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IMPACTS OF DIGITAL VIDEO PIRACY ON THE U.S. ECONOMY

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FOREWORD

Revolutionary technologies and new methods to distribute content are enabling consumers to access video streaming on virtually any connected device from any location. As of 2018, there are more video streaming subscribers than paid-TV subscribers worldwide, accessing over **500 licensed online video portals**. As a result of this rapid expansion and exploding consumer demand, the industry is producing original content at an unprecedented rate and creating new and innovative ways for consumers to watch their favorite sports around the world, their favorite television series, their favorite movies, and countless other consumer choices.

This eruption of consumer choices is fueled by rapidly adapting creative and technology industries, which employ up to **2.6 million workers** in the U.S. and provide **$229 billion** in annual economic benefits to the U.S. economy. However, as legal streaming access has proliferated, so has digital piracy, as criminal actors adapt to take advantage of new technologies and consumer behaviors. Research indicates that more than **80% of piracy** is attributable to streaming. Illegal streaming is enabled by piracy devices and apps, which have overtaken BitTorrent and other download-based technologies that deliver unauthorized live television shows and video on demand over the internet.

Impacts of Digital Piracy on the U.S. Economy takes a close look at how piracy stifles the economic growth and progress generated by streaming. The study shows that all of the benefits that streaming brings to our economy have been artificially capped by digital piracy. Using macroeconomic modeling of digital piracy, the study estimates that global online piracy costs the U.S. economy at least **$29.2 billion** in lost revenue each year.

Digital video piracy results in significant losses to the U.S. economy, harming businesses ranging from content production firms to the innovative technology companies that are driving the digital distribution revolution. While there is no single solution, global collaboration among industries and governments to educate consumers of the dangers of piracy, coupled with the expansion of legal options in cases of infringement, is necessary to curb these negative effects. All parties must continue to work creatively and constructively to enable dreamers, innovators, and creators around the world to continue to tell their unique stories and advance our culture and economy.

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EXECUTIVE SUMMARY

KEY FINDINGS

- The U.S. movie and television production and distribution industry is an important component of the U.S. economy, with revenues in 2017 of about $229 billion. It is also a major job creator, directly supporting 927,000 jobs and 2.6 million in total.
- Video streaming accounts for a large and growing share of content industry revenues—indeed, there are more than 500 licensed online video portals worldwide and as of 2018, more video streaming subscribers than pay-TV subscribers. This growth is threatened by the increase in streaming-enabled piracy, which has overtaken BitTorrent and other download-based technologies as the primary vehicle for digital video piracy.
- Overall, approximately 26.6 billion viewings of U.S.-produced movies and 126.7 billion viewings of U.S.-produced TV episodes are pirated digitally each year, mostly from outside the U.S.
- The impact of digital video piracy on revenues of the U.S. content production sector and related industries depends on the extent to which piracy is assumed to displace legal purchases. Based on a broad range of estimates, we find that digital video piracy conservatively causes lost domestic revenues of at least $29.2 billion and as much as $71.0 billion annually, representing a revenue reduction between 11% and 24%.
- Digital video piracy not only causes lost revenues to the U.S. content production sector, it also results in losses to the U.S. economy of between 230,000 and 560,000 jobs and between $47.5 billion and $115.3 billion in reduced gross domestic product (GDP) each year. While piracy remains a problem in the U.S., our analysis indicates that most of these losses (223,000 to 541,000 jobs and $45.7 billion to $111.1 billion in lost GDP) are due to digital video piracy of U.S. content by non-U.S. residents.

METHODOLOGY

- We utilize a well-established national macroeconomic model (IMPLAN) to estimate the overall impacts on the U.S. economy from digital video piracy, focusing primarily on digital piracy by non-U.S. residents of U.S content but also on U.S. digital video piracy.
- The IMPLAN model takes as inputs estimates of the potential losses in revenue to U.S. producers and others due to digital video piracy. Revenue losses are based on estimates of the number of digitally pirated movies and TV episodes, the market value of the pirated content, and the fractions of pirated digital video content that would be purchased and paid for absent piracy. Our modeling approach yields estimates of the net effects of piracy on the U.S. economy, including direct, indirect, and induced effects.
- Our figures are based on a range of estimates of the proportion of pirated content that would have been paid for if it had not been available through piracy (the “displacement rate”). Based on prior research, our lower-bound estimates assume a displacement rate of 14%; our upper-bound estimates assume a displacement rate of 34%.
- Our estimates of the economic impact of piracy are conservative in that they do not incorporate the effects of piracy on the quantity of video content produced in the U.S., which we expect would be negative; if these effects were included, our estimates would be higher.

I. Introduction and Overview

This study assesses losses to the U.S. economy resulting from digital piracy of video content produced and/or distributed by U.S. companies. The U.S. video content industry is a major contributor to the U.S. economy, both in terms of revenue and jobs, accounting for $229 billion in revenue and directly supporting 927,000 jobs and 2.6 million in total in 2017.[1] However, the industry suffers from online video piracy, which has been and continues to be a significant channel of video consumption both domestically and abroad.

Video distribution technologies are shifting rapidly in the direction of video streaming: there are now more than 500 licensed online video portals worldwide[2] and more subscribers to subscription streaming services than traditional pay TV.[3] The nature of online piracy has evolved as well: Just a few years ago, it was estimated that BitTorrent downloads accounted for nearly 40% of digital video piracy, but recent research indicates that more than 80% is now attributable to streaming.[4] This new piracy ecosystem has been boosted by the proliferation of piracy devices and apps that deliver unauthorized live television shows and video on-demand over the internet and directly to the television set.[5] These rapid changes necessitate up-to-date estimates of the impact of digital piracy.[6]

Previous studies have estimated specific aspects of the effects of piracy; We consolidate prior empirical estimates and the most recent available data to provide a more complete picture of how piracy affects the entire U.S. economy. We build on previous literature and improve on previous estimation methods by considering data specific to each method of consumption. Using a BitTorrent tracking database as well as publicly available data, we estimate the total amount of digital video piracy, broken down by region (U.S. vs. non-U.S.) of content production and of pirating activity. We also estimate the weighted average price of watching a movie or TV episode and review the literature on piracy's displacement of legal consumption to produce estimates of revenue losses in the affected industries. Finally, we model the impact of those revenue losses on the U.S. economy, quantifying the losses from digital video piracy in terms of lost jobs and reduced gross domestic product (GDP).

The remainder of this report is organized as follows. Section II discusses the existing literature on piracy's displacement of paid video consumption and describes our methodology for estimating the revenue losses to U.S. companies associated with digital video piracy. Section III provides the methodology we use to estimate the overall impacts of global digital video piracy on the U.S. economy and presents the results of our impact analysis. Section IV presents a brief conclusion.

II. Forgone Revenues to U.S. Industries from Video Piracy

The first step in our analysis is to estimate the impact of piracy on the revenues of U.S. industries. The revenue impacts of piracy depend primarily on three magnitudes: (1) the amount of digital piracy (i.e., how many movies and TV episodes are viewed through pirated sources); (2) the extent of displacement (i.e., how many of those movies and TV episodes would have been purchased if they had not been pirated); and (3) the revenue per unit (i.e., how much revenue the U.S.-based content producing and related industries would have received for each displaced sale). In the first section below, we review the existing literature on these topics. In the second section, we explain how the economic effects of piracy differ based on both where it was produced and where it was pirated. In the third section, we present our methodology for estimating revenue losses from digital video piracy and our results.

A. PRIOR RESEARCH

There is an extensive existing literature on the degree of digital video piracy and the extent to which it displaces authorized viewing. Using a variety of methodologies, these studies have found that piracy displaces a significant number of authorized viewings. We review studies of displacement effects in the first subsection below and studies of the total volume of piracy in the second subsection.[7]

1. Displacement Effects of Digital Video Piracy

Several studies estimate the effect of piracy on the consumption of licensed content. Together, they span a variety of geographies, populations, time periods, and media.

Some studies rely on natural experiments involving changes in the availability of pirated content. For example, Danaher and Smith found in 2014 that the shutdown of Megaupload led to an increase in digital revenues of between 6.5% and 8.5% for three major studios.[8] Similarly, Danaher, Smith, and Telang found that the shutdown of 53 piracy sites in the U.K. in November 2015 led to a 6% increase in visits to paid streaming sites and a 10% increase in videos viewed on legal ad-supported streaming sites.[9] Although these studies show that piracy displaces a significant amount of licensed consumption, they do not quantify the reduction in piracy that corresponds to the increase in paid consumption and thus do not allow for calculation of a displacement rate per se.

Other studies offer explicit estimates of video piracy displacement rates, as presented in Table 1. At the high end of the range, Rob and Waldfogel studied University of Pennsylvania students and found that 80% would have otherwise paid for content that they were watching for the first time and 20% would have paid for repeat viewings, yielding a weighted average estimated displacement rate of 66.7%.[10] An Ipsos and Oxford Economics study of movie piracy in Australia surveyed 3,500 adults and found that 45% of those who engaged in piracy would have paid to watch authorized versions if they had not been able to access the pirated version.[11] Poort and colleagues estimated that piracy displaces paid purchases by 37.5%.[12] Herz and Kiljanski conducted an online survey with about 30,000 respondents in Europe and applied regression analysis to the results; depending on the specification, they estimated a displacement rate of between 34% and 37%.[13] At the low end, Bai and Waldfogel studied Chinese college students and a larger sample of internet users in China, finding implied displacements rates of 14% and 0% for the respective groups.[14]

TABLE 1: ESTIMATES OF VIDEO PIRACY DISPLACEMENT RATES

Study	Displacement Rates
Rob and Waldfogel (2007)	66.7%
Ipsos and Oxford Economics (2011)	45%
Poort et al. (2018)	37.5%
Herz and Kiljanski (2018)	34%–37%
Bai and Waldfogel (2012)	0%–14%

Sources: See sources in text.

