election was closely contested, there is little evidence of any impact of the resulting Republican win on the stock prices of for-profit colleges. Figure **??** reveals that the average cumulative change in stock prices closely tracks those of the Nasdaq, consumer services sector, and other education companies for five days after the election. The estimates presented in Table 3.2 confirm this result, with an initial negative abnormal return relative to the sector of less than 3 percent and no significant cumulative abnormal return five days after the election. The magnitudes are confirmed by abnormal return estimates relative to the market and other education companies.[18] As noted in Section 3.4, the result of the 2008 election was widely anticipated, so observed changes in stock prices are unlikely to stem from an election shock. The resulting estimates from this election are not consistent across comparison indices, which may stem from the high level of volatility at the time. Specifically, for-profit colleges reveal zero abnormal return the day after the election, counterintuitive positive returns in subsequent days relative to the market and sector, and no significant change relative to other education stocks.

The lack of an effect after a Republican win in 2004 is in stark contrast to the large and sudden increase in prices associated with the Republican presidential win in 2016. Relative to the rest of the market, sector, and industry, for-profit colleges had cumulative abnormal returns exceeding 20 percent. While the market as a whole moved upward, the for-profit sector vastly exceeded these returns. Though not as sharp, the Democratic win in 2012 resulted in three consecutive days of statistically significant negative abnormal returns, resulting in a cumulative abnormal return of negative 8 percent relative to the rest of the sector, and

[18] As shown in Appendix Table 3.11, there is no statistically significant abnormal return three days after the 2004 election.

negative 7 and 12 percent relative to the market and industry, respectively. Adjusting the 2012 and 2016 three day cumulative abnormal returns by their Betfair win probabilities suggests a 32 percent negative effect of a Democratic win in 2012 and a 28 percent positive effect of a Republican win in 2016. That is, the two elections in the post gainful employment rule era reveal similar net effects of the party in control of the executive branch on the value of for-profit college stocks. The magnitude of these effects indicates that investors view the industry as highly vulnerable to federal policies.

The congressional elections in 2006, 2010, and 2014 shed light on whether the House and Senate impact for-profit college stocks. The 2006 midterm election was characterized by a switch from Republican to Democratic control in both chambers, with a narrow majority of 51-49 in the Senate. Despite the fact that the outcome was unlikely to have been predicted with high probability, the estimates in Table 3.3 reveal no large or statistically significant abnormal return among for-profit stocks. Likewise in 2010, when the Democrats retained a narrow Senate majority but lost the House majority, and in 2014 when Republicans won a new Senate majority, there is no evidence of any statistically significant abnormal returns among for-profit colleges in the days following the elections. That is, despite narrow wins and switching majorities, control of Congress appears to have little effect on this industry. This is an interesting result in and of itself, as it suggests that investors do not perceive the legislative branch as having a strong influence on for-profit colleges. Further, the midterm results suggest that, during the presidential election years of 2004, 2008, 2012, and 2016, when there were no changes in the majority of either chamber, the estimated effects are likely to be driven primarily by the executive branch.

The roll out of the gainful employment rule in 2010 generated very modest

short-run effects. Figure **??** reveals a small and gradual change in the price of for-profit college company stocks in the five days after the announcement, which is not consistent with investors perceiving the regulation as a significant threat to firm value. The estimates in Table 3.4 support this, with a negative 2 percent cumulative abnormal return after three days. Likewise, the announcement of the final rule in October had no significant effect. This lack of a response could stem from anticipation of the policy or from investors not perceiving that the rule would be binding due to a lack of information about the debt and earnings of student who attend for-profit colleges. One year later, however, when the final rule was revised and weakened (allowing a multi-year period before offending programs are closed), stock prices immediately increased by 10 percent, which indicates that the policy change was at least partially unexpected and that investors perceived significant implications for the industry. In 2018, the release of the notice of proposed rulemaking to rescind the gainful employment rule again generated no notable effect on for-profit colleges, suggesting that this was fully anticipated by the market and capitalized into stock prices.[19] The difficulty of interpreting the response to policy announcements highlights the advantage of national elections, which are characterized by shocks that are well-defined in terms of both magnitude and timing.

In contrast to the initial introduction of the gainful employment rule, several events that occurred in the subsequent weeks did generate a sizable stock price re-

[19]The lack of response to government announcements is not restricted to those associated with gainful employment. The announcement in 2016 that ITT Tech had lost eligibility for federal student aid, leading to its immediate bankruptcy, had little effect on the stocks of other for-profit colleges. This may indicate that this event was fully anticipated by the market or that, by this time, investors were fully aware of the financial health and likelihood of action against each of the publicly traded for-profit colleges. There is also no evidence of a significant stock price effect following the DOE decision not to recognize the accreditation agency ACICS in 2016. The possibility of anticipation of policy changes is evident in, for example, a letter from several prominent economists to the Department of Education in 2017 (Cellini, Deming, Looney, Matsudaira, 2017).

sponse. First, the release of a GAO report documenting recruiting fraud resulted in an immediate abnormal negative return of 12 percent. This effect is likely to reflect the new information it revealed to investors about the health and business practices of these companies, and fears of additional regulatory action.[20] Of interest is that even this significant event generated a reduction in stock price that was about one-third of the magnitude of changing the party in control of the executive branch. Shortly after the GAO report, the DOE released debt and earnings data for each for-profit college program, generating an immediate 11 percent negative abnormal stock return. Again, this is likely to reflect both the direct effect of new information, and the interaction of this information with the new rule.[21] That is, while there was no notable effect of the gainful employment rule in the short run, a series of subsequent information revelations about the industry generated several sharp negative abnormal returns that are likely to be partially attributable to their interaction with the rule.

There is evidence that the for-profit colleges that are most exposed to potential changes in federal regulation experience the largest changes. After the 2016 election, the largest single shock to the industry, there is a strong positive correlation between a for-profit college company's average debt-to-earnings ratio and the price change they experienced.[22] Appendix Table 3.12 presents the change in stock price after the election, the debt-to-earnings ratio in 2015, and the de-

[20]For example, during the hearing when the GAO report was released, Senator Tom Harkin expressed his desire to examine the accreditation procedure for all for-profit colleges, stating explicitly that the problem was unlikely to be limited to just those campuses that were investigated as part of the report (Lewin, 2010).

[21]In addition to the release of information by government agencies, investors also responded strongly to new information from the for-profit colleges themselves. Two months after the GAO report, Apollo Education Group, whose University of Phoenix has the largest enrollment in the sector, withdrew its earnings outlook for the next year, resulting in an additional 14 percent abnormal negative return that spilled over and generated negative returns for each other for-profit college stock.

[22]The sole exception to this relationship is American Public University, which depends heavily on the GI Bill and Department of Defense Tuition Assistance.

pendence on military aid for each company in 2015.[23] A regression of the price change on the debt-to-earnings ratio and percentage of students receiving military aid reveals a strong positive relationship for both predictors of policy exposure. However, it is notable that responses to election shocks and other unanticipated events are not restricted to the most exposed companies. As shown in Appendix Figure 3A.1, nearly every company exhibits an abnormal return of the same sign after each of the four largest shocks. Specifically, nearly every for-profit college company has cumulative price changes exceeding the market immediately following the release of the GAO report in 2010, the release of DOE data in 2010, and the 2012 and 2016 presidential elections. This would not be the case if some for-profit colleges were highly unlikely to be affected by federal policy, or if they could benefit from reduced competition if other colleges became ineligible for aid. That is, investor responses reveal that they believe that the industry as a whole is sensitive to federal policies, not just those campuses that seem most likely to experience significant sanctions.

3.6 Student Loan Companies

As detailed in Section 3.2, the Democratic and Republican parties are associated with fundamentally different policies relating to student loans. Most notably, Democratic politicians favor direct student loans administered by the government over guaranteed loans and subsidies for private loan companies. In addition, Democratic administrations have taken legal action against private loan companies that provide incorrect and costly information to borrowers, and have implemented rules to protect borrowers who have debt after attending colleges that commit re-

[23]The debt-to-earnings ratio and fraction of student receiving military aid are computed by collapsing DOE data across all branch campuses owned by a publicly traded company weighted by enrollment.

cruiting fraud. In contrast, Republicans in the executive branch and Congress have favored a greater role for private lenders, limiting the level of federal undergraduate grants and loans, and reducing regulatory oversight. This section examines how the stocks of publicly traded private student loan companies respond to the results of presidential elections, congressional elections, and several other major events that have affected the industry.

Figure 3.3 presents graphical evidence of changes in stock prices after each presidential election, showing sharp increases after Republican wins in 2004 and 2016. Using the finance sector as the comparison index, Table 3.5 reveals that the 2004 Republican presidential win resulted in an immediate 8.4 percent positive abnormal return. Adjusting for the win probability, this indicates that a Republican administration increased the value of these companies by 20 percent on the day after the election. Similarly, the 2016 Republican election win resulted in an immediate 15 percent increase, also corresponding to a 20 percent increase after accounting for the win probability. The effects are even larger when the abnormal returns are relative to the market rather than the financial sector (see Appendix Table 3.13). That is, both the 2004 and 2016 Republican presidential wins indicate that a policy environment that favors an expanded role for private loans and reduced oversight increase the value of the industry by approximately one-fifth.

