

Piracy Landscape Study:

*Analysis of Existing and Emerging Research Relevant to Intellectual Property Rights (IPR)
Enforcement of Commercial-Scale Piracy*

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Table of Contents

Executive Summary	3
1. The Piracy Ecosystem.....	4
1.1 Piracy of Physical Goods	6
1.1.1 Manufacturing.....	7
1.1.2 Discovery	7
1.1.3 Distribution	8
1.1.4 Communication, Payment Processing and Fulfillment.....	11
1.2 Piracy of Digital Goods	11
1.2.1 Sources.....	12
1.2.2 Distribution	14
1.2.3 Economic and Social Incentives	16
2. The Scope and Magnitude of Economic Harm from Piracy.....	18
2.1 Methodologies of Academic Studies on Piracy and Sales.....	19
2.2 Estimated Effects of Piracy on Legal Consumption.....	22
2.3 Indirect Impacts of Piracy.....	29
2.4 Summary.....	32
3. The Effectiveness of Anti-Piracy Strategies	33
3.1 Increasing the Availability and Appeal of Legal Content	33
3.1.1 Increased Availability	34
3.1.2 Increased Appeal.....	35
3.2 Making Illegal Content Less Attractive.....	37
3.2.1 Demand Side Interventions.....	38
3.2.2 Supply Side Interventions	39
3.3 Summary.....	42
4. Open Questions for Future Research.....	43

EXECUTIVE SUMMARY

The objective of this paper is to produce a “comprehensive landscape study of existing and emerging research relevant to intellectual property rights enforcement in the area of commercial-scale piracy.”

This report addresses that goal in three main sections. First, we produce an overview of the actors involved in the generation and distribution of pirated content, how these actors are organized, and their financial motivations. Second, we review the peer-reviewed academic literature analyzing the harm caused by digital piracy, both to revenue in legal channels and to creative output in the entertainment sector. Finally, we review the peer-reviewed academic literature analyzing the effectiveness of both industry- and government-initiated anti-piracy efforts.

Our analysis of the academic literature on the impact of piracy shows that 29 out of 33 peer-reviewed papers find that piracy results in significant harm to legal sales. The 29 papers finding evidence of harm from piracy span markets for music, television, books, and films, and have considered physical CDs, DVDs, and Blu-Ray Discs sales; legal digital downloads, paid video streaming services; and the theatrical box office. There is also an emerging academic literature that these reduced financial incentives lead to a reduction in investment and overall creative output.

Our analysis of the academic literature on anti-piracy strategies shows that firms can reduce piracy by making legal content more available and more appealing. Strategies such as making legal content available on convenient digital channels or reducing the release windows between different releases of the same product are both effective at changing consumption of pirated content. However, none of these strategies have been shown to reduce piracy by more than 25 percent. Thus, there is a limit to firms’ ability to combat piracy by making legal channels more appealing.

Because of the limited effect of legal content on pirate consumption, there have been a variety of efforts initiated by firms and governments to make pirated content less appealing. The peer-reviewed academic literature shows that these efforts can be effective at reversing the harm from piracy. Specifically, a variety of “demand-side” anti-piracy efforts have been effective at reducing piracy and increasing legal consumption. These efforts target individuals demanding pirate content, either through legal actions against such individuals or notice sending programs informing individuals that they have been observed consuming pirated content, and may face legal action. However, there is also evidence that the popularity of demand-side anti-piracy efforts have declined in recent years, possibly due to their high cost, legal overhead, and PR risks.

As the popularity of demand-side anti-piracy efforts have declined, there has been an increase in the use of anti-piracy policies focused on limiting the supply of pirated content. The academic literature shows that these efforts can be effective at reducing pirate consumption. For example, ISP-level site blocking, which is gaining popularity worldwide, can reduce piracy and increase legal sales, but only when a sufficiently large number of sites are blocked simultaneously. Likewise, removing pirate links from online sources and reducing the prominence of pirated links in search results can reduce pirate consumption and increase legal consumption.

1. The Piracy Ecosystem

Article 1, Section 8, Clause 8 of the U.S. Constitution grants Congress the power “to promote the progress of science and useful arts, by securing for limited time to authors and inventors the exclusive right to their respective writings and discoveries.” The ability to protect intellectual property rights in this way has always been a central tool for providing artists and rightsholders with the necessary economic incentives to invest in creating content, but it is particularly important today. Because digitized works like films, books, music, television shows, and software can be reproduced and distributed at near zero cost, economic theory predicts that in the absence of copyright protection markets for selling such goods would be fiercely competitive—with prices dropping toward zero. This, in turn would leave little room for creators to recover the fixed costs associated with creating the original piece of work.

Given that creators invest substantial resources, in terms of time, money, talent, energy, and risk, to create products,¹ if rightsholders have limited opportunities to recover their initial investment, they will in turn have limited incentives to create future products. These reduced creative incentives could cause significant problems for creators, and for the broader society that benefits from their talents. Given the association between copyright protection and artists’ incentives to create, it is vitally important to understand the impact of piracy on economic markets, and the steps policymakers, rightsholders, Internet intermediaries, and other stakeholders can take to ensure the efficient functioning of markets for creative content.²

Our goal in this report is to present a holistic view of the piracy landscape. We define piracy as the consumption of unlicensed consumption of copyrighted products, as distinct from counterfeiting, which is the consumption of unlicensed trademarked products.

In this section, our analysis of the pirate landscape starts with the origination of pirate leaks and the manufacturing of pirated physical goods; a discussion of piracy distribution mechanisms including their supporting intermediaries, such as payment processors, online marketplaces, web

¹ For example, music labels may invest millions of dollars to “break” a new artist, Hollywood films regularly have production budgets of several hundred million dollars, and authors can spend years working on a single book.

² In this report we define piracy as the unauthorized reproduction or use of another’s copyright.

hosting services, and social networks; and a discussion of how actors in the ecosystem are organized and their financial and social incentives for participating in piracy. We discuss the academic literature regarding the impact of piracy on legal sales and creative incentives and the impact of anti-piracy efforts in sections 2 and 3.

Before discussing the current state of piracy, it is important to note that piracy is not new. In the nineteenth century, piracy of European books was widespread in the United States, given the relatively weak protection U.S. copyright law provided to foreign authors (Balazs 2011). However, the relatively high cost to duplicate and distribute printed books limited the scope and impact of piracy in the nineteenth century. That changed in the late twentieth century as new technologies reduced the costs associated with reproducing copyrighted content. For example, the introduction of cassette tapes and photocopying machines enabled the unauthorized copying of audio files and books in the 1960s and 1970s. Similarly, consumer adoption of Betamax and VHS recorder systems in the 1970s and 1980s allowed home users to make copies of films distributed on VHS and Betamax tapes and to record television and movie content from television broadcasts. However, there is some evidence that when copying was limited to physical media in this manner, its effects on copyright owners and markets for creative works was muted (see, for example, Liebowitz 1985a, Liebowitz 1985b, Biasi and Moser 2018).

The digitization of media content and the widespread availability of the Internet in the late 1990s radically changed the ease, quality, and scope of piracy. The introduction of MP3 encoding technology for music reduced the size of song files dramatically and facilitated the introduction of technologies that enabled widespread filesharing of music on the Internet. This culminated in the introduction and popularity of Napster and other file sharing sites starting in 1999. In 2003, the development of the BitTorrent filesharing protocol extended the digital piracy distribution ecosystem by enabling the piracy of larger files, including movies and television shows.

Because Internet-based piracy of digital goods is unrestrained by physical media or distance, it is significantly more widespread than physical piracy and significantly more difficult to combat. As a result, theory suggests that Internet piracy could be vastly more disruptive to legal markets for creative works than prior forms of physical piracy. For this reason, we will discuss the piracy ecosystem for physical products and digital products separately in this section, and in the

remaining sections we will focus our discussion on the academic literature pertaining to digital piracy.

1.1 Piracy of Physical Goods

Our review of the physical and digital piracy ecosystems starts with a high-level discussion of the scale of piracy in the marketplace, the potential economic harm from piracy, and the ecosystem supporting the production, distribution, and discovery of pirated products. We define physical goods as copyrighted products that are distributed in a physical medium (e.g., pirated CDs, DVDs, and Blu-ray discs).

Based on various government and industry studies, the scale of physical piracy is extensive. The Organization for Economic Cooperation and Development (OECD 2019) examined the rise in sale of pirated copyrighted goods and counterfeit trademarked goods. They found that “in 2016, international trade in counterfeit and pirated products amounted to as much as USD 509 billion.” This number made up 3.3 percent of world trade and represented a substantial increase from a prior study that found counterfeit and pirated products represented only 2.5 percent of world trade in 2013.

Similarly, the Government Accountability Office (GAO 2018) conducted a study of shipments entering the U.S. of both copyrighted and trademarked goods. The GAO study used “undercover purchases” of consumer goods offered by third-party sellers on “popular consumer websites” and found that 43 percent (20 of 47) of the products they purchased were pirated or counterfeit. For entertainment products, the likelihood of finding pirated physical products may be lower than for counterfeit goods, but it is still substantial. A recent study by the Recording Industry Association of American found that, among a sample of popular and “evergreen” records, 16 percent (13 of 79) of the titles purchased on eBay and 11 percent (9 of 80) of the titles purchased on Amazon were pirated (RIAA 2019).

Given the likelihood of finding pirated physical products in online markets, it’s not surprising that many consumers have purchased pirated or counterfeit physical products online. A 2019 study by the Better Business Bureau (BBB 2019b) found that 25 percent of American consumers have purchased a pirated or counterfeit product online, and a 2018 study by Incopro (Incopro 2018),

found nearly identical results in the UK, with 25 percent of UK consumers reporting that they had purchased pirated or counterfeit products in 2017.

The supply chain of physical pirated goods is similar in many ways to the supply chain of legitimate physical goods. The supply chain contains manufacturers and distributors, and involves intermediaries facilitating product discovery and payment processing. There is one important difference however: unlike the supply chain for legitimate products, payments in the piracy ecosystem don't make their way back to the intellectual property owner.

Below we discuss the manufacturing, discovery, distribution, payment processing, and fulfillment functions for physical pirated goods.

1.1.1 Manufacturing

The vast majority of manufacturing operations for pirated physical products are located internationally, particularly in Pacific Rim countries. For example, the Government Accounting Office found that in 2016, 88 percent of all intellectual property rights seizures came from China or Hong Kong (GAO 2018, Figure 2, page 13).

With respect to book piracy, the Authors Guild notes that the advent of print-on-demand technologies has dramatically lowered the cost of book printing, allowing pirates to flood the market with cheaper print-on-demand copies of books.³ The lack of vetting mechanisms by print-on-demand service providers makes it very convenient for pirates to upload digital files of infringing copies and use the file to print and sell pirate copies directly to customers through third-party seller accounts, frequently located in the United States.

1.1.2 Discovery

The Better Business Bureau states that “most people find fake products from internet searches,” and it is common for pirates and counterfeiters to use standard Search Engine Optimization strategies to ensure that their products are listed toward the top of search results (BBB 2019a). The sale of pirated content in online channels may be particularly problematic for consumers given the difficulty in distinguishing pirated products from legitimate ones. If you buy a CD or a DVD from

³ Authors Guild Comments to the Department of Commerce, p. 4, <https://www.authorsguild.org/wp-content/uploads/2019/07/Authors-Guild-Comments.DOC-Counterfeiting-1.pdf>

a physical marketplace, there are ample physical clues one can use to determine whether it is a fake, but there are far fewer clues online. Once arriving at an online site, pirated products are difficult to identify—even for the rightsholders themselves—without actually purchasing and receiving the product (BBB 2019a, p. 6).

1.1.3 Distribution

Traditional online marketplaces such as Amazon and eBay, are responsible for a significant proportion of piracy in physical goods. According to the Seal Network, 70 percent of the pirated and counterfeit goods sold each year are sold through online marketplaces.⁴ The role online marketplaces play in piracy is not surprising given their prominence in all forms of commerce, but it is exacerbated by the relative anonymity of sellers in Amazon and eBay’s online marketplaces.

Sites like Amazon and eBay have strong business reasons for wanting to create online marketplaces that allow buyers and sellers to transact. Two-sided markets, such as those present in eBay’s auction marketplace and Amazon’s retail marketplace, have strong network effects, creating near “winner-take-all” outcomes for market leaders (Eisenmann et al. 2006; Van Alstyne et al. 2016). Amazon and eBay also benefit significantly from the scale present in their online marketplaces. While eBay has always relied on its role as a marketplace between independent sellers and buyers, Amazon’s marketplace business has grown significantly since its founding. Jeff Bezos announced that marketplace sales made up 58 percent of Amazon’s total merchandise revenue in 2018 versus just 3 percent in 1999.⁵ Most of the transactions on Amazon and eBay occur directly between the buyer and the seller without requiring the platform to take possession of the product itself. Given their size and market power, eBay and Amazon are able to charge sellers a substantial share of the purchase price (around 5-9 percent in the case of eBay and 15 percent in the case of Amazon) simply for facilitating the transaction (although sellers have the

⁴ See <https://medium.com/sealnetwork/70-of-counterfeit-products-are-sold-online-c6eafe07083>

⁵ <https://www.statista.com/chart/18751/physical-gross-merchandise-sales-on-amazon-by-type-of-seller/>. See also <https://www.statista.com/statistics/259782/third-party-seller-share-of-amazon-platform/> which finds that Amazon’s marketplace made up 54 percent of unit sales in the second quarter of 2019.

option to pay Amazon to facilitate product fulfillment, and eBay has announced a similar fulfillment service will launch in 2020).⁶

However, while there are many legitimate benefits to platforms giving access to third-party sellers, the anonymity offered by online marketplaces means that third-party sellers are significant sources for counterfeit and pirated physical products. In the context of trademarked goods, counterfeit copies of a variety of products including Elevation Lab headphone mounts,⁷ Forearm Forklift moving straps,⁸ Nite Ize car mounts, Otterbox electronics cases, and Vera Bradley bags have been reported to be available from Amazon Marketplace sellers.⁹ Some brands have responded to the threat posed by these goods by removing all their products from eBay or Amazon's online marketplace. For example, in 2017, Birkenstock removed their products entirely from Amazon's platform after discovering multiple counterfeit products available from Amazon marketplace sellers.¹⁰

Both eBay and Amazon have responded to rightsholder concerns by taking steps against pirated and counterfeit products on their site. eBay has a detailed policy prohibiting the sale of "replicas, counterfeits, or unauthorized copies,"¹¹ a money-back guarantee program that covers items that "don't match the listing" on eBay,¹² and procedures for buyers and rightsholders to report eBay listings that potentially infringe copyright.¹³ Similarly, in February 2019 Amazon announced "Project Zero," a program designed to empower rightsholders to "drive counterfeits to zero."¹⁴ The program aims to use Machine Learning methods based on brand images and logos to proactively identify counterfeit products among the 5 billion product listings Amazon receives per day,¹⁵ enhanced "self-service" tools to allow copyright owners and trademark owners to identify

⁶ <https://venturebeat.com/2019/07/24/eBay-takes-on-amazon-with-managed-delivery-a-fulfillment-service-for-u-s-sellers/>

⁷ <https://fortune.com/2018/03/03/amazon-complicit-selling-counterfeit-products/>

⁸ <https://www.forbes.com/sites/wadeshepard/2017/09/27/amazon-com-the-place-where-american-dreams-are-stolen-by-chinese-counterfeiters/#e94739c4c72e>

⁹ <https://techcrunch.com/2019/06/27/amazon-files-suit-against-more-counterfeiters/>

¹⁰ <https://www.theatlantic.com/technology/archive/2018/04/amazon-may-have-a-counterfeit-problem/558482>

¹¹ <https://www.ebay.com/help/policies/prohibited-restricted-items/fake-items-policy?id=4276>

¹² <https://www.ebay.com/help/policies/eBay-money-back-guarantee-policy/eBay-money-back-guarantee-policy?id=4210>

¹³ <https://www.ebay.com/help/policies/listing-policies/selling-policies/intellectual-property-vero-program?id=4349>

¹⁴ <https://blog.aboutamazon.com/company-news/amazon-project-zero>

¹⁵ <https://techcrunch.com/2019/06/27/amazon-files-suit-against-more-counterfeiters/>

and remove their products from Amazon's marketplace, and procedures to help buyers differentiate between legitimate and counterfeit goods through serial numbers assigned by the trademark owner.

