



## Gone in 60 Seconds: The Impact of the Megaupload Shutdown on Movie Sales

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### ABSTRACT

The growth of Internet-based piracy has led to a wide-ranging debate over how copyright policy should be enforced in the digital era. In this paper we analyze the impact of the US government's shutdown of a major piracy site – Megaupload.com – on digital sales and rentals of movies.

Exploiting cross-country variation in pre-shutdown usage of Megaupload, we find that the shutdown of Megaupload and its associated sites caused digital revenues for three major motion picture studios to increase by 6.5–8.5%. Our results suggest that some consumers will turn to legal channels when a major filesharing site is shut down, and by extension that illegal filesharing displaces digital movie sales.

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### 1. Introduction

The revenue impact to media firms from illegal filesharing on the Internet has been an important and still open question in both academic and policy discussions for over a decade. Industry concern about the impact of illegal filesharing derives in part from significant drops in industry revenue following the introduction of piracy-enabling Internet technologies. For example, revenues from recorded music contracted by 50% in the ten years following the introduction of Napster (1999–2009) (IFPI, 2010) and home video sales of movies declined by 27% from 2004 to 2008 after BitTorrent piracy became widespread (Zentner, 2010). While these statistics alone don't establish a causal relationship, the economics literature has generally found a negative causal impact of piracy on media sales (see for example literature reviews by Danaher et al., 2014; Liebowitz, 2008a; Oberholzer-Gee and Strumpf, 2009).

With many industry studies and academic papers finding evidence of significant harm to media sales from widespread Internet piracy, the debate around piracy has shifted recently to a new question: are

policy interventions an effective way to reverse the negative impact of piracy on media sales? In this paper we provide one of first academic studies to empirically analyze this question.

Specifically, in this study we examine the impact of a complete shutdown of a major cyberlocker and filesharing site, Megaupload, and ask whether it had any impact on digital purchases or rentals of films. While earlier studies in the economics literature on filesharing have aimed to quantify the losses in music or film sales that are attributable to piracy, this study contributes to a small but growing literature on the effectiveness of anti-piracy interventions by governments on media sales. Within this literature Danaher et al. (2012) examine the growth in French digital music sales caused by the passage of HADOPI, a French graduated response anti-piracy law under which consumers receive a warning for their first two instances of illegal filesharing and then are subject to penalties (such as loss of Internet access) on their third instance. The other study (Liang and Adermon, 2011), examines the impact of a copyright protection law in Sweden on music and movie sales.

Our study differs from these two prior studies in that it is the first research paper we are aware of to analyze changes in digital media sales following a “supply-side” intervention (an effort to limit the supply of pirated content by targeting pirate sites and networks) as opposed to prior studies which analyzed “demand-side” piracy (efforts to influence the demand for pirated content by targeting consumers).

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The question of whether supply-side antipiracy policies can affect demand for media is timely and important. Because media goods such as movies have high fixed costs of production, one may worry that when filesharing reduces demand, and therefore revenues in the media industries, the quantity and/or quality of new media products could diminish over time as there is less incentive to invest the fixed cost necessary to produce such products. This possibility is particularly worrisome in the film industry where products have extraordinarily high fixed costs of production. However, shutting down major piracy sites or protocols such as Megaupload or Limewire is not without cost. Governments spend resources in order to win court cases against such sites and to mount shutdown operations. Further, even if such actions do reduce filesharing, consumers who would have pirated movies but would not otherwise have paid for them lose surplus when they do not have access to the films. Since this surplus from piracy came with no marginal cost to producers, the elimination of piracy turns this potential surplus into deadweight loss. Thus, a necessary condition for supply-side anti-piracy policies to be worthwhile is that we must see a causal gain in media sales and revenues resulting from the reduction in piracy.

In this regard, we argue that it isn't obvious *ex ante* that media sales will increase after shutting down piracy enabling sites. First, when a major filesharing site or protocol is eliminated, other alternatives exist. Policy interventions against particular sites or protocols may simply transfer filesharing from one platform to another with no net effect on total piracy or sales (see for example the arguments in [Bilton, 2012](#)). Second, even if total filesharing activity decreases, if the discouraged pirates consist largely of consumers whose reservation prices for the content are lower than the market price, no sales gain will be realized. On the other hand, if the elimination of some of the largest and most convenient filesharing platforms leads some consumers to turn from piracy to purchases on legal channels, then revenues to content providers can increase. For these reasons, the question of whether shutting down major piracy platforms will causally impact consumer purchases is theoretically ambiguous and must be answered empirically.

We address this question in the context of the shutdown of Megaupload.com. Megaupload.com, was shut down over the course of several days, such that on January 18, 2012 25 petabytes of content, much of it motion picture content, was available to the world through illegal download or streaming from the Megaupload.com and Megavideo.com sites; and by January 22, this content was no longer available for illegal consumption through these sites. For this reason, simulation of the counterfactual – how sales of these films would have changed over time if Megaupload had not been shut down – is difficult. Fortunately there exists cultural variation across countries in the degree to which Megaupload was used as a channel for piracy.

Our empirical analysis shows that before the shutdown of Megaupload, the variation in Megaupload usage across countries is random with respect to the modeled time trend of digital movie purchases. However, after the shutdown, countries with higher pre-shutdown usage of Megaupload experience larger increases in digital sales and rentals than countries with lower pre-shutdown usage do. This difference is both statistically and economically significant. Our findings indicate that digital movie revenues for two studios were 6.5–8.5% higher over the 18 weeks following the shutdown (across 12 countries) than they would have been if not for the shutdown. Thus, our analysis shows that the shutdown of a major online piracy site can increase digital media sales, and by extension we provide evidence that Internet movie piracy displaces digital film sales and rentals.