While Obama was heavily favored in 2008, making a modest response predictable, it is notable that private lender stocks did not drop after a Democratic win in 2012. This is interesting due to the fact that the Republican candidate favored a greater role for private lenders in the student loan market.[24] One potentially mitigating factor during this election was that Congress was split, with the Republicans retaining control of the House, which is in contrast to the 2004

[24]Republican candidate Mitt Romney's education policy proposal, "A Chance for Every Child," explicitly laid out a plan to reverse the "nationalization of the student loan market" and to "welcome private sector participation" (Romney, 2012).

and 2016 elections when the Republicans controlled the executive and legislative branches. The midterm election estimates in Table 3.6 provide some evidence of the importance of Congress, revealing an immediate 6 percent reduction in abnormal returns after the Democrats retained the House and won a narrow majority in the Senate in 2006. This suggests that the legislative branch, through its role in determining the level of Pell Grants and federal loans, may play a greater role for the student loan market than it does for regulating for-profit colleges.

Table 3.7 presents evidence of three types of policy events that could affect the profitability of private student loan companies. Most notably, the President's Fiscal Year 2010 Budget detailed a plan for reverting from private banks administering loans that were guaranteed by the federal government to direct loans made by the Department of Education. This plan, which fundamentally challenged the business model of for-profit lenders, was clearly unanticipated and resulted in an immediate 40 percent abnormal decrease in stock prices. Figure 3.4 shows that this change occurred immediately in the day of the budget release. The subsequent laws and implementation of this change did not generate additional changes, suggesting that the information revelation in the budget was the primary shock. However, several key announcements that are likely to affect private lenders did not generate significant abnormal returns. For example, there is no evidence that the introduction of the College Cost Reduction and Access Act of 2007, which undermined the profit margins of private issuers of federally guaranteed loans, resulted in a significant change in stock price.[25] Likewise, the DOE announcement of proposed borrower defense rules had no notable affect in 2016. In addition to policy announcements, there have been several major investigations and lawsuits into corruption and fraud by student loan companies. Two of the most high

[25]Similarly, examining the dates when the CCRAA was passed by the House and Senate and the date it was signed by the president reveal no abnormal returns.

profile cases were the investigation into the six largest private lenders by the Attorney General of New York in 2007, and the CFPB's lawsuit against Navient for predatory lending servicing practices in 2015. There is no evidence of stock price reductions after the announcement of either of these events. The lack of responses to these major announcements supports the concern that they may be anticipated by the market.

Appendix Figure 3A.2 presents the distribution of abnormal returns for the four events with the largest effect on the stock prices of private student lending companies. This reveals that the change after the 2004 presidential election, 2006 midterm election, 2010 presidential budget, and 2016 presidential election were very similar across each publicly traded private student loan company. This is interesting due to the fact that these companies perform fundamentally different functions (issuing loans versus servicing loans) and have faced differing levels of legal oversight. This is consistent with the stocks responding to the overall policy environment generated by administrations that are more or less in favor of increasing the role of direct government involvement in the student loan market.

3.7 Conclusion

The for-profit sector plays a significant role in postsecondary education through for-profit colleges and the student loan market. This paper exploits abnormal changes in stock prices in order to provide direct empirical evidence of the effect of federal policies on the profitability and viability of publicly traded postsecondary education companies. Stock prices reflect the immediate, efficient market updating of investors' expectations and thus limit bias from confounding factors that change over time. An inconsistent pattern of results indicates that responses to policy announcements are difficult to interpret due to the possibility that they were

anticipated by the market. In contrast, national elections provide a well-quantified exogenous shock to the regulatory environment. Both the executive and legislative branches are characterized by clear partisan differences in terms of the policies they support.

The analysis reveals that, over the last two elections, the for-profit college industry has become highly sensitive to control of the executive branch, accounting for approximately 30 percent of company value. However, there is little evidence of that Congress has a significant impact on this industry. In contrast, private student loan companies are sensitive to both branches of government and this has been the case over the last two decades. There is evidence that the effects of changes in party control of the federal government are strongest for companies that are most exposed to federal rules and regulations. That is, that federal policy isolates the lowest performing companies. However, shared positive and negative shocks are typically evident across all for-profit colleges and private lenders. Thus investors also appear to believe that a significant fraction of for-profit colleges will struggle to meet federal regulatory standards and that private companies that issue or service student loans are dependent on favorable federal grant and loan environment.

3.8 References

Armona, Louis, Rajashri Chakrabarti, and Michael Lovenheim."How Does For-Profit College Attendance Affect Student Loans, Defaults, and Earnings?" *Federal Reserve Bank of New York, 2017, Working Paper No. 811.*

Binder, John J. "Measuring the Effects of Regulation with Stock Price Data," *The RAND Journal of Economics , 1985, 16 (2),* 167-183.

Born, Jeffery, David Myers, and William Clark. "Trump Tweets and the

Efficient Market Hypothesis," *Algorithm Finance , 2017, 6,* 103-109.

Campbell, John, Andrew Lo, and Craig MacKinlay. The Econometrics of Financial Markets. *Princeton University Press, Princeton, NJ, 1997.*

Cellini, Stephanie. "Financial Aid and For-Profit Colleges: Does Aid Encourage Entry?" *Journal of Policy Analysis and Management , 2010, 29 (3),* 526-552.

Cellini, Stephanie. "For-Profit Higher Education: An Assessment of Costs and Benefits, " *National Tax Journal, 2012, 65 (1),* 153-180.

Cellini, Stephanie, and Latika Chaudhary. "The Labor Market Returns to a For-Profit College Education,"*Economics of Education Review , 2014, 43,* 125-140.

Cellini, Stephanie, and Nicholas Turner. "Gainfully Employed? Assessing the Employment and Earnings of For-Profit College Students Using Administrative Data," *Journal of Human Resources , 2018* .

Cellini, Stephanie, Rajeev Darolia, and Lesley J. Turner. "Where Do Students Go when For-Profit Colleges Lose Federal Aid?' ' *2016, NBER Working Paper No. 22967.*

Cellini, Stephanie, and Rajeev Darolia. "College Costs and Financial Constraints: Student Borrowing at For-Profit Institutions." in Student Loans and the Dynamics of Debt. eds. by Brad Hershbein and Kevin Hollenbeck. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 2015.

Cellini, Stephanie, David Deming, Adam Looney, and Jordan Matsudaira. "Comment to the Department of Education," *2017,* Docket ID: ED-2017-OPE-0076-0001.

Chung, Anna. "Choice of For-Profit College" *Economics of Education Review, 2012, 31 (6),* 1084-1101.

Consumer Financial Protection Bureau."CFPB Sues Nation's Largest Student Loan Company Navient for Failing Borrowers at Every Stage of Repayment." *Press Release, January 18, 2017.*

Darolia, Rajeev, Cory Koedel, Paco Martorell, Katie Wilson, and Fran-

cisco Perez-Arce."Do Employers Prefer Workers Who Attend For-Profit Colleges? Evidence from a Field Experiment," *Journal of Policy Analysis and Management, 2015, 34 (4),* 881-903.

Deming, David, Claudia Goldin, and Lawrence Katz. "The For-Profit Postsecondary School Sector: Nimble Critters or Agile Predators?" *Journal of Economic Perspectives, 2012, 26 (1),* 139-164.

Deming, David, Noam Yuchtman, Amira Abulafi, Claudia Goldin, and Lawrence Katz. "The Value of Postsecondary Credentials in the Labor Market: An Experimental Study," *American Economic Review , 2016, 106 (3),* 778-806.

Deming, David, Michael Lovenheim, and Richard Patterson. "The Competitive Effects of Online Education," *in Productivity in Higher Education. eds.* Caroline M. Hoxby and Kevin Stange, 2018.

Denice, Patrick. "Does it Pay to Attend a For-Profit College? Vertical and Horizontal Stratification in Higher Education," *Social Science Research, 2015, 52, 161-178.*

Dillon, Sam. "Online Colleges Receive a Boost From Congress," *The New York Times*, *March 1, 2006.*

Dynarksi, Susan. "With Trump, Investors See Profits Again in For-Profit Colleges," *The New York Times: The Upshot, November 18, 2016.*

Eaton, Charlie, Sabrina Howell, and Constantine Yannelis. "When Investor Incentives and Consumer Interests Diverge: Private Equity in Higher Education," *2018, Working Paper.*

Fama, Eugene, and Kenneth French. "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics, 1993, 33,* 3-56.

Fan, Rui, Oleksandr Talavera, and Vu Tran. "Does Connection with @realDonaldTrump Affect Stock Prices?" *2018, Working Paper.*

Gregory Gilpina, Joseph Saunders, and Christiana Stoddard. "Why Has For-Profit Colleges' Share of Higher Education Expanded So Rapidly? Estimating the Responsiveness to Labor Market Changes," *Economics of Education Review,*

2015, 45, 53-63.

Goodell, John W. "Do For-Profit Universities Induce Bad Student Loans?" *The Quarterly Review of Economics and Finance, 2016, 61,* 173-184.

Goodman, Sarena, and Alice Henriques. "The Effect of Shocks to College Revenues on For-Profit Enrollment: Spillover from the Public Sector," *Finance and Economics Discussion Series 2015-025.*

Huang, Roger. 1985. "Common Stock Returns and Presidential Elections," *Financial Analysts Journal, 1985, 41 (2),* 24-39.

Kundu, Santanu. "Trump, Regulation and Stock Returns," *2018, Working Paper.*

Lang, Kevin and Russell Weinstein. "The Wage Effects of Not-for-Profit and For-Profit Certifications: Better Data, Somewhat Different Results," *Labour Economics , 2013, 24,* 230-243.