Nonetheless, many copyright owners argue that Amazon's efforts have been ineffective at reducing overall copyright violations on the site. In a June 2019 story in the *New York Times*, Mary Rasenberger, executive director of the Authors Guild, observed that "counterfeiting of books on Amazon has surged" in recent years. Likewise, an August 2019 investigation by the *Wall Street Journal* found 4,152 items for sale on Amazon's marketplace that "have been declared unsafe by federal agencies, are deceptively labeled or are banned by federal regulators," and that 46 percent of these products were fulfilled by Amazon as opposed to being shipped from the marketplace seller.

In spite of the fact that many pirated and counterfeit products remain on these platforms, the increased enforcement at Amazon and eBay has caused many pirates to move their operations to social media platforms. According to a study in the UK, social media sites like Facebook and Instagram have overtaken online auction sites like eBay as the source of counterfeit products, due in large degree to eBay's aggressive stance against counterfeiting (Forster 2015). For trademarked goods, Stroppa and Specchiarello (2014) found that 24 percent of all Facebook advertisements for fashion and luxury products link to sites trafficking in counterfeit products.

In some cases, the ability to sell pirated goods on social media sites is directly facilitated by the site's privacy protection features. For example, Instagram allows users to post "Instagram Stories," short video clips that "disappear" after 24-hours. While this feature has legitimate purposes for Instagram's users, an article in *Business Insider* argues that it has made it easier for pirates and counterfeiters to advertise products without leaving a permanent record of the advertisement.¹⁶ Consistent with this view, a study by Ghost Data identified over 55,000 accounts on Instagram that create an average 1.6 million Instagram stories per month advertising pirate and counterfeit products (Stroppa et al. 2019).

¹⁶ <https://www.businessinsider.com/instagram-riddled-with-people-selling-fake-fashion-goods-2019-5>

1.1.4 Communication, Payment Processing and Fulfillment

Social media sites are also increasingly popular for sellers of pirated physical products because of their flexible payment systems. On platforms like Amazon and eBay, communication and payment occur through the platform. This allows the platform to maintain ownership over the transaction and the customer, but it also increases the risk for sellers of counterfeit goods: if a seller's account is shut down by the platform, the seller will no longer be able to communicate with their buyers.

In contrast, pirates and counterfeiters on social media channels are able to use third-party tools to communicate directly with customers and process payments. According to Ghost Data (Stroppa et al. 2019), the most popular communication tools for Instagram pirates and counterfeiters in 2019 were WhatsApp (used by 57 percent of all the pirates and counterfeiters in the Ghost Data sample), WeChat (15 percent) Line (13 percent) and Viber (5 percent);¹⁷ and the most popular payment processors accepted by Instagram pirates and counterfeiters were WeChat Pay (40 percent), PayPal (36 percent), Venmo (7 percent), and CashApp (6 percent). Within the same sample, most fulfillment of pirated and counterfeit goods was handled by EMS (54 percent), DHL (33 percent), and UPS (10 percent). Pirate sellers even exploit the characteristics of payment systems to protect their sales. A *Business Insider* story found that many sellers request payment through PayPal's Friends and Family feature, which does not protect buyers against pirated and counterfeit goods.¹⁸

1.2 Piracy of Digital Goods

As with physical piracy, government and industry studies suggest that there is substantial economic harm from digital piracy. For example, Blackburn et al. (2019) find that, worldwide, there are approximately 26.6 billion illegal pirated viewings of U.S. produced films each year as well as 126.7 billion pirated viewings of U.S. produced television shows. The authors estimate that this causes a loss to domestic revenues of \$29.2 billion to \$71 billion per year, which implies losses between 11 percent and 25 percent of industry revenue. The authors also find that this leads to between 230,000 and 560,000 lost jobs in the U.S. each year. Similarly, according to a 2017

¹⁷ The advantage of using these external communication applications is that if Instagram shuts down the counterfeiter's Instagram account, the counterfeiter maintains their ability to communicate with their customers.

¹⁸ <https://www.businessinsider.com/instagram-riddled-with-people-selling-fake-fashion-goods-2019-5>

Digimarc/Nielsen survey, U.S. publishers lost approximately \$315 million in sales because of digital piracy.¹⁹

While industry studies such as these provide high-level estimates of the total impact of digital piracy across a variety of sectors, a growing academic literature extends these industry studies by providing detailed causal analysis, and peer-review quality validation. We review these academic studies in detail in section 2 below.

The supply chain for digital pirated goods mirrors the supply chain for physical pirated goods in that intermediaries facilitate discovery of pirated content by consumers, the distribution of content from providers to consumers, and the flow of payments from consumers to both platforms and providers. The major difference between the supply chains for physical and digital piracy is that, while physical piracy must be manufactured and delivered in a physical format, digital piracy requires no manufacturing step and is distributed virtually, thereby reducing the cost and increasing the scope and scale of digital piracy operations.

1.2.1 Sources

According to a report by the Federation Against Copyright Theft (FACT 2017), “most [digital] pirated content starts with so-called *release groups*.” Release groups are loosely organized groups of individuals, frequently located in different countries. Release groups list the group’s name in content they post online and compete with other groups to “build their brand and develop a reputation for reliable and high-quality content” (FACT 2017).

Content provided by release groups can come from almost any stage in the production and distribution of entertainment goods, including prior to their official release. For example, in 2009, the movie “X-Men Wolverine” was released onto pirate networks more than a month before its official theatrical release date when a workprint copy of the movie was leaked during the post-production process.²⁰ Similarly, in February 2017 several shows were leaked from the post-

¹⁹ Digimarc Corporation Press release, <https://www.prnewswire.com/news-releases/e-book-piracy-costspublishers-315-million-in-lost-sales-300423534.html>

²⁰ <https://www.nytimes.com/2009/04/02/business/media/02film.html>

production company Larson Studios, including season five episodes of the Netflix Original series “Orange is the New Black.”²¹

However, it is relatively rare for content to leak prior to their official release because firms are able to use both technical and procedural practices to limit the number of people who have access to their content prior to its release.²² Once content is released onto legal distribution channels, that control goes away. In the case of movies, piracy occurs almost immediately after a movie’s initial theatrical release with so-called “Cam” rips of movies. Cam copies of movies are made by pirates who use video cameras to record movies in the theater, sometimes with ambient audio from the theater and sometimes with audio from a higher quality audio source synced to the source video.

Because Cam rips are obtained from an analog source, they usually have relatively low quality, which some research suggests reduces their harm relative to higher quality digital rips (see, for example, Burtch et al. 2019). Trade organizations, such as the Motion Picture Association, also go to great lengths to make it difficult for individuals to record video in theaters and conduct enforcement against individuals caught recording content in theaters.²³

Digital releases present a much more significant challenge for content owners. Once content is released in a digital format, it becomes much easier for release groups to obtain and distribute. For example, anyone in the manufacturing or distribution supply chain for CDs and DVD/Blu-Ray discs is a potential source of pirate content. This is why high-quality digital rips of most movies are available 1-2 weeks *before* the official DVD or Blu-ray release date, and almost immediately after release on digital platforms such as iTunes and Google Play.

Similarly, in the music industry it has long been the case that consumers could copy songs from CDs which lack Digital Rights Management (DRM) protection. But as the industry has shifted away from physical sales and toward digital subscription services, it has seen a significant rise in stream-ripping — copying music files from the digital content provided by legal streaming

²¹ <https://www.wired.com/2017/05/orange-is-the-new-black-leak/>

²² See, for example, the Motion Picture Association of America’s Content Security Guidelines at <https://www.mpa.org/wp-content/uploads/2019/05/MPAA-Best-Practices-Common-Guidelines-V4.05-Final.pdf>

²³ See, for example, <https://arstechnica.com/tech-policy/2014/10/mpaa-movie-theaters-announce-zero-tolerance-policy-against-wearables/>

services. A 2017 survey conducted by the International Federation of Phonographic Industries (IFPI) found that 35 percent of Internet users across 13 countries surveyed obtain music through stream ripping, versus only 30 percent the prior year (IFPI 2017). Similarly, a 2019 survey by MusicWatch “estimated that there are 17 million stream-rippers in the US during 2018, up from 15 million in 2017.”²⁴

The same goes for publishing: as the demand for ebooks increases, especially in genres like romance, which has almost entirely migrated to digital distribution, pirates have more opportunities to disrupt legitimate distribution channels. So far, the publishing industry has not been able to develop protective technologies against mass copyright infringement. The industry standard DRM protection is very easy to circumvent. As with other digital content, pirated ebooks are typically sourced from files where DRM protection has been stripped.

Video games and other entertainment software can include more flexible digital rights management systems than what is available within the ebook, DVD and Blu-ray standards. Nonetheless, gaming release groups compete with each other to see who can be the first to break the copy protection and release the game onto pirate networks. Chandra (2016) describes the structure of gaming release groups as “following a strict division of labor” across suppliers, crackers, testers, and packers. Suppliers frequently have strong connections within the gaming supply chain, which gives them the ability to obtain copies of games either prior to their release or immediately after release. Crackers then take the game and determine how to remove or disable any digital rights management software. Testers ensure that the cracked game works according to its design (thus maintaining the reputation of the release group), and packers remove any unnecessary code to reduce the size of the released content.

1.2.2 Distribution

Once a pirate source is available, release groups race to be the first to post it to online websites and networks. These networks can take a variety of forms. Early piracy networks such as Napster and Grokster were based on peer-to-peer networks with a centralized structure. While a centralized peer-to-peer structure simplifies the operation of the network, centralization comes with a

²⁴ <https://www.musicwatchinc.com/blog/thanks-to-stream-ripping-music-piracy-still-a-scourge/>

significant vulnerability: A central point of operation that can be targeted and shut down through technical and legal means. For example, both the Napster and Grokster networks were shut down through court orders in the U.S.

Decentralized peer-to-peer networks such as BitTorrent gained popularity following the shutdown of Napster and Grokster. BitTorrent piracy operates with “swarms” of users who provide and download segments of an individual digital file. BitTorrent tracker sites such as The Pirate Bay and Torrentz2 provide users with links to tracker files that maintain a record of the file segments of the content and which participants in the swarm are sharing each segment of the file. One weakness of BitTorrent networks, however, is that to participate users have to make their IP address available to the network, which can expose the user’s identity to rightsholders and other enforcement agencies (although many BitTorrent users mask their true IP address using the services of various Virtual Private Networks).

The weaknesses of the BitTorrent network gave rise to downloading from cyberlocker sites like Rapidgator, M247, and uploaded.net; and to streaming sites like 123movies.com, Kinogo.cc, and movies.nl. Cyberlocker sites directly host content uploaded by users and make this content available to downloaders. Streaming piracy sites host content and deliver this content to users through video streaming.

The popularity of these sites has increased relative to BitTorrent in recent years. Sandvine estimates that BitTorrent traffic declined from 23 percent of all North American Internet traffic in 2011 to just 5 percent in 2016.²⁵ Similarly, the office of the U.S. Trade Representative (USTR 2018) estimates that pirate streaming sites have “[overtaken] pirate torrent and direct download sites for distribution of pirated content.” One reason for their popularity is that it is difficult for rightsholders to identify the individual users downloading content from these sites because of the direct connection between the user and the site, and it is difficult to target the sites themselves because they are generally located in countries with lax copyright enforcement (USTR 2018).

While pirate content sourced from cyberlockers and streaming sites can be downloaded and viewed directly on a user’s computer, Kodi software and hardware makes it easy for individuals to watch

²⁵ <https://www.wired.com/2017/05/orange-is-the-new-black-leak/>

pirated content on home theater systems by providing a piracy platform and user experience that mimics the experience through standard cable boxes. Kodi, which was initially called the Xbox Media Center (or XBMC), was designed as an open source application to allow consumers to play video content stored on their local devices and to stream content from remote sources. While Kodi itself is an open source software application, maintained by the XMBC Foundation (Sandvine 2017), many individuals have developed “add-ons” that allow users to extend the capability of the baseline Kodi software to access and stream content from sources online. Some of these add-ons allow users to stream from licensed sources, including YouTube and the BBC iPlayers. However, many Kodi add-ons exist primarily to provide users with a way to consume unlicensed copyrighted content, much of which are sourced from pirate cyberlocker and streaming sites.