## 2. Background on the motion picture industry and Megaupload

Internet file sharing became a significant problem for the music industry with the development of Napster in 1999, but film piracy lagged behind music piracy due to larger file sizes and longer file transfer times associated with motion picture content ([Smith and Telang, 2010](#)).

However, in the mid-2000s technological advances such as the BitTorrent protocol made movie filesharing more convenient and popular. More recently, with the development of large-scale file hosting services, Internet film piracy has shifted somewhat from BitTorrent and other peer-to-peer networks toward cyberlocker direct download sites.

At one level, a cyberlocker is simply a company or website that provides cloud storage to consumers through the Internet. A cyberlocker user pays for – or is given – a certain amount of password-protected space on the cyberlocker's hard drive where she can store files. This can enable the user to easily back up her data or make those available to her from anywhere she has Internet access. While this sort of service can be used for legal purposes, many of these sites quickly became leaders in illegal filesharing, allowing users to upload media files to their lockers and then share a link to this file with others on the Internet. Cyberlocker piracy is further enabled by search engines that crawl all of the major cyberlockers,<sup>1</sup> allowing users to search cyberlockers for a particular media file they may want and then providing a link to the downloadable content.

Cyberlockers profit from such activity, either through advertising or by reducing download speeds for free users, thus encouraging upgrades to premium membership with faster, easier downloads ([Parloff, 2012](#)). Not surprisingly, the content industries have argued strongly against unauthorized sharing of copyrighted content on cyberlockers, and recently the U.S. government made headlines when it successfully secured an indictment against the popular cyberlocker Megaupload.com, allowing them to raid Megaupload's offices, secure all of their servers that hosted the content, and effectively shut down their operation.<sup>2</sup>

This action is significant for our purposes because Megaupload.com was one of the largest and most heavily used cyberlockers on the Internet. According to the indictment, Megaupload encouraged uploading of illegal content by providing financial rewards to uploaders of heavily downloaded content and by allowing open access to a user's uploaded content.<sup>3</sup> At one point, it was the thirteenth most visited site on the Internet according to Alexa.com (ahead of Netflix and the New York Times), it reportedly hosted over 25 petabytes (25 million gigabytes) of user uploaded data, and accounted for 4% of worldwide Internet traffic ([Parloff, 2012](#)). In short, while Megaupload offered a service that could have legitimate purposes, it was predominantly a warehouse of user uploaded pirated content available freely to downloaders.

In January 2012, a U.S. federal grand jury charged Megaupload with aiding copyright infringement. The government's case consisted of several items, including allegations that defendants earned over \$175 million dollars (through advertising and subscription fees) by "facilitating the illegal distribution of over \$500 million worth of copyrighted (material)," and that "90% of Megaupload's 66.6 million registered users had never stored anything there" ([USA v Kim Dotcom et al., 2012](#)), and were simply downloading copyright infringing files that others stored there ([Parloff, 2012](#)).

Following the indictment, on January 19, 2012, in one of the largest piracy takedowns in history, the U.S. Department of Justice shut down Megaupload.com and seized the servers and assets on which all of the Megaupload content was stored ([Fowler et al., 2012](#)). By January 22, none of the Megaupload content was available to users for download. A sister site called Megavideo.com, owned by the same company, had previously allowed site visitors to stream videos hosted at Megaupload to their screens without downloading them, and since the hosted files were no longer available, illegal streaming at Megavideo.com also ceased to function. Importantly, following the shutdown users trying

<sup>1</sup> For example, [Filestube.com](#) is a search engine for free cyberlocker content, much of which is copyright infringing.

<sup>2</sup> [http://news.cnet.com/8301-1023\\_3-57414104-93/u.s.-says-megaupload-hosting-service-is-no-innocent-bystander/](http://news.cnet.com/8301-1023_3-57414104-93/u.s.-says-megaupload-hosting-service-is-no-innocent-bystander/).

<sup>3</sup> A fully copy of the indictment can be found at <http://www.scribd.com/doc/78786408/Mega-Indictment>.

**Table 1**  
Descriptive statistics.

Country	Mean pre-shutdown sales per week	Mean pre-shutdown rentals per week	Megaupload/Megavideo unique visits Dec '11 (thousands)	Internet accounts Dec 31, 2011 (millions)	Mega penetration ratio
Austria	1816	2589	140.5	6.1	0.023
Australia	14,788	25,561	440	19.6	0.022
Belgium	1795	963	820	8.5	0.096
Canada	11,897	26,860	1300	27.8	0.047
France	7599	12,833	5600	50.3	0.111
Germany	17,153	26,129	1740	67.4	0.026
Great Britain	32,889	42,458	1390	52.7	0.026
Ireland	1193	2525	119	3.1	0.038
Mexico	3671	6112	2900	42.0	0.069
New Zealand	1769	1801	72	3.6	0.020
Spain	2372	4743	5200	30.7	0.169
United States	166,348	515,648	4300	245.0	0.018

to access these sites would see only a large DOJ warning against piracy, which may have added to the effect on user behavior by also sending a signal regarding piracy's illegality. In this study, we estimate the combined effect of the shutdown of these Megaupload sites (and any signaling from the anti-piracy warning pages set in their place) on paid digital movie downloads at three major movie studios. We find that the shutdown of Megaupload led to a meaningful increase in legitimate sales, rentals, and revenues of these studios' content.

