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Movie Piracy and Displaced Sales in Europe: Evidence from Six Countries

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Abstract: This paper presents estimates of lost movie sales due to unpaid movie consumption. We are the first to provide estimates that are recent, representative of the internet-using population, and cover multiple countries. Based on an online questionnaire with almost 30,000 respondents, we document that one unpaid (first) viewing of a movie displaces about 0.37 units of paid viewings. Using a back-of-the-envelope calculation, we show that this implies that unpaid movie viewings reduced movie sales in Europe by about 4.4% during the sample period. Lost sales differ substantially by country: they are in the range of 1.65% for Germany and 10.4% for Spain. We also find that 94% of lost sales are due to unpaid viewings by a small group of only 20% of consumers. Our findings have important implications for copyright policy.

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1 Introduction

Unpaid movie consumption is widespread in Europe. According to a 2014 study, nearly 70% of Europeans report to download or stream films “for free.”¹ To what extent such unpaid consumption reduces movie sales is difficult to quantify. One might argue that if a movie was not available “for free” the consumer would pay for it instead; one unpaid viewing would then displace one paid viewing. However, this only holds if the consumer’s willingness to pay for that movie was at least as high as its market price. For consumers with a willingness to pay below the market price sales displacement would be zero. It is therefore likely that at least a share of individuals who saw a given movie “for free” would have never bought that movie in the first place. The size of the so-called “displacement rate” is therefore ultimately an empirical question.

Estimates of the displacement rate in the existing literature suffer from several problems. Firstly, studies are usually based on “convenience samples” that are not representative of the population and are therefore of only limited use for policy makers. Secondly, there is a lack of studies that cover multiple countries. Thirdly, there are few studies that use recent data. Recent evidence, however, is essential since both the legal and illegal consumption of copyrighted content changed substantially in the last years, particularly due to the emergence of streaming services. Finally, while there are many studies on the displacement rate for music, evidence for movies is scarce. This paper aims to fill this void in the literature by providing estimates of the displacement rate for audiovisual content that are recent, representative of the internet-using population, and cover multiple countries.

We use a big online questionnaire of almost 30,000 individuals in six major European countries to empirically assess the displacement rate for movies and to quantify lost movie sales due to unpaid consumption in Europe. Respondents were given a list of 100 popular movies and asked to, firstly, select the movies they had seen, and secondly, to state *how* they had seen a given movie: e.g., in the cinema, by a legal stream, or by downloading it from a file-sharing or hosting site (unpaid consumption). Since a movie can be watched more than once, one unpaid movie viewing can theoretically even displace more than one movie sale. We therefore also ask respondents whether they saw a movie more than once.

A naive approach to quantify the displacement rate would be to ask whether respondents who report more unpaid viewings have fewer paid viewings. A well known problem of this approach is that individuals are likely to differ concerning their taste for movies. Individuals with a relatively high preference for movies probably engage in both more paid and unpaid consumption. Unless these differences in the taste for music can be controlled for, this will result in an underestimation of the rate of displacement due to omitted variable bias.

¹European Commission (2014)

In this paper, we follow Rob and Waldfogel (2007) to address this problem by using a longitudinal approach. The movies that are shown in the survey to respondents have been released either in 2011, 2012, or 2013. Under the assumption that paid or unpaid consumption of a movie primarily took place in the year of release, we can use this data to build a quasi-panel of movie consumption. Since this panel has information on an individual's movie consumption over several years, we can account for unobserved differences in the taste for movies by using individual fixed effects.

