

Converting Pirates without Cannibalizing Purchasers:
The Impact of Digital Distribution on Physical Sales and Internet Piracy

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ABSTRACT

The availability of digital distribution channels for media content has raised several important questions for marketers. Notable among these questions are whether the use of digital distribution channels will significantly cannibalize physical sales and whether legitimate digital distribution channels will be able to dissuade consumers from using (illegitimate) digital piracy channels. We address these two questions in this paper using the removal of NBC content from Apple's iTunes store in December 2007, and its restoration in September 2008, as natural shocks to the supply of legitimate digital content and analyzing its impact on demand through DVD and piracy channels.

We address these questions using two large datasets from Mininova and Amazon.com documenting the levels of piracy and DVD sales for both NBC and other major networks' content around these events. We analyze this data in a difference-in-difference model and find that NBC's decision to remove its content from iTunes in December 2007 is causally associated with an 11.5% increase in the demand for pirated content. This is roughly equivalent to an increase of 53,000 downloads a day for NBC's content and is approximately twice as large as the total legal purchases on iTunes for the same content in the period preceding the removal. We also find evidence of a smaller, and statistically insignificant, decrease in piracy for the same content when it was restored to the iTunes store in September 2008. Finally, we see no change in demand for NBC's DVD content associated with NBC's closing or reopening of their digital distribution channel on iTunes.

“We can’t compete with free. That’s an economic paradigm that doesn’t work.”
James Gianopulos, Co-Chairman, Twentieth Century Fox, (quoted in Thompson 2003)

“You’ll never stop [piracy]. What you have to do is compete with it.”
Steve Jobs, CEO Apple Inc., (quoted in Goodell 2003)

1. Introduction

The development of digital distribution channels has raised several important questions for marketers. For television networks and movie studios, two of the more important questions are (1) can paid digital distribution channels serve as an attractive alternative to consumption through (free) digital piracy channels and (2) will digital distribution cannibalize DVD box set sales?

With respect to the first question, the quote above from James Gianopulos, Co-Chairman of Twentieth Century Fox, is representative of many in the industry who claim that it is difficult, if not outright impossible, to successfully use paid digital distribution channels to compete with a free (albeit illegal) piracy channel. On the other side of this argument, Steve Jobs, CEO of Apple Incorporated, claims that digital distribution channels, such as Apple’s iTunes video store, offer studios the best opportunity to compete with piracy channels by mimicking the ease and convenience of pirated channels at a “fair” and competitive price point.

With respect to the second question, there is ample evidence in the business press that DVD retailers feel that studios’ distribution through digital channels will significantly cannibalize sales of DVDs. For example in late 2006 after Disney finalized a deal to distribute its movies through iTunes, press reports claim that a Wal-Mart executive visited Hollywood studios to tell them that “it will retaliate against them for selling movies on Apple’s iTunes [store]” (Arango 2006). This report goes on to note that Wal-Mart, which makes up an estimated 40% of studios’ DVD sales,

made good on this threat by sending “‘cases and cases’ of DVDs back to Disney.” Similarly, Target, which makes up an estimated 15% of DVD sales, sent a letter to studios threatening them not to follow Disney into digital distribution (McBride and Marr 2006), and reportedly after sending this letter “ordered its stores to take down a multitude of internal signs steering customers to Disney products,” and replaced Disney’s end-cap promotional displays with displays for Disney’s competitors (Menn 2006). Studios have also expressed concerns about lower margin digital channels cannibalizing physical sales. For example, Jeff Zucker, CEO of NBC Universal has said that “our challenge with all these [digital] ventures is to effectively monetize them so that we do not end up trading analog dollars for digital pennies” (Stetler 2008).

However, while these questions have received much discussion in the industry and in the press, we are aware of no studies in the literature that address the degree to which digital distribution of media content impacts demand for physical content and demand for Internet piracy. The goal of this paper is to analyze these questions through a quasi-experiment that occurred on December 1, 2007. During August of 2007, NBC expressed dissatisfaction with the Apple iTunes store’s pricing policy. While NBC (and other media companies) wanted more flexibility in pricing, Apple was enforcing a one-price-fits-all policy across nearly all episodes of television. When negotiations broke down, NBC announced that they would remove all of their content from iTunes on December 1, 2007, a significant move since they reportedly supplied 40% of all video content on the iTunes store.¹ In response, Apple refused to offer NBC’s fall 2007 season for sale starting in September 2007, and then on December 1, 2007 Apple removed all older NBC content from iTunes.

¹ <http://www.msnbc.msn.com/id/20531069>

In our analysis, we use this event as an exogenous shock to legal digital supply of all older seasons of NBC television. This content was generally available for sale on DVD, on iTunes (prior to December 1), and through piracy, and thus we study a market with a physical sales channel, a digital sales channel, and a piracy channel. In this analysis, we account for the possibility of a time trend by observing changes in piracy or DVD sales two weeks before versus two weeks after December 1 for NBC's competitor networks: ABC, CBS, and Fox (all of which continue to offer their content and thus received no shock on December 1). We then contrast this time trend with the change in piracy and DVD sales for NBC, arguing that any differences for NBC content after December 1, over and above the difference for similar television networks, was caused by the removal of NBC content from iTunes. Finally, we ask if our findings are upheld in a second experiment on September 9, 2008, when NBC restored all of their content to the iTunes store.

We find that the removal of NBC content from iTunes caused a 11.5% increase in piracy for their content, which corresponds to 31 more pirated downloads per day per episode, or about 53,000 total additional pirated downloads per day. This number is twice as high as estimates for the daily number of downloads of these episodes on iTunes in the two weeks prior to December 1, implying a fixed cost associated with the decision to pirate: once individuals start to pirate, they pirate more content than they would have originally purchased. This may also imply a spillover effect — that piracy of content on other networks could have increased as a result of NBC's decision to remove their own content from iTunes. While we cannot positively identify this externality due to lack of an appropriate counterfactual, our results are consistent with such an effect as non-NBC piracy increases by 7.6% over this time period (and thus the documented 11.5% increase in piracy may understate the true displacement of piracy by digital distribution).

Finally, while studying NBC's return to iTunes in September 2008 is complicated by the start of a new season of television, our evidence suggests that the restoration of NBC content to iTunes caused a smaller, statistically insignificant drop in piracy, which is also consistent with a fixed cost to piracy.

In contrast to the strong correlation between legitimate digital distribution and piracy, we find no change in the Amazon.com sales rank of NBC television season box sets in the four weeks surrounding December 1 relative to the baseline change in non-NBC box sets, implying that while customers who cannot purchase digitally may turn to piracy, they do not consider DVD box sets as a substitute to digital downloads.