### 3. Literature review

Our paper is related to the academic literature on the impact of file sharing on media sales. In this literature, Oberholzer and Strumpf (2007) were one of the first papers to analyze the impact of piracy on music sales, using German school holidays as an instrument for the availability of pirated files in the United States. While their paper remains one of the most well-known and well-cited papers in the literature, their finding that there is no evidence of harm from file sharing has been critiqued in other academic papers (see Liebowitz, 2010; Rob and Waldfogel, 2006 for example). Following Oberholzer-Gee and Stumpf's work, most of the literature has found that piracy harms music sales. These papers include Zentner (2006), Hui and Png (2003), Peitz and Waelbroeck (2004), Zentner (2009), and Liebowitz (2008b), among others.

The literature analyzing the impact of piracy on movie sales, is smaller, but also predominantly finds significant harm from piracy. This literature includes Smith and Telang (2010), Zentner (2010), Bounie et al. (2006), Hennig-Thurau et al. (2007), Zentner (2012), and Danaher et al. (2010). However, with the exception of Danaher et al. (2010), which focuses on paid digital downloads of television, these papers focus on the effect of piracy on physical sales of video content (DVD's or theatrical attendance). In contrast, our paper focuses on paid digital downloads of movies, and in finding that the shutdown of a major piracy site increases paid digital movie downloads, we also indirectly provide the first evidence we are aware of showing that Internet film piracy displaces digital movie sales and rentals.

In addition to addressing a different channel (digital versus physical purchases of movies), our paper addresses a different question than most of the prior literature: can direct government anti-piracy intervention cause consumers to migrate from illegal consumption channels to legal ones? We are aware of only two other complete studies in the literature to analyze this specific question. First, Danaher et al. (2012) find that the French HADOPI anti-piracy law caused a 20–25% increase in music sales in France. Similarly, Liang and Adermon (2011) find that the enforcement of the European Union's IPRED 2009 directive caused a 48% increase in digital music sales and a 27% increase in CD sales in Sweden. This paper represents the first effort we are aware of to extend this literature by analyzing the impact of a different anti-piracy tool: the seizure and shutdown of popular piracy sites. Finally,

after our paper was made available Peukert et al. (2013) released a paper suggesting that the Megaupload shutdown may have increased box office revenues for large blockbusters but diminished box office revenues for smaller movies.

### 4. Data

Our methodology for estimating the effect of the Megaupload shutdown on sales involves cross-country variation in the penetration level of the Megaupload cyberlocker site among Internet users. Our sales data are provided by three major U.S. movie studios and include all digital purchases and rentals through their major digital channels aggregated at a weekly level from September 2, 2011 until May 31, 2012. These data include each of the 12 countries where these digital channels were available as of September 2011. We also have a similar dataset for a similar period from September 2012 until March 2013, allowing us to conduct a placebo test.

We use digital sales and rental data for movies for two reasons. First, data on physical sales (DVDs) are significantly less reliable or in some cases unavailable, and prior research suggests that consumers may be tied to physical or digital channels, and thus digital pirates who are encouraged to purchase as a result of Megaupload's shutdown are more likely to turn to digital downloads and rentals than physical DVDs (see Danaher et al., 2010; Hu and Smith, 2012). Second, digital sales have become an increasingly important channel for motion picture content. For example, IHS Screen Digest reports that in 2012 consumers spent \$4.9 billion to buy and rent movies on digital platforms, representing 7% of worldwide consumer expenditures on motion picture content.<sup>4</sup>

Our Internet penetration data is based on two statistics. First, Google AdWords estimates of the total number of unique visitors, by country, to Megaupload.com and Megavideo.com during December 2011, the last full month before the shutdown. Second, we obtained the total number of Internet users in each country in our sample as reported by the International Telecommunications Union at the end of 2011.<sup>5</sup> We use this as a measure of the potential market size for digital sales in each country, and divide the number of unique visits to Megaupload and Megavideo in December 2011 by the number of Internet users in that month to obtain the Megaupload penetration rate in that country (for parsimony, in what follows we refer to this as the Megaupload penetration rate, or MPR). Table 1 presents descriptive statistics of the relevant variables for each country.

As this table makes clear, the U.S. is by far the largest market in our set of countries, and rentals are more popular than purchases in most

<sup>4</sup> See press release at <http://www.isuppli.com/media-research/news/pages/worldwide-consumer-spending-on-movies-sees-accelerated-growth-in-2012.aspx>. We note that the \$4.9 billion figure includes digital sales, digital rental, and subscription-based movie streaming, and that our sales data only includes the first two categories.

<sup>5</sup> We obtained these data from the site <http://www.internetworldstats.com>.

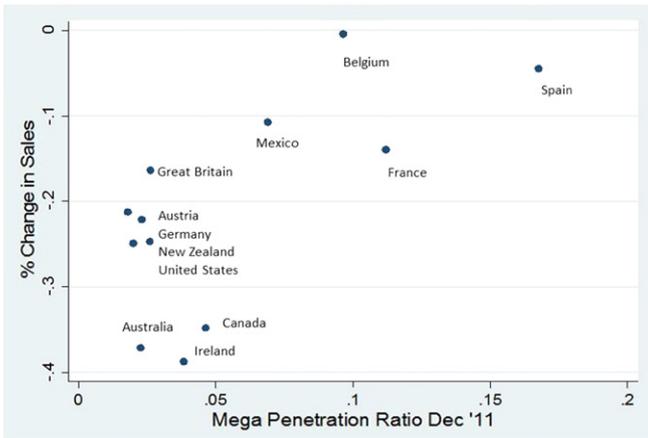


Fig. 1. Post-shutdown change in weekly sales vs. Dec 2011 Megaupload penetration.