Lewin, Tamar. "Senator to Review Accreditation of For-Profit Colleges," *The New York Times , August 4, 2010.*

Navient. 2018. Quarterly Report [Press Release]. Retrieved from www.navient.com /about/ investors.

Nelnet. 2018. Quarterly Report [Press Release]. Retrieved from www.nelnet investors.com /news.

Romey, Mitt. "A Chance for Every Child: Mitt Romney's Plan for Restoring the Promise of American Education," *2012, Campaign publication.*

Rothman, Robert. "Bennett Asks Congress to Put Curbs on Exploitative For-Profit Schools." *Education Week, February 17, 1988.*

Sallie Mae. 2018. Quarterly Report [Press Release]. Retrieved from www.sallie mae.com /investors.

Santa-Clara, Pedro, and Rossen Valkanov. "The Presidential Puzzle: Political Cycles and the Stock Market," *The Journal of Finance*, *2003, 58 (5),* 1841-1872.

Schwert, G.William. "Using Financial Data to Measure Effects of Regulation," *Journal of Law and Economics , 1981, 24*, 121-158.

Snowberg, Erik, Justin Wolfers, and Eric Zitzewitz. "Partisan Impacts on the Economy: Evidence from Prediction Markets and Close Elections," *Quarterly Journal of Economics , 2007, 122, 807-829.*

Wagner, Alexander F., Richard J. Zeckhauser, and Alexandre Ziegler. "Company Stock Price Reactions to the 2016 Election Shock: Trump, Taxes, and Trade." *Journal of Financial Economics, 2018.*

Wolfers, Justin, and Eric Zitzewitz. "What do Financial Markets Think of the 2016 Election?" *2016 Brookings Working Paper.*

U.S. Department of Education. 2017a. National Center for Education Statistics. *Digest of Education Statistics.* Table 303.20.

U.S. Department of Education. 2017b. Federal Student Aid Office. "Proprietary School Revenue Percentages Report for Financial Statements with Fiscal Year Ending Dates Between 07/01/15 - 06/30/16." *Released December, 2016.*

U.S. Department of Education. 2016. National Center for Education Statistics. Integrated Postsecondary Education Data System. Enrollment and Employees in Postsecondary Institutions.

U.S. Department of Education. "U.S. Department of Education Proposes Overhaul of Gainful Employment Regulations." *Press Release. August 18, 2018.*

U.S. Government Accountability Office. 2010. "Undercover Testing Finds Colleges Encouraged Fraud and Engaged in Deceptive and Questionable Marketing Practices." GAO-10-948T.

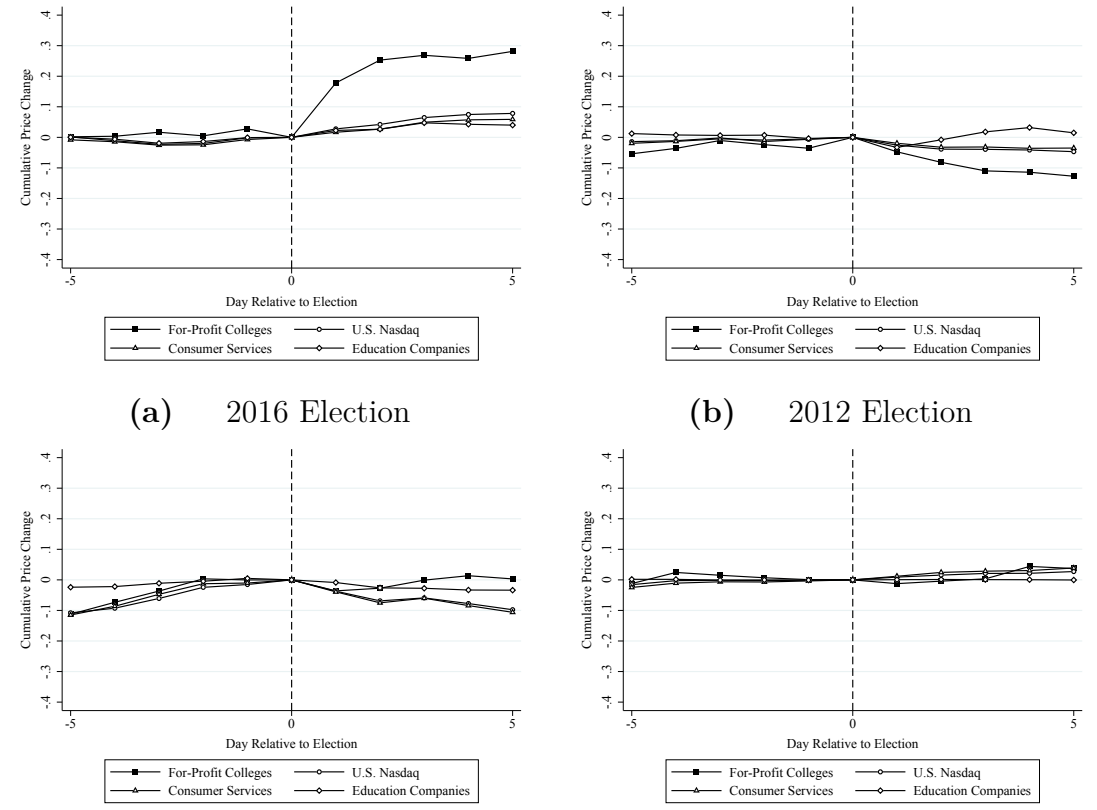
U.S. Congress. 102nd Congress. 1992. Higher Education Amendments of 1992. Public Law No: 102-325.

U.S. Congress. 105th Congress. 1998. Higher Education Amendments of 1998. Public Law No: 105-481.

U.S. Senate. "For Profit Higher Education: The Failure to Safeguard the Federal Investment and Ensure Student Success." *Health, Education, Labor and Pensions Committee. July 30, 2012.*

Zillman, Claire. "Obama's Budget Aims to Eliminate For-Profit Colleges' GI Bill Loophole." *Fortune*, February 3, 2015.

3.9 Figures

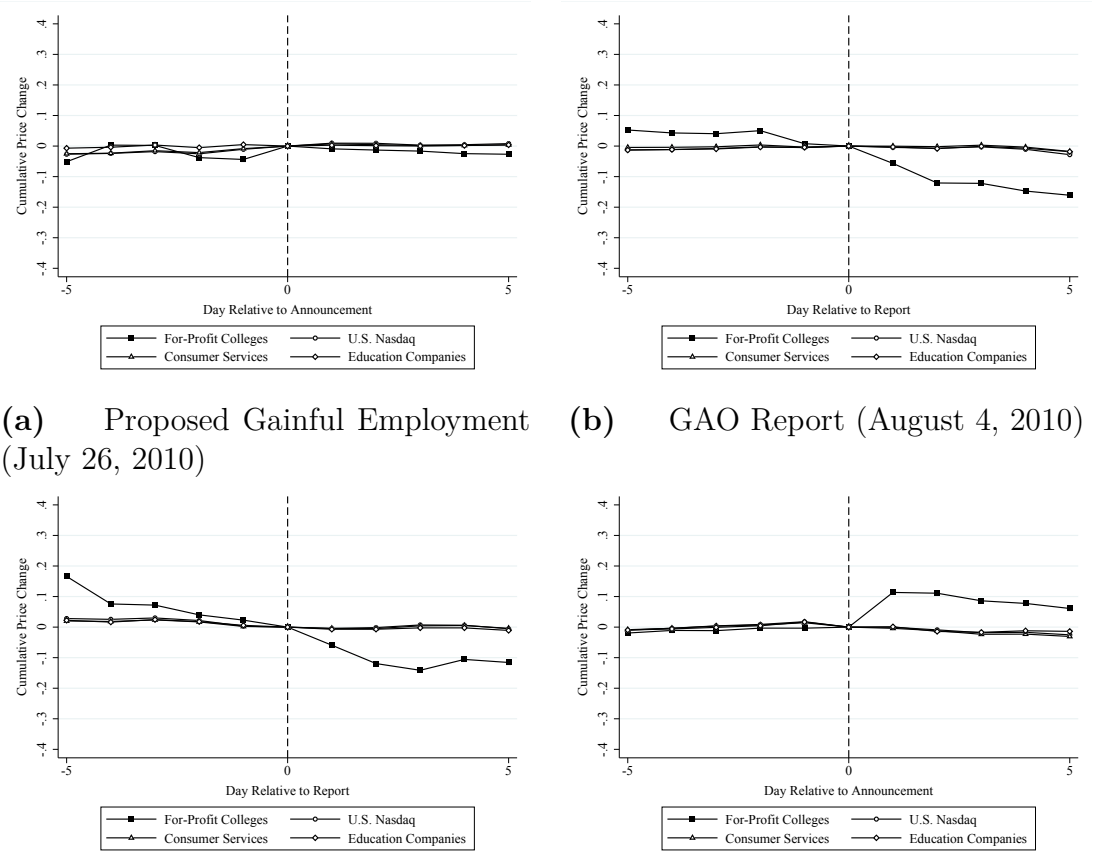


(a) 2016 Election **(b)** 2012 Election

(c) 2008 Election **(d)** 2004 Election

Figure 3.1 For-Profit College: Cumulative Price Change

Note: Each graph presents the average cumulative change in prices among for-profit college stocks, the Nasdaq index, the consumer services sector, and publicly traded education companies. The change is measured as a fraction of the baseline closing price on election day (day 0). The comparison indices include only U.S.-based companies and the returns are adjusted by the average beta of the for-profit college stocks in order to match their volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. The presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016.



