Catch Me if You Can: Effectiveness and Consequences of Online Copyright Enforcement*

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Abstract

We study the effectiveness and consequences of the takedown of `kino.to`, a major platform for unlicensed video streaming in the German market. Analyzing individual-level clickstream data in a difference-in-differences approach, we show that prior users of `kino.to` decrease their visits to unlicensed video streaming websites by 28%. This decline is much smaller than what could be expected given `kino.to`'s pre-intervention market share, mostly because consumers switch to alternative unlicensed websites. At the same time, we find limited substitution towards licensed video consumption. We show that the shutdown additionally had a number of unintended consequences. First, we provide evidence for a small increase in unlicensed video consumption for consumers that didn't use `kino.to` before. This effect is purely driven by individuals that visit news websites relatively frequently, implying that the press coverage of the shutdown made them aware of unlicensed video streaming websites. Second, we also find some evidence that those users also reduce their licensed video consumption. Third, we document that the unlicensed video streaming market is much more fragmented after the takedown, and therefore more resistant to future interventions. We discuss implications for the design of private and public anti-piracy policies.

Keywords: Anti-Piracy Policy, Copyright, Movie Industry, Clickstream, Natural Experiment

JEL classification: K42, L82, O34, O38

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1 Introduction

The media industry has been drastically affected by digitization, with information and communication technologies changing the way music, movies, and books are consumed and produced. On the one hand, consumers have seen a radical increase in their ability to consume cultural products following digital formatting. On the other hand, digitization has also facilitated access to copyright infringing content thanks to the advent of file-sharing networks and, more recently, unlicensed online streaming. Because of the important investments needed to bring creative products to the market, this expansion in unpaid consumption has led to serious concerns about its negative effects on producers' revenue and ultimately on the supply of such products. For this reason, both industry representatives and academics have for many years sought to identify the effects of illegal file-sharing on sales. In the case of the movie industry, most empirical studies find that illegal consumption does indeed displace sales.[1] Given the drastic improvements in both unlicensed video consumption platforms and Internet connection speeds, these findings have understandably raised concerns about continued investment in movie production and overall welfare.

Governments and industry representatives have contemplated different sets of actions to increase copyright enforcement on the Internet. One of the most prominent types of intervention involves governments' seizures of specific platforms hosting or providing access to pirated content. These interventions usually involve large amounts of public resources – both in direct intervention costs (e.g. police force) and in court cases[2] – and governments and public entities have realized the importance of taking into account empirical evidence when considering their implementation (Hargreaves, 2011; Intellectual Property Office, 2014).

Several studies have shown that, under certain circumstances, sales of licensed video content increase in response to supply-side anti-piracy interventions (Peukert et al., 2013; Danaher and Smith, 2014; Danaher et al., 2015b), and that removing (adding) licensed content increases (decreases) piracy of

[1] See, for instance, Bai and Waldfogel (2012); Bounie et al. (2006); Danaher and Waldfogel (2012); Rob and Waldfogel (2007); Zentner (2010).

[2] For instance, the UK Intellectual Property Office created an Intellectual Property Crime Unit as part of the City of London Police in September 2013, which is "dedicated to tackling online piracy and other forms of intellectual property crime." See http://tinyurl.com/govuk-piracyunit. It initially provided £2.5 million in funding over two years to the City of London Police, and has now expanded its budget by £3 million until 2017. See http://tinyurl.com/govuk-piracyunit2.

that content (Danaher et al., 2010, 2015a). Existing studies mostly rely on aggregated consumer or market-level data. While they are informative and allow for the identification of the intervention's effect on sales, they are nevertheless constrained to treat consumer behavior as a "black box." These limitations result in an incomplete picture of the effectiveness and the consequences of these interventions. From a firm perspective, opening the "black box" of consumer behavior is necessary to design an effective (and efficient) private copyright enforcement strategy, as well as to understand the nature of competition between licensed and unlicensed services. In this paper, we contribute to this debate by providing evidence on the effects and potential pitfalls of this type of anti-piracy policy. We also discuss a number of important insights for firms and highlight general implications that go beyond our specific empirical setting. The key novelty of our paper is to highlight that not only direct, but also indirect effects (which we will simply refer to as "externalities") need to be taken into account when evaluating the effectiveness and consequences of anti-piracy interventions.

From a legal perspective, a primary goal of law enforcement is certainly a reduction of illegal behavior. In theory, removing a website will reduce the size of the illegal market proportionally to the website's market share. Recent evidence nevertheless suggests that consumers simply switch from one unlicensed website to another (Poort et al., 2014; Danaher et al., 2015b). In the extreme case where consumers perceive different platforms as perfect substitutes, shutting down one platform should not affect market size at all. However, externalities from the intervention may also lead consumers or platforms to exit the market. For instance, the media coverage surrounding the website's seizure may reinforce the intended effect of the intervention by raising awareness about the unlawfulness of such platforms. This may deter consumers from using alternative unlicensed websites or even cause platforms to exit the market out of fear of similar legal actions. These externalities may therefore lead the market to shrink. On the other hand, the same media coverage may inform the public about the existence of unlicensed content online. For consumers already in the market, this can inform them about the availability of alternative platforms, therefore facilitating substitution toward alternatives. Such coverage may also lead previously unaware consumers to start consuming unlicensed content. These reactions may therefore lead to a market expansion. It follows that while copyright enforcement interventions are likely to generate externalities affecting the size of the market, the direction of these effects remains unclear.

From a welfare perspective, evaluating an anti-piracy intervention solely based on its effect on overall piracy levels is not sufficient. Any policy that is successful in reducing overall piracy levels will destroy surplus for individuals who consume copyright infringing content. If these consumers are not willing to pay for the licensed version of these products, their surplus will not translate into surplus to producers. Removing access to pirated content will therefore simply convert consumer surplus into deadweight loss. Removal of pirated content can be beneficial to producers, however, if some copyright infringing consumers are willing to migrate to licensed versions of the content. A necessary condition for online copyright enforcement to increase total welfare is therefore to manage converting unlicensed consumption into licensed consumption. The externalities described above may further reinforce this effect if consumers learn about the existence of licensed alternatives through the media coverage of the intervention.[3]

Economic theory alone does not provide unambiguous predictions on the effects of anti-piracy interventions. Whether overall piracy and welfare levels increase, decrease, or stay constant as a result of the intervention therefore remains a question that must answered empirically. We do so by focusing on the unexpected shutdown of `kino.to`, an unlicensed video streaming website which was very successful in the German-speaking market. To study the effects of this supply-side intervention, we rely on detailed clickstream data that allows us to observe the complete web browsing history of 4 country-specific sets of 5,000 individuals in Germany, France, Italy, and the United Kingdom. Our data allows us to observe individuals' behavior on a very large set of websites, including visits to licensed and unlicensed video consumption websites, throughout 2011. Our paper is the first to provide individual-level evidence on the effects of a copyright enforcement intervention on consumer behavior and on the structure of the piracy market.

We rely on a difference-in-differences approach to identify the effects of the `kino.to` shutdown. Using alternative control groups to establish causality, we find that the intervention was successful in substantially reducing overall levels of piracy. Individuals who were using `kino.to` before its seizure decreased their piracy consumption by about 28%. This is less than the decline proportional to `kino.to`'s market share that one might have expected, mainly because consumers

[3]Note, however, that these effects are only necessary conditions for welfare improvement. In particular, any anti-piracy intervention will not be welfare enhancing if the increase in either consumer or producer surplus falls short of the intervention's implementation costs.

substitute towards existing and newly entering alternative unlicensed platforms. We also find evidence of negative externalities generated by the intervention. In particular, we find that individuals who never used `kino.to` prior to its shutdown increased their visits to piracy websites by 1.7%. This increase is exclusively driven by individuals who use news websites to a larger extent, providing evidence that the media coverage surrounding the intervention has positively affected piracy consumption.

Second, we find limited substitution into consumption of licensed video content, proxied by visits to specific types of websites. Our results show that users of `kino.to` do not increase their visits to movie theaters' websites or to DVD/Blu-ray-related `Amazon` webpages. However, we find that they increase visits to licensed online video services (such as Maxdome, Lovefilm, and iTunes) by 2.7%. In contrast, we show that individuals who never used `kino.to` prior to its shutdown decrease their visits to movie theaters' websites and licensed online video services by about 1%, while clicks to DVD-related `Amazon` webpages do not change. This again reflects the potential negative externalities generated by media coverage surrounding the intervention.

Third, we assess the effect of the shutdown on the overall structure of the market for unlicensed video streaming. While the market was largely dominated by `kino.to` before its seizure, the intervention triggered an increase in competition between alternative platforms, ultimately resulting in a much more fragmented market. After the shutdown, the market was evenly split between `movie2k.to` (the second largest player at the time of the shutown), `kinoX.to` (a new entrant), and a remainder of 17 websites which cumulatively accounted for one third of the market.

Overall, our results raise concerns about the effectiveness of the shutdown of `kino.to`. The existence of alternative sources of unlicensed consumption, coupled with the rapid emergence of new platforms, limited the positive effects of the intervention on overall piracy levels and on movie consumption through licensed alternatives. Additionally, we find evidence of negative externalities from the intervention, leading to an increase in usage of unlicensed websites and a decrease in usage of licensed websites from consumers who would otherwise not have changed their consumption. Our results on the unintended effects of the `kino.to` shutdown on the structure of the market for unlicensed video streaming could also have an important negative impact on the effectiveness of

future interventions. In particular, a more fragmented market could make future law enforcement interventions either more costly – there would not be a single dominant platform to shutdown anymore – or less effective if only a single website is targeted by the intervention. We conclude the paper by discussing implications for private and public anti-piracy policy.

The remainder of the paper is organized as follows. Section 2 presents some of the mechanics of unlicensed video streaming platforms, discusses the literature relevant to our study, and provides some background on the `kino.to` shutdown. Section 3 presents the data for the study as well as descriptive evidence on the market for unlicensed video streaming. Section 4 presents our estimation of the direct effects and externalities from the shutdown on overall piracy levels and substitution toward licensed consumption alternatives. We also discuss and present several robustness checks. Section 5 analyzes analyzes the effect of the intervention on the overall structure of the market for unlicensed video streaming. We discuss firm and policy implications in Section 6 and conclude in Section 7.