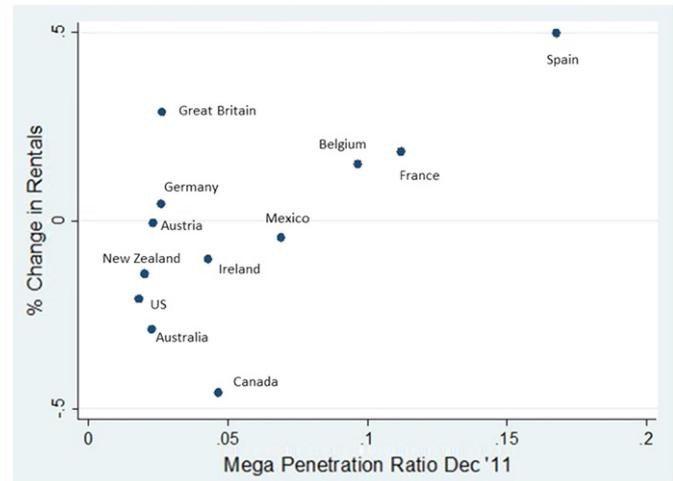


Fig. 2. Post-shutdown change in weekly rental units. Dec 2011 Megaupload penetration.

countries. Importantly, there is significant variance in the Megaupload penetration rate across countries in our sample: In the U.S. just under 2% of Internet users visited Megaupload or Megavideo during December 2011; but in Spain, nearly 17% of all Internet users visited Megaupload or Megavideo. We will exploit this variance to determine the impact of shutting down Megaupload on digital sales and rentals for three studios.

## 5. Model and results

Our basic behavioral model for how the shutdown will affect sales is as follows:

$$\Delta Purchases_j = (p * n) * (\#Megaupload Visits_j) + Trend_j$$

$\Delta Purchases_j$  represents the change in purchases in country  $j$  after the shutdown,  $n$  is the number of illegal movie downloads per visit to Megaupload or Megavideo,  $MegauploadVisits_j$  is the number of visits to Megaupload or Megavideo in country  $j$  before the shutdown,  $p$  is the probability that an illegal download will be converted to a sale if the download is thwarted due to the shutdown, and  $Trend_j$  is the change in sales that would have occurred after the shutdown in country  $j$  if not for the shutdown.

We make two assumptions in order to isolate the effect of the shutdown. First, we assume that we can construct a variable that proxies for  $p * n * Megaupload$  visits, such that this variable can measure the treatment intensity of the Megaupload shutdown in each country. Second, we must assume that we can model  $Trend_j$  in some manner (for example, linearly or quadratically) such that post-shutdown deviations from the modeled trend are independent of pre-shutdown Megaupload visits. We explore a number of empirical specifications below in order to test these assumptions.

In exploring the descriptive data, the simplest question to ask is whether there is a basic correlation between the post-shutdown change in sales units or rental units and the pre-shutdown Megaupload penetration, particularly during a tight time window surrounding the shutdown. The scatterplots below are revealing; they show the changes in average weekly sales units (Fig. 1) and rental units (Fig. 2) from the 3 weeks prior to the shutdown to the 3 weeks after and plot these changes against the Megaupload penetration rate for each country.

In each case we observe a generally positive correlation between Megaupload penetration rate and the post shutdown change in sales or rental units across countries. This suggests that countries with a higher Megaupload penetration ratio experienced relatively higher

sales and rental increases after the Megaupload shutdown than did countries with lower Megaupload penetration ratios.<sup>6</sup> Of course, these scatterplots do not control for pre-existing sales or rentals trends in each country, and these trends may differ for many reasons including the fact that digital video stores had different opening dates across the countries and thus these platforms were likely at varying levels of adoption/maturity.

In Fig. 1 we also observe that much of the positive correlation between the post-shutdown sales change and the pre-shutdown Megaupload penetration is driven by France, Spain, Belgium, and Mexico. The other countries all have less variance in their Megaupload penetration rate, although together they serve as low Megaupload contrasts to the previous four countries. In Fig. 2 we observe a similar pattern for rentals.

Of course, a positive correlation between sales changes and Megaupload penetration doesn't necessarily imply that the shutdown actually increased sales. It may be that countries with higher pre-shutdown MPR were growing at a faster rate regardless of the shutdown. To explore the data further, we estimate the following model using ordinary least squares (OLS):

$$\ln Sales_{jt} = \beta_0 + \beta_1^t Week_t + \beta_2^t MPR_j * Week_t + \mu_j + \varepsilon_{jt} \quad (1)$$

where  $\ln Sales_{jt}$  is the natural log of digital movie sales in country  $j$  during week  $t$ ,  $Week_t$  is a vector of dummies for each week (omitting the first week),  $MPR_j$  is the Megaupload penetration ratio in December 2011 for country  $j$ , and  $\mu_j$  represents country fixed effects. We use the log of sales for two reasons: first, the distribution of sales is right skewed; and second, we expect general cross-country market trends to influence each country on a percentage basis. In other words, if a popular movie is released and increases sales in Spain by 7%, then it should also increase sales in the other countries by 7% on average.

In (1),  $\beta_1^t$  represents the changes in sales over time for a hypothetical country with no Megaupload use. The coefficients of interest are  $\beta_2^t$ , as these indicate how the sales trend differs over time as a function of a country's Megaupload penetration ratio. Specifically, if  $\beta_2^t$  are equal for all  $t$  before the shutdown, then this indicates that the December 2011 MPR is independent of each country's sales trend, at least until the shutdown (and if the "left out" dummy date is typical, then  $\beta_2^t = 0$  for all  $t$  prior to shutdown). If the shutdown caused some consumers to migrate

<sup>6</sup> One also notes that January purchases are generally lower than December purchases. It should of course be clear from our setting and methodology that (a) this is entirely expected given the Christmas buying period in December and (b) this does not impact our identification strategy which is based on the relative changes in sales across countries as a function of Megaupload penetration.