The remainder of this paper proceeds as follows. In Section 2, we review the relevant literature. In Section 3, we give a general description of the digital market for media and present a theoretical model of the consumer's choice between piracy, digital channel purchase, and physical channel purchase. In Section 4, we discuss our data. In Section 5, we present our empirical models and results. Finally, in Section 6, we discuss the implication of these findings, the limitations of the analysis, and areas for future research.

2. Literature Review

As this paper addresses the interaction between legitimate digital and physical distribution channels and the interaction between legitimate and illegitimate (piracy) digital distribution channels, the paper fits into two main literatures: the marketing literature studying interactions between various distribution channels, and the economics and information systems literature on online piracy of digital goods.

With respect to the piracy literature, most existing studies examine the effect of online piracy on physical media sales. The majority of these studies analyze the impact of piracy on music CD sales, with a few recent studies examining the impact of piracy on movie or television revenue. The challenge in this literature is typically identification, as the correlation between physical sales and pirated downloads of each movie or song is predominantly driven by unobserved heterogeneity across goods, which may mask the true causal effect of piracy on sales.

Papers in this literature address the identification issue in several different ways: through cross-country variation, exogenous shocks to demand, or through survey results. With respect to cross-country variation, Zentner (2005), Hui and Png (2003), and Peitz and Waelbroeck (2004) use international panel data on music sales and pirated downloads with each study finding that piracy displaces CD sales to some extent. Similarly, Danaher and Waldfogel (2008) examine the impact of online piracy of Hollywood movies on international box office revenue and find evidence of displacement of ticket sales by online piracy.

In the context of exogenous shocks, one of the tests used by Oberholzer and Strumpf (2004) takes holidays in the German school system as exogenous demand shocks and find little or no displacement associated with music piracy, while Smith and Telang (2009) use the television broadcast of a movie as an exogenous demand shock for the DVD and find little or no displacement of DVD sales from piracy for movies broadcast on television.

Finally, in the context of survey data, Rob and Waldfogel (2006) use survey data from a population of college students, asking whether individuals who pirate music purchase less music, including controls such as stated valuations of the albums in question or personal taste for music. Rob and Waldfogel (2007) uses a similar approach to study the effect of movie piracy on paid

consumption of movies such as theater attendance, DVD rental, and DVD purchase. In both studies the authors find displacement of paid consumption by piracy.

Thus, the majority of existing studies in the literature find some degree of substitution of unpaid “pirated” consumption for paid consumption, which raises the question of how firms should optimally combat the negative effects of piracy. Recent papers in the literature have examined this question in the context of litigation against pirates, protection of media content through Digital Rights Management (DRM) systems, and purposefully damaging the performance of file sharing networks.

Addressing the effectiveness of the first anti-piracy tool, Bhattacharjee *et al.* (2008) examine the impact of the RIAA’s legal threats against individual file sharers during the summer of 2003 as a quasi-experiment and find that when the threat of litigation is higher, file sharing declines but availability of content is still substantial. In the context of DRM protection, Vernik (2008) uses an analytic model to argue that the presence of DRM may actually increase piracy by reducing the usability of the purchased files. In the context of degrading the performance of file-sharing networks, Christin *et al.* (2005) study the impact of several different “poisoning” strategies on four popular peer-to-peer file sharing networks and find that the injection of a few replicated decoys can strategically manipulate users’ perception of content availability in the network.

However, another important tool that media companies may be able to use to reduce the impact of piracy is directly competing with piracy channels by adding digital distribution channels. To the best of our knowledge, there are no papers in the literature that examine the interaction between legitimate and illegitimate (piracy) digital distribution channels, and one contribution of this paper is to examine this question.

The interaction among different distribution channels has been studied in the marketing literature in a variety of important contexts. For example, Jeuland and Shugan (1983) show that coordination between distribution channels lead to higher profits. Extending this finding, Chiang *et al.* (2002), Chu *et al.* (2007), and Webb (2002) develop strategies for firms to manage multiple distribution channels effectively. In the context of direct distribution channels, Balasubramanian (1998) uses analytic models to show that the presence of direct distribution channels, including Internet channels, yields higher returns when the product is well adapted to the channel. Other papers in the marketing literature also note that the more differentiated two channels are, the less likely they are to cannibalize one another (e.g., Friedman and Furey (1999) and Viswanathan (2005)).

However, there are relatively few papers in the literature that attempt to directly measure the effect of digital distribution on physical channel sales. One exception is Deleersnyder *et al.* (2002) which uses a sample of 85 British and Dutch newspapers who added digital distribution channels and find that when newspapers make their content available online it only has a small impact on physical newspaper sales. Likewise, Biyalogorsky and Naik (2003) find that Tower Records' addition of an Internet distribution channel did not significantly cannibalize their retail sales. With respect to video distribution, Waldfogel (2007) uses survey data to show that authorized Youtube viewing of television content has only a small net displacement effect on over-the-air viewing and may achieve complementarities between the two channels.

A contribution of this paper is to extend this literature by examining the impact of digital distribution of paid television content on paid physical channels and also to address whether there are stronger interactions between legitimate digital and legitimate physical consumption, or between legitimate digital and pirated digital consumption.

3. Theory

3.1. *Digital Distribution and Piracy*

Theory does not clearly predict the effect of a digital sales channel on consumption in a digital pirate channel. On one hand, iTunes purchases (by far the dominant legitimate digital channel for video purchases) and pirated downloads are similar in that both provide high quality, usually fast file downloads that can be viewed on a computer or, with some effort, a television or portable video device.²

Given these similarities, one might ask why anyone would purchase through a digital distribution channel if piracy is free. For this to occur, there must be some non-financial cost to piracy. There are several possible categories into which that cost could fit:

- i) There may be a cost to learn to use BitTorrent, which would be akin to a fixed cost (especially since BitTorrent is generally considered to be easy to use once learned).
- ii) Individuals may experience moral qualms about pirating, which could have the characteristic of a fixed or variable cost.³
- iii) Individuals may fear being caught and punished, a cost which is also variable with respect to downloads.

² Pirated files, of course, tend to be easier to share or use on a variety of devices (due in large part to the lack of Digital Rights Management restrictions on playback) whereas iTunes downloads tend to have more consistent quality.