As Kodi grew in popularity, a cottage industry developed of individuals selling “fully loaded” Kodi boxes—small computers pre-loaded with the Kodi software and add-ons necessary to obtain a wide variety of unlicensed content through online sources. Fully loaded Kodi boxes became available from a variety of sources including eBay, for prices in the range of \$50 to \$200. As of 2017, Sandvine estimated that 8.8 percent of North American households had Kodi boxes and roughly 68 percent of these boxes were configured with add-ons designed to access unlicensed content (Sandvine 2017). Alongside Kodi, similar piracy ecosystems have developed around the Plex media player.²⁶

1.2.3 Economic and Social Incentives

Participants in the digital piracy supply chain are motivated by a powerful combination of economic and social incentives. On the economic side, piracy can be a profitable endeavor for leakers, sites, and individuals. While many leakers primarily seek social incentives, as we describe below, some are well paid for their ability to obtain leaked content early in a product’s release. For example, a 2015 article on the TorrentFreak blog discussed the experiences of a pirate going by the name of SaInT from the release group MaTinE who claimed that “he was offered \$3,000 each [to supply] movies on the day of their release.”²⁷

²⁶ See, for example, <https://www.theverge.com/2019/7/23/20697751/piracy-plex-netflix-hulu-streaming-wars>

²⁷ <https://torrentfreak.com/movie-piracy-veteran-recalls-20-years-in-the-scene-151011/>

After content has been leaked, sites who host the content can profit in a variety of ways, starting with advertising. Incopro (2015) found that advertising is the primary source of revenue for the top 250 piracy sites it surveyed, and it identified DirectREV, PropellerAds/OneClickAds, and AdCash as the top intermediaries serving advertisements to piracy link sites and public P2P portals. Similarly, a study commissioned by the Digital Citizens Alliance (2014) estimated that the top 600 piracy websites online earned a combined \$227 million in advertising revenue annually, and that the top 30 sites earned, on average, \$4.4 million annually. Overall, the study estimated that piracy sites enjoy profit margins ranging from 80-94 percent. A RAND study found that the profit margins for pirated goods are “much higher than those for drugs” and quoted a pirate suspect as telling the Los Angeles Sheriff’s Department that piracy is “better than the dope business, and no one’s going to prison for [selling pirated] DVDs” (Treverton, et al. 2009). Advertising is sufficiently profitable that some pirate sites have created affiliate programs that allow users who post sufficiently popular content to share in the advertising revenue generated by their posts.

Subscription fees are another way that pirate sites can generate revenue. For example, before it was shutdown, the cyberlocker Megaupload received more than \$110 million through PayPal for user subscriptions to its premium accounts.²⁸ Ironically, Kodi boxes, have weakened the business model of some sites by allowing Kodi users to avoid on-site advertising. In April 2019, TorrentFreak reported that RapidVideo was changing its business model from advertising to subscription because “freeloading” Kodi users were capturing “half of the site’s bandwidth without generating any revenue.”²⁹ Two weeks later the same blog reported that Openload, another major file hosting site, was discontinuing its advertising affiliate program due to “ongoing weakness in generating revenue from advertising.”³⁰

In addition to advertising and subscription revenue, malware is a significant source of revenue for pirate sites. The Incopro study cited above found that one-third of advertisements on pirate sites were “trick button/malware” advertisements—advertisements that expose users to malware and

²⁸ <https://www.wired.com/2012/01/megaupload-indicted-shuttered/>

²⁹ <https://torrentfreak.com/freeloading-kodi-add-on-users-are-undermining-rapidvideo-190405/>

³⁰ <https://torrentfreak.com/huge-video-hoster-openload-stops-paying-uploaders-190419/>

other security risks. A 2017 study by the Digital Citizens Alliance (2017) estimated that pirate websites make \$70 million annually from exposing their users to malware.

Direct extortion is also an economic option being explored by some pirates. After the leak of the fifth season of “Orange is the New Black” in February 2017, a hacker going by the name “The Dark Overlord” demanded a “modest” ransom from Netflix not to release the leaked episodes. The Walt Disney Company also received a ransom demand from a pirate claiming (falsely) to possess a leaked copy of *Pirates of the Caribbean 5*.³¹

While there are clear economic incentives to participate in piracy, social and reputational incentives are also important motivators for individuals involved in the generation and distribution of digital piracy. For example, a 2002 article in *The New York Times*, compares participation in piracy to the “technological equivalent of joy riding—a form of bravado” used to secure “acceptance in a hierarchical social sphere.” The article quotes David Grime, a former member of the release group “DrinkOrDie,” as saying that participation in pirate release groups is “all about stature...they are just trying to make a name for themselves for no reason other than self-gratification.”³² In 2010, Wesley Hsu, an assistant U.S. attorney who prosecuted some of the individuals responsible for releasing “X-Men Wolverine” on the Internet observed that many leakers were driven by “some sort of Internet prestige thing” and saying “that’s sort of how the culture works.” Similarly, Basamanowicz and Bouchard (2011) summarize the motivation for many release group participants as “seeking thrill from law enforcement,” being ideologically against copyright protection, or being attracted by the personal challenge and reputation of being the first to “crack” the protection on a piece of software.

2. The Scope and Magnitude of Economic Harm from Piracy

The purpose of this section is to evaluate the academic literature on the effect that Internet piracy has had on sales of copyrighted works. Below, we start by analyzing the statistical difficulties in understanding the relationship between piracy and legitimate sales, and the various methodological

³¹ <https://www.hollywoodreporter.com/news/disney-chief-bob-iger-says-hackers-claim-have-stolen-a-disney-movie-1003949>

³² <https://www.nytimes.com/2002/07/11/technology/pirates-on-the-web-spoils-on-the-street.html>

approaches that papers in the academic literature have used to overcome these statistical difficulties.

2.1 Methodologies of Academic Studies on Piracy and Sales

The adage that “correlation does not establish causation” is critically important when analyzing whether piracy harms legal sales because it is common to hear simple comparisons of sales across time, across products, or across customers provided as evidence for the harm or benefit of piracy.

A quick glance at industry sales figures after the introduction of file sharing technologies in the late 1990s and early 2000s might suggest that digital piracy was devastating to sales in legitimate markets. For example, in the 10 years after Napster made music piracy popular, worldwide recorded music sales shrunk by over 50 percent (Liebowitz 2014). Similarly, in the four years following the introduction of the BitTorrent protocol in 2003, home video sales decreased by 27 percent (Zentner 2010). On the other hand, looking at piracy levels across products or across consumers would suggest that piracy has been massively *beneficial* to legal sales. It is well documented that movies which are pirated more also tend to sell more, and that consumers who pirate content are more likely to purchase content than other customers.

However, none of the above comparisons establish a causal link between piracy and sales. The mere fact that legal music sales dropped after the introduction of Napster, and that legal motion picture sales dropped after the introduction of BitTorrent, does not establish that piracy caused this decline in sales. It is entirely possible that the observed drop in legal sales was caused by other unrelated events—changes in consumer tastes, changes in consumption patterns, a recession economy, competition from other entertainment sources—that happened to coincide with the introduction of these piracy-enabling technologies.

Similarly, the mere fact that movies that have higher levels of piracy also tend to have higher levels of sales, or that consumers who are likely to pirate entertainment are also likely to purchase entertainment, does not establish that piracy causes an increase in sales. Some movies are just more popular than others, and this increased popularity at the product-level causes both increased sales and increased piracy for that product. Likewise, consumers with greater interest in entertainment products are likely to both purchase more products and pirate more products than other consumers.

What we really want to know is how many more products might have sold, and how many more consumers might have purchased, if piracy had not been an option. Fortunately, there are several empirical methods that have been used in the academic literature to reliably analyze causation between piracy and sales.

The first method involves the use of individual data—whether from surveys or from Internet panel tracking companies—on piracy rates and legal consumption rates. In studies using individual survey data, authors typically try to find some source of variation in piracy rates across consumers (or within consumers but over time) that is not itself correlated with variation in legal purchases. For example, in an early version of this method, Rob and Waldfogel (2006) use the fact that some students in their survey attended a university that provided broadband Internet access, while others chose a university that provided only slower dial-up connections. Based on the assumption that students did not choose their university based on their interest in entertainment, Rob and Waldfogel asked how the increased ease of consuming piracy via high-speed connections on some campuses influenced music CD purchases by students residing at those campuses. Similarly, under the assumption that the decision to adopt the Internet prior to Napster was unrelated to the desire to consume entertainment, Hong (2013) uses data from the Consumer Expenditure Survey to ask how individuals who identified as Internet users changed their music purchasing behavior after the introduction of Napster relative to the individuals who did not identify as Internet users (and thus were unaffected by Napster).

More recently, researchers have relied on individual data from Internet panel tracking companies who monitor a random sample of Internet users and track their daily Internet activity. These studies also attempt to isolate differences in pirated consumption that are unrelated to the propensity to consume legally. For example, Aguiar and Martens (2016) use Internet panel data from Nielsen and ask whether individuals who increase their visits to music piracy sites (from period to period) increase or decrease their visits to legal music purchasing sites, relative to individuals who do not change their visits to piracy sites. They also partly control for changing preferences for music (within individuals) with measures of the number of music-related sites that individuals visit, such as music blogs or concert listing sites. Danaher et al. (2020) study individuals in a UK Internet panel before and after a number of video piracy websites were blocked in that country and ask

whether more intense users of those sites increase their legal video consumption after the blocks relative to lighter or non-users of the blocked sites.

The second method involves changes in piracy and sales across different media products, often exploiting shocks that impact only some products or time-periods, and that directly influence either piracy or sales but not both. In this vein, Oberholzer-Gee and Strumpf (2007) obtain data on both pirated downloads and legal CD purchases of various albums over time, and exploit German school holidays (which they argue influence piracy availability on music filesharing networks but do not directly affect U.S. CD purchases) as an instrument for piracy to determine whether illegal downloads affect purchasing behavior. Danaher et al. (2010) study the removal of all NBC television content from iTunes in 2007 and ask how piracy of that content changes relative to piracy of television content from ABC, CBS, and Fox, all of which remained on iTunes during this time.

A third and related method to understand the causal link between piracy and legal sales uses geographic panel data, asking whether countries or regions that experience greater increases or decreases in piracy also experience larger changes in legal consumption. Some of these studies overcome the endogeneity problem (the fact that overall changes in media preference in a certain geographical area will impact both piracy and legal purchases) by finding circumstances that directly impact piracy in some geographic regions without being directly related to sales in those same regions. For example, Zentner (2005) uses differential changes in broadband penetration across countries to study the impact of piracy on sales. He does this under the assumption that increased broadband penetration correlates with increased piracy without directly influencing preferences for media sales. Other papers use country-specific shocks that affect piracy. For example, Danaher et al. (2014) study the change in French digital music sales after the French government passed a strict antipiracy law by comparing changes in French music sales after the law's passage to sales changes in other similar European countries who passed no such law. Similarly, Adermon and Liang (2014) study the passage of an antipiracy law in Sweden and compare changes in music sales to other similar countries without a legal shock.

Overall, while the units of observation differ across these three types of studies (individual consumers versus products versus geographic areas), what these studies have in common is that

they attempt to find some random shock that leads to variance in piracy levels but that is unrelated to legal consumption. These approaches are often referred to as “natural experiments” or “quasi-experiments,” and are well-established tools used by econometricians and statisticians to account for the endogeneity between piracy and sales discussed earlier.

Given the presence of reliable methods for determining whether there is a causal link between piracy and sales, the next question is what these methods tell us about how and whether piracy influences sales. We address this question in the next section.

2.2 Estimated Effects of Piracy on Legal Consumption

From a purely theoretical standpoint piracy could either decrease, increase, or have no effect on legal sales. Most obviously, if pirates are people who would have otherwise purchased the content they are pirating, then the presence of piracy will displace legal sales, reducing revenues to rightsholders. However, if pirates are individuals who would not have purchased the content they are pirating in the first place, then piracy will have no effect on legal sales. It is even possible that individuals who pirate content will tell their friends about the content, creating a promotional “buzz” that could in turn increase legal consumption if the pirate’s friends choose to consume through legal channels instead of illegitimate channels. Alternatively, some individuals may use piracy as a sampling method to decide whether they like a product before buying it. In short, the impact of piracy on sales is inherently an empirical question. In this section we study the empirical evidence associated with piracy’s impact on sales for three categories of goods: music, motion picture content, and books.

In reviewing this literature, three things are important to note:

First, the broad question of “does piracy harm sales?” is unlikely to have a simple “yes” or “no” answer that applies to all products, channels, and contexts. The effect of piracy on legal sales may differ depending on the time-period being studied, the type of content in question, or the sales channels under analysis. A pirated MP3 may be a strong substitute for a legal iTunes download, while a low-quality pirated movie may be a poor substitute for seeing a film in the theaters. Likewise, the impact of piracy may vary over the lifecycle of a product. The availability of a

pirated version immediately after a movie is first released in theaters might have a different impact on sales than one that appears weeks after the movie's initial release.

Second, there are no perfect empirical studies. All of the methodologies described above have advantages and disadvantages, weaknesses and strengths.

Third, not all academic studies are created equal. The gold standard of quality in the academic literature is publication in peer-reviewed journals.

Because of this, in our review of the literature below, instead of relying on a single study as the source of "truth" on the impact of piracy on sales, (a) we analyze the results from a broad set of studies that use different methods in different contexts over different time periods and (b) we focus on articles that have been published in peer-reviewed academic journals.

With these points in mind, below we review the empirical evidence on how piracy impacts legal consumption, starting with the music.

Music: Because widespread digital piracy affected the music industry before it affected books and video, music piracy has been studied in the academic literature over a much longer timeframe (roughly 1998-2012) than other categories of entertainment. While the broad timespan of study has some advantages, it also creates three notable challenges when generalizing the results from these studies to the current music market. First, piracy's effect may have changed over time, particularly as legal music streaming services have entered the market. Second, these studies focus on different formats, such as CD sales vs. digital music downloads. Finally, these studies attempt to measure piracy's effect in different units. For example, some measure the displacement rate (how many pirated downloads does it take to reduce legal purchases by one unit?) while others measure the aggregate loss directly in sales units or revenue.

Nonetheless, a meta-review of all of the academic studies on music piracy can give a sense of both the direction (positive or negative) and the general magnitude of the impact of digital piracy on legal sales. The earliest study of music piracy in the peer-reviewed academic literature is Hui and Png (2003). Their study used worldwide CD sales data collected from 1994-1998 to analyze the impact of *physical* piracy on music sales. They found that physical piracy caused about a 6.6 percent drop in CD sales relative to what sales would have been in the absence of piracy.