(a) Proposed Gainful Employment (July 26, 2010)

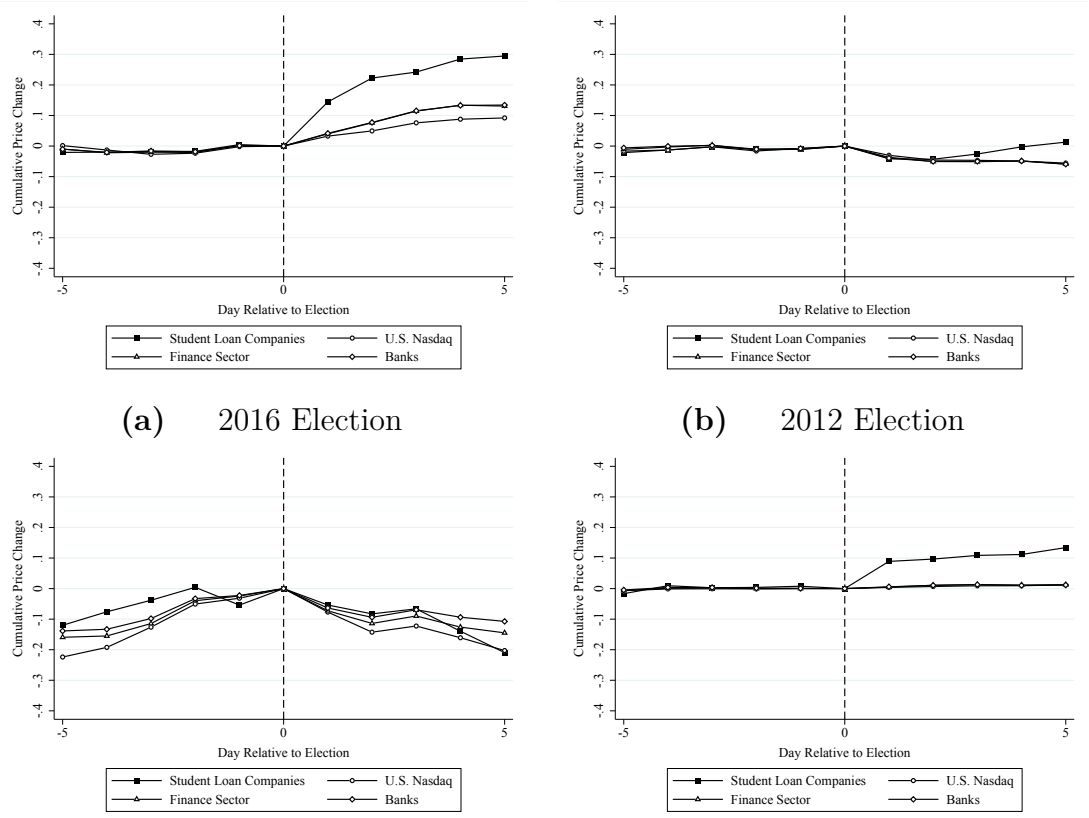
(b) GAO Report (August 4, 2010)

(c) DOE Debt Data (August 16, 2010)

(d) Revised Gainful Employment (June 2, 2011)

Figure 3.2 For-Profit Colleges: Major Events and Policy Announcements

Note: Each graph presents the average cumulative change in prices among for-profit college stocks, the Nasdaq index, the consumer services sector, and publicly traded education companies. The change is measured as a fraction of the baseline closing price on the day before the announcement could be capitalized in prices (day 0). The comparison indices include only U.S.-based companies and the returns are adjusted by the average beta of the for-profit college stocks in order to match their volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. The four events include: a) a proposed rule making for gainful employment on July 26, 2010; b) the release of a GAO Report on August 4th, 2010, based on an undercover investigation and detailing fraud by for-profit colleges; c) the release of student debt information for each college by the Department of Education on August 16th, 2010; and d) revised final regulations for gainful employment on June 2, 2011.

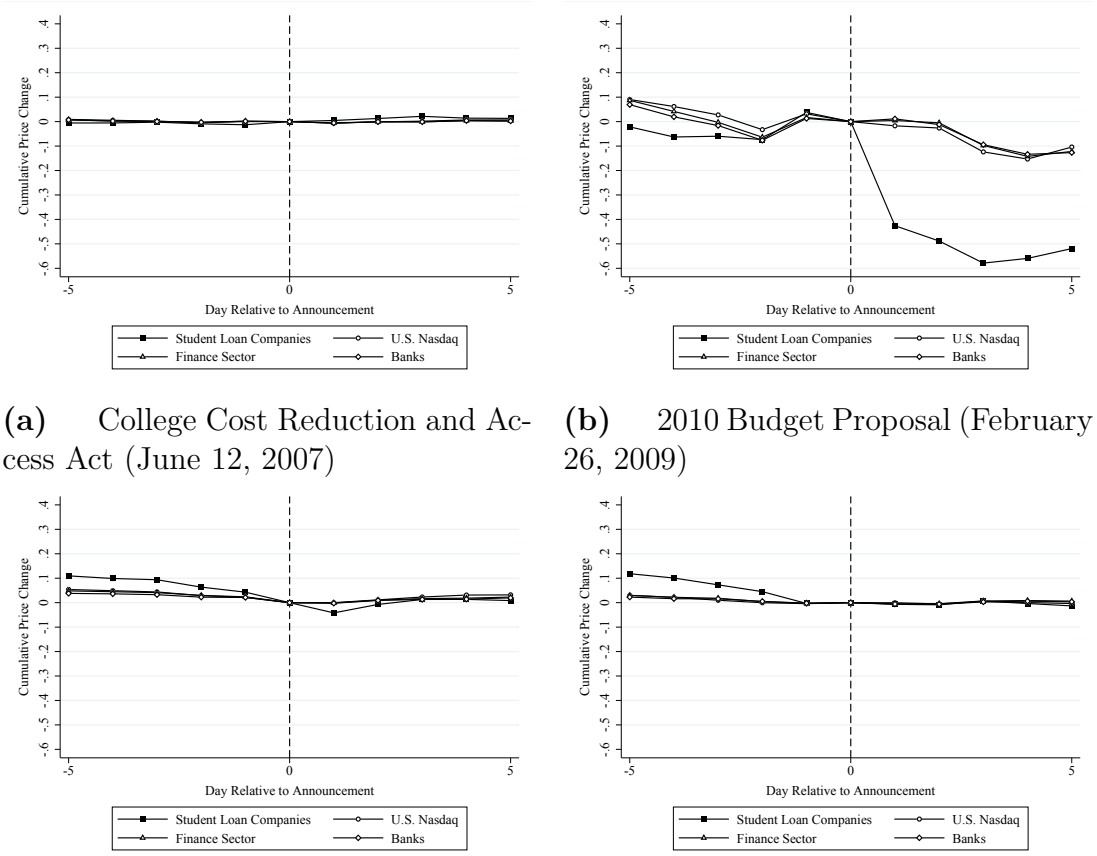


(a) 2016 Election **(b)** 2012 Election

(c) 2008 Election **(d)** 2004 Election

Figure 3.3 Student Loan Companies: Cumulative Price Change

Note: Each graph presents the average cumulative change in prices among student loan company stocks, the Nasdaq index, the finance sector, and major banks. The change is measured as a fraction of the baseline closing price on election day (day 0). The comparison indices include only U.S.-based companies and the returns are adjusted by beta in order to match the volatility of the student loan companies. Stock prices are daily closing prices adjusted for stock splits and dividends. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016.



(a) College Cost Reduction and Access Act (June 12, 2007)

(b) 2010 Budget Proposal (February 26, 2009)

(c) Notice of CFPB Legal Action Notice (August 24, 2015)

(d) Proposed Borrower Defense Rule (June 16, 2016)

Figure 3.4 Student Loan Companies: Major Events and Policy Announcements

Note: Each graph presents the average cumulative change in prices among student loan company stocks, the Nasdaq index, the finance sector, and major banks. The change is measured as a fraction of the baseline closing price on the day before the announcement could be capitalized in prices (day 0). The comparison indices include only U.S.-based companies and the returns are adjusted by beta in order to match the volatility of for-profit colleges. Stock prices are daily closing prices adjusted for stock splits and dividends. The four events include: a) the introduction of the College Cost Reduction and Access Act in congress on June 12, 2007; b) the release of the President's Proposed 2010 Federal Budget on February 26, 2009; c) the mandatory announcement by Navient that it had been notified by the Consumer Financial Protection Bureau of pending legal action on August 24, 2015; and d) the DOE announcement of a proposed borrower defense rule on June 16, 2016.