To bound our estimates of the impact of piracy on content industry revenues, we rely conservatively on Bai and Waldfogel's 14% for Chinese students for the lower bound and Herz and Kiljanski's 34% for Europeans for the upper bound.

2. Extent of Digital Video Piracy

Industry analysts have developed several estimates for the amount of pirated content consumed globally. For example, a report by the digital piracy data firm MUSO estimated that there were 106.9 billion visits to television piracy sites and 53.2 billion visits to film piracy sites globally in 2017. The same report estimated that torrenting made up 5% of TV piracy and 20% of film piracy.[15]

A 2016 report by Frontier Economics used a methodology similar to ours "to quantify the global value of counterfeiting and piracy and related economic and social costs."[16] Specifically, Frontier used data from TECXIPIO, a software development company that tracks BitTorrent activity, to estimate total BitTorrent activity in 2015. Relying on a NetNames study, Frontier next estimated the proportion of total piracy accounted for by BitTorrent and used that estimate to calculate the total number of pirated films in 2015. They then calculated the average price of watching a movie, weighted by the amount of time spent on each viewing method, and multiplied the average price by the total number of pirated films to arrive at an estimate of the total value of film piracy in 2015.[17] Specifically, Frontier estimated the total value of global digital film piracy at $160 billion in 2015.

While we adopt some aspects of Frontier's overall approach, we also make many adjustments. First, unlike Frontier, our estimates incorporate losses resulting from TV piracy as well as movie piracy. Second, and relatedly, we utilize separate estimates of the average prices of movie and television viewing. Third, we extend the analysis to incorporate a range of estimated displacement rates, which allows us to approximate lost revenues due to digital video piracy and, ultimately, the impact of digital piracy on U.S. jobs and economic output.

B. GEOGRAPHY OF GLOBAL PIRACY

To relate forgone legal consumption of movies and television to U.S. economic impact, it is important to consider the location (U.S. vs. non-U.S.) of both the pirating activity and the producer of the pirated content. Figure 1 presents a matrix that summarizes the geographic breakdown of video content creation and piracy of such content. The economic impact of digital piracy varies across the different cells of the matrix.

FIGURE 1: IMPACT OF PIRACY BY LOCATION OF PIRACY

	Pirated Outside the U.S.	Pirated Inside the U.S.
Pirated Movies/TV Produced Inside the U.S.	A	B
Pirated Movies/TV Produced Outside the U.S.	C	D

- *Cell A represents foreign digital video piracy of U.S.-produced content.* This category is the largest source of the adverse impacts of digital video piracy on the U.S. economy. The purchases that are displaced by this piracy represent revenue losses to U.S. film and television producers (revenue losses for content distributors are assumed to affect non-U.S. entities). Note that there is likely to be little or no offsetting benefit to the U.S., as non-U.S. residents who pirate U.S. content are not likely to spend very much of the "savings" they get from piracy on goods and services that are produced in the U.S.

- *Cell B represents U.S. domestic piracy of digital video content produced inside the U.S.* We include this category of piracy in our modeling as revenue losses for the relevant domestic industries, including both production and distribution. However, we also model the effective income gain for pirating consumers (from not spending money on videos they would have bought otherwise). Consumers spend the income gained from displaced legal consumption on other goods and services, many of which are produced in the U.S.[18] Therefore, the net effect on the U.S. economy of this component of piracy could be either positive or negative, depending on the relative magnitudes of the multipliers for the revenue losses and the revenue gains.

- *Cell C represents foreign digital piracy of content produced outside the U.S.* Any legal video consumption displaced by this form of piracy would involve payment by non-U.S. consumers to non-U.S. firms and would have a negligible impact on the U.S. economy. Though it is possible that U.S. parties have partial stakes in the production and/or distribution of this pirated content, the impacts of this digital piracy are likely to be small relative to the other components of global piracy. Thus, partial ownership aside, this form of piracy would have no direct effect on the U.S. economy, and we do not include it in our impact modeling.

- *Cell D represents U.S. domestic digital piracy of video content produced outside the U.S.* This form of piracy leads to revenue losses for distributors in the U.S. (e.g., theaters, DVD vendors, cable companies[19]). We model the impacts of those losses together with the positive income effects for domestic consumers (from not paying for videos). As in Cell B, the net effect depends on the magnitudes of the opposing impacts.

As discussed below, these geographic distinctions and their different implications for U.S. economic impact play an important role in our empirical methodology.

C. REVENUE LOSSES TO U.S. CONTENT PROVIDERS

As noted above, our approach to assessing the impact of digital piracy on the U.S. economy begins by estimating the revenues of U.S. content producers and related firms. This section explains our methodology and presents our results.

First, we acquired data on the total volume of domestically and globally torrented movies and television shows for 2017 from TECXIPIO, which tracks worldwide BitTorrent activity. To arrive at an estimate of total online pirating activity, we combined

the TECXIPIO data with MUSO's 2017 estimates that 20% of digital film piracy and 5% of digital television piracy was committed through torrenting, with streaming piracy making up the balance.[20] As explained in Appendix A, based on these data and our own calculations, we estimate approximately 46.9 billion instances of digital movie piracy and about 183.4 billion instances of digital television piracy took place globally in 2017. The MUSO and TECXIPIO data also allow us to disaggregate these estimates geographically by both the source of the content and the location of the piracy, as described above. Tables 2 and 3 present the resulting estimates.

TABLE 2: VIDEO PIRATED VIA BITTORRENT (BILLIONS, 2017)

Production Location	Torrenting Location		Total
	Outside U.S.	U.S.	
Movies			
U.S.	5.0	0.3	5.3
Outside U.S.	3.9	0.2	4.1
Movies Total	**8.9**	**0.4**	**9.4**
TV Shows			
U.S.	1.9	0.1	2.1
Outside U.S.	0.9	0.1	0.9
TV Shows Total	**2.8**	**0.2**	**3.0**
Total	**11.7**	**0.7**	**12.4**

Sources: TECXIPIO; Internet Movie Database. Note: Due to rounding, values do not always sum to totals.

TABLE 3: TOTAL DIGITAL VIDEO PIRATED (BILLIONS, 2017)

Production Location	Piracy Location		Total
	Outside U.S.	U.S.	
Movies			
U.S.	25.1	1.4	26.6
Outside U.S.	19.5	0.8	20.3
Movies Total	**44.7**	**2.2**	**46.9**
TV Episodes			
U.S.	117.9	8.8	126.7
Outside U.S.	52.7	4.1	56.7
TV Episodes Total	**170.6**	**12.8**	**183.4**
Total	**215.3**	**15.1**	**230.3**

Sources: See Appendix A. Note: Due to rounding, values do not always sum to totals.

Next, we use publicly available data to estimate a weighted average price of watching a TV episode or film across various media. These data account for the time consumers spend watching video via different media (e.g., cable television, movie theater attendance, video on-demand, physical and digital sales) as well as the average revenue received by content producers and distributors via each medium.[21]

As shown in Table 4 and detailed in Appendix A, these calculations yield an average industry revenue per viewing of a movie of about $6.09 in 2017, of which about $3.34 went to content producers. For TV episodes, the equivalent figures are $1.53 per episode, of which content producers received about $0.83 per episode.

TABLE 4: AVERAGE REVENUE PER VIEW OF MOVIE OR TV EPISODE BY MEDIUM (2017)

Medium	% Time		Average Revenue per View		% Revenue to Content Producers	Average Revenue to Content Producers per View	
	Movie	TV	Movie	TV		Movie	TV
Cable	55%	47%	$7.51	$2.82	54%	$4.02	$1.51
Box Office	14%	–	$8.97	–	53%	$4.75	–
Subscription Video On-Demand	23%	24%	$0.77	$0.39	54%	$0.41	$0.21
Ad-supported Video On-Demand	–	22%	–	$0.17	55%	–	$0.09
Physical Disc Sales and Rentals	6%	5%	$6.75	$0.68	67%	$4.50	$0.45
Electronic Sell-Throughs and Rentals	2%	2%	$7.92	$2.07	70%	$5.54	$1.45
Time-Weighted Average			**$6.09**	**$1.53**		**$3.34**	**$0.83**

Sources: See Appendix A.

We next multiply the total levels of digital piracy of film and TV content by average industry revenues to calculate the total value of global video pirated digital content, yielding a total of $285.7 billion in pirated digital film content and $280.5 billion in pirated digital television content in 2017.

To estimate how much of this value represents lost revenues to content producers and related firms, we rely on the existing studies of displacement rates reviewed in this section. As discussed there, we apply a lower-bound displacement rate of 14% and an upper-bound of 34%; that is, we assume conservatively that 66% to 86% of digital video piracy does *not* displace paid consumption. Applying these percentages to the estimated total value of pirated content, we estimate that total global revenue losses from digital piracy are between $40.0 billion and $97.1 billion for the film industry and between $39.3 billion and $95.4 billion for the television industry.[22] As discussed above, for purposes of our IMPLAN analysis, we disaggregate these estimates into four categories based on the source of the content and the location of the piracy. The results are presented in Tables 5 and 6.