2 Institutional Background

2.1 The Economics of Crime and Deterrence

Early theoretical literature on the economics of crime (e.g. Becker, 1968) highlights that crime deterrence is a function of both the certainty and the severity of punishment. Recent evidence indeed shows that exogenous shocks that increase police presence (Levitt, 1997; DiTella and Schargrodsky, 2004; Draca et al., 2011) or the expected time of a prison sentence (Drago et al., 2009) lead to less crime. However, the review of a large body of theoretical suggests that the effectiveness of law enforcement may be undermined by displacement effects, adaptive behavior, and effects on the industry's supply behavior of organized crime (Cameron, 1988). That is, the effect of increased effort to deter crime may be short-lived, with crime returning to its equilibrium level in the long run, because criminals adjust to changes in law enforcement efforts and shift their activity to a different time or place (Buck et al., 1985; Galenianos et al., 2012). The empirical evidence is consistent with such ideas. Dobkin and Nicosia (2009) show that while a large anti-drug enforcement effort in California was successful in increasing the price of methamphetamine, reducing drug-

related hospital and treatment admissions, and substantially reducing methamphetamine use among arrestees, all variables went back to pre-intervention levels in between four and eighteen months. Related to our empirical setting, Adermon and Liang (2014) show that, relative to Norway and Finland, Internet traffic decreased substantially after a demand-side copyright enforcement reform in Sweden, but went back to pre-intervention levels after six months. The authors further document that a substantial increase in physical music sales vanishes after six months, while it remains stable regarding digital music sales. Studies that look at the effect of website shutdowns or website blockings come to similar conclusions; consumers quickly switch to alternative consumption modes (other websites or VPN services that are helpful to circumvent the blocking), leading to limited reductions in overall piracy consumption (Poort et al., 2014; Danaher et al., 2015b).[4] Such results are in line with the literature on search and switching costs on the Internet. For example, Goldfarb (2006b) shows that consumers easily switch to a competing website when their preferred website is temporarily unavailable because of denial of service attacks. However, once they switched, consumers tend to stay even when their previously most preferred website becomes available again. In other studies such switching costs are shown to be stronger for websites offering features that increase loyalty (e.g. search engines that additionally offer free email; Goldfarb, 2006a; Chen and Hitt, 2002) and weaker for users that simultaneously use competing websites (Chen and Hitt, 2002).

A number of studies report evidence of both positive and negative externalities from crime deterrence efforts. For example, Ayres and Levitt (1998) show that the availability of a radio-transmitter technology for retrieving stolen vehicles, while hidden from potential thefts, is related to a sharp decrease in auto theft. The idea is that this feature of the technology makes auto theft riskier and less profitable overall. The authors show that such spillovers are less strong for older cars that

[4]Both papers look at the blocking of *The Pirate Bay* in the Netherlands and the United Kingdom, respectively. Poort et al. (2014) analyze consumer survey and peer-to-peer network usage data and show an increase in self-reported piracy levels over a six-month period after the intervention, and very limited changes in the observed activity on the BitTorrent network. Because of data limitations and an identification strategy that only uses temporal variation, it remains unclear whether and how much this is driven by a simple trend, or by users reducing their piracy levels, switching to similar websites, converting to licensed services, the entry of new platforms, or by new users starting to pirate. The difference-in-differences analysis of aggregate clickstream data in Danaher et al. (2015b) suggests that visits to *The Pirate Bay* decrease substantially, but consumers increase visits to similar websites and virtual private network services (which are helpful to circumvent the blocking) at the same time. A potential problem is that statistical inference in this paper is based on highly aggregated data and a very small number of observations. It remains to note that a court ruling mandating Internet Service Providers to block access to specific websites – the type of intervention Poort et al. (2014) and Danaher et al. (2015b) look at – most likely involves less public resources than the shutdown a website, including seizure of hardware and potential incarceration of instigators. This is reflected in the grounds on which to evaluate the effectiveness of the intervention from a welfare perspective.

are less likely to be equipped with the technology. In the context of illicit drugs, some plausibly causal evidence shows that increased efforts of law enforcement efforts leads to geographical shifts in the production and trafficking of drugs, which is mirrored in substantial increases in drug-related violence (Angrist and Kugler, 2008; Dell, 2015). The conclusion is that violence is a result of rivals' attempts to take over territories after enforcement efforts have weakened incumbent traffickers. This line of work seems to suggests that crime deterrence can trigger unintended effects, but is limited to the study of organized crime.

Research in criminology, psychology, and communication shows that information contained in mass media can have immediate and sometimes unintended effects on individuals' behavior. A large body of literature shows that media coverage of suicides is related to subsequent increases in suicide rates (for a survey see Gould, 2001). There is also some evidence for a link between media and violent behavior against others. For example, Esser and Brosius (1996) show that the number of right-wing violent offenses increases with the intensity of TV news coverage of previous right-wing violent offenses. Finally, exposure to campaigns that aim at establishing social norms regarding health issues - such as smoking, drinking, unsafe sex, and cancer prevention - has been shown to be negatively correlated to people's attitudes and intentions of use (Cho and Salmon, 2007).

In summary, a large body of work across disciplines leads us to conclude that the deterrence effect of an online copyright enforcement effort is likely to be challenged by adaptive behavior on both the demand and the supply side. In addition, externalities may either enhance or reduce the deterrence effect of such interventions.

2.2 The Evolution and Diffusion of Movie Piracy

Consumption patterns of media products have drastically changed since the beginning of the 21st century. Ever since the advent of Napster in 1999 and the creation of subsequent file-sharing networks, individuals are able to freely share and access vast amounts of digital media files. While this started as a major concern for the music industry, it only appeared as a real threat to the movie industry a few years later. Because videos naturally come in much larger digital files than music, downloads only became feasible with the increasing availability of broadband Internet connections. Furthermore, although very efficient in allowing sharing of relatively small size files, the initial peer-

to-peer (P2P) networks (such as Napster and Kazaa) were ill-suited for the sharing of larger files and therefore only allowed for the sharing of relatively low quality videos. In 2003, however, the BitTorrent protocol made sharing of large files much easier, popularizing and drastically increasing high quality video file-sharing and raising important concerns for the movie industry (Thompson, 2005; Danaher and Waldfogel, 2012).

Offering several technical advantages over BitTorrent, the development of cyberlockers and streaming sites services has, in the past few years, facilitated the upsurge of a professional market for unlicensed media content. We can think of cyberlockers and linking sites as the core of this relatively new piracy ecosystem. In their simplest form, cyberlockers are online services that allow Internet users to upload and store large files. While this type of service can be used to back up any type of personal data, it can also be used to share copyright protected files such as movies and episodes of TV series (Antoniades et al., 2009; Liu et al., 2013). Someone willing to share a video would start by uploading it to the cyberlocker. Once the video is uploaded, the uploader receives a download URL which provides access to the file. Uploaders could therefore share their content with other individuals, e.g. by simply emailing this link to friends. Alternatively, they could reach a much larger number of users by posting the link on a website where anyone could get direct access to their uploaded content.[5] These linking sites would typically do more than simply providing access to these links, as they would also categorize content, make it searchable, and provide meta-information (such as credits and ratings).

The whole piracy ecosystem essentially runs on advertisement revenues. The more visits a cyberlocker gets, the more advertisement revenue it will obtain. In order to generate traffic to its website, a cyberlocker would sometimes pay the uploaders a share of the advertising revenue generated by their uploaded content. This naturally generates strong incentives for users to upload as much content as possible and to drive traffic to that content. For uploaders, posting links on popular streaming websites therefore increases their income. Finally, linking sites also show third-party advertisements to final consumers, generating revenue for their owner. Therefore, any individual who visits the linking website and clicks on the link freely enjoys the movie, generating revenue for

[5]The name streaming site relates to the fact that the links provided on the websites allow for the immediate consumption of the movie, without having to download the complete file. We will use the terms linking and streaming interchangeably in the remainder of the text.

the cyberlocker, the initial uploader, and the linking site. Overall, this whole process has enabled popular cyberlockers to store huge amounts of media products such as movies, episodes of TV series, e-books, and recorded music. Linking websites play a crucial role in the unlawful sharing of copyright protected movies by acting as platforms for uploaders and final consumers.

While usage of unlicensed services and websites is spread out widely, the literature hints at differences in consumption across demographic groups. Specifically, age, income, and education seem to be significant predictors of piracy behavior. Evidence from music shows that unlicensed consumption is negatively related with income levels, education levels, and age (Aguiar and Martens, 2016). Evidence from individual surveys suggests that users with a lower budget for licensed content and younger users consume more unlicensed (Al-Rafee and Cronan, 2006; Mandel and Süssmuth, 2012). This is in line with research showing that - in the context of online newspapers - young consumers reduce their usage after the introduction of a paywall (Chiou and Tucker, 2013). Consumers with a higher perceived probability to get caught report a lower frequency of digital piracy (Mandel and Süssmuth, 2012). This result is also reflected in a representative survey conducted in Germany in 2011, where it is shown that individuals younger than 30 believe using unlicensed video streaming websites is legitimate (GfK et al., 2012, p. 31). Finally, there is evidence that education reduces criminal behavior in general (Lochner and Moretti, 2004).

2.3 The German Market and `kino.to`

The German market for unlicensed movie and TV content had a substantial size in 2010, with at least one million people using cyberlockers and linking sites to stream or download motion pictures and TV episodes (GfK et al., 2011, p. 17).[6] This accounts for more than 1% of Germany's entire population. Related evidence also suggests that Germans had downloaded 54 million movies and 23 million TV episodes from unlicensed sources in 2010 (GfK et al., 2011).

[6] A total of 4.3 million consumers accessed movies and 5.8 million accessed TV episodes online in 2010. Most commonly (47%), survey participants indicated that legal streaming sites (such as MyVideo) and TV station websites (many German TV stations have large online archives) were the primary source to consume TV episodes. However, only 22% considered those services as the primary source of movie consumption. The majority of consumers (38%) reported filehosters and streaming sites (such as `kino.to`) as their main source of movie consumption, while 18% indicated that they mainly used filehosters and streaming sites for consuming TV episodes. For movies, 17% of the consumers mainly used paid download services, while only 9% mainly used such services for TV episodes.

While an important number of linking sites were available in the German market, `kino.to` was - as will be detailed below - the dominant platform providing access to unlicensed video streaming in 2011. Following a complaint filed by movie industry representatives, a joint raid involving police, computer specialists, and tax officers led to the seizure of `kino.to` on June 8, 2011, effectively removing access to copyright infringing content. In the couple of months following the intervention, visitors of `www.kino.to` were shown a police notice stating that the domain had been seized, owners had been arrested, and users that had created or distributed unlawful copies of copyrighted material would be facing prosecution. As a result of various court decisions between December 2011 and June 2012, 6 members of the `kino.to`'s management team were sentenced to prison for up to four and a half years (Spiegel Online, 2012).

It is typically hard to obtain detailed information on the contents of piracy sites, or even observe revenue figures. In the case of `kino.to`, a publicly available verdict from a German district court nevertheless sheds some light on these points (Amtsgericht Leipzig, 2011). The document, used against a member of `kino.to`'s management team, reveals that `kino.to` users had clicked 1.74 billion times on links to movies and TV episodes between September 1, 2010 and June 8, 2011 alone, an average of some 7 million clicks per day. The district court considered that the website had made available at least 1.3 million links to some 21,000 motion pictures, 7,000 documentaries, and 106,000 TV episodes. `Kino.to` provided an average of about ten alternative links for each movie, about two alternative links for each documentary and some eight alternative links for each TV episode. This content was not directly hosted by `kino.to`, but was mostly available from external cyberlockers. Interestingly enough, `kino.to` was vertically integrated into some of these cyberlockers (`freeload.to` and `ebays.to`). The district court considered that at least 12,970 links (less than 1% of the total number of links) were hosted on vertically integrated filehosters. As is typical for linking sites, the owners of `kino.to` assumed an active role in obtaining links to video files, setting incentives for uploaders, and enforcing minimum quality standards. Monthly advertising revenues were estimated at €150,000, which amounts to almost €6 million over the period from March 2008 to June 2011. During the same period, revenues from integrated cyberlockers were some additional €634,000.