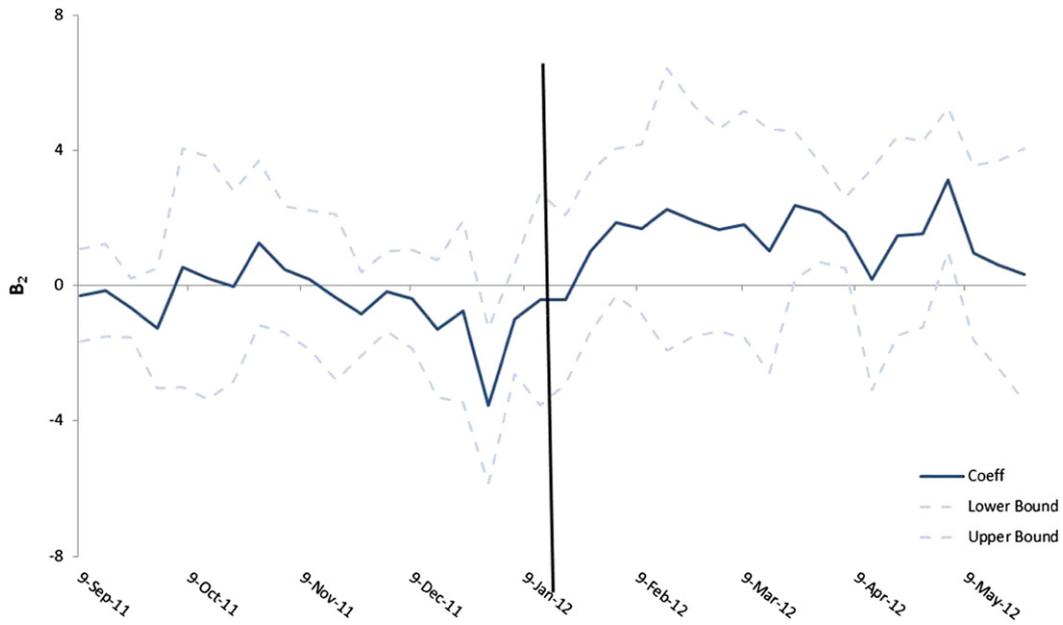


Fig. 3. Moderation of sales trend by Megapload penetration rate.

to legal sales, we would expect  $\beta_2^l > 0$  after the shutdown. In Fig. 3 we plot all of the coefficients  $\beta_2^l$  (using natural log of sales as the dependent variable) along with their 95% confidence intervals, and we do the same in Fig. 4, but this time using the natural log of rentals as the dependent variable.

In Fig. 3 we note that from early September 2011 until mid-November,  $\beta_2^l$  appear to be statistically indistinguishable from zero, suggesting MPR is independent of the sales trend during this period. However, as the Christmas season approaches (when sales increase and then spike), we note that the line falls off and exhibits a large negative spike during the week of Christmas. This indicates that countries with higher MPR tend to receive lower sales spikes from the Christmas holiday. While this could be random, it is also possible that in countries where use of the most popular movie downloading cyberlocker is widespread, digital movie sales will receive less of a demand shock from Christmas. This indicates that each country's sales trend is not independent of the MPR during this time, even before the actual shutdown, and we will

need to account for this when making a causal argument. Finally, we note that after the week of the shutdown  $\beta_2^l$  shifts into positive territory where it remains. This is consistent with what was suggested by the scatterplots: post-shutdown sales increased more in countries with higher MPRs than in countries with lower MPRs.

The picture for rentals in Fig. 4 is less clear: even before the shutdown it appears as if rentals are trending slightly downward (or growing more slowly) for countries with higher MPR. This fact would actually make it harder to find an impact of the shutdown by biasing any estimates that don't account for pre-existing trends toward zero. However, we note that the downward trend halts during the week of the shutdown, after which higher MPR countries get a larger boost to rentals. Noting the potential for differential pre-existing time trends, in our analysis below we will not assume that December MPR and sales trends are independent. Rather, in most specifications we will include country-specific trends in our model, imposing a linear or quadratic form on the sales trend of each country and asking if (after the shutdown) high MPR