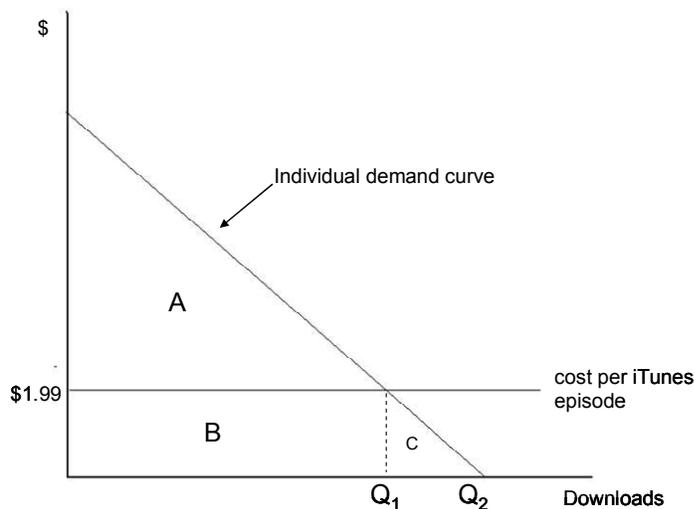
³ The criminology literature (Nagin and Paternoster 1991) suggests that juvenile delinquency has a fixed cost component such that prior involvement in illegal activity reduces barriers to future involvement. However, one could also imagine illegal downloading having a marginal cost component associated with each additional download.

iv) It is possible that pirated downloads are viewed as less convenient (and lower quality) as compared to iTunes consumption (either due to the relative ease of use of iTunes versus piracy sites or the variability in quality through piracy sites). This cost would also be variable with respect to the number of downloads.

The nature of these costs tells us a lot about what we expect to happen to piracy when the digital distribution channel is removed (or introduced). Consider Figure 1 below.

Figure 1 represents an individual's demand curve for downloads of episodes of television. In this figure, we assume a typical downward sloping demand curve for episodes — the intercept would be the most highly valued show download, and each successive download has diminished returns. In this figure, we assume that the non-financial cost of pirated downloads is completely fixed, equal to some number F .⁴

Figure 1



⁴ For simplicity, we also assume that there is no fixed cost to using iTunes, as it is a legal and less intimidating platform. Our analysis could easily be adapted to include a small fixed cost to using iTunes.

In this setup, if an individual chooses to download through iTunes, she will download Q_1 episodes and receive consumer surplus equal to area A. If the individual chooses to pirate, she will download Q_2 episodes (her satiation point for digital television) and receive consumer surplus equal to $A+B+C-F$. The consumer decides whether to pirate or purchase by comparing the surplus from iTunes (A) and piracy ($A+B+C-F$) and choosing the greater of the two. Thus, the individual will choose to download all episodes from iTunes if $B + C < F$ — in other words, if the additional surplus gained from piracy is less than the fixed cost (or the perceived fixed cost) of pirating.

This leads to some notable predictions for our empirical analysis. For an individual who is using iTunes ($B+C<F$), if the content is removed from iTunes there are two possible outcomes. If $A+B+C<F$, then the individual will not turn to piracy and will no longer download the content (either no longer consuming it, or possibly purchasing the box set if that is a substitute). However, if $A + B + C > F$, then if the iTunes channel is removed, the individual will download Q_2 episodes, and thus the increase in piracy will be greater than the original number of iTunes purchases.

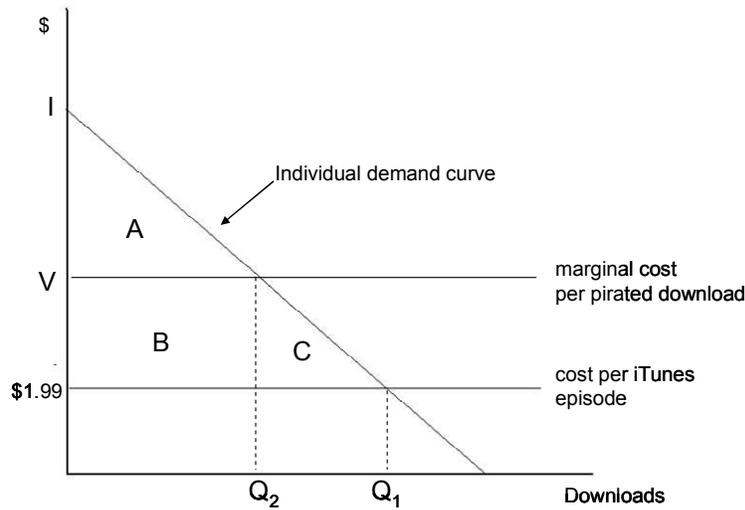
As an alternative outcome, consider Figure 2, in which there is no fixed cost to piracy but instead a constant marginal cost equal to V .

Note first that if V (the constant marginal cost of each pirated download) were greater than I (the demand intercept) the individual would never pirate regardless of the availability of a legal download source (a result similar to that from Figure 1 when there is a very high fixed cost). However, if $\$1.99 < V < I$ as in the diagram,⁵ then the individual will purchase Q_1 episodes from

⁵ If $V < \$1.99$, then this is effectively equivalent to Figure 1 where we get the result that $Q_2 > Q_1$.

iTunes if they are available and receive surplus of $A + B + C$. If the legal purchase option is removed, then the individual will pirate Q_2 episodes and receive surplus equal to area A. Note that in this case, $Q_2 < Q_1$ so the increase in piracy is less than the original number of iTunes purchases before removal of the legal download alternative.

Figure 2



There are other possible structures for the non-financial cost of piracy, including a mix of fixed and variable costs as well as increasing or decreasing marginal cost.⁶ However, in even the simple examples diagrammed here we have shown that when the digital purchase channel is removed, it is possible that an individual would either not turn to piracy, begin to pirate a number of episodes less than or equal to the number of purchases she had been making on iTunes, or even begin pirating more content than she had ever purchased.

⁶ In fact, it is possible to show that if the marginal cost is increasing then consumers might mix behaviors, pirating some episodes and purchasing others.

Unfortunately, because we only observe aggregate changes in piracy levels after removal of the iTunes channel, we cannot use these models to analyze the perception of piracy costs at an individual user level. However, these models suggest that we can infer the general nature of piracy costs perceived by consumers on average by observing changes in piracy after iTunes removal. Specifically, an increase in piracy after iTunes removal that is larger than the pre-removal iTunes sales would be consistent with a fixed cost to piracy among a substantial number of users, either through learning or moral costs.

In addition to this prediction, we also note that when a network's digital distribution channel is removed we may see the appearance of unique new torrents for shows of that network that were previously unavailable through piracy. The nature of the BitTorrent protocol is such that demand actually creates supply as users who are downloading an episode typically allow others to download from them the portions that they have already received. Thus, to remain viable a torrent for an episode often needs to generate a large enough "swarm" of downloaders. It is possible that if the removal of a legitimate digital distribution channel causes an increase in the demand for piracy, then some shows which were unable to generate enough demand to remain available through piracy when they were available via digital distribution will become available through piracy once the digital distribution channel is removed.