3.10 Tables

For-Profit Colleges

Company	Primary College	Ticker	Publicly Traded	Avg Mkt Cap
Adtalem Education Group	DeVry U	ATGE	1991 - current	$2,316m
American Public Education	Am. Public U	APEI	2007 - current	$607m
Apollo Education Group	U of Phoenix	APOL	1994 - 2016	$7,560m
Bridgepoint Education Group	Ashford U	BPI	2009 - current	$728m
Capella Education Co.	Capella U	CPLA	2006 - current	$783m
Career Education Co.	Am. InterContinental U	CECO	1998 - current	$1796m
Corinthian College	Everest College	COCO	1999 - 2015	$1,042m
Education Management Co.	Argosy U, The Art Inst	EDMC	2009 - current	$1,325m
Grand Canyon Education	Grand Canyon U	LOPE	2008 - current	$1,442m
ITT Educational Services	ITT Tech Inst	ESI	1996 - current	$1,897m
Lincoln Ed Services Co.	Lincoln Tech Inst	LINC	2005 - current	$284m
National American U Holdings	National American U	NAUH	2007 - current	$96m
Strayer Education Inc.	Strayer U	STRA	1996 - current	$1,386m
Universal Technical Institute	Universal Tech Inst	UTI	2003 - current	$285m

Student Loan Companies

Company	Primary Service	Ticker	Publicly Traded	Avg Mkt Cap
Navient Co.	Service fed & private loans	NAVI	2014 - current	$5,713m
Nelnet Inc.	Service fed & private loans	NNI	2003 - current	$1,380m
Sallie Mae Co,	Originate private loans	SLM	1983 - current	$11,017m

Note: This table presents information about publicly traded for-profit college and student loan companies. Column 2 includes the primary college or university brand owned by each for-profit college company. A full list of colleges and universities provided in Appendix Table 3.8. Column 2 lists the primary services provided by the three student loan companies. Column 3 presents each company's stock ticker, and column 4 shows the range of years during which the company was publicly traded. Column 5 presents the average market capitalization during the period of thus study, though these values frequently vary substantially due to fluctuation in stock price. Only companies that operate primarily in the U.S. are included in this table and the analysis. Laureate Education is not included because it became publicly traded in 2017, after each event examined in the study.

Table 3.1: Publicly Traded Postsecondary Education Companies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Daily Abnormal Return				Cumulative Abnormal Return			
Election	2016	2012	2008	2004	2016	2012	2008	2004
Day -5	-0.008	0.019	0.027***	-0.007	0.021	0.028	0.039*	-0.013
	(0.022)	(0.018)	(0.009)	(0.012)	(0.040)	(0.025)	(0.023)	(0.031)
Day -4	0.008	0.013	0.013	0.024*	0.029	0.009	0.012	-0.005
	(0.005)	(0.008)	(0.008)	(0.013)	(0.020)	(0.016)	(0.024)	(0.023)
Day -3	0.025***	0.019**	-0.002	-0.013	0.021	-0.004	-0.001	-0.029*
	(0.008)	(0.009)	(0.018)	(0.009)	(0.019)	(0.015)	(0.020)	(0.016)
Day -2	-0.011	-0.008	0.006	-0.007	-0.005	-0.023	0.001	-0.017*
	(0.017)	(0.012)	(0.011)	(0.006)	(0.018)	(0.015)	(0.017)	(0.010)
Day -1	0.006	-0.015	-0.005	-0.010**	0.006	-0.015	-0.005	-0.010**
	(0.009)	(0.010)	(0.010)	(0.004)	(0.009)	(0.010)	(0.010)	(0.004)
Day 1	0.161***	-0.028***	0.003	-0.024***	0.161***	-0.028***	0.003	-0.024***
	(0.054)	(0.005)	(0.005)	(0.005)	(0.054)	(0.005)	(0.005)	(0.005)
Day 2	0.050***	-0.023***	0.046***	-0.004	0.211***	-0.051***	0.050***	-0.028***
	(0.014)	(0.006)	(0.016)	(0.006)	(0.062)	(0.009)	(0.017)	(0.009)
Day 3	-0.011	-0.032**	0.010	0.004	0.201***	-0.083***	0.060***	-0.025**
	(0.007)	(0.015)	(0.007)	(0.006)	(0.065)	(0.020)	(0.022)	(0.011)
Day 4	-0.011	-0.001	0.040***	0.039***	0.190***	-0.084***	0.100***	0.014
	(0.010)	(0.004)	(0.008)	(0.009)	(0.056)	(0.021)	(0.026)	(0.012)
Day 5	0.014	-0.017**	0.014***	-0.015***	0.204***	-0.100***	0.114***	-0.001
	(0.009)	(0.007)	(0.005)	(0.005)	(0.063)	(0.025)	(0.026)	(0.016)
R-Squared	.384	.243	.293	.447	.476	.426	.43	.192
Mean Dep	.018	-.004	.013	-.002	.094	-.032	.034	-.012
Observations	121	154	121	77	121	154	121	77

Note: This table presents the daily and cumulative abnormal returns of for-profit college stocks relative to other U.S.-based consumer service stocks traded on the Nasdaq. Estimates are presented for the five days before and after presidential elections, with Day 0 representing election day and acting as the baseline date for cumulative returns. The daily and cumulative returns of the comparison index are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016. Standard errors are clustered at the stock and day level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

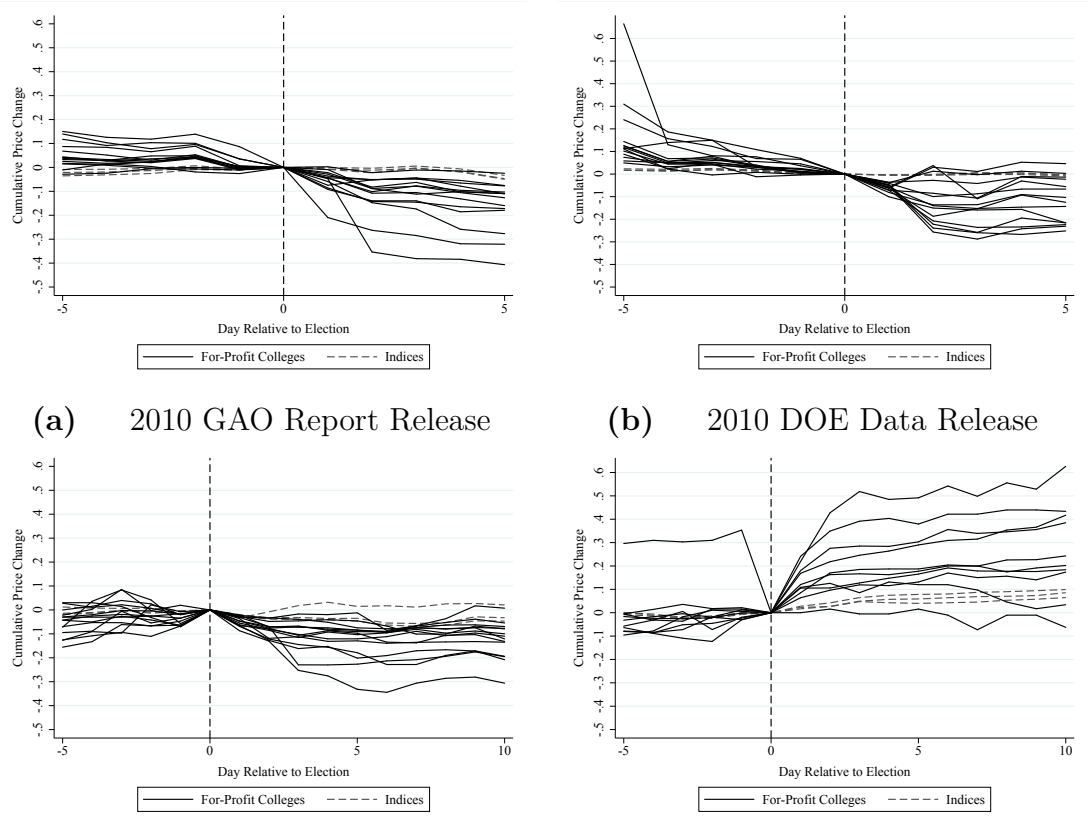
Table 3.2: For-Profit Colleges: Presidential Elections

	(1)	(2)	(3)	(4)	(5)	(6)
	Daily Abnormal Return			Cumulative Abnormal Return		
Election	2014	2010	2006	2014	2010	2006
Day -5	0.021	-0.034**	0.007	0.013	-0.009	-0.009
	(0.014)	(0.016)	(0.005)	(0.021)	(0.026)	(0.007)
Day -4	-0.007	0.008	-0.011***	-0.008	0.025	-0.016*
	(0.007)	(0.008)	(0.004)	(0.023)	(0.016)	(0.008)
Day -3	0.006	0.005	0.012***	-0.000	0.017	-0.005
	(0.011)	(0.005)	(0.004)	(0.020)	(0.014)	(0.009)
Day -2	-0.000	0.007	-0.013***	-0.006	0.012	-0.017**
	(0.012)	(0.007)	(0.004)	(0.019)	(0.010)	(0.007)
Day -1	-0.006	0.005	-0.004	-0.006	0.005	-0.004
	(0.012)	(0.006)	(0.004)	(0.012)	(0.006)	(0.004)
Day 1	-0.009	-0.013	0.019	-0.009	-0.013	0.019
	(0.015)	(0.016)	(0.013)	(0.015)	(0.016)	(0.013)
Day 2	0.005	-0.024	-0.025	-0.004	-0.037	-0.005
	(0.018)	(0.016)	(0.018)	(0.025)	(0.028)	(0.026)
Day 3	0.014	0.001	-0.023***	0.011	-0.036	-0.029
	(0.014)	(0.005)	(0.007)	(0.024)	(0.025)	(0.028)
Day 4	-0.013**	0.018***	-0.001	-0.003	-0.018	-0.030
	(0.006)	(0.004)	(0.004)	(0.025)	(0.023)	(0.030)
Day 5	0.002	0.022	0.003	-0.001	0.004	-0.026
	(0.006)	(0.016)	(0.004)	(0.029)	(0.029)	(0.032)
R-Squared	.089	.138	.284	.008	.072	.116
Mean Dep	.004	0	-.003	-.001	-.005	-.011
Observations	154	154	88	154	154	88