2.4 Media Coverage Surrounding the Shutdown of `kino.to`

Given the massive popularity of `kino.to`, its shutdown unsurprisingly generated tremendous media attention. Google News lists 1374 news articles for the keyword "kino.to" between June 8th, 2011 and December 31st, 2011, published in all kinds of outlets, including major ones such as *Bild* (Germany's largest tabloid) or *Süddeutsche Zeitung* (largest national subscription daily newspaper). The media coverage can be broadly characterized into "Background stories" (about 29% of the articles), "Legal information for consumers" (about 39%), and "Alternative websites" (about 32%). Typical examples of background stories include "Polizei schaltet kino.to ab (Police takes down kino.to)" in *Zeit Online* and "Millionenkonten bei kino.to entdeckt (Millions found in kino.to bank accounts)" in *Süddeutsche Zeitung*, which typically summarize key facts about `kino.to` and the procedure and surrounding events of the takedown.[7] Articles like "Millionen Nutzer haben Angst (Millions of users fear legal action)" and "Kino.to: GVU will Nutzer verfolgen und bestrafen (GVU wants to prosecute and punish users)" include stories that we include in the "Legal information for consumers" category.[8] The last category of media coverage - referring to licensed and unlicensed alternative websites - includes stories such as "Kino.to-Nachfolger bereits online: Video2k.tv (Kino.to successor already online)" in *Gulli*, and "Illegales Filmportal ist zurück – Kino.to-Piraten verhöhnen Ermittler (Illegal movieportal is back – Kino.to-pirates mock investigators)" in *Bild*.[9]

The different types of stories published in news outlets following the shutdown of `kino.to` illustrate our idea that media coverage may generate externalities going in several directions. First, coverage may deter consumers from using alternative websites out of fear of legal action. Second, media coverage may inform users of the seized platform about the existence of alternative websites and therefore lower search and entry costs. Similarly, it may also inform previously unaware individuals about the existence of such websites, causing them to start consuming unlicensed content online.

[7] See http://www.zeit.de/digital/internet/2011-06/kinotto-razzia-streaming and http://www.sueddeutsche.de/digital/illegales-filmportal-kinoto-staatsanwaltschaft-entdeckt-millionen-konten-1.1110172.

[8] See http://www.n-tv.de/technik/Polizei-schliesst-Kino-to-article3538481.html and http://www.chip.de/news/Kino.to-GVU-will-Nutzer-verfolgen-und-bestrafen_49724949.html.

[9] See http://www.gulli.com/news/16397-kinoto-nachfolger-bereits-online-video2ktv-2011-06-20 http://www.bild.de/regional/leipzig/kino-to/illegales-filmportal-wieder-online-kinoto-piraten-verhoehnen-ermittler-1881 bild.html.

Third, by providing information on the expected income from operating unlicensed websites, media coverage may trigger supply-side entry from potential copycat website operators.

3 Data and Descriptive Evidence

We have access to clickstream data from Nielsen's Internet audience measurement service NetView. This service monitors the online activity of a large number of Internet users by recording all of their URL visits via an application that is installed on the consumer's device (desktop PC or Mac) and operates in the background. Consumers are incentivized to take part and stay in the panel by a rewards program, in which they can exchange credit points for retail and travel vouchers. Consumers earn a fixed amount of credit points every month, and take part in a lottery every quarter.[10] Upon signing up, Nielsen requires participants to fill out a survey about basic demographics, such as household size, net household income, age, gender, education, and employment status.[11]

Our main sample consists of the browsing history of 5,000 Internet users in Germany throughout 2011. We similarly have access to the browsing history of 3 sets of 5,000 individuals located each in Italy, France, and the United Kingdom, throughout the same period. We observe the URL of every website visited together with a timestamp, the referral URL, and the amount of time spent on that URL.[12] To check whether this sample is representative of the population of Internet users, we compare key demographic variables to a representative sample of Internet users in Germany which we construct using data from a household survey that has been widely used in the literature (SOEP, Wagner et al., 2007). This exercise shows that differences in household income, education, and age are significantly different from zero, but small in size. We note, however, that representativeness is not crucial for the purpose of our study, because we are interested in across- and within-group comparisons in the same sample.

[10] See https://digitalvoice.nielsen.com/us/en/home.html.

[11] In an analysis not detailed here, we investigate whether the effects found below differ across demographic groups. Results don't provide much evidence that this is the case regarding total piracy levels. If anything, we find some indication that age and income can partly explain the negative effects of non-users of Kino with high news readership on licensed consumption.

[12] Nielsen measures time spent on a given URL while it is in focus (tab and browser window), see http://en-us.nielsen.com/sitelets/cls/digital/Online-NetView-FAQ.pdf.

The URL information lets us distinguish different kinds of online activities. Most importantly, it allows us to identify visits to webpages linking to copyright infringing content – such as unlicensed video streaming – as well as domains related to licensed video consumption. The great level of detail in this data even allows us to go beyond the website level. For example, we distinguish different product categories users are browsing on Amazon, or identify whether users are watching movies or TV shows on `kino.to`. We aggregate the data from the clickstream level to a domain-week-level, so that the unit of observation for most of our analyses consists in the sum of clicks per individual and domain in a given week. With 52 weeks, this leaves us with 260,000 observations. For one extension of our analysis, we also include the browsing history of 5,000 users each from France, Italy, and the United Kingdom, yielding a total of 1,040,000 observations.

3.1 Defining the Market for Unlicensed Video Streaming

Measuring the consumption of unlicensed video content requires the identification of domains providing access to such content. We manually identified such websites by going through the top-1000 domains classified by Nielsen as entertainment-related websites. We triangulated this approach by going through available lists of piracy websites in 2011.[13] This led us to a total of 20 websites offering unlicensed video streaming content, which defines our unlicensed video streaming market in Germany. The most popular site in this set of domains is `kino.to`, which was visited around 6,000 times per week between January and June 2011 in our sample. This is more than 8 times the traffic received by the second most visited website in our data, `movie2K.to`, which had an average of 730 weekly visits over the same period of time. The 20th and last website included in the definition of our movie streaming piracy market, `streams.to`, received an average of less than 1 weekly click between January and June 2011. With a weekly average of 79% market share, `kino.to` was clearly the dominant unlicensed movie streaming platform in the German market at the time of its shutdown. We perform a similar exercise to define the corresponding movie piracy markets in Italy, France, and the UK using our data on users in those countries.

Figure 1 depicts the evolution of the average log weekly number of clicks on the 20 unlicensed video streaming websites defining our market, together with the average log weekly number of clicks to

[13] See for example http://tinyurl.com/lvaunh6 and http://repat.de/2011/06/alternativen-zu-kino-to.

kino.to. Two main points should be taken away from the figure. First, the shutdown of kino.to had a significant negative effect on overall piracy levels, although this decline is clearly not as strong as the decline in kino.to usage. Second, one can observe that visits to piracy websites quickly increased again following the 5th week after the shutdown, almost returning to pre-intervention levels towards the end of the year.

3.2 Defining Types of Users

Because different users may be affected differently by the shutdown of kino.to, it is useful to define groups of users according to specific characteristics. In our German sample, we observe 843 (16.9%) users in the German sample that have visited the kino.to website at least once between January 1st and June 8th 2011. We refer to these individuals as the set of "Kino users," and to the set of individuals who never visited kino.to before its shutdown as "Non-users of Kino." We observe effectively zero visits to kino.to from users located in other countries. Table A.1 in Appendix A show that, before the shutdown of kino.to, Kino user visited kino.to and alternative unlicensed streaming websites about 7.2 and 1.4 times per week on average, respectively. The large standard deviations (16.5 and 6.0, respectively) indicate the presence of a substantial amount of variation in the intensity of usage. Users that didn't visit kino.to between January 1st and June 8th 2011 clicked on alternative unlicensed streaming sites about 0.1 times per week (standard deviation 1.5) before the shutdown of kino.to. Figure 2 depicts the average weekly clicks (in logs) to unlicensed video streaming sites by types of users over time. Two main points become evident. Kino users reduce their usage by about 25%, whereas Non-Users of kino.to increase their clicks to unlicensed video streaming websites more than twofold compared to their pre-intervention levels.

4 Effects of the Shutdown on Consumer Behavior

4.1 Effects of the Shutdown on Unlicensed Video Consumption

We now present different approaches that will allow us for the identification of the direct effects and the externalities from the shutdown of kino.to on unlicensed video consumption. We start by using a simple difference-in-difference approach by comparing Kino users to Non-users of Kino

in our German sample. We then rely on our international data to establish causality in a clearer way, arguing that individuals located outside of Germany constitute an appropriate control group. We finally turn to the identification of mechanisms driving our results. Our most conservative model specification will provide a set of baseline results and the basis for all following analyses. Throughout, we are careful in making a distinction between the externalities and the direct effect of the intervention.

4.1.1 Comparing Kino users to Non-users of Kino

In a first attempt to identify the effect of the `kino.to` shutdown, we follow a simple difference-in-difference approach and compare changes in overall unlicensed streaming consumption for Kino users and for non-users of Kino. The idea is therefore to use the set of non-users of kino as a control group. The underlying assumption in this identification strategy is that the piracy usage of Kino users would have followed a similar trend as the piracy usage of non-users of Kino in the absence of the intervention. Our model specification is therefore as follows:

$$\begin{aligned}\ln(Clicks_{it}+1) = \alpha + \beta_1 t + \beta_2 \left(t * KinoUser_i\right) + \gamma_0 After_t \\ + \gamma_1 \left(After_t * KinoUser_i\right) + \mu_i + \varepsilon_{it},\end{aligned} \tag{1}$$

where $Clicks_{it}$ is the sum of clicks to all 20 websites defining our video streaming piracy market for individual i in week t, t is a linear time trend, $KinoUser_i$ indicates whether individual i is a Kino user, $After_t$ is a dummy variable equal to 1 during the weeks after the shutdown, μ_i is an individual fixed effect that captures any individual-specific unobserved time-invariant factors, and ε_{it} is an individual-time specific error term. We estimate equation (1) using OLS and cluster standard errors at the individual level. Because our individual-level clickstream data tends to be dispersed and we are interested in relative changes, we use the logarithm of the number of clicks as a dependent variable.[14]

Column (1) in Table 1 presents the results of estimating (1). We cannot reject the hypothesis that non-users of Kino were not affected by the intervention. Our estimate suggests that non-users of

[14] Often we do not observe a user visiting a piracy website in a given week. To avoid losing those zero observations, we follow the prior literature and take the log over $Clicks_{it} + 1$.

Kino increased their usage of piracy websites after the shutdown of `kino.to`. While this would introduce a positive bias in our estimate of γ_1, it also provides some indication on the potential externalities resulting from the intervention. As suggested above, it is indeed likely for the media coverage surrounding the shutdown of `kino.to` to have affected individuals who were not users of the platform. Consumers of alternative unlicensed platforms may decide to reduce their piracy levels out of fear of legal action. Alternatively, they may rely on the media coverage to learn about new unlicensed consumption platforms. Individuals who were not using unlicensed platforms may also learn about their existence and start consuming such content.

We now turn to an alternative approach to identify the causal effect of the shutdown of `kino.to` on both the users of the platform (the direct effect of the intervention) and on non-users of Kino (the externalities generated by the intervention).