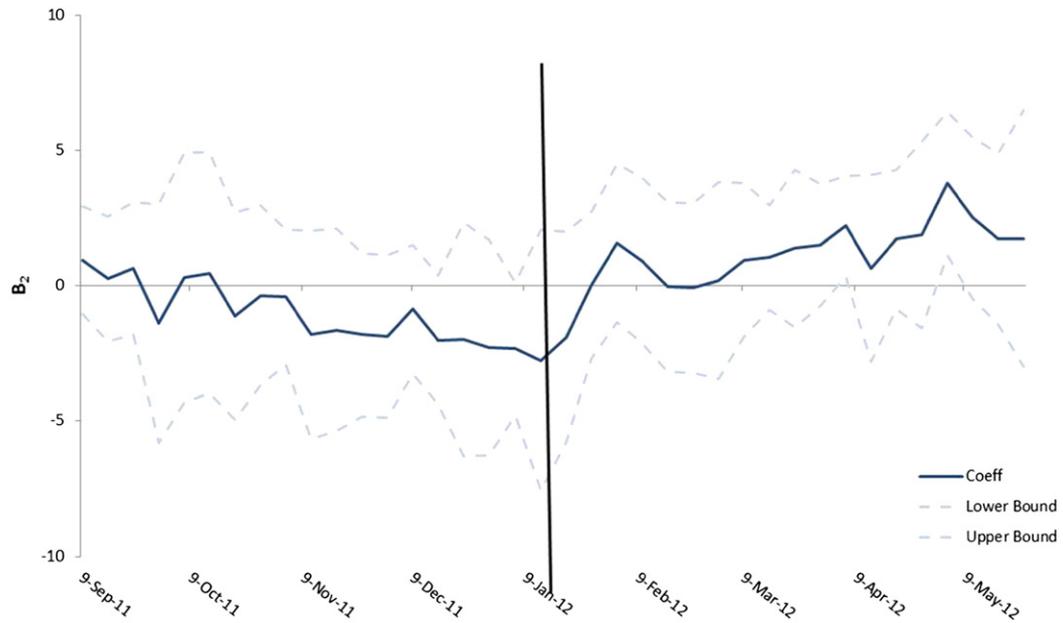


Fig. 4. Moderation of rentals trend by Megapload penetration rate.

**Table 2**  
OLS regression of Ln digital movie sales units.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
MPr* after shutdown	1.720* (0.753)	1.853* (0.640)	3.150** (0.794)	3.246** (0.957)	2.803* (0.925)	2.482* (0.811)
Constant	8.743** (0.024)	8.336** (0.052)	8.349** (0.025)	8.376** (0.041)	8.375** (0.041)	8.378** (0.042)
Week fixed effects	no	yes	yes	yes	yes	yes
Linear country trends	no	no	yes	no	no	no
Quadratic country trends	no	no	no	yes	yes	yes
Christmas week dropped	no	no	no	no	yes	yes
Christmas season dropped	no	no	no	no	no	yes
Observations	24	463	463	463	451	391
Clusters (countries)	12	12	12	12	12	12
R-squared	0.997	0.989	0.99	0.991	0.991	0.991

Robust standard errors clustered at country level in parentheses + significant at 10%; \* significant at 5%; \*\* significant at 1%.

Christmas season is classified as beginning after Thanksgiving and ending after the first week of January.

countries depart from their pre-shutdown trends more than low MPR countries do.

In that vein, we estimate the following model to quantify the relationship between Megaupload penetration in December and the post-shutdown sales trend:

$$\ln \text{Sales}_{jt} = \beta_0 + \beta_2 \text{MPr}_j * \text{After}_t + X_{jt} \varphi + \mu_j + \Omega_t + \varepsilon_{jt}. \quad (2)$$

In this model  $\text{After}_t$  is a dummy variable equal to one if the week ended after January 19, 2012 (the day of the shutdown),  $\Omega_t$  is a vector of week fixed effects, and  $X_{jt}$  represents any country and time varying control variables.<sup>7</sup>  $\beta_2$  represents how much higher the log of sales would be after the shutdown in country  $j$  if MPR were to increase from zero (no Mega users) to one (i.e., every Internet user accessing Megaupload or Megavideo before the shutdown).

We report our estimates for (2) (log sales as the dependent variable) in Table 2, and in Table 3 we report estimates for the same model but with log rentals as the dependent variable. Due to the potential for serial correlation in sales or rentals within country, we cluster our standard errors at the country level as suggested by Bertrand et al. (2004). This leaves us with twelve clusters, and so we report robust clustered standard errors in parentheses and, following Donald and Lang (2007), we report significance levels using a t-distribution with ten degrees of freedom.<sup>8</sup> As additional evidence that statistical significance is not driven by serial autocorrelation in the data, we run a model where the data for each country are collapsed into just two points, the mean sales before shutdown and the mean sales after. These estimates included a dummy for the post-shutdown period and are provided in column (i) of Table 2.

In column (ii) of Table 2 we observe that the coefficient of interest is 1.853 and is statistically significant at the 5% level. To put this into context, it implies that a country with a 1% higher pre-shutdown Megaupload penetration rate would have a post-shutdown weekly sales increase in units that is 1.9% higher than it would otherwise have experienced. If one believes that sales trends are independent of the December MPR, then this increase is causal and the logical conclusion would be that the Megaupload shutdown increased sales (with 95% confidence). Relaxing the assumption that sales trends are independent of MPR, in columns (iii) and (iv) we include linear and quadratic sales trends for each country and ask whether the post-shutdown deviation from these trends is moderated by December MPR. Here we find even stronger results than in column (ii) and our statistical confidence level increases to 99%.

<sup>7</sup> Specifically, we included a supply side variable indicating the total number of titles offered for sale on digital channels by the three studios (in case this was endogenously impacted by the shutdown), though inclusion of this variable causes little change in the coefficient of interest. In most specification we also include linear or quadratic country-specific trends.

<sup>8</sup> The number of clusters minus two.

**Table 3**  
OLS regression of Ln digital movie rental units.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Mpr* after shutdown	2.291* (0.913)	2.386** (0.644)	3.119** (0.842)	2.571** (0.765)	2.521** (0.731)	2.560* (1.026)
Constant	9.204** (0.029)	8.857** (0.062)	8.844** (0.064)	8.832** (0.079)	8.834** (0.078)	8.840** (0.077)
Week fixed effects	no	yes	yes	yes	yes	yes
Linear country trends	no	no	yes	no	no	yes
Quadratic country trends	no	no	no	yes	yes	yes
Christmas week dropped	no	no	no	no	yes	yes
Christmas seasons dropped	no	no	no	no	no	yes
Observations	24	463	463	463	451	391
Cluster (countries)	12	12	12	12	12	12
R-squared	0.996	0.983	0.984	0.986	0.986	0.985

Robust standard errors clustered at country level in parentheses + significant at 10%; \* significant at 5%; \*\* significant at 1%.