Note: This table presents the daily and cumulative abnormal returns of for-profit college stocks relative to other U.S.-based consumer service stocks traded on the Nasdaq. Estimates are presented for the five days before and after congressional elections, with Day 0 representing election day and acting as the baseline date for cumulative returns. The daily and cumulative returns of the comparison index are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. Congressional election dates were: November 7, 2006; November 2, 2010; November 4, 2014. Standard errors are clustered at the stock and day level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.3: For-Profit Colleges: Congressional Elections

3.11 Appendix

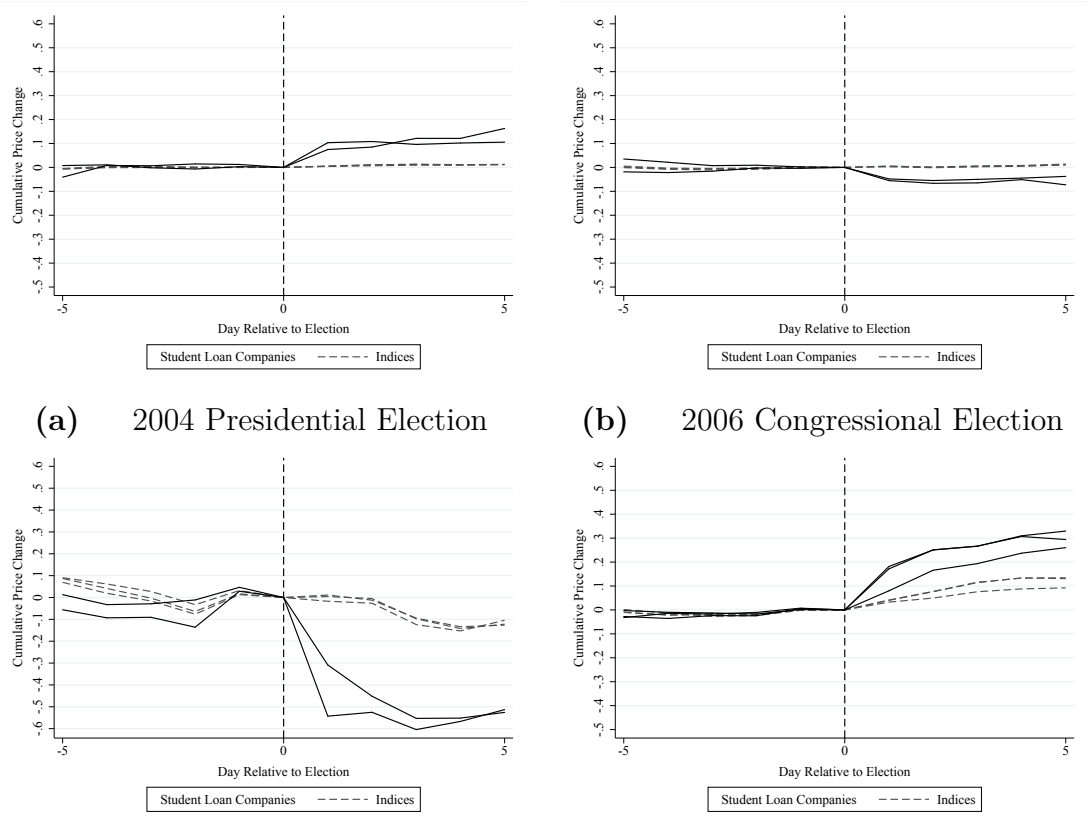


(a) 2010 GAO Report Release **(b)** 2010 DOE Data Release

(c) 2012 Presidential Election **(d)** 2016 Presidential Election

Figure 3A.1 For-Profit Colleges: Cumulative Stock Returns

Note: Each graph presents the average cumulative change in prices for each for-profit college stock, the Nasdaq index, the consumer services sector, and education companies. The change is measured as a fraction of the baseline closing price on election day or the day before the announcement could be capitalized in prices (day 0). The comparison indices include only U.S.-based companies and the returns are adjusted by beta in order to match the volatility of the for-profit colleges. Stock prices are daily closing prices adjusted for stock splits and dividends. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016.



(a) 2004 Presidential Election **(b)** 2006 Congressional Election

(c) 2010 Obama Budget **(d)** 2016 Presidential Election

Figure 3A.2 Student Loan Companies: Cumulative Stock Returns

Note: Each graph presents the average cumulative change in prices for each student loan company stock, the Nasdaq index, the finance sector, and major banks. The change is measured as a fraction of the baseline closing price on election day or the day before the announcement could be capitalized in prices (day 0). The comparison indices include only U.S.-based companies and the returns are adjusted by beta in order to match the volatility of the student loan companies. Stock prices are daily closing prices adjusted for stock splits and dividends. Day 0 corresponds to the day of the presidential election and is used as the baseline closing price for measuring the cumulative change. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016.

	(1)	(2)	(3)	(4)	(5)
	Cumulative Abnormal Return				
	GE Proposed	GAO Report	Debt Data	GE Final	GE Revised
Day -5	0.007	-0.047***	-0.144***	0.001	0.019
	(0.014)	(0.009)	(0.031)	(0.024)	(0.013)
Day -4	-0.004	-0.049***	-0.092***	0.005	-0.010
	(0.012)	(0.008)	(0.027)	(0.024)	(0.013)
Day -3	-0.059***	-0.039***	-0.027**	-0.022	-0.013**
	(0.014)	(0.006)	(0.010)	(0.022)	(0.005)
Day -2	-0.053***	-0.033***	-0.020**	-0.026	-0.005
	(0.010)	(0.004)	(0.008)	(0.021)	(0.007)
Day -1	-0.021**	-0.037***	0.002	0.008	-0.009
	(0.008)	(0.006)	(0.004)	(0.008)	(0.005)
Day 1	-0.019***	-0.052***	-0.055***	0.007	0.114***
	(0.006)	(0.014)	(0.005)	(0.007)	(0.021)
Day 2	-0.022**	-0.118***	-0.122***	0.012	0.120***
	(0.009)	(0.025)	(0.029)	(0.010)	(0.021)
Day 3	-0.020**	-0.125***	-0.154***	0.017	0.108***
	(0.009)	(0.030)	(0.027)	(0.013)	(0.019)
Day 4	-0.030**	-0.146***	-0.112***	0.004	0.099***
	(0.012)	(0.031)	(0.029)	(0.019)	(0.018)
Day 5	-0.036***	-0.144***	-0.111***	-0.020	0.092***
	(0.013)	(0.031)	(0.029)	(0.032)	(0.019)
R-Squared	.395	.621	.59	.041	.654
Mean Dep	-.023	-.072	-.076	-.001	.047
Observations	154	154	154	154	154

Note: This table presents the daily and cumulative abnormal returns of for-profit college stocks relative to other U.S.-based consumer service stocks traded on the Nasdaq. Estimates are presented for the five days before and after the event or announcement. The daily and cumulative returns of the comparison index are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. In chronological order, the following events and announcements are examined: 1) a proposed rule making for gainful employment on July 26, 2010; 2) the release of a GAO Report on August 4th, 2010, based on an undercover investigation and detailing fraud by for-profit colleges; 3) the release of student debt information for each college by the Department of Education on August 16, 2010; 4) the final regulations for gainful employment on October 29, 2010; and 5) revised final regulations for gainful employment on June 2, 2011. Standard errors are clustered at the daily level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.4: For-Profit Colleges: Major Events and Policy Announcements

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Daily Abnormal Return				Cumulative Abnormal Return			
Election	2016	2012	2008	2004	2016	2012	2008	2004
Day -5	0.011	0.001	-0.001	-0.002	0.026	0.012**	-0.066***	0.017
	(0.011)	(0.004)	(0.005)	(0.010)	(0.016)	(0.004)	(0.010)	(0.021)
Day -4	0.013	0.001	0.046**	0.020	0.014	0.011***	-0.065***	0.019
	(0.009)	(0.004)	(0.017)	(0.025)	(0.011)	(0.000)	(0.015)	(0.031)
Day -3	0.000	0.005	-0.004	-0.007	0.001	0.010**	-0.111***	-0.001
	(0.005)	(0.004)	(0.034)	(0.006)	(0.009)	(0.004)	(0.032)	(0.006)
Day -2	0.001	0.007	-0.035***	0.003	0.001	0.005	-0.108***	0.006***
	(0.003)	(0.007)	(0.004)	(0.006)	(0.005)	(0.008)	(0.001)	(0.000)
Day -1	-0.000	-0.002***	-0.073***	0.003	-0.000	-0.002***	-0.073***	0.003
	(0.005)	(0.001)	(0.006)	(0.006)	(0.005)	(0.001)	(0.006)	(0.006)
Day 1	0.104***	-0.005	0.019	0.084***	0.104***	-0.005	0.019	0.084***
	(0.031)	(0.008)	(0.025)	(0.015)	(0.031)	(0.008)	(0.025)	(0.015)
Day 2	0.033***	0.013	0.012	0.001	0.138***	0.008	0.031**	0.085***
	(0.007)	(0.014)	(0.013)	(0.002)	(0.025)	(0.006)	(0.012)	(0.014)
Day 3	-0.020***	0.018	-0.007	0.009	0.118***	0.026	0.024***	0.094***
	(0.005)	(0.017)	(0.016)	(0.022)	(0.021)	(0.023)	(0.004)	(0.008)
Day 4	0.016***	0.021	-0.041	0.004	0.134***	0.047	-0.017	0.098***
	(0.003)	(0.026)	(0.025)	(0.003)	(0.020)	(0.050)	(0.021)	(0.006)
Day 5	0.011	0.025	-0.063	0.019	0.145***	0.072	-0.079	0.117***
	(0.009)	(0.015)	(0.035)	(0.017)	(0.020)	(0.064)	(0.056)	(0.023)
R-Squared	.823	.509	.689	.814	.927	.539	.890	.950
Mean Dep	.015	.008	-.01	.012	.062	.017	-.04	.048
Observations	33	22	22	22	33	22	22	22