4.1.2 Identification Using Individuals Located Outside of Germany

Individuals located in Italy, France, and the UK are unlikely to have been affected by the shutdown of `kino.to`, either directly or indirectly. First, we observe essentially zero clicks to `kino.to` from users located in these countries. They could therefore not have been directly affected by the intervention. Second, because the media coverage of the shutdown was limited to Germany - perhaps German-speaking countries - these users are also unlikely to have been affected by this coverage. Individuals from these 3 countries therefore constitute an appropriate control group to test the effects of the shutdown on both Kino users (direct effect of the shutdown) and non-users of Kino (externalities from the shutdown). The underlying assumption in this setting is that the control group and both Kino users and non-users of Kino would have followed similar trends in piracy usage had the shutdown not happened. We can partially test this assumption by looking at these trends before the intervention. In particular, we can estimate the following specification to test whether pre-trends in the visits to piracy websites are statistically different for our treated and control groups.

$$\ln(Clicks_{it} + 1) = \alpha + \beta_1^t w_t + \beta_2^t (w_t * NonKino_i) + \beta_3^t (w_t * KinoUser_i) + \mu_i + \varepsilon_{it}, \qquad (2)$$

where w_t is a vector of week dummies (omitting the week prior to the shutdown). The β_2^t coefficients therefore reflect differences in piracy usage by week between non-users of Kino compared to all users in France, Italy and the UK (the control group). The β_3^t coefficients similarly reflect differences in usage between Kino users and international users. Figure A.1 plots the resulting β_2^t and β_3^t coefficients along with their 95% confidence bands. Overall, these appear to be statistically indistinguishable from zero prior to the intervention. This indicates that both Kino users and non-users of Kino follow very similar trends compared to users outside of Germany in the period preceding the shutdown, giving further support to our identification strategy.

Column (2) of Table 1 reports the estimation results from our difference-in-differences specification. We find that the estimate of the coefficient on the variable $After_t$ is not distinguishable from zero, indicating that piracy consumption for users outside of Germany was indeed not affected by the shutdown of `kino.to`. The estimate of the effect of the intervention on Kino users is significant and equal to -0.317, indicating that the intervention was successful in reducing piracy consumption levels by 27.2%.[15] Looking at the effect of the shutdown on non-users of Kino provides us with evidence on the externalities generated by the intervention. The corresponding coefficient for non-users of Kino is equal to 0.008 and significant at the 10% level. This indicates that shutting down Kino.to not only affected Kino users directly, but also non users of the platform, who significantly increased their visits to piracy websites by 0.8%.

Our results above indicate that non-users of Kino were positively affected by the intervention. We now turn to a more detailed analysis of the mechanisms that could lead to such effect. In particular, we will test whether the media coverage surrounding the shutdown of `kino.to` affected consumption of unlicensed video content.

4.1.3 Exploring Mechanisms Driving Externalities

The estimates presented in column (2) of Table 1 indicate an increase in piracy consumption for individuals who were non-users of Kino. We now test whether this is the result of an increase in awareness due to the media coverage surrounding the shutdown of `kino.to`. To this end, we rely on differences in the level of news consumption across individuals. The idea is to exploit variation

[15] Point estimates are transformed to percentage values as follows: $PercentageChange = (exp(Coefficient) - 1) * 100$.

in the likelihood of consumers being aware of the shutdown through news consumption. By looking at information spillovers in this direct way, the approach helps in getting a better understanding of the mechanism that drives non-users to increase their visits to piracy websites.

For each individual in the sample, we construct a measure of news consumption intensity by counting the total number of visits on technology news outlets prior to the shutdown of `kino.to`.[16] We then classify users in one of two equally sized groups, based on their intensity of usage from news outlets. In particular, we define users as being "high-news" ("low-news") if their intensity of news outlet's usage is above (below) the median intensity of usage in the sample. Looking at differences across individuals with different intensities of news readership allows to directly test for the shutdown's externalities being driven by media coverage. Low-news and non-users of Kino are a good candidate for the control group if we assume that they are not affected by the shutdown either directly or indirectly because they are less likely to be exposed to news coverage of the intervention. The model we estimate can therefore be expressed as:

$$\begin{aligned}\ln(Clicks_{it}+1) = \alpha + \mu_i + \beta_1 t + \beta_2 \left(t * KinoUser_i\right) \\ + \delta_0 After_t + \delta_1 \left(After_t * HighNews_i\right) \\ + \delta_2 \left(After_t * KinoUser_i\right) + \delta_3 \left(After_t * KinoUser_i * HighNews_i\right) + \varepsilon_{it}, \quad (3)\end{aligned}$$

where $HighNews_i$ is an indicator equal to 1 if individual i is a high-news intensity user. The coefficient δ_1 represents the effect of the shutdown on high-news and non-users of Kino, while δ_2 identifies the effect of the shutdown on low-news Kino users. The effect of the shutdown on high-news Kino users is captured by $\delta_1+\delta_2+\delta_3$. The coefficient δ_0 represents the effect of the shutdown on the control group, i.e. the low-news and non-users of Kino. The identifying assumption underlying equation (3) is that the control group and the different treated groups would have followed similar trends in piracy usage had the shutdown not happened. We can again partially test this assumption by estimating an equation similar to (2). Figure A.2 presents these differences in pre-trends and gives support to our identification strategy. Differences are not statistically distinguishable from

[16] Our measure is based on the top outlets for technology news as according to T3N (e.g. Chip, Computerbild, Heise, Giga, Golem) listed at http://t3n.de/news/ranking-deutsche-top-tech-medien-netz-289475/. Note that measuring news consumption in the post-period could undermine causal identification if users adapt their news consumption.

zero overall, neither across high-news Kino users and low-news non-users (upper left panel), across low-news Kino users and low-news non-users (upper right panel), nor across high-news non-users and low-news non-users (lower left panel).

Column (3) of Table 1 reports the results of estimating equation (3). The estimate for δ_0 is not significant, meaning that low-news and non-users of Kino did not change their piracy behavior after the shutdown. On the other hand, the results show that non-users of Kino with a high usage of news websites were positively and significantly affected by the intervention. This result supports the underlying mechanism - namely the news coverage surrounding the intervention - leading to the externalities identified in column (2) of Table 1.

One could expect Kino users to be affected in different ways according to their news consumption. On the one hand, Kino users exposed to more media coverage may decrease their piracy consumption to a larger extent out of fear of potential legal action. On the other hand, they may also be exposed to media coverage about alternative unlicensed platforms, which may increase their overall piracy consumption to a larger extent. Our results show that low-news Kino users decrease their piracy usage significantly (coefficient -0.282). The linear combination $\widehat{\delta_1} + \widehat{\delta_2} + \widehat{\delta_3}$ provides us with the effect of the shutdown on high-news Kino users. This results in a statistically significant coefficient of -0.329 (standard error 0.037). While the effect of the shutdown is larger in magnitude for high-news than for low-news Kino users, the difference is not significantly different from zero.

The results reported in columns (1)-(3) of Table 1 present convincing evidence of both a direct effect and of externalities from the shutdown of `kino.to`. Instead of estimating the effect of the intervention on the control group as we did in the first three columns of the tables (the coefficient on the $After_t$ variable), we now allow for more flexible time effects by introducing weekly fixed effects in our difference-in-difference model. Our preferred specification therefore becomes:

$$\begin{aligned}\ln(Clicks_{it}+1) = \alpha + \mu_i + w_t + \beta\,(t * KinoUser_i) + \delta_1\,(After_t * HighNews_i) \\ + \delta_2\,(After_t * KinoUser_i) + \delta_3\,(After_t * KinoUser_i * HighNews_i) + \varepsilon_{it}, \quad (4)\end{aligned}$$

where w_t is a vector of week dummies. Column (4) in Table 1 reports the results of estimating equation (4), which are identical to the results in column (3). In summary, a comparison of

the various approaches presented in Table 1 gives us confidence in the fact that the estimates in columns (2)-(4) reflect plausibly causal effects of the shutdown. We find that high-news Kino users reduce their overall visits to unlicensed video streaming websites by 28 percent.[17] The externalities from the intervention play out in the unintended direction by increasing visits to unlicensed video streaming websites by 1.7% for non-users of Kino with high-news consumption, but this effect is small compared to the decrease we observe for Kino users. We do not find evidence that Kino users with high news consumption react differently than Kino users with low news consumption.

If we put these results in relation to the 79% market share of `kino.to` before the shutdown, a 28% decline is much less than what we would expect if consumers would not switch to alternative piracy websites. This result indicates that the existence of alternative unlicensed platforms challenges the effectiveness of `kino.to`'s shutdown in deterring consumers from online piracy.

4.2 Effects on Licensed Video Consumption

While shutting down `kino.to` led to a temporary decrease in overall piracy levels, it could only have benefited copyright holders by increasing consumption of licensed content. We now investigate whether the shutdown led consumers to increase their use of licensed modes of video consumption.

Our data provide us with good proxies for several licensed video consumption channels. In particular, we can observe visits to websites related to movie theaters, DVD/Blu-ray purchases, and paid licensed video services. We proxy for movie theater visits by measuring clicks on the main movie portal that includes showing times (`kino.de`) as well as the websites of the major movie theater companies.[18] We proxy for DVD and Blu-ray sales by measuring visits to pages in the DVD and Blu-ray categories on `Amazon`.[19] The German home video market was dominated by DVD and Blu-ray in 2011, with a market share of more than 96%, leaving less than 4% to digital distribution channels (GfK and Bundesverband Audiovisuelle Medien, 2013). We finally track visits to paid licensed video services. While German consumers could not subscribe to flat-rate services that

[17] (exp(-.282-.063+0.017)-1)*100=-27.96

[18] A representative survey among 8,639 German consumers estimates that 16.21 million people have bought cinema, concerts or theater tickets online in 2011. Around 30.5 million Germans went to a movie theater in 2011. This implies that almost every second cinema goer purchased tickets online. See `http://tinyurl.com/nhur74u` and GfK and German Federal Film Board (2012).

[19] `Amazon` is by far the dominant online retailer in the German market with a revenue of €4.8 billion in 2012. The second biggest online retailer is `Otto` with €1.7 billion in revenues. See `http://tinyurl.com/pq9vyvf`.

were already popular in other countries (e.g. `Netflix`) and the number of digital pay-per-view services were limited in 2011, we are still able to measure the visits to platforms such as `Maxdome`, `Lovefilm`, `Videoload`, and `iTunes`.[20]

We analyze the effects of the shutdown on licensed video consumption by running regression models as specified in equation (4) and using clicks to movie theater websites, licensed video streaming services, and DVD/Blu-ray pages on `Amazon` as the dependent variable.

Results are reported in Table 2. We find that low news Kino users increase their visits to websites offering paid licensed video services by 2.7%. The effect for the high news Kino users is positive but not significant (coefficient 0.009, s.e. 0.01), while the effect for low-news Kino users is positive and significant. There is no evidence that either high-news or low-news Kino users increase their visits to websites related to movie theaters or to the DVD/Blu-ray category at Amazon. For high-news non-users of Kino, we find a significant and negative effect on movie theater and licensed video website visits. They reduce visits to movie theater websites by 1.1% and to licensed video by 1.0%.