In the context of *digital* piracy, the results of early studies are mixed. Peitz and Waelbroeck (2004) combined worldwide CD sales with survey data across countries on piracy behavior and found that piracy may have led to a 20 percent decline in CD sales from 1998 to 2002, while Zentner (2005) finds from 1997 to 2002 that countries with larger increases in broadband penetration experienced steeper drops in music sales than those with smaller increases in broadband. Similarly, Rob and Waldfogel (2006) use differing Internet speeds provided at different universities in 2003 to tease out piracy's effect on music sales. Their analysis of these data shows that one out of every five illegal downloads led to a lost CD sale.

On the other hand, Oberholzer-Gee and Strumpf (2007), in a highly cited study, used German school holidays as an instrument for piracy availability in 2002 and found that piracy had no statistically significant impact on album purchases. Similarly, Andersen and Frenz (2010) found no association between pirated downloads and legal purchases in a 2006 survey of Canadian consumers.

In spite of somewhat mixed results in early studies of music piracy, more recent studies have converged on the finding that digital piracy significantly displaces legal music sales in almost all contexts. For example, Liebowitz (2008) finds that music piracy was responsible for almost the entire decline in record sales from 1998 to 2003; Bender and Wang (2009) find that for each one percent increase in piracy, music sales decline by 0.6 percent; Waldfogel (2010) finds that each additional pirated song reduces song purchases by 1/3 to 1/6; and Hong (2013) finds that filesharing is likely to explain about 20 percent of the total decline in music sales following Napster. Danaher et al. (2014) find that the passage of HADOPI, a major anti-filesharing law in France, increased French digital music sales by 20-25 percent relative to a group of control countries. Given that the law wasn't 100-percent effective at eliminating piracy, the estimated 20-25 percent increase in legal sales is a lower bound on the effect that piracy had on total digital music sales. Similarly, Adermon and Liang (2014) found that the passage of a major antipiracy initiative in Sweden increased music sales by 36 percent after it was implemented, again implying a lower bound on the effect that piracy had on sales.³³ Finally, Koh et al. (2019) find that piracy displaces

³³ The above two studies are lower bounds because neither law completely eliminated piracy. If a law that partially reduces piracy increases music sales by x percent, then logically it follows that x percent is a lower bound on the total effect that all piracy has on music sales.

music sales using data from 1982 to 2012, but they suggest that its effect has been partly attenuated by the introduction of digital downloads and the unbundling of the album (a factor we discuss in more detail below).

Altogether, we found 20 peer-reviewed studies that address the question of what impact piracy has on music sales. Seventeen of these studies find evidence that piracy significantly displaces legal sales, while two studies find no evidence of any effect, and one suggests a small causal increase in some countries and no effect in other countries. As we noted above, while scientific research may produce differing results because causal inference is complicated and the settings under analysis differ, our meta-review suggests that the vast majority of scientific work finds evidence that piracy causes legal music sales to fall. Estimates of the magnitude of this effect vary, but nearly all of the studies find effects that are not just statistically significant but also economically substantial.

However, even the most recent studies in the literature use data collected prior to 2012 (e.g., Aguiar and Martens (2016) use data from 2011, Papiés and van Heerde (2017) use data from 2003-2010, and Koh et al. (2019) use data from 1982-2012). During these periods most music sales were generated through a la carte purchases of physical albums or digital albums or singles. Since 2012, music streaming services such as Spotify have become significantly more popular ways for consumers to access music. Unfortunately, there is no peer-reviewed academic literature of which we are aware that estimates piracy's impact on subscriptions and consumption through subscription streaming services. Thus, while our meta-analysis strongly suggests that piracy harms sales, it comes from a time when the primary method of consumption looked different than it does today. In Section 4 we will discuss in more detail the importance for future research to analyze the impact of piracy on consumption through legal streaming services for music.

Movies and Television: Research on the effect of video piracy on legal markets for film and television is similar to that for music piracy in that the studies examine different sales channels (box office, DVDs/Blu-Rays, paid downloads, subscription streaming, etc.), cover different periods of time, and use different methodologies to establish a causal effect. However, there appears to be even more consensus among this literature than there was among music—piracy reduces legal video sales in nearly all peer-reviewed studies and across nearly all motion picture sales channels.

Initially, movies are released in theaters, and later through what the industry calls “home entertainment” channels, which include DVD and Blu-ray sales, purchases and rentals on cable services and digital sales platforms such as iTunes, and consumption through online subscription services such as Netflix. While home entertainment sales make up a larger proportion of studio revenue than theatrical sales, the theatrical release window remains vital to a movie’s financial success. Theatrical revenue generally comes from a movie’s most ardent fans, and a movie’s success in the theater strongly influences its licensing value in other downstream channels (see, for example, Gunter (2018), Smits (2016), and Grant and Meadows (2010)).

Among the studies analyzing the impact of piracy on theatrical revenue, Bounie et al. (2006) use survey data of French consumers and find no evidence that piracy affects box office sales. In contrast, De Vany and Walls (2007) find that piracy of one major studio film caused the picture to lose about \$40 million in U.S. box office revenue. Hennig-Thurau et al. (2007) find evidence that piracy cannibalizes box office sales in Germany, but their study estimates the total effect of piracy across all channels and thus does not isolate the magnitude of the loss in the box office (just the direction of the effect). Ma et al. (2014) study Hollywood studios’ major wide release films between 2006 and 2008 and find that pre-release piracy—piracy that occurs before the film appears in theaters—causes a 19.1 percent decline in box office revenue over and above any losses caused by post-release piracy. McKenzie and Walls (2016) study Australian theatrical ticket sales in 2010 and 2011 and find that piracy causes a statistically significant displacement effect on Australian box office revenue, attributable to the delay between the U.S. theatrical release of a film and its release in Australia, but they find that the magnitude of the loss is economically small. Finally, Peukert et al. (2017) study the effect of the Megaupload shutdown (at the time a very popular cyberlocker) on film box office revenues for both large-budget, wide-release films and smaller, independent films. For large budget, wide-release films (which represent the top 10 percent of films by revenue), they find that shutting down Megaupload caused a statistically and economically significant increase in ticket sales. However, they find no statistically significant effect on the box office for the middle 80 percent of films in their data, and for some small independent films they find that shutting down piracy on Megaupload decreased box office revenues. Their finding implies that piracy may have positive word of mouth effects for some smaller, limited release films.

Thus, of the six peer-reviewed studies on the effect of piracy on box office revenue, two find economically and statistically significant displacement rates, one finds evidence of a statistically significant but economically small displacement effect, one study finds no evidence of a displacement effect, and one study finds that piracy causes significant harm to box office sales of wide release films but has little impact, or in some cases a positive impact, on smaller independent movies.

There is more consensus in the literature studying the impact of piracy on home entertainment channels. While the study by Bounie et al. (2006) discussed above finds no evidence that piracy harmed French theatrical sales, the authors find that piracy had a strong negative impact on VHS and DVD sales and rentals. Likewise, Rob and Waldfogel (2007) use survey data from a sample of U.S. college students in 2005 and find that each instance where a person first consumed the content via piracy reduces paid consumption by one unit. Bai and Waldfogel (2012) apply a similar methodology to a sample of Chinese University students in 2008 and find a displacement rate of 0.14 lost sales for each illegal download, which likely implies that a larger percentage of piracy in China was driven by individuals who would not have purchased in the absence of piracy. Hennig-Thurau et al. (2007) also employ survey data from a sample of German consumers in 2006 and find that piracy causes annual movie revenue losses of about \$300 million in Germany. Finally, Danaher and Smith (2014) study the shutdown of Megaupload in 2012 and find that shutting down just this one site increased digital movie revenues (from digital downloads and rentals) by 6.5-8.5 percent across twelve different countries, implying that losses to piracy are higher than this (since much piracy remained after the shutdown of this one popular site).

In the context of home entertainment sales of television content, Danaher et al. (2010) use a natural experiment approach and found that removing NBC television content from the iTunes store in 2007 caused a 12 percent increase in piracy relative to a control group of content from other networks. Similarly, when NBC content was restored to iTunes a year later, piracy fell.

In the context of piracy's impact on subscription streaming services, Danaher et al. (2020) find that the UK blocking of 53 major video piracy websites caused a 7-12 percent increase in visits to paid subscription streaming sites, along with a 1.1 to 1.5 percentage point increase in the probability that a user of the blocked sites would sign up for a new paid subscription as a result of

the blocks. This finding implies that piracy cannibalizes both visits to paid subscription sites (like Netflix) and subscription payments to such sites. The study also establishes a lower bound on the rates of displacement for these legal channels (again, because the website blocks did not eliminate all piracy).

There is one contrasting study of the impact of piracy on home entertainment sales. Smith and Telang (2009) find that in 2005-2006, films that were broadcast on television experienced a boost in DVD sales at Amazon.com, but that the presence (or lack) of a piracy source for a film online at the point in time it was broadcast did not attenuate this sales increase.

Together, seven of the eight peer-reviewed studies analyzing the effect of piracy on home video sales find evidence of statistically and economically significant displacement effects, while one finds no evidence of an effect, but this last study pertains to films during a period long after their peak sales. Broadly speaking, the literature also shows that reductions in home video sales is economically significant—whether the displacement rate is one-for-one as in Rob and Waldfogel (2007) or one-for-seven as in Bai and Waldfogel (2012). For example, if the shutdown of one popular piracy site—Megaupload.com—caused a 6.5-8.5 percent increase in digital movie revenues in spite of all of the video piracy that remained after Megaupload, total losses to rightsholders from piracy in the home market could be quite substantial.

In summary, nearly all of the studies on video piracy find evidence that piracy displaces theatrical and home entertainment sales. However, the estimates for home video losses are, on average, larger than those for the box office, with the exception of the study on piracy that occurs before a film's theatrical premiere (suggesting that the special case of pre-release piracy may be particularly devastating to theatrical revenue).

Books: Book piracy and its effect on legitimate sales remains largely unstudied in the academic literature. We are aware of only one study that informs this question: Reimers (2016) studied the effect of private copyright protection on book sales. Copyright protection in Reimers' context consisted of an intense campaign of takedown notices sent to piracy sites for some titles and not others. She found that this sort of protection increases e-book sales of protected titles by 14 percent relative to a control group of titles that received no extra protection. This implies that book piracy decreases e-book sales by at least 14 percent, and likely more if one assumes that not all piracy of

the protected titles was prevented. However, Reimers also finds no increase in print book sales of protected titles. This implies that digital book piracy is a much closer substitute for digital book sales than for physical book sales.

2.3 Indirect Impacts of Piracy

While most of the academic literature has focused on the direct impact of piracy on legal consumption, there are five notable indirect impacts that piracy could have on both the entertainment industry and on society in general.

First, while studies in the literature have shown that the impact of digital piracy is lessened when digital à la carte and streaming-based distribution channels are made available to consumers, this only conveys part of the story. While it may be true that entertainment firms' use of digital distribution channels and streaming services have reduced the impact of piracy, the fact remains that the presence of piracy lessens content creators' bargaining power in negotiations with digital platforms. For years, a key component of content creators' economic leverage in negotiations was their ability, granted by copyright law, to withhold their content from a distributor if they were unable to obtain favorable terms. Given the presence of piracy, it is likely that content creators have been forced to accept less favorable terms from distributors than they otherwise would have obtained. Piracy may cause creators and rightsholders to accept less favorable terms given that some revenue (through a less favorable contract) is better than no revenue (if erstwhile consumers choose to pirate when content is unavailable on legal digital distribution channels). If this is the case, it would mean that piracy harms industry revenues in ways that do not show up in figures cited above for the direct effect of piracy on sales. This hypothesis is loosely consistent with the fact that platforms that solely provide licensed music content pay rightsholders far higher rates (\$12/1,000 streams for Apple Music and \$7.50/1,000 streams for Spotify) than does YouTube (\$1.50/1,000 streams) which hosts both licensed and unlicensed content.³⁴ In a 2017 article, Cary Sherman, then CEO of the Recording Industry Association of America, attributes the difference in streaming payments to the fact that "YouTube wrongly exploits legal loopholes to pay creators at rates well below the true value of music."³⁵

³⁴ <https://www.digitalmusicnews.com/2017/08/21/apple-music-spotify-youtube-riaa/>

³⁵ <https://medium.com/@RIAA/2016-a-year-of-progress-for-music-4e9b77022635>

A second, and related, indirect effect of piracy on sales is that content creators may be forced to reduce the length of their release windows in the presence of piracy. There is empirical support for this. For example, Danaher et al. (2015) show that in the presence of digital piracy, “releasing digital movies before the physical (i.e., DVD and Blu-ray) release date nearly doubles U.S. digital sales,” and Smith and Telang (2013) show that in the presence of digital piracy “an additional 10-day delay in a particular country between the availability of digital piracy and the availability of the legal DVD is correlated with a 2-3 percent reduction in DVD sales in that country.” However, reducing release windows—even if optimal in the presence of piracy—can reduce the rightsholder’s profits as compared to a world where piracy was not available by making it more difficult for the rightsholder to segment customers with different valuations for the content.

A third indirect effect of piracy is that rightsholders spend a great deal of money to protect their intellectual property against piracy. This includes the added costs to protect digital copies of files before their release dates, the cost of contracting with firms to watermark digital files during their digital release, the costs associated with monitoring sites for pirated content and sending requests to online platforms to remove pirated content from search results, and the costs associated with lobbying governments for stricter antipiracy legislation.

A fourth indirect effect of piracy is the impact piracy may have on the incentives for artists to create. It is difficult to identify the effect that piracy may have on the supply of new entertainment products to the market, both because such supply-side effects might only manifest slowly over a number of years, and because Internet piracy materialized at the same time that digitization lowered the costs to produce, promote, and distribute entertainment products. In short, at the same time that piracy has been reducing demand for creative works, digitization has been reducing the costs required to supply them. In this regard, while Waldfogel (2012) finds that the number of albums that surpass a certain quality threshold has not diminished since the appearance of Napster, and Waldfogel (2016) finds a similar result for films, these results represent the net effect of both the rise of piracy and the rise of digitization.

To analyze the causal impact of piracy on the incentives for artists to create content one would need to isolate the effect of piracy on the supply of creative works from other effects of digitization. We are aware of two academic studies that specifically attempt to separate these two effects.