TABLE 5: REVENUE EFFECTS OF DIGITAL VIDEO PIRACY OF FILM (2017)

Region	Total Pirated Films (Billions)	Average Revenue per Film		Total Value of Films Pirated ($Billions)		Lost Revenue ($Billions)			
		Industry Total	To Movie Producers	Industry Total	To Movie Producers	Industry Total		To Movie Producers	
						Low	High	Low	High
U.S. Content									
Non-U.S. Piracy	25.1	$6.09	$3.34	$153.1	$83.8	$21.4	$52.1	$11.7	$28.5
U.S. Piracy	1.4	$6.09	$3.34	$8.7	$4.8	$1.2	$3.0	$0.7	$1.6
U.S. Content Total	**26.6**	**$6.09**	**$3.34**	**$161.9**	**$88.6**	**$22.7**	**$55.0**	**$12.4**	**$30.1**
Non-U.S. Content									
Non-U.S. Piracy	19.5	$6.09	$3.34	$119.1	$65.2	$16.7	$40.5	$9.1	$22.2
U.S. Piracy	0.8	$6.09	$3.34	$4.8	$2.6	$0.7	$1.6	$0.4	$0.9
Non-U.S. Content Total	**20.3**	**$6.09**	**$3.34**	**$123.8**	**$67.8**	**$17.3**	**$42.1**	**$9.5**	**$23.0**
Total	**46.9**	**$6.09**	**$3.34**	**$285.7**	**$156.4**	**$40.0**	**$97.1**	**$21.9**	**$53.2**

Sources: See Appendix A. Notes: [1] The difference between lost industry revenues and lost revenues to movie producers is lost revenues to distributors. [2] Due to rounding, values do not always sum to totals.

TABLE 6: REVENUE EFFECTS OF DIGITAL VIDEO PIRACY OF TELEVISION (2017)

Region	Total Pirated TV Episodes (Billions)	Average Revenue per Episode		Total Value of TV Pirated ($Billions)		Lost Revenue ($Billions)			
		Industry Total	To TV Producers	Industry Total	To TV Producers	Industry Total		To TV Producers	
						Low	High	Low	High
U.S. Content									
Non-U.S. Piracy	117.9	$1.53	$0.83	$180.3	$97.8	$25.2	$61.3	$13.7	$33.3
U.S. Piracy	8.8	$1.53	$0.83	$13.4	$7.3	$1.9	$4.6	$1.0	$2.5
U.S. Content Total	**126.7**	**$1.53**	**$0.83**	**$193.8**	**$105.1**	**$27.1**	**$65.9**	**$14.7**	**$35.7**
Non-U.S. Content									
Non-U.S. Piracy	52.7	$1.53	$0.83	$80.5	$43.7	$11.3	$27.4	$6.1	$14.8
U.S. Piracy	4.1	$1.53	$0.83	$6.2	$3.4	$0.9	$2.1	$0.5	$1.1
Non-U.S. Content Total	**56.7**	**$1.53**	**$0.83**	**$86.7**	**$47.0**	**$12.1**	**$29.5**	**$6.6**	**$16.0**
Total	**183.4**	**$1.53**	**$0.83**	**$280.5**	**$152.1**	**$39.3**	**$95.4**	**$21.3**	**$51.7**

Sources: See Appendix A. Notes: [1] The difference between lost industry revenues and lost revenues to movie producers is lost revenues to distributors. [2] Due to rounding, values do not always sum to totals.

III. Impacts of Digital Video Piracy on the U.S. Economy

This section describes the data and methodology we use to estimate the overall economic losses to the U.S. economy from global digital video piracy; we also present the results of our analysis.

We use the IMPLAN model to estimate the impacts of global digital video piracy on the U.S. economy. IMPLAN is a widely used input-output (I-O) model in impact studies and a leading provider of economic impact data. By pairing an I-O model with regional social accounting matrices, IMPLAN allows users to model the economic impacts of many policies and other changes to the economy. IMPLAN is used by nearly 20,000 individuals all over the world and across all industries. The IMPLAN model contains more than 500 industry sectors; it is described in more detail in Appendix B.

IMPLAN allows us to estimate the full set of economic impacts of digital video piracy on the U.S. economy, by including the subsequent rounds of impacts that follow the direct losses in consumption of various goods and services resulting from the initial loss of revenue; these subsequent effects are often referred to as "multiplier effects" and reflect both the indirect effects on suppliers and the induced effects on consumers from reduced income. We consider two potential types of direct effects: (1) reductions in revenues to U.S. movie and television industries; and (2) income gains to U.S. consumers who pirate video content. IMPLAN can be used to evaluate economic impacts of both the losses and the gains.

A. MODELING APPROACH AND IMPLAN INPUTS

This section describes our modeling approach and the inputs we used to estimate the economic impacts of video piracy on the U.S. economy. We begin by summarizing the steps taken to model the economic impacts of piracy. We then provide a more detailed explanation of each step in our approach, followed by a summary of the IMPLAN model inputs.

1. Overview of Modeling Approach

The modeling approach comprises four main steps:

1. *Estimate revenue losses due to digital video piracy.* Section II estimates the effects of U.S. and non-U.S. digital piracy on paid film and television viewership in 2017. These estimates include revenue losses, broken down by region (U.S. vs. non-U.S.) of the source content and of the pirating activity.

2. *Translate revenue losses into IMPLAN inputs.* As discussed in Section II, the location of the pirated content and of the pirating activity affect how digital video piracy impacts the U.S. economy. Accordingly, the impacts of the revenue losses measured above are modeled differently for each geographic component of digital video piracy. This step allocates the relevant portions of the revenue losses and income changes to the relevant IMPLAN sector.

3. *Estimate the impact of revenue losses by location of digitally pirated video content and of pirating activity.* We run the IMPLAN model using the inputs above to estimate economic impacts associated with the relevant revenue losses due to digital video piracy by specific geographic components. As noted, for piracy by U.S. residents, these impacts include negative effects on producer income and positive effects on those who pirate the content.

4. *Estimate the combined impact of all digital video piracy on the U.S. economy.* We combine the results of the previous step to develop complete estimates of the net effect of digital video piracy on the U.S. economy. The economic impacts are measured by employment (jobs) and GDP.

2. Determination of Lost Revenue Inputs

We organize our estimates of the relevant revenue changes to U.S. content producers and distributors due to digital video piracy based on the matrix given in Section II, which provides a four-way distribution of digital video piracy based on the location of those who pirate the content and the location of the content provider. Below, we provide descriptions of how these four categories are treated in our economic impact methodology.

a. Non-U.S. Digital Piracy of U.S. Video Content

Digital piracy of U.S. video content by non-U.S. individuals leads to reductions in revenues to U.S. video producers. We model the effects of these revenue losses as reductions in proprietors' income. Reductions in proprietors' income will lead to additional impacts on the U.S. economy through multiplier effects.

Our modeling is based on two further assumptions about this case. First, because the individuals pirating content are outside the U.S., we assume that they do not spend income saved from pirating on U.S. goods and services. There may be some spending on imports from the U.S., but such spending is likely to be a small fraction of the saved income. Thus, this form of digital video piracy does not have the same offsetting effect that results from digital video piracy by U.S. residents. This means that this category of piracy will have an unambiguously negative impact on the U.S. economy.

Second, we assume that this type of digital video piracy does not affect the supply of video content produced by U.S. studios. Our model assumes that revenue losses reduce studio profits but do not affect the quantity of video content supplied by U.S. studios. Thus, our model does not capture any potential reductions in the quantity of video content resulting from digital piracy, nor does it include any subsequent indirect or induced impacts resulting from any initial reduction in content. To the extent that piracy *does* affect the quantity of video content supplied, our results represent conservative estimates of digital video piracy's impact on the U.S. economy.

b. U.S. Digital Piracy of U.S. Video Content

Domestic digital piracy of U.S.-produced content differs from the piracy outside the U.S. in two respects. First, in addition to producers of content, U.S. firms that distribute video content also suffer the effects of U.S. digital video piracy. Movie theaters, cable companies, and DVD vendors, for example, lose sales that would have otherwise supported additional jobs and contributed to GDP. Using data on video viewership by medium, we allocate the forgone sales from this intra-U.S. digital video piracy to the appropriate IMPLAN sectors associated with video content distribution (e.g., motion picture industries, wired telecommunications carriers, retail electronic stores). Note that unlike the fixed video supply assumption for non-U.S. piracy, forgone sales from domestically distributed videos will have supply effects for distributors. Fewer DVD sales, for example, represent a direct reduction in output for retail electronic stores.

Second, because this form of digital video piracy is by U.S. consumers, the effect of piracy on their spending patterns is relevant for the estimates of the net U.S. economic impacts. When U.S. consumers pirate videos, they save the income that they would have otherwise spent buying videos and are able to spend this additional income on other U.S. goods and services; these expenditures then lead to positive impacts on the economy. Additional spending on restaurant meals, for example, would contribute positively to the U.S. economy and could potentially offset the losses due to reduced income to producers and distributors. We capture these offsetting, positive impacts by including an increase in household income equivalent in magnitude to the total revenue loss for this form of piracy. We allocate the increase in household income across household income levels using IMPLAN's data on video media spending by household income bracket. We then model the impacts of additional household spending using IMPLAN's data on spending patterns by income level.[23]

c. Non-U.S. Digital Piracy of Non-U.S. Video Content

We do not include non-U.S. digital piracy of non-U.S. video content in our impact modeling because it would have a negligible impact on the U.S. economy relative to the other components of global piracy. While it is possible that U.S. entities could be affected by this form of piracy—for example, if non-U.S. residents pirated films they would have watched via U.S. distributors or if non-U.S. pirates imported U.S. goods with the income they saved by pirating non-U.S. videos—we assume, for simplicity, that this form of digital video piracy would affect only non-U.S. economies. Our results are thus conservative to the extent that this form of piracy has a negative net impact on the U.S. economy.

d. U.S. Digital Piracy of Non-U.S. Digital Content

Finally, we consider the impact of U.S. digital piracy of video content produced outside the U.S. On the supply side, even though the video content is originally produced abroad, distributing firms in the U.S. are negatively affected by this form of piracy. Therefore, we model the impacts from revenue losses for distribution (but not production) within the U.S. As with U.S. piracy of U.S. content, as noted above, we allocate the forgone sales to different distributing sectors based on data on film and television viewership by medium. These forgone sales are associated with reduced supply in the relevant distribution sectors and thus have direct impacts on employment and output.