3.2. Digital Distribution and Physical Sales

The theory behind the substitutability of iTunes purchases for DVD box sets is less clear than it was for piracy. DVD box sets may take longer to acquire and are often priced differently than the equivalent television content sold on iTunes. One might also speculate that DVD box sets appeal to a different market segment than the iTunes video store — possibly less technologically savvy viewers, viewers who prefer to watch content on their televisions, or perhaps gift givers. Finally,

DVD's often contain "bonus" extra content that is lacking in iTunes files or (some) pirated copies.

Even if box sets and file downloads are substitutes for each other, it is possible that individuals who "go digital" will be disinclined to go back to the physical product (indeed, this would be consistent with a fixed cost associated with beginning to download/watch television online). However, it is also possible that some iTunes consumers would have otherwise purchased the DVD box set. Thus, when deciding whether and how to have a digital distribution channel, networks must balance the potential benefits (revenues from new consumers, regained revenues from pirates) against the potential costs (lost revenues from original channel sales).

In summary, iTunes customers may otherwise have been pirates, may otherwise have purchased the box set, or may otherwise not have consumed the content at all. We have shown that it is theoretically possible that the availability of content on iTunes could displace more pirated downloads than the number of episodes being purchased on iTunes.

Following this theoretical analysis, we ask the following two major empirical questions:⁷

- i) What happens to the level of piracy of television content when that content is removed from iTunes (and when it is returned)?
- ii) What happens to DVD sales of television seasons when those seasons are removed from the iTunes store?

The answers to (i) and (ii) also provide evidence as to the percentage of iTunes purchases that come from otherwise would-be pirates, the possibility that one network's decision to use (or not

⁷ As we discuss in detail in the data section, it is important to note that of necessity we are asking these questions in relation to older, off-season content for most of our analysis.

use) a digital distribution channel can influence piracy of content on other networks, and the shape of the non-financial cost curve associated with piracy.

4. Data

To answer these questions we use panel data on consumption of pirated television content through major BitTorrent tracker sites, and panel data on sales of DVD season box set at Amazon.com. We describe these data in more detail below.

4.1. Piracy Data

Following Smith and Telang (2009), we use the level of daily downloads of BitTorrent tracker files at Mininova.org as a proxy for piracy activity on the programs in our sample. The website Mininova is a search engine for torrent trackers — the files that allow you to link to other computers and download a specific file. BitTorrent serves as a useful proxy for video piracy as it was the most popular source of pirated video downloads during our study period (Smith and Telang 2009). Mininova is a useful proxy for download levels through the BitTorrent protocol because it was the most popular BitTorrent tracker site during our study period according to Alexa.com,⁸ it posts a large number of television tracker files, and unlike some other sites it provides information on the cumulative number of downloads for all tracker files downloaded from its site.

Our piracy dataset contains the daily number of downloads for 5,200 unique episodes of television (corresponding to roughly 75 unique series) for the four week period surrounding December 1 (November 18 – December 15, 2007). The data include the series name, season

⁸ <http://www.alexa.com/browse?CategoryID=1316737>

number, and episode number of each television program and the number of times that file was downloaded each day. We also added indicators for the network that owns the rights to the show, the genre of the show, and whether it is a series that is still producing new episodes (such as *Heroes*) or a “catalog” series (such as the original *Star Trek*).

This dataset was created from a larger dataset we collected monitoring all trackers posted to Mininova. We collected data at the torrent level starting in November 2007, obtaining roughly 210,000 records per day and yielding dataset of over 68 million observations for 180,000 torrents. We extracted the torrent (file) names from this dataset and interpreted the file names to code the series, season, and episode for our television data. When a file contains multiple episodes of a television show, we counted this as a download for each episode contained in the file. Because multiple files frequently map to the same episode of television (for example, there may be 6 different torrent files that contain, say, season 1 episode 4 of *Grey’s Anatomy*), we then collapsed the data to the episode level by adding the total daily downloads for an episode across all tracker files mapping to that episode.

For our analysis, we focus on piracy among television programming for NBC and its subsidiaries (USA and the Sci-Fi Channel). We also analyze piracy for television programming from the other major television networks — ABC, CBS, and Fox — as a control. We removed all content from the 2007-2008 season from the data because, as noted above, the NBC content being sold on iTunes prior to December 1 only included episodes prior to the 2007-2008 season.⁹ Thus, our analysis compares changes in piracy for older “out-of-season” content.

⁹ This is because, starting in August 2008, Apple did not add any new NBC content to the iTunes store in response to NBC’s announcement that it would remove all of its content in December.

Finally, we limit our study to just data from the two weeks before and two weeks after December 1, 2007 (as well as the two weeks before and after September 9, 2008) in order to best isolate the effect of the removal of NBC content from iTunes on piracy (although our results are not sensitive to small changes in this choice of time frame). Our main strategy will be to compare the change in piracy for NBC content after December 1 to the change in piracy for non-NBC content, arguing that any incremental NBC change over and above the non-NBC change is attributable to the removal of NBC content from iTunes.

Importantly, while December 1, 2007 was the official date of NBC's removal from iTunes and December 2 is the first entire day on which the iTunes store held no NBC content, Apple actually began the removal process on November 30 and continued through December 1. Thus we might expect to see some increase in piracy as early as November 30, but we conservatively code December 2 as the first day of the "post removal" period in the data. If, as our data shows, piracy began to increase as soon as the removal began, then our selection will lead to an underestimate of the change in piracy caused by the content's removal from iTunes.

It is also worth noting that past studies on Internet piracy have rarely made use of events or "quasi-experiments," because these events often occur with short notice and data collection on piracy cannot begin soon enough to match the event. Thus a contribution of our study is the method of data collection, which allows us to track a very good index of piracy over time and analyze this data when shocks are observed.

4.2 DVD Sales Data

To analyze the effect of the December 1 experiment on DVD sales, we use a panel data on sales ranks of DVD season box sets on Amazon.com for the same date range: November 18 –

December 15, 2008. Amazon is one of the largest Internet DVD retailers and updates the sales rank of each season box set (relative to all other DVD sales) hourly. We capture this information for all DVDs Amazon sells once per day, at roughly same time each day. These data contain the daily sales rank at Amazon for the box set, as well as the television series, season, network; and daily price at Amazon.

Prior work¹⁰ has shown that the relationship between sales rank and sales follows a Pareto distribution:

$$Quantity = \beta_1 Rank^{\beta_2} \quad (1)$$

Thus, following the experiment proposed by Chevalier and Goolsbee (2003), one can estimate the parameters of the relationship between Amazon.com sales rank and actual sales of the product. However, for the purpose of this study, we simply note that this implies that the relationship between price and sales rank is best modeled as an elasticity. When actual sales figures are not necessary, prior research¹¹ has dealt with the non-linear relationship between Amazon sales and Amazon sales rank by simply analyzing the effect of events or explanatory variables on the log of sales rank. If an effect is found, the experimental approach can allow us to translate the coefficient into the actual effect on sales, but this turns out to be unnecessary here as we find no statistical effect.