Telang and Waldfogel (2018) examine production in the Indian “Bollywood” film industry immediately before and after the invention of the VCR led to widespread VHS tape piracy throughout Indian urban areas. They find that movie industry revenues were increasing in the time leading up to the introduction of the VCR, and accordingly so were the number of Bollywood films being brought to the market. However, after the VCR made physical movie piracy commonplace in India, Bollywood revenues began to fall sharply. Moreover, as revenue fell in India the number of Bollywood films produced began to fall, along with the quality of the remaining films being created (as measured by ratings on IMDb.com). Because the introduction of piracy here was unaccompanied by any digitization-related cost reductions for producers, Telang and Waldfogel’s results show that VCR-based piracy caused a sharp decrease in both the number and quality of movies produced in India.

Danaher and Smith (2017) take a different approach to analyze whether piracy impacts the supply of creative content. These authors note that while all countries experienced a surge in video piracy after the invention of BitTorrent in 2003, some countries’ legal markets were more heavily affected by this piracy than others. Recognizing that it is difficult to produce a foreign film unless it will perform well in its local market, they ask whether the number of Academy Award winning (or nominated) films decreases faster in countries that were more affected by piracy relative to other countries. They find that countries whose domestic markets have been most harmed by piracy suffered precipitous drops in the number of award-winning films produced for those domestic markets, relative to much smaller or no changes in countries whose legal markets have experienced less harm from piracy.

The results of these two papers suggest that piracy impacts the incentives to create. As such, countries or cultural markets that pirate more may find a reduction in the number of quality entertainment products produced that target their cultural preferences.

A fifth indirect impact of piracy relates to the computer security risks pirate sites pose to consumers who download pirated content. A recent academic working paper suggests that exposure to pirated content directly increases the likelihood of a user being exposed to malware and computer security vulnerabilities. Telang (2018) uses a unique panel dataset collected by Carnegie Mellon University’s Security Behavior Observatory project. This dataset contains a demographically

representative sample of 250 users who have voluntarily allowed researchers to instrument their computers to monitor what sites they visit and what processes are running on their machines (including both anti-virus software and potential malware processes). This paper shows that consuming content from pirate websites is causally associated with increased malware infections. Specifically, a doubling of the time users spent on pirate sites was associated with a 20 percent increase in the likelihood that they would become infected with malware. In a blog post, Telang observes that his research shows that while many pirates “don’t worry about the harm that piracy does to content creators, but they should still be concerned about the harm it can do—to themselves” through increased exposure to malware and other security vulnerabilities.³⁶

Thus, while there is some academic research on the indirect effects of piracy, much more research is needed to gain a full understanding of their impact. Nonetheless, the presence of these indirect effects suggests that the estimates of the direct impact of piracy that we discussed in section 2.3 understate the true impact of piracy on the creative industries, on consumers, and on society as a whole.

2.4 Summary

The results found in the vast majority of peer-reviewed academic studies indicate that Internet piracy reduces legal sales of music, film, television, and books. Of the 33 peer-reviewed studies on this topic, 29 studies find that piracy significantly harms legal sales, while only four find no statistically significant impact of piracy on sales. Our summary review of these 34 studies can be found in Tables 1 and 2 at the end of this report.

We also note that the literature shows that digital piracy is generally a closer substitute for digital sales than for physical sales (e.g., Reimers (2016) in the context of books and Danaher et al. (2010) and Danaher et al. (2015) in the context of motion picture content). While not directly related to piracy, Chen et al. (2019) draws a similar conclusion—that ebooks and print books are not close substitutes in the minds of consumers. The general conclusion that digital piracy is a stronger substitute for digital sales than for physical sales may inform some of the observed divergence in findings across the academic literature: most of the studies finding no harm from piracy relate to

³⁶ <https://techpolicyinstitute.org/2018/03/13/piracy-and-malware-theres-no-free-lunch/>

physical sales (e.g., Oberholzer and Strumpf (2007) and Andersen and Frenz (2010) with respect to CD sales, Smith and Telang (2009) with respect to DVD sales, and Peukert et al. (2017) with respect to box office sales for small/independent movie releases).

In addition to the direct effect of piracy on sales measured in these studies, there is good reason to believe that the presence of piracy has important indirect impacts on the entertainment industry (by forcing them to alter their release strategies or accept less favorable terms in negotiations with platforms), on society (through reduced economic incentives to create new content), and on individual consumers (through increased exposure to malware and other consumer security issues)—although more research is needed on each of these topics.

Given the strong empirical evidence of the harm caused by piracy, it is important to analyze what strategies firms and policymakers can use to mitigate this harm. We discuss that topic in our next section.

3. The Effectiveness of Anti-Piracy Strategies

Given the overwhelming evidence in the peer-reviewed academic literature that Internet piracy has decreased sales and revenues to creators of entertainment products, one might ask what strategies are available to mitigate this impact. While much of the early academic research focused on measuring displacement rates due to piracy, a more recent stream of the literature seeks to evaluate the effectiveness of various business strategies and antipiracy policies aimed at reducing piracy and increasing consumption through legal channels. In general, this literature takes the position that pirated versions of goods substitute for legitimate consumption and asks what strategies or policies can make legal consumption channels more competitive with (“free”) piracy channels. The research has focused broadly on two different means of achieving this: actions and strategies that make legal content more appealing to consumers, and strategies or policies designed to make pirated content less appealing to consumers.

3.1 Increasing the Availability and Appeal of Legal Content

Although pirated versions of books, music, movies, and television shows are copies of the same essential product, they are differentiated along a number of dimensions that may influence a

consumer's decision to pirate or consume through legal channels. For example, a pirated version of a film may differ in video quality from a legal version of the film (say, the version offered for sale on the iTunes store). Piracy channels may also differ from legal channels in terms of availability of products, timing of product releases, the convenience of using the channel, risks associated with using the channel, restrictions associated with consumption through the channel, and, of course, financial cost. Thus, at least in theory, improving the utility of using legal channels relative to the utility associated with illegal channels along one of these dimensions could entice some consumers to decrease piracy consumption and increase legal consumption. Whether or not such strategies work is an empirical question. We examine the empirical evidence related to this question below, first in the context of increasing the availability of content on digital channels and second in the context of increasing the appeal of content provided on digital channels.

3.1.1 Increased Availability

There are three academic studies we are aware of showing that making legal content available on convenient digital channels causes some potential pirates to shift from piracy to legal consumption. First, Danaher et al. (2010) studied the removal of NBC television content from iTunes in 2007 and found that piracy of NBC content increased by 12 percent after it was removed from the iTunes store relative to a control group of content from other networks. Moreover, they found that the increase in total piracy was about twice as large as the number of legal iTunes purchases for that content before it was removed from iTunes. This increase in consumption implies that, after shifting to pirate channels, viewers consumed more content than they had when purchasing legally. Later, when NBC restored their content to iTunes, piracy of NBC's content dropped by 7-8 percent—a drop that was smaller in both percentage and unit terms than the initial increase in piracy. This suggests that after switching from legal to pirate channels, it can be difficult to persuade pirates to switch back to legal consumption.

Similarly, Danaher et al. (2014) considered the addition of ABC television series to Hulu in 2009. At the time, Hulu was a free streaming channel supported by a small number of short advertisements. The addition of ABC's content caused piracy of that content to drop by 25 percent relative to a control group of content that experienced no similar change. It is likely that the decrease in piracy from adding content to Hulu is larger than that from adding content to iTunes

because iTunes charges an a la carte price for downloads while Hulu was free with limited advertisements.

In the context of making movies available on digital channels, Smith et al. (2019) studied the addition of 1,520 catalog films to the iTunes store from 2011 to 2012. They found that making these movies available for purchase and rental on iTunes decreased piracy of the same films by 12 percent relative to a control group of films.

Thus, the existing literature shows that the availability of content through convenient legal digital channels can reduce piracy of that content, but it also suggests that lack of legal availability alone does not drive piracy, as none of the shifts in availability cited above reduced piracy by more than 25 percent.

3.1.2 Increased Appeal

With regard to the convenience and usability of legal channels, there is some evidence that reducing restrictions on the use of legal content—specifically, making content more portable across devices—can increase the competitiveness of the legal channel. Zhang (2017) studied the DRM system that was once associated with iTunes music downloads. Under this system, music downloads from iTunes could only be transferred to other devices with iTunes software, and only if the device was signed in under the original purchaser’s account. Further, a purchased song could only be shared to a limited number of devices. As a result, users faced significant restrictions in how they could use their purchased content, especially compared to the usability and flexibility of illegal MP3s downloaded from piracy networks, which could be played and shared across devices made by many different manufacturers and on an unlimited number of devices owned by a particular consumer. Zhang exploited the fact that different music labels removed this DRM system from the iTunes download store at different times and found that the removal of DRM (and thus the less restricted nature of a legal purchase) caused a 10 percent increase in legal sales on the iTunes platform. Zhang also found that this increase was largely driven by increases in sales of lower-selling and less-known albums, suggesting increased sharing and discovery made possible by the removal of restrictions may have driven this sales growth.

The timing of availability of content across channels also appears to be a factor that firms can leverage to increase the desirability of legal content over pirated content. In an unpublished

working paper, Danaher and Waldfogel (2012) consider international box office release windows—the time between the U.S. release of films and their releases in foreign countries. Exploiting quasi-experimental variance in piracy caused by the growth of BitTorrent and the fact that some genres of film are more heavily pirated than others, they find that foreign box office revenues decline by at least 1.3 percent for each week between the initial U.S. release of a film and its subsequent release in a foreign box office. In another unpublished working paper, Smith and Telang (2013) employ a similar strategy, looking at the period of time between the first availability of a pirated copy of a film and its subsequent home video release (release on DVD or digital download channels) in a foreign country. They find that a 10-day delay between the availability of a film on piracy channels and its home video release in a foreign country is associated with a 2-3 percent decrease in home video sales.

Likewise, in a peer-reviewed study cited in section 2.2 above, Ma et al. (2014) estimate the effect of pre-release movie piracy—that is, the effect of piracy that occurs before the start of a film’s official box office release window. They find that pre-release piracy causes a 19.1 percent decline in sales over and above any decline caused by post-release piracy. This finding—that pre-release piracy is more damaging than post-release piracy—again implies that the timing of legal availability relative to piracy availability plays a role in a consumer’s decision to pirate or purchase. In short, there is abundant evidence in the literature that the timing of the release of content on legal channels relative to piracy availability can change some consumer’s decisions about whether to consume in legal or pirate channels.

Finally, we are not aware of published papers finding that increasing the video or audio quality of pirate offerings impacts legal sales; there is one working paper that suggests that this is likely true. Burch et al. (2019) study the effect of piracy sources of varying qualities on U.S. box office revenues of films. They find that while low quality piracy sources cause a 31 percent decrease in revenue after they become available (relative to a hypothetical world where no piracy exists), the subsequent emergence of a high-quality pirate source causes an additional 14 percent decline in theatrical revenue. This implies that the relative quality of pirated copies versus legal copies of films—and possibly other entertainment goods—moderates the effect of piracy on sales.

In summary, it is clear that rightsholders can, to a degree, compete with piracy by increasing the availability of products on convenient legal channels, by reducing restrictions on how consumers are able to use their purchased products, by reducing the delay in legal availability between releases of products across various channels and across geographic areas, and by competing on quality. However, it is also clear that none of these strategies alone is a panacea, as each one only causes a limited decrease in piracy and a limited increase in legal consumption when piracy remains a free alternative, ubiquitously available across the world, often at an early stage in a product's lifecycle.

Perhaps the strongest evidence that firm strategies are limited in their ability to combat piracy by making legal content more appealing comes from de Matos et al. (2018). These researchers worked with a major multinational telecommunications provider to run an experiment where they randomly selected a subset of the provider's subscribers and gifted them with free access to a large subscription video on demand (SVOD) service, a service that contained a plethora of popular television shows and films. They found that, although this free offering caused selected households to increase their legal video consumption, it caused no change in the use of BitTorrent. Moreover, even for the particular set of households whose preferences were closely aligned with exactly the content that was available on the SVOD service, the free gift only caused an 18 percent decrease in the likelihood that they used BitTorrent. Thus, while legal availability on an attractive, and in this case free, channel can increase legal consumption and decrease piracy, to the extent that piracy remains readily available to consumers it represents a compelling alternative to legal consumption.

3.2 Making Illegal Content Less Attractive

The alternative to making legal content more attractive is making illegal content less attractive. Although piracy is often financially free, Danaher et al. (2010) note that consumers may face a number of non-financial costs associated with pirating content. These may include search and learning costs associated with finding piracy sites and learning to use them, risks associated with downloading malware from piracy sites, the risk of getting caught pirating and facing legal penalties, consuming lower quality content on pirate networks, and possibly the moral qualms associated with illegal activity or with consuming content without providing remuneration for creators.

There are variety of policies and strategies that firms and governments can take that may increase the magnitude of these costs to consumers, but whether increasing these costs will actually change behavior is debatable in theory and thus a question for empirical researchers. Fortunately, this topic has received significant attention from academic researchers, who have estimated the effects of a sufficiently large number of policies and strategies that we can begin to draw conclusions as to which anti-piracy policies are effective in changing consumer behavior.

Following Danaher et al. (2020), we broadly classify anti-piracy enforcement actions as either “demand side” actions or “supply side” actions. Demand side anti-piracy enforcement refers to actions or policies that target consumers of pirated content, usually with potential penalties or education efforts meant to dissuade them from illegal consumption. Supply side anti-piracy enforcement refers to actions or policies that target the websites, software, payment processors, or protocols that facilitate piracy. Such actions can be further divided into two sub-types—actions that attempt to remove pirated content from the Internet, and actions that attempt to make pirated content more difficult or costly to access from the Internet.

Danaher et al. (2020) published a table that presented the results of peer-reviewed academic studies on antipiracy enforcement actions and summarized their findings by category of action. We present a version of that table at the end of this report, adapted to include additional published papers and an additional column to differentiate between public (government imposed) and private (firm- and industry-led) policies.

3.2.1 Demand Side Interventions

We are aware of four studies that ask whether various demand side antipiracy interventions have been effective at decreasing piracy and increasing sales. The first of these involves a private intervention—the music industry’s targeting of individual pirates with legal threats and lawsuits. Bhattacharjee et al. (2007) find that these threats decrease individuals’ tendency to download and share pirated music files.