Though only the distributors' portion of revenue losses are modeled on the supply side, on the demand side U.S. pirates gain the full value of their forgone video spending in the form of additional income. As described in Section III.2.b, we allocate the increase in income across household income levels using IMPLAN data on video media spending by household income bracket, and we model the impacts of additional household spending using IMPLAN's data on spending patterns by income level.

3. Revenue Losses From Digital Video Piracy

We calculated estimates of the revenue losses to U.S. producers and distributors under these various cases for film piracy and TV piracy. Table 7 summarizes the direct revenue losses from film piracy in 2017, using both low and high displacement rate assumptions (i.e., 14% and 34%) and excluding losses that are not expected to have any impact on the U.S. economy. For example, in the case of non-U.S. digital piracy of U.S. video content, we estimate the total dollar value of all digitally pirated movies to be $153.1 billion. Assuming a displacement rate of 14% yields an estimated loss of $21.4 billion in paid movie consumption; however, only $11.7 billion of the total $153.1 billion is allocated to U.S. film producers and thus relevant to the U.S. economy.

As described above, these losses to video content producers are modeled in IMPLAN as lost profits, reflecting forgone income of the relevant proprietors/shareholders. In contrast, U.S. digital piracy of U.S. films results in losses to both film producers and distributors (e.g., DVD vendors, movie theaters, "over-the-top" providers, cable companies). Thus, we model total lost sales of $1.2 billion and $3.0 billion for the low and high displacement rates, respectively. Note that this U.S. digital video piracy leads to an equivalent and potentially offsetting increase in income for U.S. consumers who pirate the content, who gain $1.2 billion to $3.0 billion that they would have otherwise spent on videos to spend on other goods and services. Similarly, U.S. digital piracy of non-U.S. films provides U.S. consumers with an additional $0.7 billion to $1.6 billion in income to spend elsewhere (as shown in Table 5 above). In the case of U.S. digital piracy of non-U.S. content, however, only U.S. distributors experience the direct negative effects of forgone sales ($0.3 billion to $0.7 billion).

TABLE 7: U.S. REVENUE LOSSES ASSOCIATED WITH DIGITAL FILM PIRACY (BILLIONS, 2017)

Region	Value of Pirated Content	Lost Revenue for U.S. Sectors		
		Production	Distribution	Total
U.S. Content				
Non-U.S. Piracy	-$153.1	-$11.7 to -$28.5	–	-$11.7 to -$28.5
U.S. Piracy	-$8.7	-$0.7 to -$1.6	-$0.6 to -$1.3	-$1.2 to -$3.0
U.S. Content Total	**-$161.9**	**-$12.4 to -$30.1**	**-$0.6 to -$1.3**	**-$13.0 to -$31.5**
Non-U.S. Content				
Non-U.S. Piracy	–	–	–	–
U.S. Piracy	-$4.8	–	-$0.3 to -$0.7	-$0.3 to -$0.7
Non-U.S. Content Total	**-$4.8**	**–**	**-$0.3 to -$0.7**	**-$0.3 to -$0.7**
Total	**-$166.6**	**-$12.4 to -$30.1**	**-$0.9 to -$2.1**	**-$13.3 to -$32.2**

Sources: Table 5. Notes: [1] Values displayed in the table represent inputs to the IMPLAN model (i.e., direct impacts on the U.S. economy). Values marked by dashes are not modeled as part of the impacts of piracy. [2] Due to rounding, values do not always sum to totals.

Table 8 provides the analogous information for digital television piracy, again excluding revenue losses that are not expected to affect the U.S. economy. As illustrated above in Table 7, non-U.S. digital piracy of U.S. video content is modeled as reduced profits for U.S. production studios, while U.S. digital video piracy is modeled as forgone sales and is balanced against income gains to pirating U.S. consumers.

TABLE 8: U.S. REVENUE LOSSES ASSOCIATED WITH DIGITAL TELEVISION PIRACY (BILLIONS, 2017)

Region	Value of Pirated Content	Lost Revenue for U.S. Sectors		
		Production	Distribution	Total
U.S. Content				
Non-U.S. Piracy	-$180.3	-$13.7 to -$33.3	–	-$13.7 to -$33.3
U.S. Piracy	-$13.4	-$1.0 to -$2.5	-$.09 to -$2.1	-$1.9 to -$4.6
U.S. Content Total	**-$193.8**	**-$14.7 to -$35.7**	**-$0.9 to -$2.1**	**-$15.6 to -$37.8**
Non-U.S. Content				
Non-U.S. Piracy	–	–	–	–
U.S. Piracy	-$6.2	–	-$0.4 to -$1.0	-$0.4 to -$1.0
Non-U.S. Content Total	**-$6.2**	**–**	**-$0.4 to -$1.0**	**-$0.4 to -$1.0**
Total	**-$200.0**	**-$14.7 to -$35.7**	**-$1.3 to -$3.1**	**-$16.0 to -$38.8**

Sources: Table 6. Notes: [1] Values displayed in the table represent inputs to the IMPLAN model (i.e., direct impacts on the U.S. economy). Values marked by dashes are not modeled as part of the impacts of piracy. [2] Due to rounding, values do not always sum to totals.

Table 9 summarizes the total effects of digital film piracy and digital television piracy on U.S. content production and distribution. As shown in the table, we estimate that digital video piracy reduces revenue to the U.S. content and distribution sectors by between $29.2 billion and $71.0 billion per year.

TABLE 9: SUMMARY OF U.S. REVENUE LOSSES ASSOCIATED WITH DIGITAL VIDEO PIRACY (BILLIONS, 2017)

Sector	Digital Film Piracy	Digital TV Piracy	Total
Production	-$12.4 to -$30.1	-$14.7 to -$35.7	-$27.1 to -$65.9
Distribution	-$0.9 to -$2.1	-$1.3 to -$3.1	-$2.1 to -$5.1
Total	**-$13.3 to -$32.2**	**-$16.0 to -$38.8**	**-$29.2 to -$71.0**

Sources: Tables 7–8. Note: Due to rounding, values do not always sum to totals.

To put these figures in context, recall that the U.S. content and distribution industry revenue in 2017 was approximately $229 billion.[24] Thus, our results suggest that digital video piracy reduces overall industry revenue by between 11% and 24%.[25]

Table 10 shows the specific assignments of revenue losses and displaced income to IMPLAN variables and sectors. The assignment of forgone sales to distributors in different sectors is based on data on video viewership by medium. IMPLAN data on household video content expenditures are used to assign displaced income to different household income levels.

TABLE 10: INITIAL IMPACTS ASSOCIATED WITH DIGITAL VIDEO PIRACY BY VARIABLE AND IMPLAN SECTOR (BILLIONS, 2017)

		Digital Film Piracy		Digital TV Piracy		Total	
IMPLAN Inputs	**IMPLAN Category**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Sales	Data processing, hosting, and related services	-$0.3	-$0.8	-$0.9	-$2.3	-$1.2	-$3.0
	Retail — Electronics and appliance stores	-$0.1	-$0.2	-$0.1	-$0.3	-$0.2	-$0.5
	Motion pictures and video industries	-$0.2	-$0.6	-$0.0	-$0.0	-$0.2	-$0.6
	Wired telecommunications carriers	-$0.9	-$2.1	-$1.2	-$3.0	-$2.1	-$5.2
	Sales Total	**-$1.5**	**-$3.7**	**-$2.3**	**-$5.5**	**-$3.8**	**-$9.2**
Proprietor Income	Motion picture and video industries	-$11.7	-$28.5	-$13.7	-$33.3	-$25.4	-$61.8
	Proprietor Income Total	**-$11.7**	**-$28.5**	**-$13.7**	**-$33.3**	**-$25.4**	**-$61.8**
	Sales and Proprietor Income Total	**-$13.3**	**-$32.2**	**-$16.0**	**-$38.8**	**-$29.2**	**-$71.0**
Household Income	Households <15k	$0.1	$0.2	$0.1	$0.3	$0.2	$0.5
	Households 15–30k	$0.1	$0.3	$0.2	$0.5	$0.3	$0.8
	Households 30–40k	$0.1	$0.3	$0.2	$0.4	$0.3	$0.6
	Households 40–50k	$0.1	$0.3	$0.2	$0.4	$0.3	$0.7
	Households 50–70k	$0.2	$0.5	$0.3	$0.8	$0.5	$1.3
	Households 70–100k	$0.3	$0.8	$0.5	$1.2	$0.8	$2.0
	Households 100–150k	$0.4	$0.9	$0.5	$1.3	$0.9	$2.1
	Households 150–200k	$0.2	$0.5	$0.3	$0.7	$0.5	$1.2
	Households 200k+	$0.3	$0.8	$0.5	$1.1	$0.8	$1.9
	Household Income Total	**$1.9**	**$4.6**	**$2.7**	**$6.7**	**$4.6**	**$11.3**

Sources: IMPLAN Model; NERA calculations. Note: Due to rounding, values do not always sum to totals.