Christmas season is classified as beginning after Thanksgiving and ending after the first week of January.

However, it is possible that neither the linear nor quadratic forms are flexible enough to model the sales spikes that occur around Christmas, and we know that these spikes are correlated with MPR (lower for countries with high MPR). Thus, in column (v) we keep the quadratic country trends but we remove the week of Christmas from the analysis since Christmas week is the week that corresponds to the large downward spike in Fig. 2. Finally in column (vi) we keep the quadratic trends and also remove the entire Christmas season, from the week after Thanksgiving until the first week of January. This sacrifices a great deal of statistical power and may be unnecessarily conservative since quadratic trends should be flexible enough to model the differing fluctuations around the Christmas season when the one spike around Christmas week is removed.<sup>9</sup> In other words, column (vi) is a very conservative specification that will likely understate the true causal effect of the shutdown.

We note that while the coefficient of interest is somewhat different across columns, it is positive and statistically significant at either the 1% or 5% level in each specification. We suggest that columns (i) and (ii) underestimate the impact by not accounting for pre-existing country trends. Under the assumption that non-shutdown related post-shutdown deviations from the linear or quadratic trends are independent of the December MPR we can infer that higher MPR caused a larger increase (or smaller decrease) in post-shutdown sales units, and thus the Megaupload shutdown caused some consumers to switch from Megaupload to legitimate digital sales.

In Table 3 we observe a similar pattern for the coefficient of interest on digital rental units. Thus it appears as if some Megaupload users also turned to digital rentals as an alternative to piracy. Notably, the estimated impact of the shutdown on digital rentals is similar to that of sales. Also, as expected, removing Christmas or the Christmas season has little effect on estimates for rentals. We also note that finding similar results for rentals strengthens our causal interpretation as they appear to be less seasonal than sales are.

## 6. Placebo test

Although we have controlled for differential country-specific trends, one might ask whether the pattern in sales trends that we document across countries is typical of this time of year—in other words, whether the change in sales in January/February each year across countries just happens to be correlated with MPR for reasons unrelated to the shutdown. One way to explore this is a placebo test, running the same model over the same time period in a different year. Most of the countries in our data did not have digital movie sales channels in January 2011, but

<sup>9</sup> Moreover, dropping so much of the pre-period means that much of the identification of the quadratic trend will come from the post-shutdown period, and thus to some degree any causal effect of the shutdown will be partially absorbed by the quadratic trend, biasing our results toward zero.

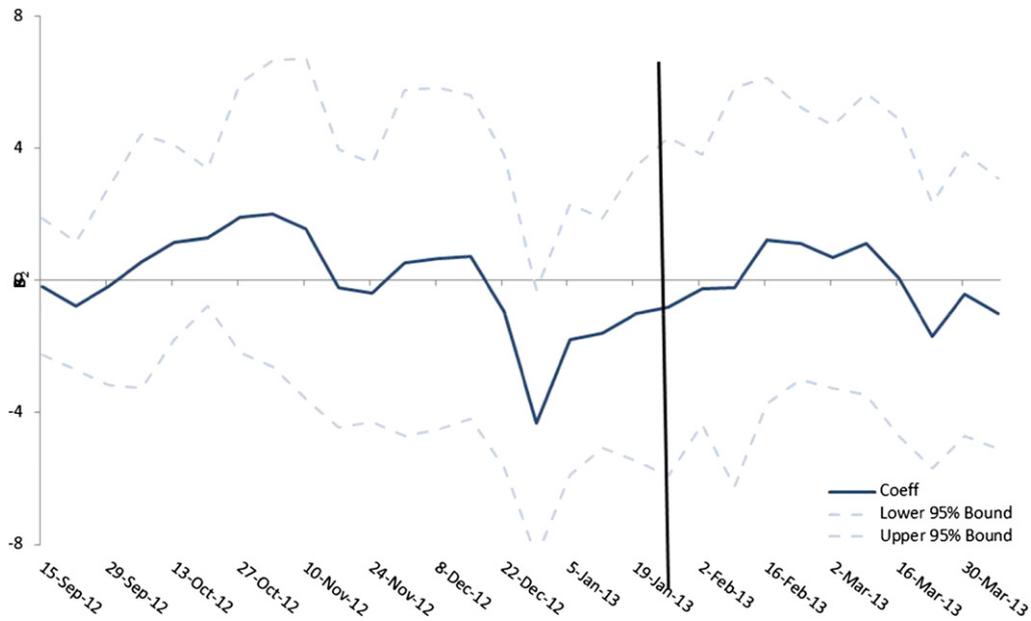


Fig. 5. Sales trend moderation for 2012–2013 (placebo test).

we can use data surrounding January 2013 to test this hypothesis. We estimated model (1) on weekly sales from September 2012 to March 2013 and we present the time graph analogous to Fig. 3 using the placebo data (Fig. 5).

We note that the 2012–2013 data shows the same dip around Christmas, as the sales spikes around the holidays are lower in high MPR countries. This may be idiosyncratic to those countries or it may be that high MPR countries are still high piracy countries even once Megaupload was gone, leading to lower Christmas peaks. Importantly, after January 19, 2013 the line is no higher than it was before Christmas. This indicates that the high MPR countries did not experience sales growth different from the low MPR countries after January 19 in the placebo year.<sup>10</sup> With Christmas removed, there appears to be no observable placebo effect in 2013, indicating that what we observed in 2012 is not typical or seasonally based.