Danaher et al. (2014) studied the HADOPI law in France, a law that empowered rightsholders to monitor Internet traffic from French citizens for instances of copyright infringement, and target individuals found pirating with legal warnings and penalties. They found that this law caused French digital music sales to rise by 22-25 percent relative to a control group of countries, and that

this increase was larger for more heavily pirated genres. They also found that this increase began, not when the law actually became effective, but when heavy publicity over its debate in Parliament increased awareness of the law among French citizens.

Adermon and Liang (2014) studied the IPRED law in Sweden, a law that increases the ability of rightsholders to pursue cases against pirates. The researchers found that this caused music sales to increase by 36 percent for the six months after the law was passed; however, the researchers found that music sales returned to normal (pre-IPRED) levels after citizens observed lax enforcement of the law.

Finally, McKenzie (2017) studied the passage of a number of graduated response antipiracy laws across six different countries, finding no increase in box office sales across those countries after the law was passed. In light of the other studies in the literature, cited above, one interpretation of this result is that piracy's effect on the box office in these countries was smaller than its effect on other sales channels and formats, leaving little room for antipiracy laws to boost box office revenues.

Overall, these studies suggest that demand-side antipiracy policies can be effective at increasing legitimate consumption—at least through some channels—but that the effect stems from consumers' awareness of enforcement against pirates and their associated perception of the legal risks of using pirate channels. This appears to be true whether the antipiracy enforcement stems from public or private efforts (although it is important to note that private efforts often rely on a public legal framework for upholding copyright protections). Danaher et al. (2017) also note that, in general, taste for direct demand-side antipiracy enforcement has waned in recent years, potentially due to the direct costs and legal overhead associated with demand-side anti-piracy efforts. For example, the HADOPI has been largely restructured to focus on educational efforts rather than penalties against pirates.

3.2.2 Supply Side Interventions

As taste has waned for demand side anti-piracy enforcement, the use of supply-side anti-piracy efforts has grown. Such efforts may include cease and desist (takedown) notices sent to websites that host pirated content or websites and search engines that provide links to such content, efforts to shut down entire sites that are dedicated to hosting pirated content, or efforts to require Internet

Service Providers (ISPs) to block access to websites that facilitate piracy. While early research on supply-side anti-piracy efforts was divided as to its effectiveness, more recent research has helped to identify conditions under which such efforts can increase legal consumption by reducing piracy.

We are aware of three studies that focus on the removal of pirated content from Internet websites. Both Danaher and Smith (2014) and Peukert et al. (2017) study the shutdown of Megaupload.com, the largest piracy cyberlocker in the world in 2012, and ask whether it increased legal consumption of movies. Danaher and Smith (2014) use variation in Megaupload's adoption rates across countries as quasi-experimental evidence and show that Megaupload's shutdown led to a 6.5-8.5 percent increase in digital movie revenues (i.e., paid legal sales and rentals) for large Hollywood studios (who primarily produce big-budget, wide-release blockbuster films). They note that shutting down Megaupload also caused a chilling effect on other piracy operations, causing some to voluntarily shut down, and thus the observed increase is likely due to the combined effect of the Megaupload shutdown and indirect effects it had on piracy at other sites.

Peukert et al. (2017) study the effect of the Megaupload shutdown on film box office revenues and find that shutting down Megaupload increased revenues for large blockbuster films, but that it had little effect on smaller releases and even had a negative impact on the bottom 10 percent of films, which may have actually benefitted from the word-of-mouth effects associated with piracy (due to lack of awareness of such films). Because both studies find that big-budget, major studio films benefitted from shutting down Megaupload, the overall impact on the movie industry in aggregate is almost certainly positive, since sales of such movies make up the vast majority of overall revenues.

Reimers (2016) also studied the removal of content from the Internet. In her context, this removal was achieved through private efforts: hiring a firm to seek out pirated versions of e-books and send takedown notices to the websites on which they were hosted. Reimers found that this anti-piracy effort caused a 15 percent increase in e-book sales for the treated titles, though she found no

corresponding increase in physical book sales.³⁷ Thus, all three studies that focused on removing pirated content from the Internet found it to be broadly effective at increasing industry sales.

In the context of studies of blocking access to sites providing pirate content, Poort et al. (2014) found that when The Pirate Bay—the largest P2P torrent piracy website in the world—was ordered to be blocked by ISPs in the Netherlands, it caused no lasting decrease in total Dutch piracy. Similarly, Aguiar et al. (2018) studied the shutdown of Kino.tv, a major German piracy linking site. Because this site contained links to pirated content, as opposed to the content itself, Danaher et al. (2020) argue that its shutdown is more similar to site blocking efforts than to the Megaupload shutdown given that the shutdown of Kino.tv did not remove pirated content from the Internet but rather was an attempt to make the pirated content linked through Kino more difficult to find or access. Aguiar et al. found that the shutdown of Kino.tv caused no increase in visits to legal consumption sites, but instead caused users to increase their visits to piracy sites other than Kino. Aguiar et al. also find that the Kino.tv shutdown caused many new piracy sites to spring into existence, presumably to take the place of the one that was shut down. These two studies suggest that blocking access to pirated content through a single dominant channel does not cause consumers to decrease piracy or increase legal consumption.

In this regard, Danaher et al. (2020) study three separate—and increasingly broad—instances of website blocks in the UK. In the first instance, in May 2012, only The Pirate Bay was blocked by ISPs, and the authors confirm findings described above: blocking access to a single site did not cause legal consumption to increase, and pirates simply increased their use of other piracy sites.

However, these results change in November 2013 when the courts ordered ISPs to simultaneously block access to 19 different major video piracy sites. These simultaneous blocks caused prior users of those sites to increase their visits to paid legal streaming sites (like Netflix) by 8 percent. Similarly, these authors find that the court-ordered blocks of 53 additional sites in 2013 caused a 7-12 percent increase in visits to paid legal streaming sites and an increase in new legal subscriptions to these sites. In short, this study found that consumer behavior changed only after it became sufficiently inconvenient for users to find new piracy sites. Thus, when trying to make

³⁷ Note that Reimers' finding that digital and physical books are not strong substitutes is broadly consistent with Chen et al. (2019) who find that the availability of ebook titles has a small and statistically insignificant impact on print book sales.

illegal content difficult to access, anti-piracy enforcement actions must substantially raise the search costs associated with piracy in order to have an impact on consumer behavior.

Another peer-reviewed study confirms that raising search costs for pirated goods sufficiently can influence marginal consumers to switch from piracy to legal channels. Sivan et al. (2020) ran a laboratory experiment in which participants were asked to acquire a copy of their favorite movie. To provide a differential treatment effect, participants were required to use a search engine created by the researchers. For the control group of participants, when searching for film titles, the search engine would return the same results that Google would return for whatever search term the participant used. For the treatment groups of participants, the search engine returned Google's results but with links to piracy websites shifted to lower ranks in the search results. The researchers found that these shifts mattered—prioritizing piracy results caused a statistically significant increase in the share of participants who pirated the movie they were trying to obtain, and de-prioritizing piracy results caused a statistically significant decrease in pirate consumption. Together with the results from Danaher et al. (2020), these results imply that the level of search costs associated with finding pirated files play a central role in the consumer's decision to pirate or purchase, and the raising these search costs sufficiently can cause erstwhile pirates to acquire content through legal channels.

3.3 Summary

The peer-reviewed academic literature shows that pirates can be induced to consume through legal channels by both increasing the attractiveness of legal content and decreasing the appeal of illegal content—through both demand-side efforts targeting individuals consuming pirated content and supply-side efforts targeting sites providing pirated content. However, the literature also shows that not all anti-piracy efforts are equally effective. Demand side efforts targeting consumers of pirated goods appear to be effective when they increase consumers' perception of the legal risks of getting caught, but such efforts lose their impact when consumers perceive low enforcement. Likewise, supply side efforts that remove pirated content from the Internet can influence consumer behavior toward legal consumption, but only when a sufficiently large number of sites are blocked simultaneously.

This literature also shows that no single policy or strategy that has been studied has been a cure-all for piracy. As such, it appears that a combination of efforts are required to mitigate the effect of piracy on legitimate markets for entertainment goods. Although we are not aware of research that has established this concept, it is likely that strategies to make legal content more attractive and policies to make illegal content less attractive are complements. Making pirated content harder to find is likely to have a larger impact on consumer choice if legal content is readily available in a timely fashion than if the content that consumers want to enjoy is difficult to find on legal channels or is not available until long after it becomes available through piracy. Similarly, making legal content available on convenient legal services is likely to have a stronger impact on consumer behavior if piracy is perceived as a costly, inconvenient, or risky alternative. If there is little anti-piracy enforcement—and piracy remains a free, easy-to-use and riskless channel—legal alternatives will have less impact on pirate consumption.

Thus, the most natural conclusion one can draw from the peer-reviewed literature is that the combination of firm strategies to make high quality legal content readily available and easy to use, and government and private actions to reduce the appeal of pirated content, is the most effective way to reduce piracy's impact on legal markets.

4. Open Questions for Future Research

There is an extensive academic literature on the impact of piracy on legal markets. The vast majority of this literature finds that piracy hurts the sales of copyrighted goods in legal markets. Our review of the literature finds that 29 of 33 peer-reviewed academic journal analyzing this question found that piracy results in significant harm to revenue in legal channels. There is also an emerging academic literature showing that these reduced economic incentives lead to reduced output by creators. Finally, there is a growing literature showing that anti-piracy initiatives by firms and governments can be effective at shifting consumption away from piracy and toward legal alternatives.

In spite of this accumulated knowledge, there are a number of open questions requiring future research. First, most of the research on piracy and legal markets for music focus on periods of time when music ownership—either through physical CDs or digital downloads—was the primary form

of consumption. In today's market streaming is the dominant form of consumption, and more research is needed to understand the impact of piracy on consumption in legal streaming channels.

Another area that requires future research is broadcast piracy, or piracy of live video streams. Live entertainment, such as sports, is thought to be more resistant to the detrimental effects of piracy because people prefer to watch these programs as they are broadcast, making download piracy (which becomes available after broadcast) a poor substitute for live consumption in legal channels. It is possible, however, that the increasing quality of live streaming of events will erode the ability of broadcasters to extract revenue from live sports and events.

Broadcast piracy not only affects live events, it is also used to rebroadcast paid cable television channels, such as HBO. Industry estimates put losses from this type of piracy in the range of 16 percent of all broadcast television revenues, or \$34.7 billion per year, and this form of piracy is likely increasing.³⁸ However, there is no rigorous, peer-reviewed academic work that we are aware of studying this phenomenon. As such, the impact of live streaming on industry revenues is a fruitful area for future academic research.

Finally, while goods like books, music, television and films have been effectively digitized, leading to widespread piracy of such goods, there are many other goods which have not been digitized or heavily exposed to piracy (for example, toys and action figures, collectibles, and clothing). As 3D printing becomes cheaper and more accessible, we expect to see more goods effectively become "digitized" in the sense that their designs can be exchanged in a digital format, in turn reducing marginal cost for a consumer to make a copy of the product via 3D printing. This may lead to increased piracy of some physical goods, much like digitization and filesharing led to piracy of media goods. Given this potential, it would be helpful for future research to analyze how 3D printing and piracy of the patterns for physical goods affects both markets for those goods and the incentives to create such goods.

³⁸ <https://www.sandvine.com/inthenews/inside-the-complex-world-of-illegal-sports-streaming>

Table 1: Peer-Reviewed Journal Articles Finding No Statistical Impact of Piracy

Citation	Media Type	Primary Data	Result
Oberholzer and Strumpf (2007, <i>Journal of Political Economy</i>)	Music—Physical and Online Album Purchases	2002 OpenNap music downloads, 2002 U.S. sales of popular albums	“[F]ile sharing has had no statistically significant effect on purchases of the average album in our sample.”
Smith and Telang (2009, <i>MIS Quarterly</i>)	Movies—Physical (DVD)	2005-2006 Amazon DVD sales ranks and BitTorrent movie file downloads	“[T]he availability of pirated content at [television broadcast] has no effect on post-broadcast DVD sales gains.
Andersen and Frenz (2010, <i>J. of Evolutionary Economics</i>)	Music—Physical (CD)	2006 survey of Canadian customers’ file sharing and CD purchasing behavior	There is “no (statistical) association between the number of P2P files downloaded and CD album sales.”
Aguiar and Martens (2016, <i>Information Economics and Policy</i>)	Music—Digital	Clickstream data on a panel of European Internet users in 2011	Find “no evidence of digital music sales displacement by unlicensed downloading” and find a “small but positive” effect “for some countries.”