B. ESTIMATED IMPACTS OF DIGITAL VIDEO PIRACY ON THE U.S. ECONOMY

This section provides the empirical results of our IMPLAN modeling for the low and high estimates. Following the methodology outlined in the previous section, we generate estimates of the overall impacts of digital video piracy to the U.S. economy. Specifically, we examine the effects of video piracy on two IMPLAN output variables:

- GDP, the total value added for goods and services
- Employment, total jobs (both full time and part time), measured as job-years

For both scenarios, results are reported for the impacts in the U.S. in a single year: 2017. IMPLAN uses the Bureau of

Economic Analysis and Bureau of Labor Statistics definition of employment, which is an annual average of full-time and part-time employment. GDP is equal to value added, which equals total output minus intermediate inputs.

Table 11 provides the impact estimates broken down by the four categories described above, and Figures 2 and 3 graph the results. For each economic impact, we present a range reflecting the lower- and upper-bound displacement rate assumptions. Using the methodologies and data described in this report, we estimate that, in 2017, digital video piracy cost the U.S. economy between 230,000 and 560,000 jobs and between $47.5 billion and $115.3 billion in GDP. As expected, these losses are dominated by losses due to digital piracy of U.S. video content (films and TV episodes) by non-U.S. residents. Digital video piracy by U.S. residents also leads to losses in overall U.S. jobs and GDP, but the sizes of these impacts are considerably smaller.

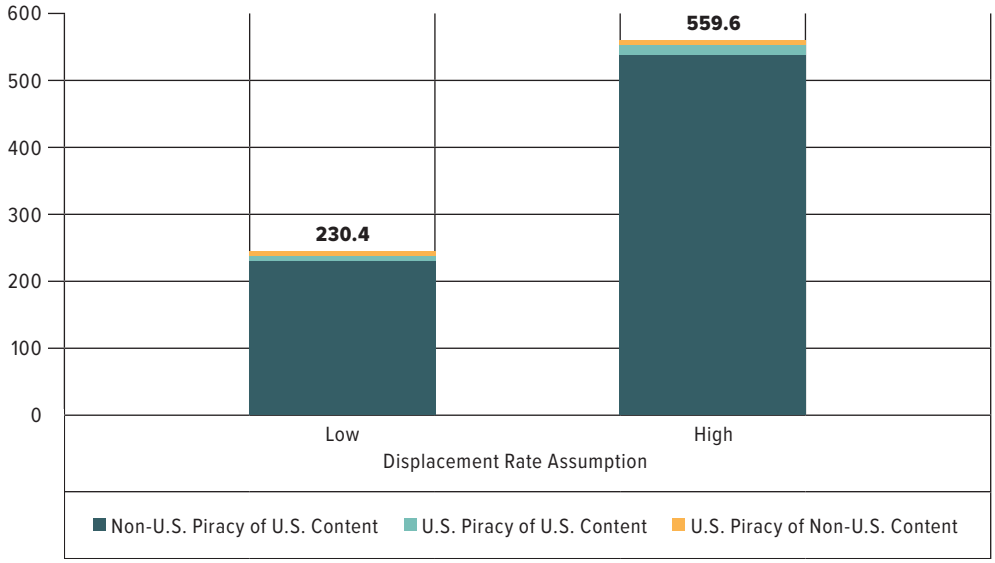
TABLE 11: IMPACTS OF VIDEO PIRACY ON THE U.S. ECONOMY (2017)

Region	Employment (Thousands)	GDP ($Billions)
U.S. Content		
Non-U.S. Piracy	-222.7 to -540.9	-$45.7 to -$111.1
U.S. Piracy	-4.9 to -11.9	-$1.2 to -$2.9
U.S. Content Total	**-227.6 to -552.8**	**-$46.9 to -$114.0**
Non-U.S. Content		
Non-U.S. Piracy	–	–
U.S. Piracy	-2.8 to -6.8	-$0.5 to -$1.3
Non-U.S. Content Total	**-2.8 to -6.8**	**-$0.5 to -$1.3**
Total Impact of Piracy	**-230.4 to -559.6**	**-$47.5 to -$115.3**

Sources: IMPLAN Model; NERA calculations. Note: Due to rounding, values do not always sum to totals.

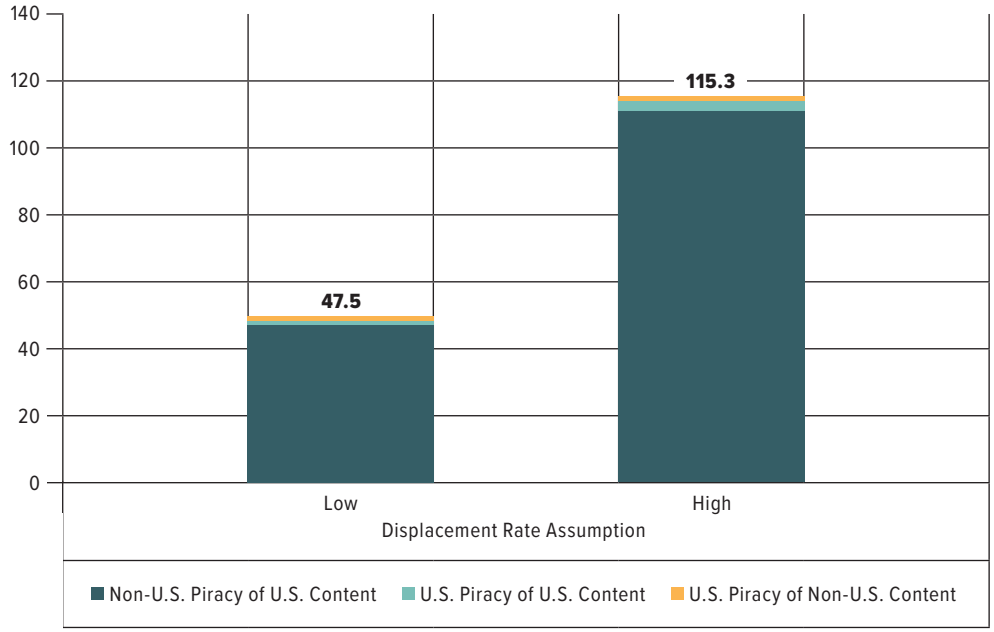
To put these figures in perspective, as noted above, about 927,000 people were directly employed in video content production and distribution and total employment (including indirect jobs) was about 2.6 million in 2017.[26] Thus, our results suggest that the economy-wide job losses (including direct, indirect, and induced jobs) resulting from digital video piracy constitute a significant proportion of all jobs associated with the content creation and distribution sectors.

FIGURE 2: ESTIMATED IMPACTS OF DIGITAL VIDEO PIRACY ON U.S. EMPLOYMENT (THOUSANDS, 2017)



Sources: IMPLAN Model; NERA calculations.

FIGURE 3: ESTIMATED IMPACTS OF DIGITAL VIDEO PIRACY ON U.S. GDP (BILLIONS, 2017)



Sources: IMPLAN Model; NERA calculations.

IV. Conclusions

Estimating the value of digital piracy and its impact on the U.S. economy is an inherently complex task. Piracy, an illicit activity by nature, is difficult to quantify, and estimating its impact on revenue and, ultimately, the U.S. economy requires several assumptions. These caveats aside, we believe this study presents a reasonable range of estimates for both the total value of video piracy and the resulting losses in U.S. employment and GDP. As such, our results provide strong evidence that digital video piracy imposes significant costs on the U.S. economy.

APPENDIX A: METHODOLOGY FOR ESTIMATING U.S. REVENUE LOSSES FROM DIGITAL VIDEO PIRACY

The following steps describe the methodology used to calculate the value of digital piracy activity associated with worldwide digital movie and television piracy:

Step 1) We rely on data from TECXIPIO, which reports activity (seeds) on the BitTorrent client network, by title, for 2017. For each title in the database (TV series or movie title), TECXIPIO reports the total number of seeds both inside and outside the U.S., based on the Internet Protocol address involved. The TECXIPIO data also include an Internet Movie Database (IMDb) ID code identifying the title; we use this to add the country of origin for the title to the data, as reported by IMDb (i.e., the first country listed in the country of origin by IMDb). Thus, the data are then split into U.S.-produced and foreign-produced television and movie titles. As a result, for both TV series and film titles, we have the BitTorrent activity split into four categories: (a) U.S.-produced and torrented in the U.S., (b) U.S.-produced and torrented outside the U.S., (c) foreign-produced and torrented in the U.S., and (d) foreign-produced and torrented outside the U.S. See Table A-1.

Step 2) To translate the torrenting data for movies into overall digital piracy data, we rely on an estimate from MUSO, which reports that BitTorrent downloads make up 20% of movie piracy, with streaming piracy making up the balance.[27] See Table A-2.

Step 3) Because the television BitTorrent data do not identify whether a torrented file represents a single episode, a season, or an entire series, we do not rely on the raw torrenting numbers to identify total digital television piracy. Instead, we rely on data from MUSO as well as Amazon, Hulu, and Netflix, which report that films make up approximately one-third of total video consumption, to calculate total television piracy.[28] Thus, the total amount of digital movie piracy—the sum of the four categories—is then doubled to estimate the total amount of digital television piracy, such that digital television piracy represents two-thirds of all digital video piracy activity in 2017. We then use the percentages of television BitTorrent activity in each of the four groupings to determine the total number of TV episodes digitally pirated in each group. See Tables A-1 and A-2.

Step 4) After estimating the total amount of digital video piracy, the next step is to calculate a weighted average per consumer view of either a TV episode or a movie across all possible consumption media, weighted by weekly time spent watching via each medium. Weekly time spent on each medium is estimated from a survey of U.S. consumers conducted by L.E.K. in 2018.[29] The percentage of weekly time spent on each medium is multiplied by the average revenue from watching an episode or a movie on each medium. As a result, the average revenue is "weighted" by the amount of time spent on each respective medium.