Our identification strategy again assumes that visits to licensed alternatives for treatment and control would have followed similar trends had the shutdown not happened. As above, we partially test this assumption by looking at across-group differences in trends prior to the intervention. Figures A.3, A.4, and A.5 plot the resulting β_2^t and β_3^t coefficients after estimating equation (2) for each of the dependent variables. We observe that the coefficients appear to be statistically indistinguishable from zero most of the times before the intervention. One might be worried that differences are sometimes not statistically different from zero, especially in the beginning of the year. Across all figures, pre-trend differences of high news types (upper and lower left panels), seem to follow a decreasing trend. Note that to capture and control for these potential differences in trends, results in Table 2 are based on regression models with group-specific linear trends.

[20] We cannot observe purchases on `iTunes`, because the Nielsen NetView application only captures traffic within the browser and `iTunes` is a standalone software. We are therefore only able to observe the visits to the `iTunes` webpage, which is a proxy of individuals signing up of the service and downloading the `iTunes` application to make purchases later. Market shares for 2011 are not available, but data in the first half of 2014 show that `Maxdome` dominates the market with a share of 35%, followed by `iTunes` with 18%, `Lovefilm` (12%) and `Videoload` (10%). See http://tinyurl.com/qb3jjsw.

Our results show that shutting down the `kino.to` platform led to economically significant, but moderate effects on overall levels of unlicensed movie consumption. The effects on consumption through licensed alternatives are – if any – small.

4.3 Robustness Checks

4.3.1 Alternative Measures of Unlicensed Video Consumption

Clicks to websites are not necessarily the perfect measure of video content consumption. Before being able to stream a movie, a user would need to make a number of navigational clicks, for instance searching or browsing through content, registering or logging in to a user account, or selecting a server that provides the video stream. A potential concern would therefore be that the unlicensed websites in our sample differ in design. This may, for example, lead to a larger number of necessary clicks to consume content on `kino.to` compared to alternative websites. It may even be possible that some websites do not offer the desired content, and that the observed clicks to that domain only reflect search as opposed to consumption. To address these issues we re-run our regressions using three alternative measures of unlicensed video consumption.

Streams The construction of our first alternative measure of unlicensed video consumption exploits the fact that a website like `kino.to` doesn't directly host video content, but only provides links to cyberlockers (external servers that operate under a different domain name, e.g. `megavideo.com`). Using historical information available online, we compile a list of 34 cyberlocker services. In our raw clickstream data, we flag a streaming session whenever we observe a click to a linking site that is directly followed by a click to a cyberlocker site, or clicks to cyberlocker sites where a linking site is listed as the referral.

Piracy Days Our second measure relies on the extensive margin of piracy consumption and makes use of daily variation within users. We therefore focus on the number of days in which a given consumer used an unlicensed video streaming website. A piracy day is flagged as such if we observe at least one visit to a unlicensed website per day and user. Our weekly measure therefore consists in a count of the number of piracy days per user and week. Because we make abstraction

of the number of clicks when constructing this measure, we avoid the concern that some platforms may require more clicks than others to reach content.

Duration Our third measure is provided directly by Nielsen and gives the time spent on each URL (in seconds). While video consumption should result in much higher values compared to navigational clicks, a few practical issues potentially challenge the accuracy of Nielsen's measure of duration. For example, Nielsen only records time spent on pages in focus and time stops being recorded once the user switches to another tab. While this implies that the duration provided by Nielsen will potentially underestimate the time spent on each URL, this measure should still be correlated with the true time spent on each URL.

The first four columns of Table 3 presents the results of estimating equation (4) using our alternative measures of piracy. The results are qualitatively similar to those obtained when relying on visits as the measure of consumption (column (4) in Table 1) and we are therefore confident that we do not have biased results stemming from differences in website functionality.

4.3.2 Falsification Exercise

An alternative explanation for our results could be that changes in the consumption of unlicensed video streams are correlated to a general unobserved shock that coincides with the timing of the shutdown, but is not causally related to the shutdown. If this was the case, we should see very similar patterns across Kino users and non-users of Kino when looking at other websites which – in the absence of a common unobserved shock – should not have been affected by the shutdown of `kino.to`. General e-commerce websites fall in such category. The last column of Table 3 presents the result of estimating equation (4) using visits to all categories on `Amazon`, except DVD/Blu-ray. It shows no significant effects for either Kino users or non users of Kino. This alleviates the concern that unobserved time shocks may be driving our main results.

5 Post-Shutdown Market Structure

We now turn to the effects of the `kino.to` shutdown on the overall structure of the market for unlicensed video streaming. In particular, we highlight their importance for the effectiveness of potential future anti-piracy interventions.

The raid against `kino.to` on June 8, 2011 involved the seizure of servers, databases of the linking site itself, and integrated cyberlocker services. However, the shutdown only resulted in a shock to part of the whole piracy ecosystem. Because content hosted on other cyberlockers remained online, it was relatively easy for existing competitors or even new entrants to supply similar content as the one initially offered by `kino.to`. Shutting down the major platform may therefore simply result in a new website capturing most of the market. However, it is a priori not clear whether a new dominant platform would emerge to take `kino.to`'s place, or if a more fragmented market should be expected as a result of the intervention. Because these alternative scenarios lead to very different policy implications, it is crucial to understand how the intervention affected the overall structure of the unlicensed video streaming market.

We can look at the evolution of unlicensed platforms' weekly market shares to assess how the structure of the streaming piracy market is affected by the shutdown of `kino.to`. Figure 3 presents the evolution of market shares for the different platforms defining our market, distinguishing between `kino.to`, `kinoX.to`, `movie2k.to`, and the 17 remaining websites included in our market definition. The figure shows that the intervention changed the structure of the streaming piracy market massively. Before the shutdown, `kino.to` (dashed blue line) clearly dominated the market with an average market share of about 80%. The second largest player `movie2k.to` had a market share of about 10%, and the remaining 16 websites jointly accounted for an average market share of 10%. During the first four weeks after the intervention, `movie2k.to`'s market share increased to about 55%, and the market share of all other streaming sites increased to about 45%. After four weeks `kinoX.to` entered and immediately gained 20% market share, while `movie2k.to`'s market share

decreased to about 30%.[21] Eight weeks after the shutdown, the market shares started to stabilize at about one third each.

The changes in market shares naturally imply changes in market concentration. Figure 4 shows the weekly evolution of the Herfindahl-Hirschman Index (HHI) of the unlicensed video streaming market. This adds some additional insight, since we do not aggregate the "long tail" websites in the HHI measure. Before the shutdown of `kino.to`, the HHI averages at around 6,500. It decreases sharply to 3,000 during the week of the shutdown, but immediately increases to about 4,000 after two weeks. After four weeks, and following the entry of `kinoX.to`, the HHI decreases again sharply to about 2,000, where it remains for six weeks before increasing slightly to about 3,000 at the end of the year.

Our results show that the streaming piracy market became much more fragmented following the shutdown of `kino.to`. This fact has important implications for the effectiveness of future anti-piracy interventions of the same kind. In particular, it could make them either more costly – as there would not be a single dominant platform to shutdown anymore – or less effective if only a single website is targeted by the intervention.

6 Discussion

We now discuss a number of boundary conditions that are likely to explain some of our results, and review findings in the literature that suggest which firm and public policies could be more effective in reducing piracy levels and increasing licensed consumption.

6.1 Awareness of Legal Status

The empirical literature has provided evidence suggesting that awareness about stricter laws - which increase the risk of consumers getting caught and punished - led to higher music sales in France and Sweden (Danaher et al., 2014; Adermon and Liang, 2014). Our results only show a moderate reduction in overall piracy, which could be explained by the fact that German consumers are not

[21] Note that the decrease in `movie2k.to`'s market share is not due to a decrease in traffic to the platform, but by an expansion of the overall piracy market driven by the entry of `kinoX.to`.

aware of the legal status of unlicensed video streaming websites. While media and press coverage is a potential mechanism to raise awareness, we have shown that it also implies a trade-off for copyright owners. Depending on the content of news articles, more information about online piracy can make consumers aware of online piracy in the first place. In the case of `kino.to`, only about one third of the press coverage was discussing legal aspects that could have had a deterring effect on consumers (and operators of unlicensed websites). If that fraction had been higher, maybe we would have seen less switching to alternative piracy websites. In other settings, the introduction of journalistic standards have been shown to be effective in reducing unintended effects of news coverage. For example, Etzersdorfer and Sonneck (1998) show that the number of copycat suicides (or suicide attempts) decreases after newspapers have adopted specific guidelines for journalists. From a policy perspective, it goes without saying that benefits from such efforts must be traded off against freedom of the press.

6.2 Broad Public Enforcement

There are reasons to expect stronger effects from greater enforcement efforts on the supply-side. In the model of Dey et al. (2016), stronger supply-side enforcement leads to higher entry costs for unlicensed websites, which in turn reduces the content available for consumers. The authors show that supply-side enforcement can lead to desirable welfare outcomes (which is similar to the result in Tsai and Chiou, 2012). In the light of this model, an interpretation of our results could be that the enforcement intensity was not high enough, in particular because the intervention affected only one unlicensed website. The implication could be that shutting down multiple websites at a time would be more effective at decreasing piracy levels and increasing welfare.[22] Nevertheless, from a practical perspective, achieving a level of enforcement that is sufficiently broad to be sustainable in the long run seems very hard. For example, evidence shows that the rate of new cyberlockers entering the market increased after the shutdown of Megaupload (Lauinger et al., 2013) and consumers use VPN services to circumvent the blocking of the PirateBay and a number of similar websites

[22] A recent working paper by Danaher et al. (2015b) looks at this question and uses highly aggregated clickstream data to compare the effects of two policy experiments in the UK – court decisions that ordered Internet service providers to block one piracy website versus the blocking multiple piracy websites. While they don't find evidence of an increase in visits to paid streaming services when one website is blocked, they find a positive effect in the case of the wide blockade. For both interventions, their analysis suggests that a change in the number of clicks to other torrent sites or cyberlockers is small or not significant, but the results also show that consumers increase clicks to VPN services that allow to circumvent the blockade.

(Danaher et al., 2015b). Putting aside country-specific legal issues - which may make a large scale international raid difficult - the associated costs of physically raiding multiple websites hosted on geographically dispersed servers would also have to be taken into account. This could naturally reduce the welfare enhancing effect of supply-side enforcement (Tsai and Chiou, 2012; Dey et al., 2016).

Theory suggests that firms find it optimal to invest in private enforcement to deter piracy when public enforcement is too weak (Banerjee, 2003; Sundararajan, 2004; Kiema, 2008; Ahn and Shin, 2010; Lu and Poddar, 2012). This is backed by evidence showing that private enforcement can be effective in the settlement infringement cases regarding digital images (Luo and Mortimer, 2016), and increase sales of e-books (Reimers, forthcoming). However, when copy protection means a reduction in utility for the consumer, private enforcement can have negative implications for firm profits and social welfare (Ahn and Shin, 2010). This idea is mirrored in evidence showing that music sales increase due to the removal of digital rights management technology (Zhang, forthcoming).