Note: This table presents the daily and cumulative abnormal returns of student loan company stocks relative to other U.S.-based finance stocks traded on the Nasdaq. Estimates are presented for the five days before and after presidential elections, with Day 0 representing election day and acting as the baseline date for cumulative returns. The daily and cumulative returns of the comparison index are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016. Standard errors are clustered at the day level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.5: Student Loan Companies: Presidential Elections

	(1)	(2)	(3)	(4)	(5)	(6)
	Daily Abnormal Return			Cumulative Abnormal Return		
Election	2014	2010	2006	2014	2010	2006
Day -5	0.001***	-0.011	0.017***	0.036***	-0.036	0.009
	(0.000)	(0.011)	(0.005)	(0.004)	(0.054)	(0.018)
Day -4	0.010***	-0.004	-0.001	0.035***	-0.025	-0.008
	(0.001)	(0.012)	(0.005)	(0.004)	(0.043)	(0.024)
Day -3	-0.000	-0.008	-0.001	0.025***	-0.020	-0.007
	(0.005)	(0.020)	(0.010)	(0.003)	(0.031)	(0.019)
Day -2	0.011***	-0.010**	0.005	0.025***	-0.013	-0.005
	(0.002)	(0.004)	(0.006)	(0.002)	(0.010)	(0.009)
Day -1	0.013***	-0.003	-0.010***	0.013***	-0.003	-0.010***
	(0.003)	(0.014)	(0.003)	(0.003)	(0.014)	(0.003)
Day 1	0.006*	0.005	-0.054***	0.006*	0.005	-0.054***
	(0.003)	(0.007)	(0.004)	(0.003)	(0.007)	(0.004)
Day 2	0.009	-0.000	-0.006**	0.016	0.004	-0.060***
	(0.007)	(0.001)	(0.002)	(0.010)	(0.008)	(0.006)
Day 3	-0.001	0.008	-0.000	0.014	0.012**	-0.060***
	(0.005)	(0.013)	(0.002)	(0.014)	(0.005)	(0.008)
Day 4	-0.003	-0.009**	0.007	0.011	0.004**	-0.053***
	(0.004)	(0.003)	(0.004)	(0.017)	(0.001)	(0.003)
Day 5	0.001	0.016	-0.013	0.012	0.020	-0.066***
	(0.002)	(0.014)	(0.016)	(0.019)	(0.013)	(0.019)
R-Squared	.561	.523	.881	.695	.328	.906
Mean Dep	.004	-.004	-.005	.018	-.005	-.029
Observations	33	22	22	33	22	22

Note: This table presents the daily and cumulative abnormal returns of student loan company stocks relative to other U.S.-based finance stocks traded on the Nasdaq. Estimates are presented for the five days before and after congressional elections, with Day 0 representing election day and acting as the baseline date for cumulative returns. The daily and cumulative returns of the comparison index are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. Congressional election dates were: November 7, 2006; November 2, 2010; November 4, 2014. Standard errors are clustered at the day level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.6: Student Loan Companies: Congressional Elections

	(1)	(2)	(3)	(4)	(5)
	Cumulative Abnormal Return				
	NY AG Investigation	CCRAA Introduction	2010 Budget	CFPB Lawsuit	Borrower Defense
Day -5	-0.018***	-0.007	0.149***	-0.033***	-0.081***
	(0.000)	(0.015)	(0.031)	(0.004)	(0.012)
Day -4	-0.018***	0.001	0.124***	-0.031***	-0.079***
	(0.005)	(0.006)	(0.039)	(0.006)	(0.013)
Day -3	-0.021***	-0.002	0.139***	-0.026***	-0.072***
	(0.005)	(0.007)	(0.034)	(0.009)	(0.014)
Day -2	-0.003**	-0.009	0.102***	-0.026**	-0.058***
	(0.001)	(0.010)	(0.031)	(0.010)	(0.009)
Day -1	0.009	-0.008	0.059	-0.013	-0.042***
	(0.010)	(0.005)	(0.061)	(0.008)	(0.013)
Day 1	-0.005	0.011**	-0.409***	-0.042**	-0.006
	(0.006)	(0.004)	(0.118)	(0.018)	(0.005)
Day 2	-0.016	0.014**	-0.484***	-0.017	-0.004*
	(0.012)	(0.006)	(0.004)	(0.016)	(0.002)
Day 3	-0.011	0.020**	-0.560***	-0.008	0.002
	(0.013)	(0.007)	(0.005)	(0.014)	(0.008)
Day 4	-0.006	0.008***	-0.481***	-0.015	-0.004
	(0.021)	(0.001)	(0.048)	(0.017)	(0.015)
Day 5	-0.025	0.006*	-0.442***	-0.021	-0.010
	(0.022)	(0.003)	(0.085)	(0.015)	(0.012)
R-Squared	.611	.659	.974	.669	.902
Mean Dep	-.01	.003	-.164	-.021	-.032
Observations	22	22	22	33	33

Note: This table presents the daily and cumulative abnormal returns of private student loan stocks relative to other U.S.-based finance stocks traded on the Nasdaq. Estimates are presented for the five days before and after each event and announcement of interest. The daily and cumulative returns of the comparison index are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. The following events and announcements are examined: 1) the 2007 announcement of a New York Attorney General Investigation of private student lenders on March 16, 2007; 2) the introduction of the College Cost Reduction and Access Act in congress on June 12, 2007; 3) the release of the President's Proposed 2010 Federal Budget on February 26, 2009; 4) the mandatory announcement by Navient that it had been notified by the Consumer Financial Protection Bureau of pending legal action on August 24, 2015; and 5) the DOE announcement of a proposed borrower defense rule on June 16, 2016. Standard errors are clustered at the day level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.7: Student Loan Companies: Major Events and Policy Announcements

Ticker	Company	Colleges and Universities
APOL	Apollo Education Group	Axia College College for Financial Planning University of Phoenix Western International University
ATGE	Adtalem Education Group	Becker Professional Education Carrington College Chamberlain University DeVry University Keller Graduate School of Management Ross University School of Medicine
APEI	American Public Education	American Public University American Military University Hondros College of Nursing
BPI	Bridgepoint Education Group	Ashford University University of the Rockies
CPLA	Capella Education Co.	Capella University Capella Learning Solutions DevMountain & Hackbright Academy Sophia Online
CECO	Career Education Co.	American InterContinental University Colorado Technical University
COCOQ	Corinthian College	Everest College and University Heald College WyoTech
EDMC	Education Management Co.	Argosy University The Art Institutes Brown Mackie College South University
ESI	ITT Educational Services	Daniel Webster College ITT Technical Institutes
LINC	Lincoln Ed Services Co.	Euphoria Institute of Beauty Arts & Sciences Lincoln College of New England Lincoln College of Technology Lincoln Culinary Institute Lincoln Technical Institute
LOPE	Grand Canyon Education	The Coangelo College of Business Grand Canyon University
NAUH	National American U Holdings	National American University
STRA	Strayer Education Inc.	Strayer University
UTI	Universal Technical Institute	Universal Technical Institute

Note: This table presents a full list of college and universities owned by publicly traded postsecondary education companies. The colleges and universities are order alphabetically. In some cases new colleges are introduced or acquired after the company is already public.

Table 3.8: For-Profit Colleges and Universities by Company

Election Year	Winning Party	Probability	Source
2016	Republican	22%	Betfair
		21%	PredictIt
2012	Democrat	76%	Betfair
		70%	Intrade
2008	Democrat	94%	Betfair
		92%	Intrade
2004	Republican	58%	Betfair
		54%	Tradesports
		56%	Iowa Electronic Market

Note: This table presents presidential election probabilities based on betting markets and prediction websites. The betting websites that were open and have active trading vary across elections, and include Betfair, PredicIt, Intrade, Tradesports, and IEM. FiveThirtyEight generated widely cited election prediction for the 2012 and 2016 elections. The probabilities for the winning candidate are based on data for the day before the election. The probabilities reveal the extent to which the election results were unexpected.