To calculate the average revenue from watching an episode or movie on each medium, it is necessary to make certain assumptions about the characteristics of the movie and television content involved. Specifically:

a) A TV episode on a streaming platform is assumed to be 46 minutes, which we calculate to be the weighted average of the reported lengths for the top 50 most torrented television shows, using TECXIPIO data and publicly available data on episode lengths.[30]

b) A movie is assumed to be 90 minutes, on average, based on a third-party analysis of IMDb data.[31]

c) For cable and physical disc sales and rentals, the assumed split between television and movie consumption is two-to-one (two-thirds television and one-third movies), again based on MUSO as well as the weighted average of the splits across Amazon, Hulu, and Netflix.

d) The average viewing time for a TV episode on cable is assumed to be 45 minutes, which is the average between a 30-minute episode aired with commercials and a 60-minute episode aired with commercials.[32]

e) A movie on cable is assumed to be two hours with commercials.

f) A TV show disc rented at a store is assumed to contain 10 episodes.

The average revenue per consumer view of a TV episode or film on each medium is calculated by dividing total revenue of that medium in the U.S. by the estimated number of minutes watched by U.S. consumers and then multiplying by the average length of an episode or film on that medium. Any number included in this calculation that was not noted as an assumption above was taken directly from reported data.

After estimating average revenue per episode, we can estimate the average revenue to producers. Cable, subscription video on-demand, and ad-supported video on-demand providers include the amount paid in content acquisition in their annual reports, which can be divided by total revenue to obtain the percentage of revenue retained by producers. Costs of production for physical discs have been estimated by various analysts, and costs to producers of electronic sales are estimated by Apple's published revenue splits for app developers. See Table A-3.

Step 5) The total amount of digital video piracy in each category is multiplied by the average revenue per consumer view of a film or TV episode. We also calculate the average share of industry revenue that flows to producers (content creators) rather than to distributors, based on publicly available data for different viewing media, resulting in two different calculations for each category of digital piracy: the total amount of industry revenues associated with the category as well as the total amount of producer revenue associated with that category (again, television and film are reported separately for each of the four categories). See Tables A-4 and A-5.

Step 6) Finally, as described in the text above, we assume that between 14% and 34% of digital video piracy displaces paid content.[33] We therefore translate the revenue associated with digital video piracy to the lost revenue to the industry and to producers in each of the categories of piracy. See Tables A-4 and A-5.

TABLE A-1: VIDEO PIRATED VIA BITTORRENT (2017)

Production Location	Torrenting Location		Total
	Outside U.S.	U.S.	
Movies			
U.S.	5,025,408,192	286,279,869	5,311,688,061
Outside U.S.	3,907,061,836	156,558,445	4,063,620,281
Movies Total	**8,932,470,028**	**442,838,314**	**9,375,308,342**
TV Shows			
U.S.	1,916,393,815	142,732,636	2,059,126,451
Outside U.S.	855,765,764	65,937,311	921,703,075
TV Shows Total	**2,772,159,579**	**208,669,947**	**2,980,829,526**
Total	**11,704,629,607**	**651,508,261**	**12,356,137,868**

Sources: TECXIPIO; Internet Movie Database.

TABLE A-2: TOTAL DIGITAL VIDEO PIRATED (2017)

Production Location	Piracy Location		Total
	Outside U.S.	U.S.	
Movies			
U.S.	25,127,040,960	1,431,399,345	26,558,440,305
Outside U.S.	19,535,309,180	782,792,225	20,318,101,405
Movies Total	**44,662,350,140**	**2,214,191,570**	**46,876,541,710**
TV Episodes			
U.S.	117,928,251,378	8,783,273,065	126,711,524,444
Outside U.S.	52,660,867,171	4,057,554,207	56,718,421,378
TV Shows Total	**170,589,118,549**	**12,840,827,273**	**183,429,945,822**
Total	**215,251,468,689**	**15,055,018,843**	**230,306,487,532**

Sources: TECXIPIO; Internet Movie Database; MUSO, "Global Piracy Increases Throughout 2017, MUSO Reveals" (March 21, 2018) (available at https://www.muso.com/magazine/global-piracy-increases-throughout-2017-muso-reveals/); Ashley Rodriguez, "People Are Using Netflix, Hulu, and Amazon Prime in Very Different Ways," Quartz (January 18, 2018) (available at https://qz.com/1180832/people-are-using-netflix-hulu-and-amazon-prime-in-very-different-ways/); Randy Olson, "Movies Aren't Actually Much Longer Than They Used to Be" (January 25, 2014) (available at http://www.randalolson.com/2014/01/25/movies-arent-actually-much-longer-than-they-used-to-be/); AT&T Internet Service, "Marathon Streaming Data" (available at https://www.attinternetservice.com/resources/marathon-streaming/); Jefferson Graham, "Hulu's 'Limited Commercials' Not So," USA Today (January 13, 2017) (available at https://www.usatoday.com/story/tech/talkingtech/2017/01/13/hulus-limited-commercials-not-so/96538590/). Note: Due to rounding, values do not always sum to totals.

TABLE A-3: AVERAGE REVENUE PER VIEW OF MOVIE OR TV EPISODE BY MEDIUM (2017)

Medium	% Time		Average Revenue per View		% Revenue to Content Producers	Average Revenue to Content Producers per View	
	Movie	TV	Movie	TV		Movie	TV
Cable	55%	47%	$7.51	$2.82	54%	$4.02	$1.51
Box Office	14%	–	$8.97	–	53%	$4.75	–
Subscription Video On-Demand	23%	24%	$0.77	$0.39	54%	$0.41	$0.21
Ad-Supported Video On-Demand	–	22%	–	$0.17	55%	–	$0.09
Physical Disc Sales and Rentals	6%	5%	$6.75	$0.68	67%	$4.50	$0.45
Electronic Sell-Throughs and Rentals	2%	2%	$7.92	$2.07	70%	$5.54	$1.45
Time-Weighted Average			**$6.09**	**$1.53**		**$3.34**	**$0.83**

Sources: See sources for Table A-3 section below. Note: Physical disc sales and rental data are a partial Kagan forecast. Ad-supported video on-demand revenue is linearly forecasted.

TABLE A-4: REVENUE EFFECTS OF DIGITAL VIDEO PIRACY OF FILM (2017)

Region	Total Pirated Films	Average Revenue per Film		Total Value of Films Pirated		Lost Revenue			
		Industry Total	To Movie Producers	Industry Total	To Movie Producers	Industry Total		To Movie Producers	
						Low	High	Low	High
U.S. Content									
Non-U.S. Piracy	25,127,040,960	$6.09	$3.34	$153,138,652,562	$83,812,869,946	$21,439,411,359	$52,067,141,871	$11,733,801,792	$28,496,375,782
U.S. Piracy	1,431,399,345	$6.09	$3.34	$8,723,771,626	$4,774,525,076	$1,221,328,028	$2,966,082,353	$668,433,511	$1,623,338,526
U.S. Content Total	**26,558,440,305**	**$6.09**	**$3.34**	**$161,862,424,188**	**$88,587,395,022**	**$22,660,739,386**	**$55,033,224,224**	**$12,402,235,303**	**$30,119,714,307**
Non-U.S. Content									
Non-U.S. Piracy	19,535,309,180	$6.09	$3.34	$119,059,420,087	$65,161,287,008	$16,668,318,812	$40,480,202,830	$9,122,580,181	$22,154,837,583
U.S. Piracy	782,792,225	$6.09	$3.34	$4,770,786,451	$2,611,054,085	$667,910,103	$1,622,067,393	$365,547,572	$887,758,389
Non-U.S. Content Total	**20,318,101,405**	**$6.09**	**$3.34**	**$123,830,206,538**	**$67,772,341,094**	**$17,336,228,915**	**$42,102,270,223**	**$9,488,127,753**	**$23,042,595,972**
Total	**46,876,541,710**	**$6.09**	**$3.34**	**$285,692,630,726**	**$156,359,736,116**	**$39,996,968,302**	**$97,135,494,447**	**$21,890,363,056**	**$53,162,310,279**

Sources: Tables A-2–A-3; Benedikt Herz and Kamil Kiljanski, "Movie Piracy and Displaced Sales in Europe: Evidence From Six Countries," Information Economics and Policy 43 (2018): 12–22, at 16–17; Jie Bai and Joel Waldfogel, "Movie Piracy and Sales Displacement in Two Samples of Chinese Consumers," Information Economics and Policy 24 (2012): 187–196, at 193–195. Note: Due to rounding, values do not always sum to totals.