6.3 Availability and Pricing of Licensed Content

A potential explanation for why we don't observe more substitution towards licensed video streaming services may be found in the relative quality of licensed alternatives in the German market in 2011.[23] The idea is that consumers may have not been able to find their preferred content offered on sufficiently appealing licensed platforms. We can partly test this idea. Looking at the URL's of visited pages on `kino.to`, we can identify whether users are watching movies or TV shows. From this, we can distinguish users based on their content preferences. Regression results show that users that mainly watched movies on `kino.to` decrease their piracy levels significantly less than consumers that mainly watched TV series on `kino.to`. An interesting implication could be that firms might be able to strategically react to differences in user preferences and offer specialized products, however – in line with the results above – we do not find evidence that either type of Kino user increases visits to licensed video streaming services.[24]

[23] We do not have access to reliable data on the catalogues of licensed services in 2011. However, according to the comparison website `www.werstreamt.es`, still in November 2014, the licensed German market offers less content than `kino.to`, with 11,600 movies on `iTunes`, 8,500 on `Maxdome`, 5,800 on `Videoload`, and 1,000 on `Netflix` compared to 20,000 movies on `kino.to`

[24] Result tables are not reported here but are available on request.

A growing literature shows that availability of licensed content has substantial effects on piracy. For example, Danaher et al. (2010) show that removal of NBC content on iTunes increased demand for the same content on pirated websites by 11%. Aguiar and Waldfogel (2015) show that the streaming platform Spotify – which offers an appealing option for legal music consumption – has had a negative and significant impact on recorded music piracy. Data from the Netherlands in Poort and Weda (2015) shows that piracy levels of music have declined from 35% of the population to 23% between 2008 and 2012, while piracy levels of video content increased from 11% to 18% during the same time. The authors conclude that this difference can be explained by differences in how consumers perceive availability and price of licensed music vs. video offers. This is in line with theoretical work showing that content services where consumers can choose between ad-supported free or fee-based subscriptions (as we see being offered in the music market, and to a much smaller degree in the video market) can reduce the demand for piracy (Thomes, 2013).

6.4 Other Policy Levers

Theoretical work in Becker et al. (2006), using a model that is applied to illegal drugs, shows that a tax on legalized production of drugs is better able to reduce the quantity of drugs in the market than quantity-restricting enforcement efforts. This is in line with what Chen and Png (2003) find in their theoretical analysis of digital piracy. They compare the welfare implications of government policies and conclude that a tax on copying is superior to a fine on consumers, and that a subsidy for legal producers is optimal. Evidence from a discrete choice experiment carried out in the Netherlands shows that a tax of less than 2 Euros on Internet subscriptions would keep revenues of music rights holders at the current level while simultaneously increasing consumer surplus (Handke et al., forthcoming).

7 Conclusion

Anti-piracy interventions involve large amounts of public resources, yet very little is known about their effectiveness, benefits, and consequences. This paper evaluates the impact of the shutdown of the largest unlicensed movie streaming site in the German market - `kino.to` - on June 8, 2011. We use clickstream data for a set of more than 5,000 Internet users, to provide detailed evidence on

the effects of this intervention on consumer behavior and on the structure of the unlicensed movie streaming market.

Relying on a difference-in-differences approach, our results show that the shutdown of `kino.to` led to a substantial decrease in the usage of unlicensed video streaming websites. This reduction is however lower than one could expect given `kino.to`'s market share, mainly because consumers substitute towards existing and newly entering alternative unlicensed platforms. We also find evidence of negative externalities generated by the intervention. In particular, we find that individuals who never used `kino.to` prior to its shutdown slightly increased their visits to piracy websites. This increase is exclusively driven by individuals who use news websites to a larger extent, providing evidence that media coverage surrounding the intervention can positively affect piracy consumption. Our results show limited substitution into consumption of licensed video content. Users of `kino.to` do not increase their visits movie theaters' websites or to DVD-related `Amazon` webpages. However, we find that they increase clicks to licensed online video services by 2.7%. The externalities from the intervention also appear when looking at licensed consumption. In particular, we show that individuals who never used `kino.to` prior to its shutdown decrease their visits to movie theaters' websites and licensed online video services by about 1%. We finally assess the effect of the shutdown on the overall structure of the market for unlicensed video streaming. While dominated by a single platform (`kino.to`) before the intervention, we document a large deconcentration in the market for unlicensed video streaming.

Overall, our results raise concerns about the effectiveness of the shutdown of `kino.to`. The existence of alternative sources of unlicensed consumption, coupled with the rapid emergence of new platforms, limited the positive effects of the intervention on overall piracy levels and on movie consumption through licensed alternatives. Additionally, we find evidence of negative externalities from the intervention. Lastly our results regarding the post-shutdown market structure imply that a more fragmented market could make future law enforcement interventions either more costly – there would not be a single dominant platform to shutdown anymore – or less effective if only a single website is targeted by the intervention.

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Tables

Table 1: Total Piracy†

	(1) Coef./s.e.	(2) Coef./s.e.	(3) Coef./s.e.	(4) Coef./s.e.
After	0.011***	0.002	0.003	
	(0.003)	(0.003)	(0.003)	
After * Non Kino		0.008*		
		(0.005)		
After * High News			0.017***	0.017***
			(0.006)	(0.006)
After * Kino User	-0.325***	-0.317***	-0.282***	-0.282***
	(0.033)	(0.033)	(0.050)	(0.050)
After * Kino User * High News			-0.063	-0.063
			(0.055)	(0.055)
Week Fixed Effects	✗	✗	✗	✓
Adjusted-R^2	0.500	0.456	0.500	0.500
No. of Ind.	5000	20000	5000	5000
No. of Obs.	260000	1040000	260000	260000

Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects and linear group-specific trends.
$*$ Significant at the 10% level, $**$, significant at the 5% level, $***$ significant at the 1% level.

Table 2: Licensed Alternatives†

	(Theater) Coef./s.e.	(Video) Coef./s.e.	(DVD) Coef./s.e.
After * High News	-0.011***	-0.010**	-0.001
	(0.00)	(0.00)	(0.00)
After * Kino User	0.002	0.027**	0.002
	(0.01)	(0.01)	(0.01)
After * Kino User * High News	0.000	-0.008	0.001
	(0.01)	(0.01)	(0.01)
Adjusted-R^2	0.195	0.344	0.342
No. of Ind.	5000	5000	5000
No. of Obs.	260000	260000	260000

Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects and linear group-specific trends.
$*$ Significant at the 10% level, $**$, significant at the 5% level, $***$ significant at the 1% level.

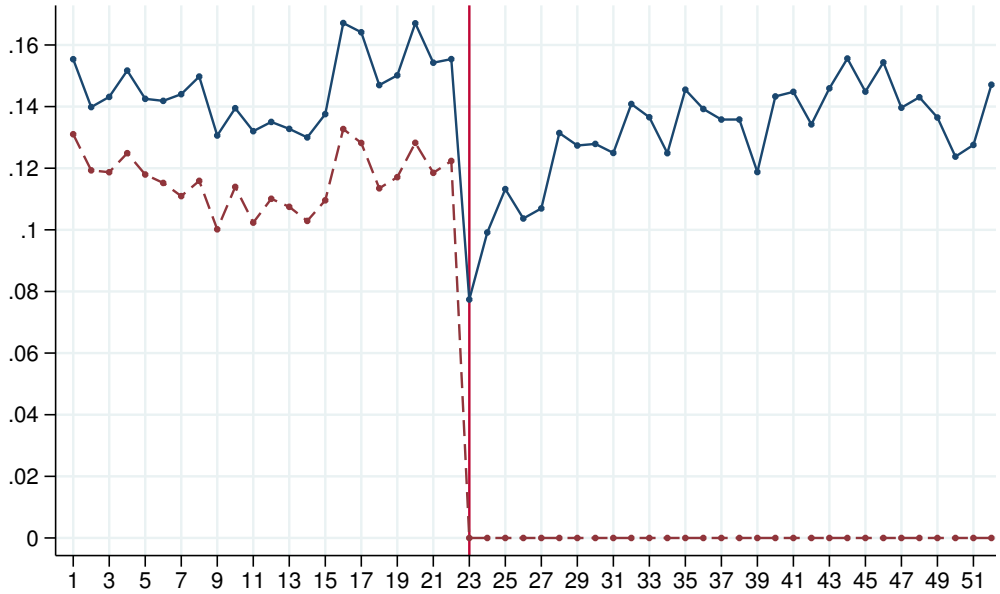
Table 3: Robustness: Total Piracy and Falsification Test.†

	(Downloads) Coef./s.e.	(PiracyDays) Coef./s.e.	(Duration) Coef./s.e.	(Amazon) Coef./s.e.
After * High News	0.035***	0.004**	0.012**	-0.021
	(0.011)	(0.002)	(0.005)	(0.016)
After * Kino User	-0.541***	-0.115***	-0.214***	-0.052
	(0.089)	(0.024)	(0.053)	(0.038)
After * Kino User * High News	-0.058	-0.067**	-0.085	0.032
	(0.096)	(0.027)	(0.058)	(0.041)
Adjusted-R^2	0.482	0.349	0.528	0.449
No. of Ind.	5000	5000	5000	5000
No. of Obs.	260000	260000	260000	260000

Standard errors are in parenthesis and clustered at the individual level. All specifications include individual fixed effects and linear group-specific trends.
$*$ Significant at the 10% level, $**$, significant at the 5% level, $***$ significant at the 1% level.

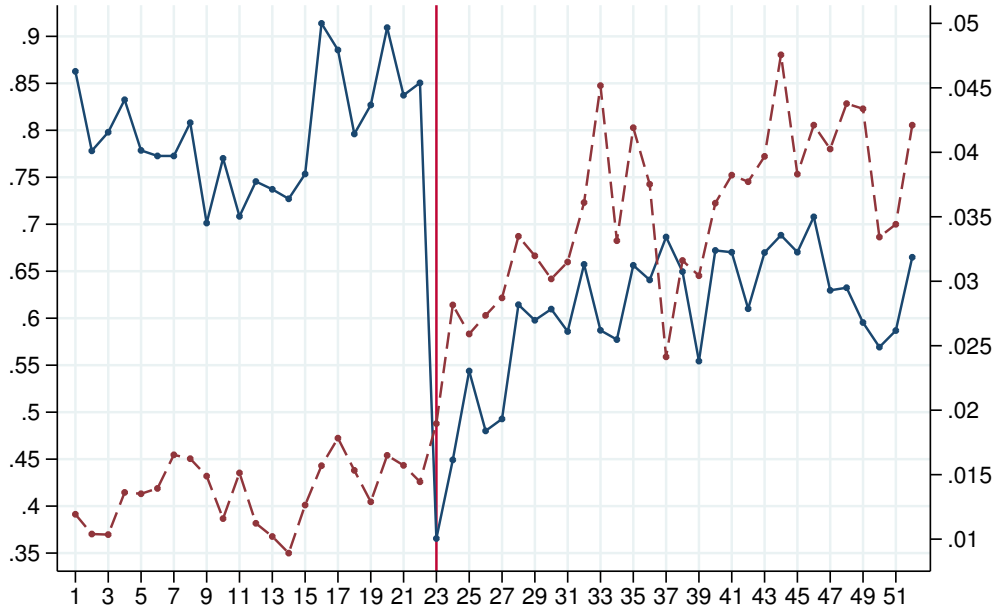
Figures

Figure 1: Evolution of Online Movie Streaming Piracy



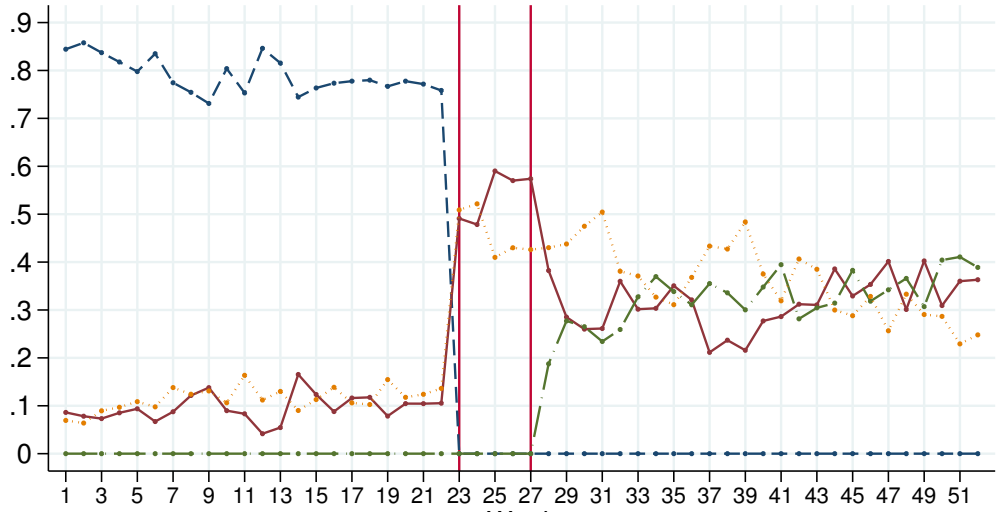
Vertical axis: Average log weekly clicks per user. Horizontal axis: Calendar weeks in 2011.
Solid blue: *Average log weekly clicks per user on all unlicensed streaming websites.*
Dashed red: *Average log weekly clicks per user on kino.to.*