Table 2: Peer-Reviewed Journal Articles Finding That Piracy Harms Sales

Citation	Media Type	Primary Data	Result
Hui and Png (2003, <i>Contrib. to Economic Analysis & Policy</i>)	Music—Physical (CD)	1994-98 IFPI worldwide CD sales data and physical piracy rates	“[D]emand for music CDs decreased with piracy, [...] actual losses amounted to about 6.6 percent of sales or 42 percent of industry estimates.”
Peitz and Waelbroeck (2004, <i>Rev. of Econ. Res. on Copyright</i>)	Music—Physical (Singles, LPs, Cassettes, CDs)	1998-2002 worldwide CD sales, IPSOS survey data for piracy downloads	Internet piracy may have been responsible for a 20 percent decrease in music sales between 1998-2002.
Stevens and Sessions (2005, <i>Journal of Consumer Policy</i>)	Music—Physical (Tapes, LPs, CDs)	1990-2004 consumer spending on cassette tapes, LPs, and CDs	“[T]he proliferation of peer-to-peer file sharing networks since 2000 has led to a <i>significant</i> decline in music format sales. [...] Due to the increased availability of the substitute good, downloaded MP3 files, a 1 percent increase in the price of recorded music after 2000 was associated with a more than proportionate 1.4 percent decline in the quantity purchased—decreasing consumption and sales.
Zentner (2005, <i>Topics in Economic Analysis and Policy</i>)	Music	1997-2002 country-level data on music sales and broadband usage	“Countries with higher internet and broadband penetration have suffered higher drops in music sales”

Citation	Media Type	Primary Data	Result
Bounie et al. (2006, <i>Rev. of Econ. Res. on Copyright</i>)	Movies—Theatrical & Video (DVD or VHS) Purchase and Rental	2005 survey of movie piracy and purchases from French universities	“[Piracy] has a strong [negative] impact on video [VHS and DVD] purchases and rentals” but statistically no impact on box office revenue.
Michel (2006, <i>Topics in Economic Analysis and Policy</i>)	Music—Physical (CD)	1995-2003 U.S. BLS Consumer Expenditure Survey data	“The relationship between computer ownership and music purchases weakened” due to piracy, potentially reducing CD sales by 13 percent.
Rob and Waldfogel (2006, <i>J. Law and Econ.</i>)	Music—Physical (CD)	2003 survey U.S. college student music piracy, sales	“[E]ach album download reduces purchases by 0.2 in our sample, although possibly by much more.”
Zentner (2006, <i>Journal of Law and Economics</i>)	Music—Physical & Digital	2001 survey of European music purchases, piracy	“[Piracy] may explain a 30 percent reduction in the probability of buying music.”
Bhattacharjee et al. (2007, <i>Management Science</i>)	Music—Weeks on Billboard Top 100	1995-2002 Billboard 100 chart rankings, WinMX file sharing post 2000.	P2P file sharing technologies have resulted in “significantly reduced chart survival except for those albums that debut high on the charts.”
DeVany and Walls (2007, <i>Review of Industrial Organization</i>)	Movie—Box Office	Box office revenue and the supply of pirated content for an unnamed movie	“[Piracy] of a major studio movie accelerated its box-office decline and caused the picture to lose about \$40 million in revenue.”
Hennig-Thurau, Henning, Sattler (2007, <i>Marketing Science</i>)	Movies—Box Office, Rental (DVD), and Purchases (DVD)	2006 survey of German movie purchases and piracy intentions	Piracy causes “substantial cannibalization of theater visits, DVD rentals [and] purchases responsible for annual revenue losses of \$300 million in Germany.”
Rob and Waldfogel (2007, <i>J. of Ind. Econ.</i>)	Movies—Legal Consumption (Theater, Television, Rental, or Purchase)	2005 U.S. college student survey movie piracy, sales	“[U]npaid first [piracy] consumption reduces paid consumption by about 1 unit.” “[Unpaid consumption] reduced paid consumption in [the] sample by 2.3 per cent.”
Liebowitz (2008, <i>Management Science</i>)	Music—Album Sales	1998-2003 Census data, Internet use, music sales	“[F]ile sharing appears to have caused the entire decline in record sales [observed from 1998-2003].”
Bender and Wang (2009, <i>International Social Science Review</i>)	Music—Digital (after 2005) and Physical	1999-2007 Country-level annual recorded music sales	“For a one percent increase in piracy rate, music sales declined about 0.6 percent.”
Danaher et al. (2010, <i>Marketing Science</i>)	Television Content – Pirated Digital (Bit Torrent) and Legal Physical (DVD)	2007-2008 BitTorrent downloads of TV shows	“[T]he removal of NBC content from iTunes resulted in an 11.4 percent increase in piracy for its content”
Waldfogel (2010, <i>Info. Econ and Policy</i>)	Music (Songs)—Physical and Digital	2009-10 survey of student music piracy, sales	“[A]n additional song stolen reduces paid consumption...between a third and a sixth of a song.”

Citation	Media Type	Primary Data	Result
Bai and Waldfogel (2012, <i>Information Economics and Policy</i>)	Movies—Consumption (Theatrical, Digital, and/or Physical)	2008-2009 survey of Chinese university students' movie behavior	“[T]hree quarters of [Chinese students'] movie consumption is unpaid and ... each instance of [piracy] displaces 0.14 paid consumption instances.”
Hong (2013, <i>Journal of Applied Econometrics</i>)	Music—Recorded Music Expenditure (CDs, Tapes, and LPs)	1996-2002 survey data from U.S. BLS Consumer Expenditure Survey data	“[F]ile sharing is likely to explain about 20 percent of the total sales decline during the Napster period, mostly driven by ... households with children aged 6-17.”
Danaher et al. (2014, <i>Journal of Industrial Economics</i>)	Music—Digital (iTunes)	2008-2011 iTunes music sales in France and other European countries	The HADOPI anti-piracy law “caused iTunes music sales to increase by 22-25 percent [in France] relative to changes in the control group [countries].”
Danaher and Smith (2014, <i>Intl. Journal of Industrial Org.</i>)	Movies—Digital (Sales and Rentals)	2011-2013 Movie sales and rentals, 12 European countries, 3 major studios	“The shutdown of Megaupload and its associated sites caused digital revenues for three major motion picture studios to increase by 6.5–8.5 percent.”
Ma et al. (2014, <i>Info. Sys. Research</i>)	Movies—Box Office	All movies in wide release, Feb. 2006 to Dec. 2008.	“Pre-release piracy causes a 19.1 percent decline in revenue compared to [post-release] piracy.”
Adermon and Liang (2014, <i>J. of Econ. Behavior & Org.</i>)	Music—Digital and Physical	Digital and physical music sales in Sweden, Norway, and Finland, 2004-2009.	IPRED copyright reform measure in Sweden “increased music sales by 36 percent in during the first six months [after it was implemented].”
Leung (2015, <i>Information Economics and Policy</i>)	Music Demand—Physical (CD), Digital (iTunes songs), and pirated—and listening options (iPod, Computer, and Radio)	Survey data from ~900 college students in 2007-2008.	“Music piracy decreases music sales by 24-42 percent” but it also “contributes 12 percent to iPod sales”.
McKenzie and Walls (2016, <i>B.E. J. of Econ. Analysis and Policy</i>)	Movies—Box Office	Australian theatrical sales, torrent downloads, Jan. 2010 through Aug. 2011.	Piracy causes “a sales displacement effect on box office revenues” via “release delay between the U.S. and Australian markets”. However, “although statistically significant, the economic significance of this displacement appears relatively small.” “[F]or every 100 downloads [of a median film from the sample data] somewhere between 2.4 and 3.4 cinema admissions are displaced.”

Citation	Media Type	Primary Data	Result
Reimers (2016, <i>Journal of Law and Economics</i>)	Books—Physical, Audio, and Digital	Print and e-book sales of 653 book titles from 2010 to 2014.	Studies implementation of private copyright enforcement against piracy of some book titles and finds “a protection-related increase of e-book sales [...] of more than 14 percent” but “sales of non e-book formats are not affected.”
Papies and ven Heerde (2017, <i>Journal of Marketing</i>)	Music—Concert and Recorded Format Revenues	German recorded music and live concert revenues for ~400 popular artists from 2003-2010.	Piracy and unbundling “weaken the effect of concert demand on record demand”, meaning that live performances have a smaller stimulating effect on record sales as a result of piracy.
Peukert, Claussen, and Kretschmer (2017, <i>International Journal of Industrial Organization</i>) ³⁹	Movies—Box Office	Weekly box office revenue of 308 movies across 14 countries from 2011-2012.	The shutdown of Megaupload caused “an increase of 47 percent” in box office revenues for the top decile of wide release films, but also caused “an average weekly decrease of 4 percent for narrow release films”.
Koh, Hann, and Raghunathan (2019, <i>MIS Quarterly</i>)	Music—Physical and Digital	U.S. physical and digital album and single sales from 1982-2012.	Piracy displaces legal sales, but “the introduction of licensed digital downloads has weakened the piracy effect” by about “15 percent every year”.
Danaher, Hersh, Smith, and Telang (2020, <i>MIS Quarterly</i>)	Movies—Digital	Clickstream data to legal and illegal video sites among a sample of UK Internet users, 2012-2014.	Blocking access to a single dominant piracy site does not reduce piracy or increase legal consumption, but simultaneously blocking access to a number of piracy sites increased legal consumption by 7-12 percent and also caused some users to buy a legal streaming site subscription.

³⁹ This paper finds that shutting down a major piracy website helped box office ticket sales of large blockbuster films, but hurt ticket sales of smaller niche films and had no statistically significant effect on mid-sized films. We include this in the “piracy harms sales” category because in film, sales of the top products drive the vast majority of overall revenues.

Table 3: Summary of Empirical Literature on Government Antipiracy Enforcement⁴⁰

Authors	Topic	Public (government) or Private⁴¹	Demand or Supply Side?	Source Content Removed?	Result
Danaher et al. (2014)	HADOPI "three strikes law" in France	Public	Demand	-	Approximately 25 percent increase in digital music sales
Adermon and Liang (2014)	IPRED law in Sweden	Public	Demand	-	36 percent increase in music sales for six months, then return to normal levels after lax enforcement of law
Bhattacharjee et al. (2006)	Highly publicized legal threats by industry against individual files sharers	Private	Demand	-	Decreased tendency to share copyright infringing files, but majority of content remained available
Mckenzie (2017)	Graduated response antipiracy laws in 6 countries	Public	Demand	-	No increase in box office revenues of films
Poort et al. (2014)	Dutch ISP domain blocking of The Pirate Bay	Public	Supply	No	No lasting decrease in total Dutch piracy
Danaher and Smith (2014)	Shutdown of Megaupload.com	Public	Supply	Yes	6.5-8.5 percent increase in digital revenues from Hollywood films
Reimers (2016)	Piracy "takedown notices" and search de-listing	Private	Supply	Yes	15 percent increase in sales for book titles whose pirated counterparts were removed from websites and delisted from search engines.
Peukert et al. (2017)	Shutdown of Megaupload.com	Public	Supply	Yes	Increase in box office for large films, decrease in box office for smaller, indie films

⁴⁰ This table is reproduced with permission from Danaher et al. (2020), but updated with additional studies and an additional column for clarity.

⁴¹ We define private enforcement as actions taken by private firms or organizations to combat piracy. However, we note that even private enforcement often relies upon a (public) legal framework upon which copyright can be upheld or enforced.

Authors	Topic	Public (government) or Private⁴²	Demand or Supply Side?	Source Content Removed?	Result
Aguiar et al. (2018)	Shutdown of Kino.to (popular German piracy streaming/linking site)	Public	Supply	No	No increase in legal consumption, increase in piracy at other sites, emergency of new piracy link sites to replace Kino.to
Sivan et al. (2020)	De-ranking of piracy sites in search engine results	Private	Supply	No	Significantly increased the percent of individuals who purchased films legally
Danaher et al. (2020)	Court ordered ISP blocking of piracy websites, 3 separate waves	Public	Supply	No	Blocking one major site had no effect on total piracy or legal consumption, blocking multiple sites increased legal consumption by 7-12 percent

⁴² We define private enforcement as actions taken by private firms or organizations to combat piracy. However, we note that even private enforcement often relies upon a (public) legal framework upon which copyright can be upheld or enforced.

References:

- Adermon, A., C-Y. Liang. 2014. Piracy and music sales: The effects of an anti-piracy law. *Journal of Economic Behavior and Organization*, **105** 90-106.
- Aguiar, Luis, Bertin Martens. 2016. Digital music consumption on the Internet: Evidence from clickstream data. *Information Economics and Policy*. 34(C) 27-43.
- Aguiar L, Peukert C., and Claussen J. 2018. Catch Me If You Can: Effectiveness and Consequences of Online Copyright Enforcement. *Information Systems Research*, 29(3) 656-678.
- Andersen, B., M. Frenz. 2010. Don't blame the P2P file-sharers: the impact of free music downloads on the purchase of music CDs in Canada. *Journal of Evolutionary Economics*, 20:715-740.
- Bai, J., J. Waldfogel. 2012. Movie Piracy and Sales Displacement in Two Samples of Chinese Consumers. *Information Economics and Policy*, 24(3) 187-196.
- Balazs, Bodo. 2011. Coda: A Short History of Book Piracy. In *Media Piracy in Emerging Economies*, Social Science Research Council, New York, N.Y.
- Basamanowicz, Jonathan, Martin Bouchard. 2011. Overcoming the Warez Paradox: Online Piracy Groups and Situational Crime Prevention. *Policy and Internet*, 3(2), 1-25.
- BBB. 2019a. "Fakes Are Not Fashionable: A BBB Study of the Epidemic of Counterfeit Goods Sold Online." Better Business Bureau. May. Available from: https://www.bbb.org/globalassets/local-bbbs/st-louis-mo-142/st_louis_mo_142/studies/counterfeit-goods/BBB-Study-of-Counterfeit-Goods-Sold-Online.pdf
- BBB. 2019b. "Better Business Bureau Study Shines Light on Prevalence of Counterfeit Products in Online Retail." Better Business Bureau. May 17. Available from <https://www.bbb.org/central-georgia/news-events/news-releases/2019/05/better-business-bureau-study-shines-light-on-prevalence-of-counterfeit-products-in-online-retail/>
- Bender, M. T., Y. Wang. 2009. The Impact of Digital Piracy on Music Sales: A Cross-Country Analysis. *International Social Science Review* 84(3-4) 157-170.
- Bhattacharjee, S., R. Gopal, K. Lertwachara, J. Marsden. 2006. Impact of Legal Threats on Online Music Sharing Activity: An Analysis of Music Industry Legal Actions. *Journal of Law and Economics*, 49(1) 91-114.
- Bhattacharjee, S., R. Gopal, K. Lertwachara, J. Marsden, R. Telang. 2007. The Effect of Digital Sharing Technologies on Music Markets: A Survival Analysis of Albums on Ranking Charts. *Management Science* 53(9) 1359-1374.
- Biasi, Barbara, Petra Moser. 2018. Effects of Copyrights on Science. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2542879

- Blackburn, David, Jeffrey A. Eisenach, David Harrison Jr., 2019. Impact of Digital Video Piracy on the U.S. Economy. Produced for the U.S. Chamber of Commerce by NERA Economic Consulting and Global Innovation Policy Center. June. Available from <https://www.theglobalipcenter.com/wp-content/uploads/2019/06/Digital-Video-Piracy.pdf>
- Bounie, D., M. Bourreau, P. Waelbroeck. 2006. Piracy and the Demand for Films: Analysis of Piracy Behavior in French Universities. *Review of Economic Research on Copyright Issues*, 3(2) 15-27.
- Burch, Gordon, Brett Danaher, Edward McFowland III, Michael D. Smith. 2019. Examining the relationship Between Box-Office Revenue and the Timing, Quality and Consumption of Movie Piracy Leaks. Working Paper, Carnegie Mellon University, Pittsburgh, Pennsylvania.
- Chandra, Priyank. 2016. Order in the Warez Scene: Explaining an Underground Virtual Community with the CPR Framework. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, San Jose, California, May 7-12, pp. 372-383.
- Chen, Hailiang, Yu Hu, Michael D. Smith. 2019. The Impact of E-book Distribution on Print Sales: Analysis of a Natural Experiment. *Management Science*. 65(1) 19-31.
- Danaher, B., S. Dhanasobhon, M.D. Smith, R. Telang. 2010. Converting Pirates without Cannibalizing Purchasers: The Impact of Digital Distribution on Physical Sales and Internet Piracy. *Marketing Science*, 29(6) 1138-1151.
- Danaher, B., J. Waldfogel. 2012. Reel Piracy: The Effect of Online Movie Piracy on Film Box Office Sales. Mimeo. Wellesley College. Boston, Massachusetts.
- Danaher, Brett, Michael D. Smith, Rahul Telang, Siwen Chen. 2014. The Effect of Graduated Response Anti-Piracy Laws on Music Sales: Evidence from an Event Study in France. *Journal of Industrial Economics*. 62(3) 541-553.
- Danaher, Brett, Michael D. Smith. 2014. Gone in 60 Seconds: The Impact of the Megaupload Shutdown on Movie Sales. *International Journal of Industrial Organization*. 33 1-8.
- Danaher, Brett, Samita Dhanasobhon, Michael D. Smith, Rahul Telang. 2015. Understanding Media Markets in the Digital Age: Economics and Methodology, Goldfarb, Greenstein, and Tucker, eds. *Economic Analysis of the Digital Economy*. Chapter 13 (pp. 385-406), University of Chicago Press, Chicago, Illinois. (Reprinted in the Alfred P. Sloan Foundation Economic Research Papers series.
- Danaher, Brett, Michael D. Smith, Rahul Telang. 2017. Copyright Enforcement in the Digital Age: Empirical Evidence and Conclusions. *Communications of the Association of Computing Machinery*. 60(2) 68-75.
- Danaher, Brett and Michael D. Smith. 2017. Digital Piracy, Film Quality, and Social Welfare. *George Mason Law Review*, Vol. 24(4).