As in our analysis of piracy, we will compare the change in sales rank of NBC season box sets after December 1 to the change in sales rank of ABC, CBS, and Fox season box sets in order to determine the effect of the removal of NBC's digital distribution channel.

¹⁰ Chevalier and Goolsbee (2003); Brynjolfsson, Hu, Smith (2003); Ghose, Smith and Telang (2006)

¹¹ Smith and Telang (2008)

5. Results

5.1 Piracy and Digital Distribution

The simplest possible analysis of this quasi-experiment is a comparison of means before and after the removal of NBC content from iTunes on December 1. So to start, we list some very high level summary statistics and ask if the average number of daily downloads of an NBC episode is greater in the two weeks after December 1 than in the two weeks before. We also test the hypothesis of whether more unique NBC episodes become available through piracy when NBC content is removed from iTunes. Table 1 displays these summary statistics.

**Table 1: Piracy Data Summary Statistics
November 11 – December 15, 2007**

	<i>NBC Networks</i>	<i>Non-NBC Networks</i>
1. Mean daily downloads of each episode before 12/1	271	415
2. Mean daily downloads of each episode after 12/1	261	401
3. <i>Change</i>	-10	-14
4. Mean daily downloads before 12/1 (balanced panel)	275	419
5. Mean daily downloads after 12/1 (balanced panel)	281	403
6. <i>Change</i>	6	-16
7. Number of unique episodes available before 12/1	1,683	3,400
8. Number of unique episodes available after 12/1	1,812	3,383
9. <i>Change</i>	129	-17
10. Total number of all downloads prior to 12/1	6,366,662	19,612,479
11. Total number of all downloads after 12/1	6,576,952	18,903,649
12. <i>Change</i>	210,290	-708,830
	3%	-4%

In rows 1, 2, and 3 of Table 1 we first see that the mean number of daily downloads for an NBC episode seems to decrease slightly (a decrease of 10), albeit slightly less than the mean for non-NBC episodes (a decrease of 14). However, this comparison is not made over a balanced panel. If new NBC episodes become available through piracy after December 1, these episodes would likely have initially low download numbers and therefore reduce the mean for NBC after

December 1. A crude way to account for this is to drop observations for any shows that are not available for all 28 days of our sample. We do this in rows 4, 5, and 6, thus giving up data in order to create a balanced panel. Here, we see that while the average number of downloads for non-NBC episodes decreased by 16, this average *increased* for NBC by 6.

Indeed, we see that the results from the balanced panel suggest that NBC piracy increased after the removal from iTunes. In rows 7, 8, and 9, we also see a possible reason why the balanced panel yields different results from the unbalanced panel: in the two weeks after December 1 there were a net 129 more unique NBC episodes available for piracy than in the previous two weeks.¹²

A more detailed analysis shows that this is the result of 147 new episodes of NBC television that became available through pirated channels in the two weeks after December 1 and 18 episodes that ceased to be available. In contrast, for non-NBC content, we don't observe any new episodes becoming available, while we observe 17 episodes cease to be available. The number of new NBC episodes is striking, since we would expect older content to simply become less popular (and as a result less available) over time.

Examining the newly available episodes, we discover that entire seasons of some less popular NBC content — seasons that were not available on Mininova before December 1 but were available on iTunes — become available on Mininova after December 1. These series include, for example, a number of seasons of *Saved by the Bell* and *Xena: Warrior Princess*. None of these seasons had new or updated box sets released or new syndication deals during the time period of the study, supporting the inference of causality with NBC's removal from iTunes. In

¹² In fact, just as we see some non-NBC torrents expiring, we also see some NBC torrents expire after December 1. So there are actually more than 128 new episodes of television being introduced on the piracy channel after December 1 — there are 147 new NBC episodes available after 12/1 that were not available before.

short, it is striking that these entire seasons of older NBC television became available for piracy immediately after the removal of the iTunes channel while no new non-NBC content becomes available. We conjecture that increased demand for these shows through piracy allowed a sufficiently sized piracy swarm to exist after the content was no longer available on iTunes.

Another important metric is to simply compare the total number of pirated downloads for all episodes on each network before and after December 1. In rows 10, 11, and 12 of Table 1 we see that while the total number of pirated downloads on non-NBC networks reduced by 4% after December 1, total piracy for all NBC episodes increased by 3%. Together these summary statistics suggest that iTunes purchases may have been displacing some amount of piracy.

However, these simple statistics only tell a partial story as they do not control for important episode-level heterogeneity, nor do they reflect an appropriate model of the actual relationship between digital distribution and piracy. Thus, we turn to a regression models for our main empirical analysis. Specifically, we run the following regression as a standard difference-in-difference model to isolate the effect of the removal of NBC content from iTunes on piracy of that content.

$$\ln Downloads_{it} = \beta_0 + \beta_1 \Phi_t + \beta_2 NBC_i * \Phi_t + \mu_i + e \quad (2)$$

where Φ_t is an indicator variable equal to 1 if the observation occurs in the two weeks after December 1, 2007 and equal to 0 if it is in the two weeks before, μ_i is a vector of fixed effects at various level of aggregation (episode, season and series), and $Downloads_{it}$ is the total number of pirated downloads of episode i in period t , where $t=1$ for the two weeks before and including December 1 and $t=2$ for the two weeks after.

We use a log transformation on downloads because the relationship between pirated downloads and the presence of a legal digital sales channel is not expected to be linear. Rather, torrents that are already highly downloaded will be more attractive to BitTorrent users because they will generally have faster download times owing to the nature of the BitTorrent protocol in creating “swarms” of users around specific files. Because of this, we believe it is appropriate to look at the change in piracy on a percentage basis.¹³

In this regression, $100*\beta_1$ indicates the percentage change in piracy for the average episode of non-NBC television for the two weeks after December 1 as compared to the two weeks before. We assume that this indicates any general or seasonal trend in piracy over the period of our study. The variable of interest is β_2 , as it indicates the percentage change in pirated downloads for NBC over and above any change for non-NBC programs. If β_2 is positive and significant then, under our identifying assumption that NBC and non-NBC piracy trend similarly in the absence of an event, $100*\beta_2$ indicates the percentage increase in pirated downloads per NBC episode that was caused by the removal of NBC content from iTunes.

We run our regression at four different levels of aggregation: episode, season, series, and channel. Running the regressions at the episode level makes the maximum use of our data, however, it has the disadvantage of potentially inflating the significance of our results as pirated downloads of, say Heroes season 1 episode 2 are probably not independent of downloads of Heroes seasons 1 episode 3. This problem is reduced when downloads are aggregated at the season level, however one might still be concerned that downloads of season 1 of a specific show

¹³ We also ran a Box-Cox test on the model to determine the best fitting transformation of downloads – the test produced a $\theta = .04$, indicating quite strongly that the log transformation produces the best fit to our data. However, if we run the linear version for our model, the coefficient of interest is similar enough that none of our interpretations would change.

are not independent of downloads of seasons 2. Accordingly, we believe that the series level of aggregation is the correct specification, as it is unlikely that downloads of, say, “Saved by the Bell” are correlated with downloads of another NBC program, say, “Battlestar Galactica.”