TABLE A-5: REVENUE EFFECTS OF DIGITAL VIDEO PIRACY OF TELEVISION (2017)

Region	Total Pirated TV Episodes	Average Revenue per Episode		Total Value of TV Pirated		Lost Revenue			
		Industry Total	To TV Producers	Industry Total	To TV Producers	Industry Total		To TV Producers	
						Low	High	Low	High
U.S. Content									
Non-U.S. Piracy	117,928,251,378	$1.53	$0.83	$180,339,650,220	$97,805,814,691	$25,247,551,031	$61,315,481,075	$13,692,814,057	$33,253,976,995
U.S. Piracy	8,783,273,065	$1.53	$0.83	$13,431,661,827	$7,284,557,992	$1,880,432,656	$4,566,765,021	$1,019,838,109	$2,476,749,694
U.S. Content Total	**126,711,524,444**	**$1.53**	**$0.83**	**$193,771,312,048**	**$105,090,372,613**	**$27,127,983,687**	**$65,882,246,096**	**$14,712,652,166**	**$35,730,726,688**
Non-U.S. Content									
Non-U.S. Piracy	52,660,867,171	$1.53	$0.83	$80,530,680,773	$43,675,191,955	$11,274,295,308	$27,380,431,463	$6,114,526,874	$14,849,565,265
U.S. Piracy	4,057,554,207	$1.53	$0.83	$6,204,941,547	$3,365,202,064	$868,691,817	$2,109,680,126	$471,128,289	$1,144,168,702
Non-U.S. Content Total	**56,718,421,378**	**$1.53**	**$0.83**	**$86,735,622,319**	**$47,040,394,019**	**$12,142,987,125**	**$29,490,111,588**	**$6,585,655,163**	**$15,993,733,966**
Total	**183,429,945,822**	**$1.53**	**$0.83**	**$280,506,934,367**	**$152,130,766,632**	**$39,270,970,811**	**$95,372,357,685**	**$21,298,307,328**	**$51,724,460,655**

Sources: Tables A-2–A-3; Benedikt Herz and Kamil Kiljanski, "Movie Piracy and Displaced Sales in Europe: Evidence From Six Countries," Information Economics and Policy 43 (2018): 12–22, at 16–17; Jie Bai and Joel Waldfogel, "Movie Piracy and Sales Displacement in Two Samples of Chinese Consumers," Information Economics and Policy 24 (2012): 187–196, at 193–195. Note: Due to rounding, values do not always sum to totals.

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APPENDIX B: OVERVIEW OF THE IMPLAN MODEL

This appendix provides details on the IMPLAN model, as described on the IMPLAN website. Note that the sources section at the end of this appendix provides specific links to the website.

A. INTRODUCTION TO IMPLAN AND INPUT-OUTPUT ANALYSIS

Input-output (I-O) analysis is a means of examining interindustry relationships within an economy. It captures all monetary market transactions between industries in a given period. The resulting mathematical formulas allow for examinations of the effects of a change in one or several economic activities on an entire economy (impact analysis).

IMPLAN expands on the traditional I-O approach to include transactions between industries and other economic sectors, such as government, as well as between pairs of other sectors, thereby capturing all monetary market transactions in a given period. IMPLAN can thus be more accurately described as a Social Account Matrix (SAM) model, though the terms "I-O" and "SAM" are often used interchangeably.

Although IMPLAN Version 3.0 provides a framework to conduct an analysis of economic impacts, each stage of an analysis should be carefully scrutinized to make sure it is logical. Procedures and assumptions need to be validated.

1. Constant Results to Scale

The same quantity of inputs is required per unit of output, regardless of the level of production. In other words, if output increases by 10%, then input requirements will also increase by 10%.

2. No Supply Constraints

I-O assumes that there are no restrictions to raw materials and employment, and it assumes that there is enough to produce an unlimited amount of product. It is up to the user to decide whether this is a reasonable assumption for his or her study area and analysis, especially when dealing with large-scale impacts.

3. Fixed Input Structure

This structure assumes that changes in the economy will affect the industry's output level but not the mix of commodities and services it requires to produce that output. In other words, there is no input substitution in response to a change in output.

4. Industry Technology Assumption

The industry technology assumption is used to convert make-use tables (or supply-use tables for some international datasets) into a symmetric I-O table. It assumes that an industry uses the same technology to produce each of its products. In other words, an industry's production function is a weighted average of the inputs required for the production of the primary product and each of the by-products, weighted by the output of each of the products.

5. Constant Make Matrix

As a requirement of the industry technology assumption, industry by-product coefficients are constant. An industry will always produce the same mix of commodities regardless of the level of production. In other words, an industry will not increase the output of one product without proportionately increasing the output of all its other products.

6. The Model Is Static

No price changes are built in. The underlying data and relationships are not affected by impact runs. The relationships for a given year do not change unless another data year is purchased.

B. IMPLAN DATABASES

IMPLAN's annual datasets provide a complete set of balanced SAMs for every ZIP code, county, and state in the U.S. These SAMs provide a complete picture of the economy and can be used to generate predictive I-O multipliers for estimating economic impacts.

Constructing IMPLAN's annual databases requires gathering data from a large variety of sources, converting them to a consistent sectoring scheme and year, estimating the missing components, and controlling the newly formatted data against other known data sources to maintain accuracy.

Raw data availability differs with each level of regional resolution. At the national level, nearly all database components are available, while at the state, county, and ZIP code levels, increasingly fewer raw data are available. County-level information is typically available for employment, employee compensation, proprietary income, population, federal and state government finances, and selected wealth data, leaving the remaining county data to be estimated. At the ZIP code level, only county business patterns (wage and salary employment) and demographic data from the Bureau of Census are available.

Each year, IMPLAN gathers current data at the national level, puts it into the IMPLAN data format, and derives new national I-O matrices (use, make, by-products, absorption, and market shares), as well as national tables for deflators, margins, and regional purchase coefficients (RPCs). State-level data are then gathered and controlled to the national totals. Next, county-level data are gathered and controlled to the state totals. Finally, ZIP code data are gathered and controlled to the county totals.

State, county, and ZIP code I-O matrices are not estimated as part of the data development process; rather, the IMPLAN software creates region-specific I-O matrices during the model creation stage. In Figure B-1, the shaded areas indicate data provided in the IMPLAN data files. The IMPLAN software estimates the remaining cells.

FIGURE B-1: SAM FRAMEWORK

	Industry	Commodity	Factors	Institutions	Enterprises	Capital	Trade	Total
Industry		Make					Exports	Total Industry Income
Commodity	Use			Consumption		Consumption		Total Commodity Income
Factors	Value Added						Exports	Total Factor Income
Institutions		Sales	Transfers	Transfers	Transfers		Exports	Total Institution Income
Enterprises								Total Enterprise Income
Capital						Transfers	Exports	Total Capital Income
Trade	Imports		Factor Trade	Imports		Transfer	Exports	Total Trade Income
Total	Total Industry Outlay	Total Commodity Outlay	Total Factor Outlay	Total Institution Outlay	Total Enterprise Outlay	Total Capital Outlay	Total Trade Outlay	

Source: Phil Cheney, "Introducing the SAM," IMPLAN (November 16, 2017) (available at https://implanhelp.zendesk.com/hc/en-us/articles/115009674708-Introducing-the-SAM-).

1. Region Specific Study Area Data

a. Model Overview Data

Data that describe the local region can be divided up into the following categories. Some examples of the available data are as follows (this is not an exhaustive list of all available data):

- **Data Year:** The economic makeup of a study region's economy for a specific calendar year
- **Population:** The number of residents in a region

- **Households:** The number of households in a region
- **Land Area:** The square miles of land area in a region, net of large bodies of water
- **Shannon-Weaver Diversity Index:** A measure of a region's diversity in terms of the spread of employment across the various IMPLAN sectors
- **Total Value Added and Total Final Demand:** Two ways of measuring the same value, which is analogous to gross domestic product for the region

b. Model Overview Data

The number of industries for which data are available is based on the current sectoring scheme. This is largely determined by the Bureau of Economic Analysis (BEA) Benchmark I-O tables. Most IMPLAN sectors can be mapped to North American Industry Classification System (NAICS) codes—with the exception of construction, which is based on Census Bureau structure types.

- **Output:** The value of industry production in producer prices. For sectors for which there is inventory, this value includes net inventory change.
- **Employment:** Annual average full-time/part-time/seasonal jobs. This includes both wage and salary workers and proprietors.
- **Value-Added:** Consists of employee compensation (EC), proprietor income (PI), other property income (OPI), and taxes on production and imports net of subsidy (TOPI).
  - **Employee Compensation:** EC includes wage and salary income plus benefits and employer paid taxes.
  - **Proprietor Income:** PI represents self-employment income including capital consumption allowance. Proprietors include sole proprietors and partnerships.
  - **Other Property Income:** OPI consists of corporate profits, rent, interest, and capital consumption allowance.
  - **Taxes on Production and Imports Net of Subsidy:** TOPI includes all payments to the government except for payroll taxes and end-of-year corporate income taxes. This includes sales tax, excise tax, fees, fines, licenses, and property tax. These payments are net of subsidy payments by the government.

c. Institutional Demands

Institutions are the components of final demand that consume commodities and drive the local economy. Note that, while the BEA denotes sales by institutions as a negative demand, IMPLAN treats it as a contribution to commodity supply.

- **Households:** The consumption of goods and services by households is traditionally known as personal consumption expenditures. IMPLAN has nine categories of household institutions distinguished by income class.
- **State and Local Government Education:** The operational spending pattern of all levels of public education, from pre-K to college.
- **State and Local Government Non-education:** Operational spending pattern of all other divisions of administrative state and local government. This includes legislature, police, fire, hospitals, prisons, etc. This does not include market-driven (enterprise) activities such as sewer, water, power, and public transportation.
- **State and Local Government Investment:** New construction and capital goods expenditures by all levels of state and local government.