Danaher, Brett, Jonathan Hersh, Michael D. Smith, Rahul Telang. 2020. The Effect of Piracy Website Blocking on Consumer Behavior. *Management Information Systems Quarterly*, Forthcoming.

De Vany, A.S., W.D. Walls. 2007. Estimating the Effects of Movie Piracy on Box-office Revenue. *Review of Industrial Organization*. 30 291-301.

de Matos, Miguel Godinho, Pedro Ferreira, Michael D. Smith. 2018. The Effect of Subscription Video-On-Demand on Piracy: Evidence from a Household Level Randomized Experiment. *Management Science*. 64(12) 5610-5630.

Digital Citizens Alliance. 2014. Good Money Gone Bad: Digital Thieves and the Hijacking of the Online Ad Business. February. Available from: <http://media.digitalcitizensactionalliance.org/314A5A5A9ABBBBC5E3BD824CF47C46EF4B9D3A76/4af7db7f-03e7-49cb-aeb8-ad0671a4e1c7.pdf>

Digital Citizens Alliance. 2017. Trouble in Our Digital Midst: How Digital Platforms Are Being Overrun by Bad Actors and How the Internet Community Can Beat Them at Their Own Game. June. <https://www.digitalcitizensalliance.org/clientuploads/directory/Reports/Trouble-in-Our-percent20Digital-Midst-percent20Report-June-2017.pdf>

Eisenmann, Thomas, Geoffrey Parker, Marshall W. Van Alstyne. 2006. Strategies for Two-Sided Markets. *Harvard Business Review*. October, 2-10.

FACT. 2017. Cracking Down on Digital Piracy. September. Available from: <https://www.fact-uk.org.uk/files/2017/09/Cracking-Down-on-Digital-Piracy-Report-Sept-2017.pdf>

Forster, Stephen. 2015. Crackdown on counterfeiting & piracy online. UK National Trading Standards, eCrime Team. June 24. Available from <http://www.tradingstandardsecrime.org.uk/crack-down-on-counterfeiting-and-piracy-on-social-media/>

GAO. 2018. Intellectual Property: Agencies Can Improve Efforts to Address Risks Posed by Changing Counterfeits Market. GAO-18-216, United States Government Accounting Office, January 2018. Available from: <https://www.gao.gov/assets/690/689713.pdf>

Grant, August E., Jennifer H. Meadows. 2010. *Communication Technology Update and Fundamentals*. Twelfth Edition, Elsevier, Oxford, UK.

Gunter, Barrie. 2018. *Predicting Movie Success at the Box Office*. First Edition, Palgrave Macmillan, Cham, Switzerland.

Hennig-Thurau, T., V. Henning, H. Sattler. 2007. Consumer File Sharing of Motion Pictures. *Journal of Marketing*. 71(October) 1-18.

Hong, S.-H. 2013. Measuring the Effect of Napster on Recorded Music Sales: Difference-in-Difference Estimates Under Compositional Changes. *Journal of Applied Econometrics*. 28 297-324.

- Hui, K., I. Png. 2003. Piracy and the Legitimate Demand for Recorded Music. *Contributions to Economic Analysis & Policy*, 2(1) Article 11.
- IFPI. 2017. *Connecting With Music: Music Consumer Insight Report*. September. Available from <https://www.ifpi.org/downloads/Music-Consumer-Insight-Report-2017.pdf>
- Incopro. 2015. The revenue sources for websites making available copyright content without consent in the EU. March. Available from <https://www.incoproip.com/reports/revenue-sources-for-copyright-infringing-sites-in-europe>
- Incopro. 2018. Counterfeit products are endemic—and it is damaging brand value. November. Available from https://www.incoproip.com/cms/wp-content/uploads/2018/11/2018_Incopro_Market-Research-report.pdf
- Koh, Byungwan, Il-Horn Hann, Srinivasan Raghunathan. 2019. Digitization of Music: Consumer Adoption Amidst Piracy, Unbundling, and Rebundling. *MIS Quarterly*, 43(1) 25-45.
- Leung, Tin Cheuk. 2015. Music piracy: Bad for record sales but good for the iPod? *Information Economics and Policy*, 31(C), 1-12.
- Liebowitz, S.J. 1985a. Copying and Indirect Appropriability: Photocopying of Journals. *Journal of Political Economy*, Vol 93(5).
- Liebowitz, S.J. 1985b. *The Economics of Betamax: Unauthorized Copying of Advertising Based Television Broadcasts*. Working Paper, University of Chicago. Chicago, Illinois.
- Liebowitz, S. 2008. Testing File-Sharing's Impact by Examining Record Sales in Cities. *Management Science*, 54(4) 852-859.
- Liebowitz, Stan. 2014. The Impacts of Internet Piracy. Chapter 13, *The Economics of Copyright: A Handbook for Students and Teachers*, Watt, ed; Edward Elgar Publishers, pp. 225-240.
- Ma, Liye, Alan Montgomery, Param Singh, Michael D. Smith. 2014. The Effect of Pre-Release Movie Piracy on Box Office Revenue. *Information Systems Research*. 25(3) 590-603.
- McKenzie, Jordi, W. David Walls. 2016. File Sharing and Film Revenues: Estimates of Sales Displacement at the Box Office. *B.E. Journal of Economic Analysis and Policy*. 16(1) 25-57.
- McKenzie, Jordi. 2017. Graduated response policies to digital piracy: Do they increase box office revenues of movies. *Information Economics and Policy*. 38(C) 1-11.
- Michel, N. 2006. *The impact of digital file sharing on the music industry: an empirical analysis*. Berkeley Electronic Press: *Topics in Economic Analysis & Policy*, 6, Article 18.
- Oberholzer, F., K. Strumpf. 2007. The Effect of File Sharing on Record Sales. An Empirical Analysis. *Journal of Political Economy*, 115(1) 1-42.

OECD. 2019. Trends in Trade in Counterfeit and Pirated Goods. OECD and European Union Intellectual Property Office. March 18. Available from https://www.oecd-ilibrary.org/trade/trends-in-trade-in-counterfeit-and-pirated-goods_c4ca6b59-en

Papies, Dominik, Harald van Heerde. 2017. The Dynamic Interplay Between Recorded Music and Live Concerts: The Role of Piracy, Unbundling, and Artist Characteristics. *Journal of Marketing*, 81(4), March, 67-87.

Peitz, M., P. Waelbroeck. 2004. The Effect of Internet Piracy on CD Sales: Cross-Section Evidence. *Review of Economic Research on Copyright Issues*, 1(2) 71-79.

Peukert, Christian, Jorg Claussen, Tobias Kretschmer. 2017. Piracy and Box Office Movie Revenue: Evidence from Megaupload. *International Journal of Industrial Organization*, 52(May) 188-215.

Poort, J., Leenheer, J, Ham, JVD, and Dumitru, C. 2014. Baywatch: Two Approaches to Measure the Effects of Blocking Access to The Pirate Bay. *Telecommunications Policy*. 38(1) 383-392.

Reimers, I. 2016. "Can Private Copyright Protection Be Effective? Evidence from Book Publishing." *Journal of Law and Economics*. 59, 411-440.

RIAA. 2019. "Recording Industry Association of American Response to Comment Request: Report on the State of Counterfeit and Pirated Goods Trafficking and Recommendations," Docket No. DOC-2019-0003. Available from: <https://www.regulations.gov/contentStreamer?documentId=DOC-2019-0003-0074&attachmentNumber=1&contentType=pdf>

Rob, R., J. Waldfogel. 2006. Piracy on the High C's: Music Downloading, Sales Displacement, and Social Welfare in a Sample of College Students. *Journal of Law and Economics*, 49(1) 29-62.

Rob, R., J. Waldfogel. 2007. Piracy on the Silver Screen. *Journal of Industrial Economics*, 55(3) 379-393.

Sandvine. 2017. Global Internet Phenomena Spotlight: "The 'Fully Loaded' Kodi Ecosystem." Available from: <https://www.sandvine.com/hubfs/downloads/archive/2017-global-internet-phenomena-spotlight-kodi.pdf>

Sivan, Liron, Michael D. Smith, Rahul Telang. 2020. Do Search Engines Influence Media Piracy? Evidence from a Randomized Field Study. *Management Information Systems Quarterly*.

Smith, M.D., R. Telang. 2009. Competing with Free: The Impact of Movie Broadcasts on DVD Sales and Internet Piracy. *Management Information Systems Quarterly*, 33(2) 312-338.

Smith, Michael D., Rahul Telang. 2013. *Windows of Opportunity: The Impact of Early Digital Movie Releases in the Home Entertainment Window*. Mimeo, Carnegie Mellon University, Pittsburgh, Pennsylvania.

- Smith, Michael, Rahul Telang. 2016. Streaming, Sharing, Stealing: Big Data and the Future of Entertainment. MIT Press, Cambridge, Massachusetts.
- Smith, Michael, Rahul Telang, Yi Zhang. 2019. I Want You Back: An Empirical Analysis of the Interplay Between Legal Availability and Movie Piracy, *International Journal of the Economics of Business*. 26(1) 199-216.
- Smits, Roderik. 2016. Industry Report: Distribution and Exhibition. Cineuropa. Available from <https://cineuropa.org/en/dossiernewsdetail/1369/314689/>
- Stevens, L.K., D.N. Sessions. 2005. An Empirical Investigation Into the Effect of Music Downloading on the Consumer Expenditure of Recorded Music: A Time Series Approach. *Journal of Consumer Policy*, 28(3) 311-324.
- Stroppa, Andrea, Agostino Specchiarelo. 2014. Online Advertising Techniques for Counterfeit Goods and Illicit Sales. Available from http://download.repubblica.it/pdf/2014/tecnologia/online_advertising.pdf
- Stroppa, Andrea, Davide Gatto, Lev Pasha, Bernardo Parrella. 2019. Instagram and counterfeiting in 2019: new features, old platforms. *Ghost Data*, April 9. Available from https://ghostdata.io/report/Instagram_Counterfeiting_GD.pdf
- Telang, Rahul. 2018. Does Online Piracy make Computer Insecure? Evidence from Panel Data. Working Paper, Carnegie Mellon University, Pittsburgh, Pennsylvania.
- Telang, R. and Waldfogel, J. 2018. Piracy and New Product Creation: A Bollywood Story. *Information Economics and Policy*. 43 1-11.
- Treverton, Gregory F., Carl Matthies, Karla J. Cunningham, Jeremiah Goulka, Greg Ridgeway, Anny Wong. 2009. The Shape of Counterfeiting and the Example of Film Piracy. Chapter 3, In *Film Piracy, Organized Crime, and Terrorism*. RAND Corporation. (<https://www.rand.org/pubs/monographs/MG742.html>)
- USPTO. 2019. Piracy Landscape Paper. Solicitation Number 1333BJ19Q00142004. Department of Commerce, U.S. Patent and Trademark Office. Posted Date: March 26.
- USTR. 2018. "2018 Out-of-Cycle Review of Notorious Markets," Office of the United States Trade Representative, Executive Office of the President. Available from https://ustr.gov/sites/default/files/2018_Notorious_Markets_List.pdf
- Van Alstyne, Marshall, Geoffrey G. Parker, Sangeet Paul Choudary. 2016. Pipelines, Platforms, and the New Rules of Strategy. *Harvard Business Review*, April, 54-62.
- Waldfogel, J. 2010. Music File Sharing and Sales Displacement in the iTunes Era. *Information Economics and Policy*, 22(4) 306-314.

Waldfoegel, J. 2012. Copyright Protection, Technological Change, and the Quality of New Products: Evidence from Recorded Music since Napster. *Journal of Law and Economics*, 55(4) 715-740.

Waldfoegel, J. 2016. Cinematic Explosion: New Products, Unpredictability, and Realized Quality in the Digital Era. *Journal of Industrial Economics*, 64(4), 755-772.

Zentner, A. 2005. File Sharing and International Sales of Copyrighted Music: An Empirical Analysis with a Panel of Countries. *Berkeley Electronic Press: Topics in Economic Analysis and Policy*, 5(1), Article 21.

Zentner, A. 2006. Measuring the Effect of File Sharing on Music Purchases. *The Journal of Law and Economics*, 49 63–90.

Zentner, A. 2010. Measuring the Impact of File Sharing on the Movie Industry: An Empirical Analysis Using a Panel of Countries. Working Paper. University of Texas at Dallas, Dallas, Texas.

Zhang, Laurina. 2017. Intellectual Property Strategy and the Long Tail: Evidence from the Recorded Music Industry, *Management Science*, 64(1) 24-42.