**Table 2: OLS Regressions of Log of Daily Downloads
November 18 – December 15, 2007**

	<i>Episode-Level</i>	<i>Season-Level</i>	<i>Series-Level</i>	<i>Network-Level</i>
After 12/1	0.043** (0.005)	0.042* (0.021)	0.076* (0.038)	-0.023 (0.092)
After 12/1 * NBC	0.138** (0.008)	0.138** (0.033)	0.115* (0.058)	0.159 (0.129)
Constant	7.157** (0.003)	10.017** (0.011)	10.969** (0.020)	14.707** (0.046)
Observations	9,776	476	150	12
Number of Groups	4,888	238	75	6
R ²	0.16	0.19	0.25	0.36

The dependent variable is ln(total pirated downloads before/after December 1). T-statistics are listed in parenthesis; ** and * denote significance at 0.01 and 0.05, respectively. Data are aggregated at the episode, season, series, and network levels in columns 1, 2, 3, and 4 respectively. In each case the regressions include fixed effects at the appropriate level of aggregation.

We report our results in Table 2 with separate columns showing the aggregation at the episode, season, series, and channel level. These regressions produce very similar results for β_2 , with the coefficient from the series level regression equal to .115 and significant at the 95% confidence level. Note that even if we run our regression aggregated to the channel level, we still see a similar coefficient, although we lose significance at this level due to the very low number of individual channels (6) in our data. The coefficients from the series level regression tell an interesting story — while non-NBC piracy increased by 7.6% during the time period of our study, NBC piracy increased an additional 11.5% over and above this level. This suggests that the removal of NBC content from iTunes caused an 11.5% increase in piracy over and above the change in the non-NBC “control group.” This shows a significant elasticity, or substitution, between legitimate digital distribution and piracy channels.

The increase in non-NBC piracy observed here could derive from some outside factor or be a general time trend for all piracy during this period, in which case the difference in difference

model is an accurate estimation of the effect on NBC piracy. However, we have not been able to determine any outside factors during this timeframe that might result in an increase in television piracy demand unrelated to NBC's iTunes decision.

An alternate explanation, and one that derives from the theory section, is that removing the digital distribution channel could have a spillover effect if the non-financial cost of piracy is largely fixed. Thus the 7.6% increase in non-NBC piracy found in column (i) could actually be a result of the December 1 NBC treatment and not a general time trend. If this were the case, then our results would understate the displacement of piracy by the iTunes channel, because the change in non-NBC piracy would no longer be an appropriate counterfactual to predict what should have happened to NBC piracy in the absence of the December 1 event. However, while the evidence is consistent with the possibility of a spillover effect, this study cannot identify this effect precisely due to lack of an appropriate counterfactual.¹⁴

To explore the source of the increase in NBC piracy, we break down our results by type of program and run model (2) for three separate genre groups in Table 3: Drama, Action, and Comedy. Naturally, since there are only 75 series in our data, further separating them by genre limits our ability to establish significance. Nonetheless, we believe our results shed some light on the nature of these changes in piracy.

Ignoring for a moment the insignificance of two of the three interaction terms and focusing on the point estimates, our results show that the piracy increase for drama programming is lower (7.6%) than action (11.6%) and comedy (24.6%). While we don't want to over-emphasize these

¹⁴ "After 12/1" coefficient could be due to NBC removing its content from iTunes or simply a time trend. Since we have a control group for NBC piracy, we can eliminate the time trend in that regression using difference-in-difference regression when we estimate "After 12/1 * NBC". However, no obvious control group exists to disentangle the time effect in the "After 12/1" coefficient.

results given the relatively small number of observations, we do note that these results are consistent with the conventional wisdom that those genres (action and comedy) most likely to appeal to demographic groups likely to pirate (young males), are also most likely to experience an increase in piracy following the removal of the iTunes distribution channel.

**Table 3: OLS Regressions of Log of Daily Downloads by Genre
November 18 – December 15, 2007**

	<i>Drama</i>	<i>Action</i> ¹⁵	<i>Comedy</i>
After 12/1	0.087 [†] (0.049)	0.037 (0.079)	0.056 (0.059)
After 12/1 * NBC	0.076 (0.091)	0.116 (0.102)	0.246* (0.109)
Constant	11.579** (.029)	10.708** (.036)	11.150** (.032)
Observations	42	64	42
# Groups (Series)	21	32	22
R ²	0.29	0.16	0.48

The dependent variable is $\ln(\text{total pirated downloads before/after December 1})$. T-statistics are listed in parenthesis; **, *, and † denote significance at 0.01, 0.05, and 0.10 respectively. Data are aggregated at the series level and each regression includes series fixed effects.

Returning to our main results, we note that there are a few ways to interpret the overall percentage change in piracy resulting from the removal of iTunes content. The first is to calculate the implied average unit increase in piracy per episode as the average number of pirated NBC downloads per episode prior to December 1 (275) times the estimated increase in piracy in our model (11.5% using series level aggregation) to obtain an average increase of 31.6 pirated downloads per episode attributable to NBC’s decision to remove the iTunes distribution channel. Since there were 1,683 NBC episodes available for piracy prior to December 1 and the average episode experienced an increase of 31.6 pirated downloads, using this method we would conclude that the removal of NBC content from iTunes caused a total increase of about 53,000 pirated downloads per day of NBC content.

¹⁵ We include science fiction and crime in the “action” category.

Another way to look at the 31 unit download increase is to compare it to iTunes purchases of NBC episodes before the removal of the content. While we were not able to directly obtain data documenting the number of NBC downloads at iTunes, we were able to obtain summary data from an independent source that suggests the mean number of downloads for these shows on iTunes is about 16 downloads per day. Thus, our results show that the unit increase in piracy was significantly larger than the pre-removal sales on iTunes. This result, while surprising at first, was predicted by the model if the fixed cost of piracy were significant, and we discuss this in further detail in the final section of the paper.