Figure 2: Evolution of Online Movie Streaming Piracy, by User Type



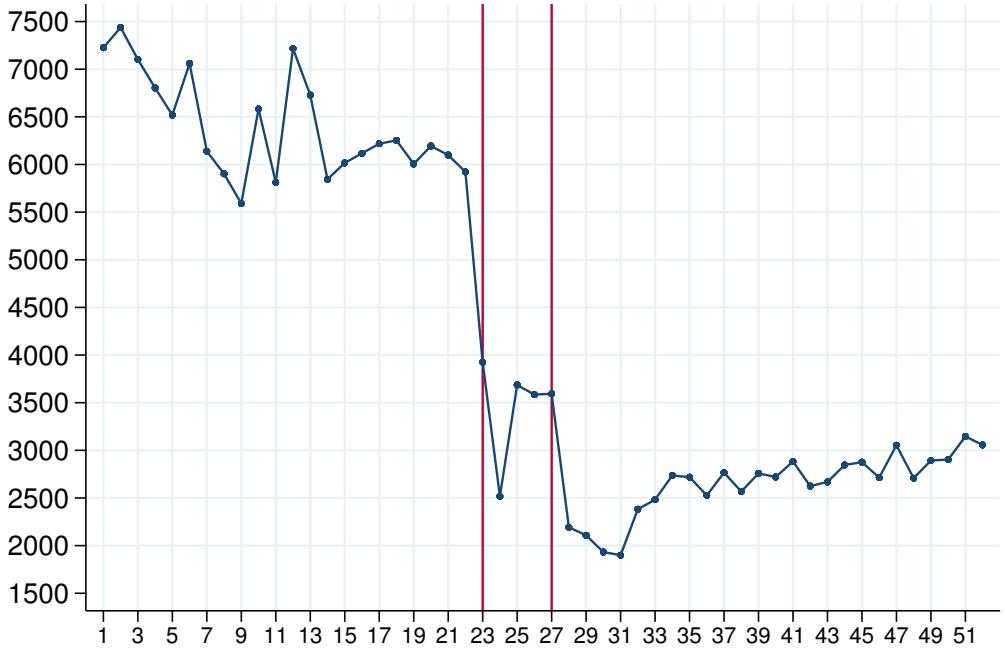
Left vertical axis: Average log weekly clicks of ***Kino users****.*
Right vertical axis: Average log weekly clicks of ***Non-Kino users****.*
Horizontal axis: Calendar weeks in 2011.
Solid blue: *Kino users.* ***Dashed red:*** *Non-Kino users.*

Figure 3: Market Shares of Unlicensed Video Streaming Websites



Vertical axis: Weekly market share. Horizontal axis: Calendar weeks in 2011.
Dashed blue: *Weekly market share of kino.to.*
Solid red: *Weekly market share of movie2k.to.*
Dashed green: *Weekly market share of kinox.to.*
Dotted orange: *Weekly market share of all other unlicensed streaming websites.*

Figure 4: Concentration in the Unlicensed Video Streaming Market



Vertical axis: Weekly HHI. Horizontal axis: Calendar weeks in 2011.

A Appendix

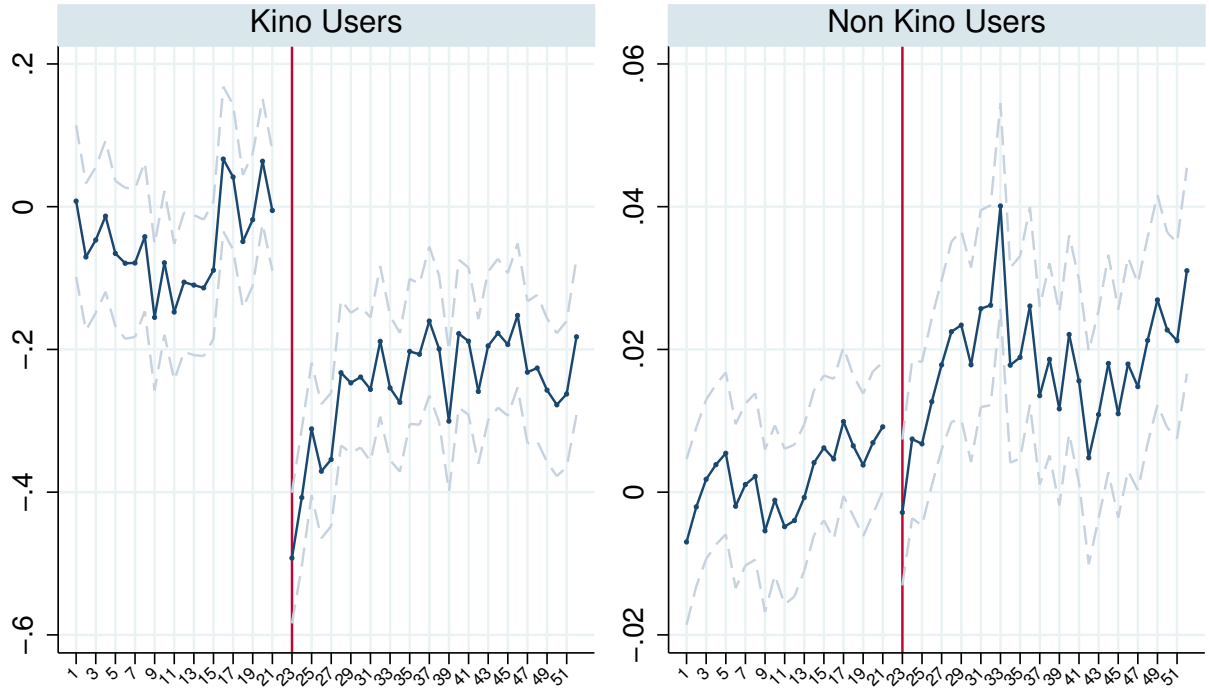
Table A.1: Descriptive Statistics

	Kino Users (N=843)				Non-Users of Kino (N=4157)			
	Before		After		Before		After	
	mean	sd	mean	sd	mean	sd	mean	sd
Total Piracy	8.566	18.125	7.805	22.756	0.105	1.524	0.383	5.447
Ln(Total Piracy + 1)	0.798	1.015	0.604	0.930	0.014	0.125	0.035	0.196
Kino	7.181	16.503	0	0	0	0	0	0
Ln(Kino clicks + 1)	0.690	0.956	0	0	0	0	0	0
Movie Kino User	0.617	0.486	0.617	0.486	0	0	0	0
Piracy Downloads	0.985	2.897	0.687	2.193	0.004	0.060	0.022	0.297
Ln(Piracy Downloads + 1)	0.255	0.432	0.169	0.338	0.001	0.021	0.007	0.054
Piracy Days	0.697	1.125	0.530	0.984	0.012	0.120	0.027	0.176
Ln(Piracy Days + 1)	0.322	0.427	0.241	0.378	0.006	0.056	0.015	0.076
Piracy Duration	143.802	289.471	152.198	560.865	2.578	37.176	9.852	172.099
Ln(Piracy Duration + 1)	1.567	1.787	1.185	1.674	0.033	0.268	0.079	0.388
High News	0.762	0.426	0.762	0.426	0.470	0.499	0.470	0.499
Amazon	7.969	15.431	9.240	17.967	7.294	32.007	7.924	22.220
Ln(Amazon + 1)	0.848	0.930	0.894	0.944	0.660	0.907	0.704	0.906
Theater	0.505	1.341	0.426	1.236	0.194	0.973	0.190	0.841
Ln(Theater + 1)	0.122	0.229	0.100	0.207	0.044	0.158	0.043	0.145
Legal Video	0.468	2.629	0.470	3.010	0.276	3.090	0.224	1.771
Ln(Legal Video + 1)	0.079	0.272	0.074	0.244	0.044	0.209	0.041	0.186
Amazon DVD	0.425	2.434	0.484	2.711	0.215	1.499	0.255	1.626
Ln(Amazon DVD + 1)	0.095	0.280	0.093	0.282	0.052	0.194	0.059	0.199

Table A.2: Correlations

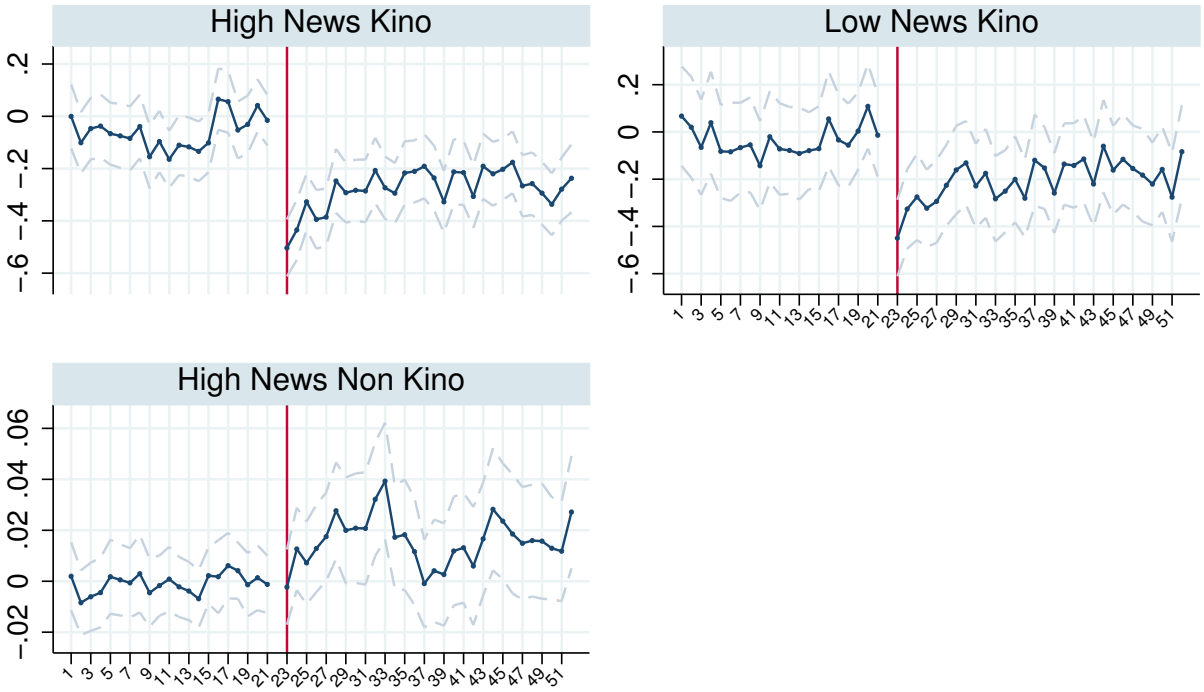
		1	2	3	4	5	6	7	8	9	10
1	Ln(Total Piracy + 1)	1.00									
2	Ln(Kino clicks + 1)	0.60	1.00								
3	High Movie Share	0.21	0.13	1.00							
4	Ln(Piracy Downloads + 1)	0.77	0.56	0.13	1.00						
5	Piracy Days	0.91	0.56	0.17	0.73	1.00					
6	High News	0.13	0.07	0.18	0.08	0.11	1.00				
7	Ln(Amazon + 1)	0.09	0.04	0.03	0.06	0.09	0.21	1.00			
8	Ln(Theather + 1)	0.09	0.06	0.05	0.07	0.09	0.07	0.10	1.00		
9	Ln(Legal Video + 1)	0.05	0.02	0.03	0.04	0.05	0.08	0.13	0.06	1.00	
10	Ln(Amazon DVD + 1)	0.07	0.04	0.02	0.06	0.07	0.08	0.30	0.08	0.09	1.00