- **State and Local Government Sales:** The goods and services sold by government administrative sectors. These include hospital care, higher education, and timber. Note that while the BEA denotes sales by institutions as a negative purchase, IMPLAN treats this category as a contribution to commodity supply.
- **Federal Defense:** Operational spending pattern of defense agencies, which include military services and the coast guard.
- **Federal Non-Defense:** Operational spending pattern of all other administrative federal agencies.
- **Federal Investment:** New construction and capital goods expenditures by all federal government agencies.
- **Federal Sales:** The goods and services sold by government administrative sectors. These include timber, lodging, and mineral leases. Note that, while the BEA denotes sales by institutions as a negative purchase, IMPLAN treats this category as a contribution to commodity supply.
- **Capital:** New construction and capital goods expenditures by all nongovernment (private) investors.
- **Inventory Purchases:** Net movement of goods into inventory.
- **Inventory Sales:** The net movement of goods out of inventory. Note that, while the BEA denotes sales by institutions as a negative purchase, IMPLAN treats the category as a contribution to commodity supply.
- **Foreign Exports:** The export of goods and services to destinations outside of the U.S.
- **Foreign Imports:** The import of goods and services from origins outside of the U.S.

d. Trade Flows

Each data year, IMPLAN runs a double-constrained gravity model to estimate the county-to-county trade flows for each commodity in the IMPLAN sectoring scheme. These data allow for multiregion I-O analysis as well as more accurate RPC estimates. Note that access to the trade data themselves is not granted under the standard user license.

- **Domestic Import:** Goods and services imported from other U.S. counties
- **Domestic Export:** Goods and services exported to other U.S. counties

e. Transfer Payments

These are the payments by value-added factors to institutions as well as institution payments to other institutions. These data are an extension to the traditional I-O accounts and make it possible to create the various forms of the Type SAM multiplier.

C. IMPLAN MULTIPLIERS

Multipliers are the basis of how an I-O analysis system, such as IMPLAN, estimates the potential impacts of economic changes. Expressed as a rate of change, a multiplier describes resultant changes in the overall economy for given changes in a particular industry. For example, a multiplier of 1.25 indicates that an additional $0.25 of economic activity is generated for every dollar spent.

Type I and Type SAM multipliers differ in their definition of “total” impact.

- **Type I:** Looks only at business-to-business purchases and does not include the effects of local household spending. The multiplier is calculated as: (Direct + Indirect Effects) / Direct Effect.

- **Type SAM:** Includes the impact of household spending and is the more common multiplier. The multiplier is calculated as: (Direct + Indirect + Induced Effects) / Direct Effect.

Multipliers exist in the IMPLAN model to describe rates of change for several different variables. The descriptions below apply to Type SAM and Type I multipliers, which are unitless values.

1. Output Multipliers

Output is the base multiplier from which all other multipliers are derived. The output multiplier describes the total output generated for every dollar of output in the target industry. Thus, if an output multiplier is 2.25, every dollar of production in this industry generates an additional $1.25 of activity in the local economy. The total effect of each dollar on the economy is $2.25: the original dollar plus an additional $1.25.

2. Employment Multipliers

Employment multipliers describe the total number of jobs generated as a result of one job in the target industry. Thus, if an employment multiplier is 2.33, every direct job creates an additional 1.33 jobs in the local economy. The total job effect of each job on the local economy is 2.33 jobs: the original job and 1.33 additional jobs.

3. Labor Income Multipliers

Labor income multipliers describe the dollars of labor income generated as a result of one dollar of labor income in the target industry. A labor income multiplier of 2.2 indicates that, for every dollar of direct labor income in this industry, another $1.20 of labor income is generated in the local economy.

4. Value-Added Multipliers

Value-added multipliers describe the total dollars of value added generated as a result of $1 of value added in the target industry. A value-added multiplier of 2.3 indicates that for every dollar of direct value added in this industry, another $1.30 of value added is generated in the local economy.

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[5] See, e.g., Office of the U.S. Trade Representative, *2017 Out-of-Cycle Review of Notorious Markets* (January 11, 2018), at 9–10 (available at https://ustr.gov/sites/default/files/files/Press/Reports/2017%20Notorious%20Markets%20List%201.11.18.pdf).

[6] Throughout this study, we address digital video piracy, by which we mean piracy using the internet or other online technologies. This study does not attempt to estimate physical piracy—i.e., the illicit reproduction of DVDs or other physical distribution technologies.

[7] We focus here on the most recent and relevant studies, though there are many others. For example, a 2006 study by L.E.K. Consulting estimated that the U.S. motion picture industry lost $918 million in 2005 from internet piracy and $1.8 billion from hard goods piracy. See Motion Picture Association and L.E.K. Consulting, *The Cost of Movie Piracy* (2006), at 9 (available at https://www.wired.com/images_blogs/threatlevel/files/MPAstudy.pdf). More recently, a 2017 study by Digital TV research estimated (based on interviews with industry executives) that the U.S. lost $8.9 billion in 2016 from online piracy. See Jesse Whittock, "Piracy to Cost TV & Film Biz $52Bn," *Television Business International* (October 30, 2017) (available at https://tbivision.com/2017/10/30/piracy-cost-tv-film-industry-biz-52bn/).

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[17] Frontier Economics, *The Economic Costs of Counterfeiting and Piracy* (June 2, 2017), at 26–28 (available at https://cdn.iccwbo.org/content/uploads/sites/3/2017/02/ICC-BASCAP-Frontier-report-2016.pdf).

[18] That is, if a U.S. individual pirates video content but would have otherwise paid for at least some of it, that savings is additional "income" to that individual, who would then spend the additional income primarily on U.S. goods and services.

[19] Throughout this study, the term "cable" refers to all multichannel video programming distributors (MVPDs), including cable companies, direct-broadcast satellite providers, telephone companies, and other entities that offer multiple channels of video programming to consumers for a subscription fee. Cable accounts for the largest portion of all MVPD subscribers. See Federal Communications Commission, *In the Matter of Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming, Eighteenth Report*, MB Docket No. 16-247 (January 17, 2017) at ¶2.

[20] MUSO, "Global Piracy Increases Throughout 2017, MUSO Reveals" (March 21, 2018) (available at https://www.muso.com/magazine/global-piracy-increases-throughout-2017-muso-reveals/).

[21] Our estimates are based on U.S. media prices. The available data suggest that using global data instead would, if anything, result in higher estimated revenue losses. See, e.g., Rebecca Moody, "Which Countries Pay the Most and Least for Netflix?" *Comparitech* (April 9, 2019) (available at https://www.comparitech.com/blog/vpn-privacy/countries-netflix-cost/) (showing monthly costs for a Netflix subscription in 76 countries, with the U.S. having the ninth-lowest cost per title); World Atlas, "How Much Are Movie Tickets Around the World?" (available at https://www.worldatlas.com/articles/the-most-expensive-movie-ticket-prices-around-the-world.html) (showing average film ticket prices in 30 countries, with the U.S. having the fourth-lowest average price).Frontier notes that "the U.S. is neither the cheapest nor most expensive country" for media costs and that costs are significantly higher in Europe. See Frontier Economics, *The Economic Costs of Counterfeiting and Piracy* (June 2, 2017), at 27–28 (available at https://cdn.iccwbo.org/content/uploads/sites/3/2017/02/ICC-BASCAP-Frontier-report-2016.pdf).

[22] As explained in Section III, we estimate total lost revenues for the U.S. content and distribution sectors of between $29.2 billion and $71.0 billion.

[23] This approach assumes implicitly that consumers who engage in video piracy have spending patterns similar to those of the average U.S. consumer.

[24] Motion Picture Association of America, *The Economic Contribution of the Motion Picture & Television Industry to the United States* (November 2018) (available at https://www.mpaa.org/wp-content/uploads/2019/03/Economic_contribution_US_infographic_Final.pdf).

[25] 11% = 29.2 / (29.2 + 229); 24% = 71.0 / (71.0 + 229).

[26] Motion Picture Association of America, *The Economic Contribution of the Motion Picture & Television Industry to the United States* (November 2018) (available at https://www.mpaa.org/wp-content/uploads/2019/03/Economic_contribution_US_infographic_Final.pdf).

[27] MUSO, "Global Piracy Increases Throughout 2017, MUSO Reveals" (March 21, 2018) (available at https://www.muso.com/magazine/global-piracy-increases-throughout-2017-muso-reveals/).

[28] MUSO, "Global Piracy Increases Throughout 2017, MUSO Reveals" (March 21, 2018) (available at https://www.muso.com/magazine/global-piracy-increases-throughout-2017-muso-reveals/); Ashley Rodriguez, "People Are Using Netflix, Hulu, and Amazon Prime in Very Different Ways," *Quartz* (January 18, 2018) (available at https://qz.com/1180832/people-are-using-netflix-hulu-and-amazon-prime-in-very-different-ways/).

[29] Alex Evans and Gil Moran, *OTT in Transition: Finding Success in Subscription Video*, L.E.K Consulting (2018), at 2 (available at https://www.lek.com/sites/default/files/insights/pdf-attachments/2029_OTT-in-Transition.pdf).

[30] Internet Movie Database (available at https://www.imdb.com/); AT&T Internet Service, "Marathon Streaming Data" (available at https://www.attinternetservice.com/resources/marathon-streaming/); Jefferson Graham, "Hulu's 'Limited Commercials' Not So," *USA Today* (January 13, 2017) (available at https://www.usatoday.com/story/tech/talkingtech/2017/01/13/hulus-limited-commercials-not-so/96538590/).

[31] Randy Olson, "Movies Aren't Actually Much Longer Than They Used To Be" (January 25, 2014) (available at http://www.randalolson.com/2014/01/25/movies-arent-actually-much-longer-than-they-used-to-be/).

[32] We include the commercial time because data on viewing patterns do not separate out cable television time watching commercials. Changing this assumption to remove the average time spending watching commercials would not change our results in a meaningful way.

[33] Jie Bai and Joel Waldfogel, "Movie Piracy and Sales Displacement in Two Samples of Chinese Consumers," *Information Economics and Policy* 24 (2012): 187-196, at 193-195; Benedikt Herz and Kamil Kiljanski, "Movie Piracy and Displaced Sales in Europe: Evidence From Six Countries," *Information Economics and Policy* 43 (2018): 12-22, at 16-17.

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