We also note that the main results reported in this section are robust to a variety of alternative specifications. A linear model also shows an increase in NBC piracy over and above non-NBC piracy, although by contrast it shows a small decrease in non-NBC piracy. Changing the time frame to three weeks before and after (or one week before and after) December 1 produces only slightly altered coefficients with the same sign and significance. Including controls for the amount of time each episode has been available online, or the time since the original air date of the show, has no observable change on the coefficients, probably because each episode has been available for long enough that any time trend due to age of torrent is insignificant. Removing the Sci-Fi Channel and USA from the analysis (since technically they are cable channels, while NBC, ABC, Fox, and CBS are public networks) does not change the coefficients significantly. Coding November 30th as the first day of the “after removal from iTunes” period produces even stronger results, likely because NBC started removing content on November 30. Finally, one might worry that the early announcement of NBC’s removal from iTunes (it was announced months before it happened) might have caused people to switch to piracy before the actual removal. If this were the case, piracy would have spiked before December 1 causing our results

to underestimate the true effect. Thus, the model appears to produce robust, and if anything somewhat conservative, results.

5.2 Piracy and DVD Box Sets

To determine the degree to which the iTunes digital distribution channel displaces purchases of DVD box sets, we employ similar tests to those above. The dependent variable in this case is the Amazon.com sales rank, and thus a decrease in a DVD's rank indicates an increase in sales of that DVD. Table 4 compares means for sales ranks of NBC and non-NBC box sets before and after December 1, 2007.

**Table 4: DVD Sales Rank at Amazon.com (Comparison of Means)
November 11 – December 15, 2007**

	<i>NBC Networks</i>	<i>Non-NBC Networks</i>
Amazon.com sales rank prior to Dec. 1	24,553	35,384
Amazon.com sales rank after Dec. 1	26,056	38,785
<i>Change</i>	<i>1,503</i>	<i>3,401</i>
	<i>6%</i>	<i>10%</i>

We see from this table that the mean rank for non-NBC box sets increased by 10%, meaning that fewer non-NBC television series box sets were sold after December 1 than before. The increase in rank for NBC box sets was only 6%, which could indicate that the removal of NBC content from iTunes caused some additional purchases of DVD box sets. However, as with our analysis for piracy, this comparison of means does not account for changes in price that may occur during this time period (especially with the approaching holidays), nor is a linear model appropriate when predicting sales rank. Thus, we run a similar difference-in-difference model to the one we ran for piracy, specified as follows:

$$\ln Rank_{it} = \beta_0 + \beta_1 \Phi_t + \beta_2 NBC_i * \Phi_t + \beta_3 \pi_{it} + \mu_i + e \quad (3)$$

where $Rank_{it}$ is defined as the Amazon.com sales rank of season box set i on day t . Φ_t is an indicator variable equal to one in the 2-week period after December 1. π_{it} is the log of the price of box set i on day t and μ_i is a vector of fixed effects for each season box set. We log transform the Amazon sales rank as well as the daily Amazon price consistent with prior literature based on the explanation provided in the data section.¹⁶ We present results for this regression in Table 5.

**Table 5: OLS Regressions of Ln Sales Rank of Season DVD Box Sets
November 18 – December 15, 2007**

	<i>DVD Box Sets</i>
Ln(Amazon Price)	1.725 (0.028)
After 12/1	-0.025 (0.008)
After 12/1 * NBC	0.003 (0.014)
Constant	2.907 (0.095)
Observations	9813
# Groups (Series)	408
R ²	0.29

The dependent variable is ln(Amazon sales rank before/after December 1). T-statistics are listed in parenthesis; ** and * denote significance at 0.01 and 0.05 respectively. Regressions include DVD-level fixed effects.

We note that raising price has the predicted effect of decreasing sales. We also note from the significant coefficient on the after December 1 term that sales of DVD box sets (relative to sales of all other DVDs) were, *ceteris paribus*, increasing slightly over time, possibly an effect of the approaching holiday season. However, the insignificance of the coefficient on the interaction terms shows that sales of NBC box sets experienced statistically the same trend over time that non-NBC box sets did, despite the removal of the NBC content from iTunes. Thus, the removal of the digital sales channel did not seem to increase sales in the physical channel.¹⁷ Our finding is

¹⁶ See Chevalier and Goolsbee (2003), Ghose et al. (2006), Smith and Telang (2008, and 2009).

¹⁷ We analyzed DVD box sets at the level of box set sales per day, because price is a significant predictor of sales and changes by box set and by the day. However, if we were to cluster our standard errors at the series level, it would merely inflate them and thus our results would remain close to zero and insignificant.

consistent with previous marketing literature saying that when the two channels differ substantially in any of the key channel parameters, firms benefit by segmenting customers based on their channel preferences and choosing their positioning and pricing strategies accordingly (Viswanathan 2005). We discuss this result in more detail below in the discussion section.

5.3 NBC's Return to iTunes

The results presented above represent the best experiment we can find to determine the relationship between piracy, digital distribution, and physical sales. However, another experiment occurred on September 9, 2008 when, after reaching an agreement with Apple, NBC restored all of their content to the iTunes store. Unfortunately, this date also coincides with the new Fall season of television in 2008, which presents complications for our empirical analysis. The premiere of a new season of television undoubtedly increases demand for older seasons of the same show, and so there are two problems in our data. First, there are large day-to-day swings in piracy of older content that correspond to the premieres of new shows. Second, this naturally implies that non-NBC piracy may not be a good control for NBC piracy as the schedule of Fall premieres is not constant across networks.

However, it still may be valuable to examine the changes in piracy around this time period to see if our earlier findings are supported. In Section 5.1 we noted that when NBC removed their content from iTunes, NBC pirated downloads increased by more than the number of iTunes purchases previously made, and we interpreted this as evidence of a fixed cost to piracy. If the non-financial cost of piracy is largely fixed, then we would not expect to see as many customers return to iTunes as left when the content becomes available again there. We list some summary statistics surrounding this event in Table 6 below.

**Table 6: Piracy Data Summary Statistics
August 26 – September 22, 2008**

	<i>NBC Networks</i>	<i>Non-NBC Networks</i>
1. Mean daily downloads of each episode before 9/9	141	286
2. Mean daily downloads of each episode after 9/9	168	307
3. <i>Change</i>	27	21

A simple comparison of means shows that non-NBC shows averaged 286 downloads per day for the two weeks prior to September 9, and this increased to 307 downloads for the two weeks after. As noted above, this change likely results from increased demand for older seasons generated by the premieres of new seasons. NBC piracy also increased, with a daily mean of 141 downloads per episode before September 9 and 168 daily downloads after. Certainly the fact that NBC piracy did not decrease is consistent with our prior finding of a fixed cost to piracy, but admittedly the increases in piracy due to the new season may be masking other effects.

The model that we ran in section 5.1 fit the log of daily downloads, which does help to reduce the effects of outliers (such as a large jump in piracy for a single season due to a premiere) and controls for heterogeneity across episodes or series. We run model 2 again but for the 4 weeks surrounding September 9, 2008, and we report these results in Table 7. Again, we perform the analysis at various levels of aggregation, but assert that the third column, containing the series level of aggregation, is the appropriate specification.