Figure A.1: Trend difference: Overall piracy, international sample



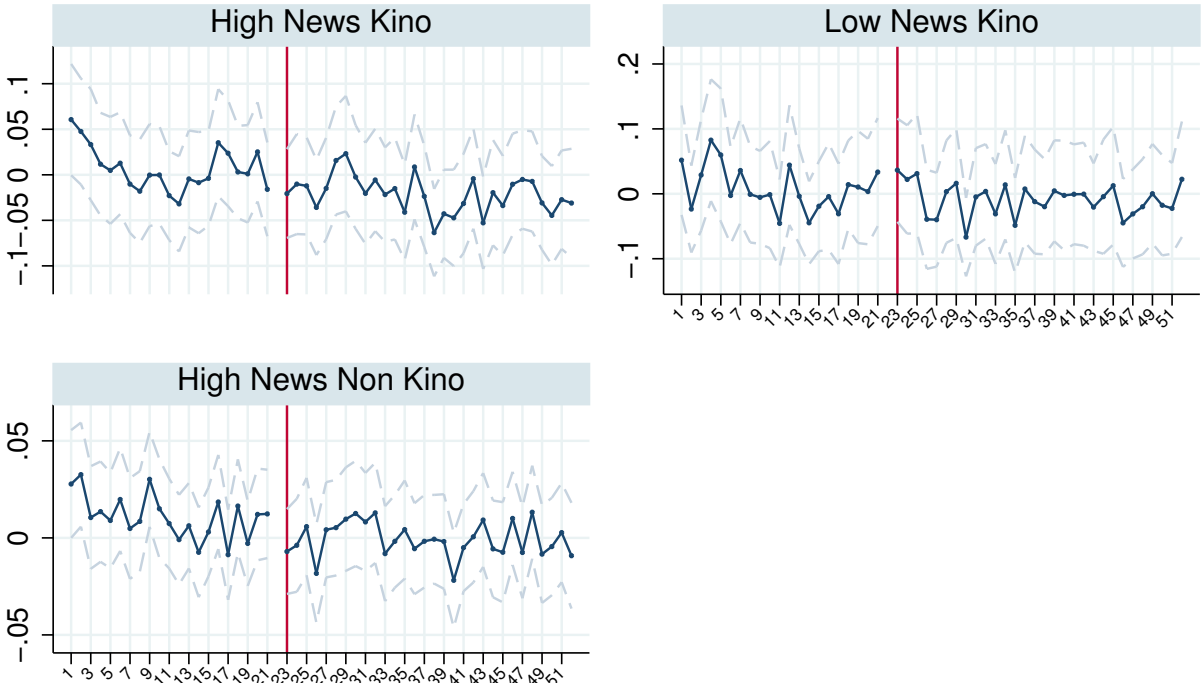
Vertical axis: OLS coefficients. Horizontal axis: Calendar weeks in 2011.
Solid blue: *Week-specific difference coefficient $\delta * \nu$. Control group: Non-users of Kino.to with low news usage.*
Dashed blue: *95% Confidence bands.*

Figure A.2: Trend difference: Overall piracy



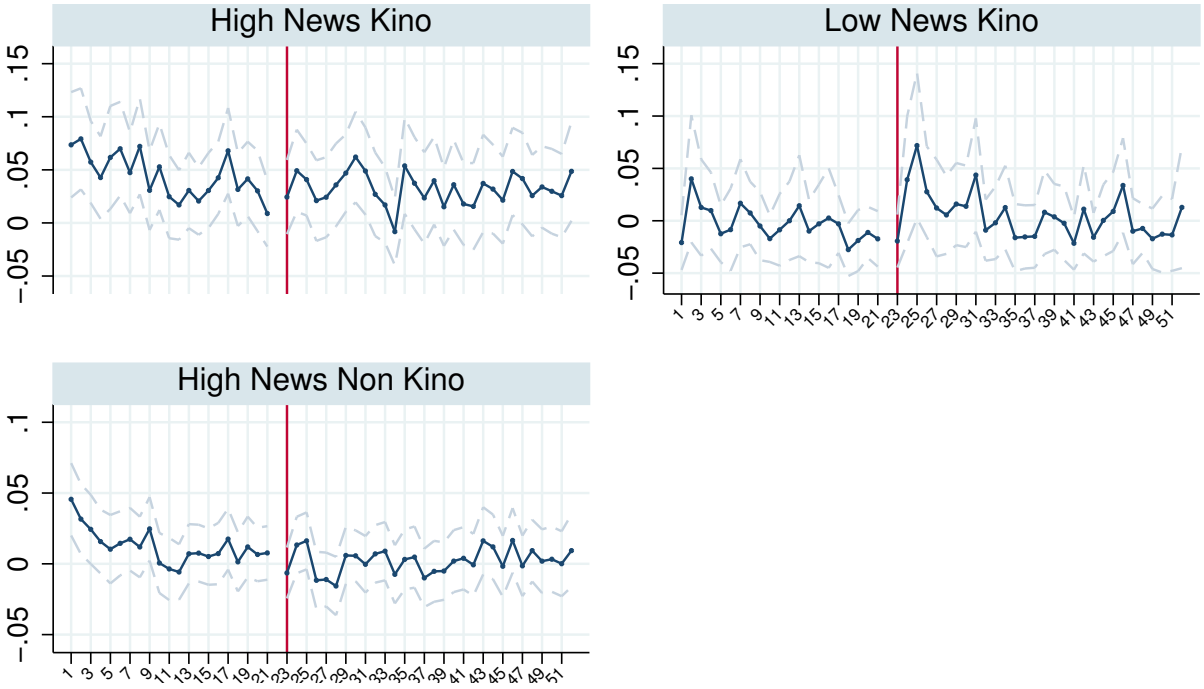
Vertical axis: OLS coefficients. Horizontal axis: Calendar weeks in 2011.
Solid blue: *Week-specific difference coefficient $\delta * \nu$. Control group: Non-users of Kino.to with low news usage.*
Dashed blue: *95% Confidence bands.*

Figure A.3: Trend difference: Movie Theater



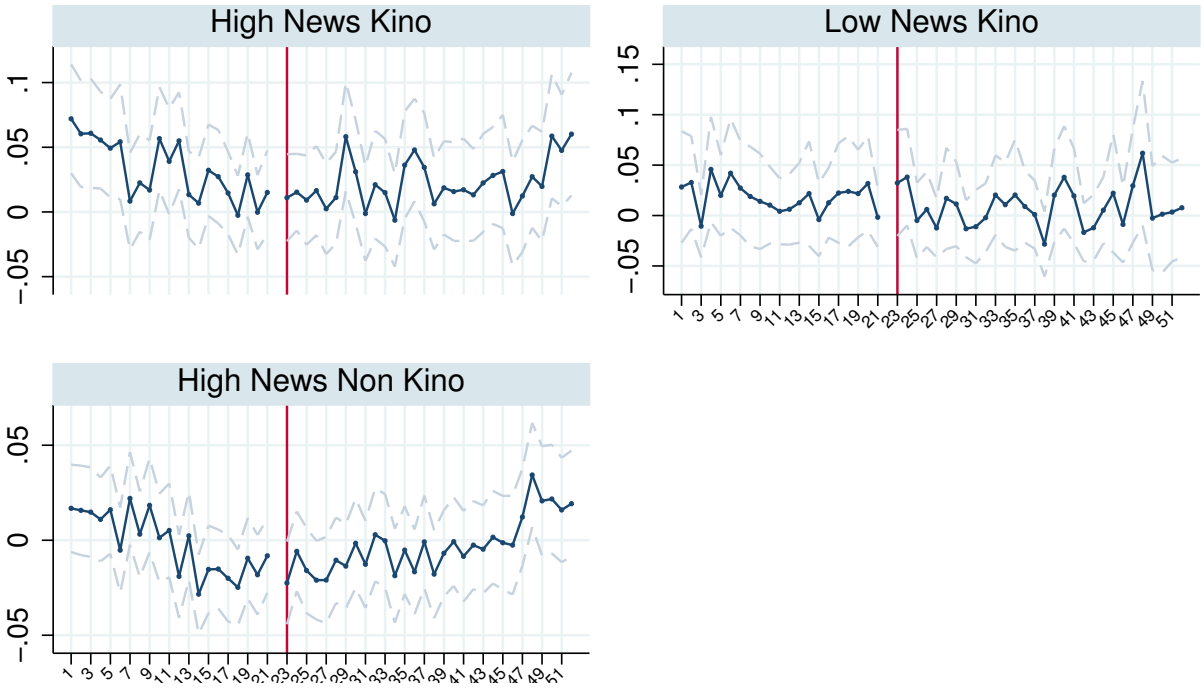
Vertical axis: OLS coefficients. Horizontal axis: Calendar weeks in 2011.
Solid blue: *Week-specific difference coefficient $\delta * \nu$. Control group: Non-users of Kino.to with low news usage.*
Dashed blue: *95% Confidence bands.*

Figure A.4: Trend difference: Licensed Video Streaming



Vertical axis: OLS coefficients. Horizontal axis: Calendar weeks in 2011.
Solid blue: *Week-specific difference coefficient $\delta * \nu$. Control group: Non-users of Kino.to with low news usage.*
Dashed blue: *95% Confidence bands.*

Figure A.5: Trend difference: DVD/Blu-ray



Vertical axis: OLS coefficients. Horizontal axis: Calendar weeks in 2011.
Solid blue: *Week-specific difference coefficient $\delta * \nu$. Control group: Non-users of Kino.to with low news usage.*
Dashed blue: *95% Confidence bands.*