### 6.1. Back of the envelope calculations

To quantify the impact of the Megaupload and Megavideo shutdown on the motion picture industry we will consider both our highest and lowest (most conservative) estimates from columns (iii) through (vi) of Table 3, dropping the first two columns because they disregard pre-existing trends. From Eq. (2),  $\beta_2$  was the coefficient of interest, and so for each country we multiply the MPR by  $\beta_2$  to predict how much higher sales or rentals were (in percentage terms) than they would have been in the absence of the shutdown. With this, we then estimate what weekly sales units would have averaged if there had been no shutdown by dividing the average weekly post-shutdown sales units in each country by  $e^{\beta_2 MPR}$ . We subtract this counterfactual unit weekly sales (rentals) figure for each country from the observed average weekly post-shutdown sales (rentals) units to estimate the number of sales (rental) units that resulted from the shutdown itself.

With respect to sales, our lowest estimate for  $\beta_2$  was 2.5 and our highest was 3.3, meaning that for an each additional 1% MPR, the shutdown caused weekly sales units to increase by 2.5% on the low end or 3.3% on the high end. Based on the above calculation process, this

means that depending on which of the four specifications one considers most accurate, the shutdown of Megaupload caused weekly digital sales units to increase by somewhere between 14,800 to 19,000 units for the three studios in our study across the twelve countries and 18 weeks in our data. With respect to rentals, our lowest estimate for  $\beta_2$  was 2.5 and our highest was 3.1. By the same process, we estimate that across the 3 studios, 18 weeks, and 12 countries in our dataset, weekly rentals increased by somewhere between 38,700 to 47,400 units due to the Megaupload shutdown.

Based on Table 1 above, it is clear that these sales increases are a small fraction of the total number of “displaced” Megaupload users. However we also note that these increases only represent sales among movies, only cover 3 major studios, and only include digital sales channels. Given this, we believe a more relevant point of comparison is the percentage increase in sales in these channels caused by the Megaupload shutdown. Using this point of reference and comparing unit sales increases to the post-shutdown average sales, we find that the shutdown of Megaupload caused a 7–9% increase in digital sales units and a 6–8% increase in digital rental units for the two studios in our sample. In terms of revenue, and assuming an average price of \$15 for digital movie sales and \$4.50 for digital movie rentals,<sup>11</sup> our data suggest that the shutdown of Megaupload resulted in a 6.5–8.5% increase in digital movie revenues for the two studios, 12 countries, and 18 weeks in our study period. We also note that all three studios in our study individually exhibit patterns similar to the combined patterns we report, and so it seems reasonable to assume that other major studios’ revenues experienced similar proportional increases.

## 7. Conclusion

Our diff-in-diff results combined with a placebo test strongly suggest that the shutdown of the popular Megaupload and Megavideo sites caused an increase in digital motion picture sales and rentals leading to an increase in digital revenues of 6.5–8.5%. However, there are several limitations associated with our study. First, Megaupload was a very well-known cyberlocker and its shutdown was highly publicized. As such, the shutdown of Megaupload influenced the policies of several

<sup>10</sup> The same pattern holds true for a placebo test of rentals. Moreover, we estimated our OLS models for the placebo year and the coefficient of interest was small and statistically insignificant in all models that included country-specific trends or that dropped Christmas.

<sup>11</sup> These average prices are consistent with the average sales prices in our data and include both HD and SD content.

other cyberlockers focused on piracy, and our results necessarily measure the “net impact” of the Megaupload shutdown across the cyberlocker industry,<sup>12</sup> as opposed to just measuring the impact of Megaupload. Thus the closure of another major cyberlocker might have a smaller impact if it creates less ripple effects. On the other hand, the shutdown of additional large piracy sites might have a larger impact if consumer “frustration” with piracy increases when more of the most convenient sites become unavailable. In addition, our results only analyze the impact of Megaupload on digital motion picture sales. We are not able to measure the effect of this shutdown on other motion picture channels (e.g., DVD sales, theatrical sales) or on other product categories (e.g., music, books). Because we only observe 18 weeks following the shutdown, we also do not know whether the sales increase will persist or if these consumers will eventually find their way back to alternative piracy channels (although we see no clear indication of such a reversion in the 18 weeks in our data). Finally, we note that our study only measures specific benefits of this regulation—it does not measure either tangible or intangible costs of this sort of intervention, and such costs should be considered carefully as part of any policy decisions.

In spite of these limitations, we believe that our study makes several important contributions to the academic literature. First, our study contributes to the established economics literature on the impact of piracy on sales. Second, our study is one of a small number of papers to use real-world sales data to analyze consumer behavior in online channels and to understand the underlying motivations of consumer choice between legal and illegal consumption channels for media. Third, our study is one of the first in the literature to analyze the impact of anti-piracy interventions on sales, and is the first study we are aware of to analyze supply-side anti-piracy intervention—an important policy question which thus far has not been informed by academically rigorous analysis. Fourth, our study contributes to the discussion of whether Internet piracy displaces movie sales and rentals, and is the first we are aware of that focuses on paid digital movie downloads. Finally, our analysis provides a methodology and approach that could be applied to other similar anti-piracy interventions in future research.

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<sup>12</sup> For example, some cyberlockers may have ceased to provide monetary incentives for individuals to upload content, while others may have prevented third parties from downloading a user's content. See <http://www.billboard.com/biz/articles/news/1099372/cyberlockers-implement-changes-after-megaupload-arrests>