**Table 7: OLS Regressions of Log of Daily Downloads
August 26 – September 22, 2008**

	<i>Episode-Level</i>	<i>Season-Level</i>	<i>Series-Level</i>	<i>Network-Level</i>
After 12/1	0.049** (0.005)	0.051* (0.022)	0.056 (0.038)	0.104 (0.058)
After 12/1 * NBC	-0.092** (0.008)	-0.125** (0.035)	-0.062 (0.058)	-0.057 (0.082)
Constant	6.906** (0.003)	9.385** (0.012)	10.212** (0.020)	14.271** (0.029)
Observations	9,678	512	150	12
Number of Groups	4,839	256	75	6
R ²	0.03	0.05	0.03	0.49

The dependent variable is ln(total pirated downloads before/after September 9. T-statistics are listed in parenthesis; **, *, and † denote significance at 0.01, 0.05, and 0.10 respectively. Data are aggregated at the episode, season, series,

and network levels in columns 1, 2, 3, and 4 respectively. In each case the regressions include fixed effects at the appropriate level of aggregation.

The coefficients on the interaction vary to some extent across specifications. At its highest in magnitude, column 2 (season-level aggregation) shows a decrease in NBC piracy of 12.5%, a similar percentage to the increase we observed when the content was removed in December. However, because the mean number of downloads for this content was much lower at this point (141 downloads per episode per day), this decrease is smaller in actual values than the increase in December. As well, the preferred specification in column 3 (series-level aggregation) shows only a 6.2% decrease in piracy, and is not statistically significant. Thus, with the caveat that measuring piracy at the beginning of a new television season does not provide a clean experiment, we note that returning content to iTunes may decrease piracy of that content to some extent, but our results suggest that the reduction in piracy when the content is restored to iTunes is lower than the increase when the content was removed. This result is consistent with our finding of an elasticity/substitution between piracy and digital sales and it is also consistent with the theoretical predictions arising from a fixed cost to piracy.

6. Discussion

The results presented above are the first test we are aware of that quantifies the effect of a legal digital distribution channel on both online piracy and physical distribution channels. As such, they offer decision-makers at media firms some much-needed evidence regarding the ability of legal digital distribution channels to compete with illegal piracy channels and physical distribution channels. In this final section, we discuss the results and their implications, as well as the limitations of the work as it stands, and how these limitations might be overcome by further research.

In this study, we used NBC's decision to its content from the iTunes music store on December 1, 2007 as a quasi experiment and found that the removal of NBC's primary digital sales channel caused an 11.5% increase in piracy of that content over and above any change experienced by competitor networks ABC, CBS, and Fox over the same period.

An 11.5% increase in piracy corresponds to about 31 more downloads per day per episode, or 53,000 additional pirated downloads of all NBC content per day. To put this number in perspective, we obtained an estimate of the average daily downloads of similar content on iTunes in the two weeks prior to December 1, and this estimate indicates that the average episode received about 16 purchases per day. Thus, when the digital sales channel was removed, piracy activity for that content on the BitTorrent tracker used in our sample increased by nearly twice the size of the actual digital sales figures before removal. As noted above, this estimate is conservative due to our decision to treat December 2 as the first day of the treatment period and due to the fact that Mininova piracy, while arguably a good proxy for overall BitTorrent piracy, represents only a portion of overall BitTorrent television piracy.

Further, this large jump in piracy (larger than the size of the iTunes market) is predicted by theory when there is a significant fixed cost to piracy but only a small (or no) variable cost. In other words, iTunes purchasers may avoid piracy because the fixed cost to learn to use BitTorrent (or the fixed moral/stigma cost of illegal behavior) makes piracy less attractive than iTunes. However, when the digital sales channel is not available, these individuals turn to piracy, pay the fixed cost and, owing to the seemingly low marginal costs of additional downloads, begin to consume much more content through piracy than they had previously purchased.

We note that this could even have a spillover effect for other networks that do have a digital sales channel, since once the fixed cost is paid for NBC it is likely paid for, say, ABC as well. The data is consistent with this possibility (the model shows a 7.6% increase in non-NBC piracy when we might have expected a decrease due to decreasing interest), but this result should be treated cautiously owing to a lack of strong counter-factual evidence for non-NBC piracy. Either way, these results should sound an alarm to content providers, because once the fixed cost of piracy is sunk it may be difficult to get pirates to return to legal options. Indeed, while the return of NBC content to iTunes presented some analytical challenges due to coinciding with the start of the Fall season, we observed a much smaller and statistically insignificant decrease in piracy for NBC content (as compared to non-NBC content) when it was returned to iTunes.

Digital distribution's impact on sales of DVD box sets present a different story, however. When NBC removed their archived seasons of television from iTunes, we found no significant change in the Amazon.com sales rank for NBC's DVD sales relative to the trend that we saw for non-NBC box sets. One possible interpretation of this is that digital television and DVD's are simply not substitutes in the short term, and thus adding a digital distribution channel would not displace DVD box set sales. However, another is that there is a fixed cost to digital viewing of television, and once a consumer has "gone digital" she is unlikely to come back.

We note that there are several limitations to our study. First, and most notably, our findings represent a test of short-term elasticity between legitimate digital distribution, pirated digital distribution, and physical distribution channels. The long-term presence of a digital distribution channel likely has a much stronger effect on physical channel sales than those observed here in the short term. However, it is important to note that there is little that media firms can do to forestall the penetration of digital channels given the increased ease, speed, and flexibility

associated with obtaining media in digital environments. Rather, our results suggest that media companies would be best served by competing with piracy through digital distribution rather than hoping that the lack of a legitimate digital distribution channel will drive consumers away from the digital channel and back to physical purchases.

In addition to this limitation, we also note that the spillover results mentioned above should be interpreted cautiously owing to the lack of an appropriate counterfactual. Further, we note that our results represent a snapshot in time for a single media type. It would be useful for future studies to analyze competition between legitimate and illegitimate digital channels in other settings to confirm our results.

Another interesting potential direction for future research relates to the “moral” cost of piracy. In the theory section, we argued that the decision to purchase or pirate rests largely on the shape of the non-financial cost curve associated with piracy. While part of that cost may be related to learning or to the (sometimes) diminished quality of the pirated copies, these costs may approach zero in the future as pirates become more sophisticated in their methods, consumers become more technologically savvy, and client software for piracy becomes even more user-friendly. We suspect that a large part of antipiracy efforts in the future may need to rely on the consumer’s “moral” cost associated with piracy. In order to price competitively, digital distribution efforts would benefit from knowing more about the shape of this moral cost. We believe that user studies — whether in the laboratory or in the field — aimed at revealing the nature of the moral cost of piracy for different types of consumers is a fertile area for future research.

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