Table 3.9: Presidential Election Winning Parties and Probabilities

Election Year	Chamber	Change	Majority Party
2016	Senate	Democrats gain 2 seats	Republicans retain majority (52-48)
2016	House	Democrats gain 6 seats	Republicans retain majority (241-194)
2014	Senate	Republicans gain 9 seats	New Republican majority (54-46)
2014	House	Republicans gain 13 seats	Republicans retain majority (247-188)
2012	Senate	Democrats gain 2 seats	Democrats retain majority (55-45)
2012	House	Democrats gain 8 seats	Republicans retain majority (234-201)
2010	Senate	Republicans gain 6 seats	Democrats retain majority (53-47)
2010	House	Republicans gain 63 seats	New Republican majority (242-193)
2008	Senate	Democrats gain 8 seats	Democrats retain majority (59-41)
2008	House	Democrats gain 21 seats	Democrats retain majority (257-178)
2006	Senate	Democrats gain 5 seats	New Democratic majority (51-49)
2006	House	Democrats gain 31 seats	New Democratic majority (233-202)
2004	Senate	Republicans gain 4 seats	Republicans retain majority (55-45)
2004	House	Republicans gain 3 seats	Republicans retain majority (232-202)

Note: This table presents the results of Senate and House of Representatives elections for each midterm and presidential election year from 2004 to 2016. Column 3 indicates the net change in seats that occurs between the period immediately before and after the election. Column 4 indicates whether a party retained its majority or became the new majority party and the size of its majority. Note that prior election results plus gains during the election may not equal the new total due to changes during the intervening period, including retirements and special elections. Independents who do not align with the Democratic or Republican parties are included with their caucus party.

Table 3.10: Congressional Election Majority Parties and Seat Margins

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Nasdaq (U.S. Companies)				Education Stocks			
Election	2016	2012	2008	2004	2016	2012	2008	2004
Day -5	0.018	0.039	0.061**	-0.004	0.027	0.066***	0.181***	0.020
	(0.040)	(0.025)	(0.024)	(0.031)	(0.041)	(0.025)	(0.028)	(0.031)
Day -4	0.032	0.016	0.027	0.001	0.031	0.039**	0.098***	0.019
	(0.020)	(0.016)	(0.025)	(0.024)	(0.020)	(0.017)	(0.025)	(0.024)
Day -3	0.018	-0.000	-0.002	-0.024	0.023	0.015	0.054***	-0.020
	(0.019)	(0.015)	(0.021)	(0.016)	(0.019)	(0.015)	(0.020)	(0.016)
Day -2	-0.008	-0.019	-0.008	-0.014	-0.005	-0.013	0.024	-0.014
	(0.018)	(0.015)	(0.017)	(0.010)	(0.018)	(0.015)	(0.017)	(0.010)
Day -1	0.005	-0.018*	-0.012	-0.008*	0.010	-0.000	-0.012	-0.006
	(0.009)	(0.010)	(0.010)	(0.004)	(0.009)	(0.010)	(0.010)	(0.004)
Day 1	0.150***	-0.022***	0.001	-0.021***	0.155***	-0.014**	-0.027***	-0.013***
	(0.054)	(0.006)	(0.005)	(0.005)	(0.054)	(0.006)	(0.006)	(0.005)
Day 2	0.196***	-0.045***	0.043**	-0.020**	0.212***	-0.077***	-0.001	-0.005
	(0.063)	(0.009)	(0.018)	(0.009)	(0.063)	(0.009)	(0.016)	(0.008)
Day 3	0.186***	-0.075***	0.059**	-0.017	0.203***	-0.134***	0.027	0.003
	(0.066)	(0.020)	(0.023)	(0.011)	(0.065)	(0.020)	(0.021)	(0.010)
Day 4	0.174***	-0.078***	0.093***	0.023*	0.204***	-0.153***	0.047*	0.044***
	(0.058)	(0.021)	(0.026)	(0.011)	(0.057)	(0.021)	(0.024)	(0.011)
Day 5	0.186***	-0.088***	0.105***	0.010	0.223***	-0.152***	0.038	0.038**
	(0.065)	(0.025)	(0.026)	(0.016)	(0.063)	(0.025)	(0.023)	(0.015)
R-Squared	.429	.384	.413	.147	.491	.662	.557	.248
Mean Dep	.087	-.026	.033	-.007	.098	-.038	.039	.006
Observations	121	154	121	77	121	154	121	77

Note: This table presents the cumulative abnormal returns of for-profit college stocks relative to: a) all U.S.-based stocks traded on the Nasdaq, and b) all education stocks traded on the Nasdaq or New York Stock Exchange, including software, publishing, and training companies. Estimates are presented for the five days before and after presidential elections, with Day 0 representing election day and acting as the baseline date for cumulative returns. The cumulative returns of the comparison indices are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016. Standard errors are clustered at the stock and day levels. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.11: Alternative Index Comparisons: For-Profit College Cumulative Abnormal Returns

Company	Stock Ticker	2016 Election 3-Day Change	Debt-to-Earn Ratio	Pass Rate	Receive Military Aid
Adtalem Education Group	ATGE	19%	7.90	0.84	0.17
American Public Education	APEI	52%	3.42	1.00	0.69
Bridgepoint Education Group	BPI	25%	6.00	0.83	0.22
Capella Education Co.	CPLA	12%	6.36	0.99	0.30
Career Education Co.	CECO	29%	8.97	0.59	0.25
Education Management Co.	EDMC	83%	12.83	0.35	0.13
Grand Canyon Education	LOPE	13%	4.58	0.94	0.13
Lincoln Ed Services Co.	LINC	9%	7.17	0.82	0.06
National American U Holdings	NAUH	0%	9.11	0.60	0.15
Strayer Education Inc.	STRA	17%	6.27	0.95	0.28
Universal Technical Institute	UTI	39%	8.23	0.67	0.18

Note: This table presents several policy-relevant characteristics of for-profit colleges and the change in stock price they experienced after the 2016 election. The debt-to-earnings ratio is based on 2015 data reported by the Department of Education. The value for each company is weighted by enrollment in each program for each college or university brand. The same method is used to determine the fraction of students enrolled in programs that are deemed passing by DOE policy. The fraction of student receiving GI Bill or DOD aid is based on 2015 data reported by the National Center for Education Statistics Integrated Postsecondary Education Data System.

Table 3.12: Stock Price Changes, Debt-to-Earnings Ratios, and Military Aid

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Nasdaq (U.S. Companies)				Bank Stocks			
Election	2016	2012	2008	2004	2016	2012	2008	2004
Day -5	0.041**	0.005	-0.106***	0.022	0.023	0.015***	-0.041***	0.020
	(0.017)	(0.005)	(0.006)	(0.020)	(0.015)	(0.004)	(0.004)	(0.021)
Day -4	0.029**	0.002**	-0.131***	0.019	0.014	0.013***	-0.045***	0.020
	(0.011)	(0.001)	(0.015)	(0.030)	(0.010)	(0.000)	(0.011)	(0.031)
Day -3	0.014	-0.003	-0.146***	-0.002	0.003	0.010**	-0.090***	0.001
	(0.010)	(0.003)	(0.031)	(0.006)	(0.009)	(0.004)	(0.029)	(0.005)
Day -2	-0.003	-0.003	-0.113***	0.005***	0.006	0.002	-0.092***	0.008***
	(0.006)	(0.008)	(0.003)	(0.000)	(0.004)	(0.008)	(0.004)	(0.000)
Day -1	0.001	-0.009***	-0.077***	0.003	0.002	-0.003***	-0.068***	0.004
	(0.006)	(0.000)	(0.006)	(0.006)	(0.005)	(0.001)	(0.006)	(0.006)
Day 1	0.112***	-0.012	0.023	0.085***	0.103***	-0.002	0.010	0.083***
	(0.030)	(0.008)	(0.026)	(0.015)	(0.032)	(0.008)	(0.026)	(0.015)
Day 2	0.164***	0.003	0.061***	0.089***	0.137***	0.007	0.011	0.085***
	(0.023)	(0.005)	(0.013)	(0.012)	(0.026)	(0.006)	(0.015)	(0.013)
Day 3	0.155***	0.022	0.058***	0.098***	0.117***	0.025	0.003**	0.094***
	(0.018)	(0.022)	(0.004)	(0.010)	(0.022)	(0.023)	(0.001)	(0.009)
Day 4	0.178***	0.048	0.020	0.101***	0.135***	0.047	-0.050*	0.100***
	(0.017)	(0.048)	(0.022)	(0.007)	(0.021)	(0.050)	(0.025)	(0.006)
Day 5	0.182***	0.069	-0.017	0.118***	0.142***	0.073	-0.118*	0.118***
	(0.017)	(0.063)	(0.056)	(0.024)	(0.021)	(0.064)	(0.061)	(0.023)
R-Squared	.958	.526	.930	.953	.921	.541	.868	.951
Mean Dep	.079	.011	-.039	.049	.062	.017	-.044	.049
Observations	33	22	22	22	33	22	22	22

Note: This table presents the cumulative abnormal returns of student loan company stocks relative to: a) all U.S.-based stocks traded on the Nasdaq, and b) all banks traded on the New York Stock Exchange. Estimates are presented for the five days before and after presidential elections, with Day 0 representing election day and acting as the baseline date for cumulative returns. The cumulative returns of the comparison indices are adjusted by beta in order to account for differences in volatility. Stock prices are daily closing prices adjusted for stock splits and dividends. Presidential election dates were: November 2, 2004; November 4, 2008; November 6, 2012; and November 8, 2016. Standard errors are clustered at the day level. The symbols *, **, and *** represent statistical significance at 10, 5, and 1 percent respectively.

Table 3.13: Alternative Index Comparisons: Student Loan Company Cumulative Abnormal Returns