This paper puts forward three main findings. Firstly, using a sample that is representative of the internet-using population in six major European countries, we find that one unit of first unpaid consumption on average displaces around 0.42 units of first paid consumption. Interestingly, for movies that a respondent reports to have seen at least twice, we find evidence of a small "sampling effect:" one unit of first unpaid consumption *increases* second paid consumption by about 0.04 units. A back-of-the-envelope calculation based on these estimates implies that unpaid movie consumption accounts for a reduction of movie sales by about 4.4% during our sample period. Secondly, we find that displacement rates are quite similar across the six countries we study. However, because unpaid consumption is much more prevalent in some countries than in others, lost movie sales nevertheless differ substantially: lost sales range between 2% for Germany and 11% for Spain. Thirdly, we document large differences across individuals. While 10% of individuals report not to have consumed any movies, 20% of the interviewees are responsible for 52% of total movies seen. These top movie consumers also have a substantially higher displacement rate: only 20% of individuals are responsible for about 96% of total lost movie sales. Particularly the last finding is informative for copyright policy. It shows that approaches that focus on a certain group of consumers will be potentially much more effective than, for example, general awareness campaigns.

The remainder of this paper is structured as follows. In the next section we briefly discuss the related literature. In Section 3 we present the questionnaire and show some descriptive statistics. In Section 4 we describe the estimation framework. Estimates of the displacement rates and of lost movie sales are presented in Section 5. Section 6 concludes and discusses implications for copyright policy.

2 Related Literature

This paper is related to a literature that analyzes the effect of unpaid consumption of music on record sales and that faces similar methodological challenges.² As for movies, individuals with a strong interest in music are more likely to have both high paid and unpaid consumption. In a simple regression framework, the displacement rate would therefore be underestimated.

²We refer the reader to Liebowitz (2006a,b) and Oberholzer-Gee and Strumpf (2010) for survey articles.

One way to address this identification problem is to use an instrumental variable approach. Rob and Waldfogel (2006) use access to broadband as a source of exogenous variation for unpaid music consumption. For a sample of 412 students at four U.S. colleges they find that one additional (unpaid) download decreases sales modestly by between 0.1 and 0.2 units, reducing purchases per capita by about 10% during 2003. In line with this “incomplete displacement” finding, their survey also shows that respondents downloaded music that they valued relatively less and would not otherwise have purchased, implying that illegal downloading led to some socially beneficial transactions. Similarly, based on a big sample of 15,000 Europeans from the year 2001, Zentner (2006) uses the speed of a respondent’s internet connection and his internet sophistication as instruments for “regularly downloading MP3 files.” He finds that downloading MP3 files reduces the probability of buying music during the month prior to the survey by 30 percent. A back-of-the-envelope calculation implies that without downloading music record sales in 2002 would have been 7.8 percent higher.

Another strand of literature exploits natural experiments for identification. Oberholzer-Gee and Strumpf (2007) analyze the impact of album downloads from file-sharing networks on album sales. They establish causality by instrumenting for the supply of music for download by using data on international school holidays. They find that file-sharing has an effect record sales that is indistinguishable from zero. In a more recent study, Hong (2013) analyzes the effect that the introduction of Napster – a peer-to-peer network – had on household expenditures on recorded music. He finds that file sharing is likely to explain 20% of the sales decline in recorded music during the Napster period.

The literature that analyzes the effect of unpaid movie consumption is smaller but results are equally mixed. Danaher and Smith (2014) analyze the effect the U.S. government shutdown of *Megaupload.com* – a major website used for watching illegal content – had on movie sales. For identification, they exploit cross-country variation in the pre-shutdown usage of *Megaupload.com* in a difference-in-difference approach. They find that digital revenues for three major motion picture studios increased by between 6.5% and 8.5%.

The article that is most related to ours is Rob and Waldfogel (2007). The authors propose a novel longitudinal approach based on an individual’s movie consumption by vintage to address the endogeneity problem discussed above. We follow the same approach in the present paper. Unlike most of the other literature, Rob and Waldfogel (2007) also take into account the possibility that a movie can be seen more than once, allowing for a displacement rate than in theory can be even higher than one-to-one. For a sample of 454 U.S. college students, they find a displacement rate of one: one unit of unpaid (first) consumption displaced one unit of paid consumption.

Bai and Waldfogel (2012) apply the same methodology to, firstly, a sample of 372 Chinese college students, and secondly, a sample of 3852 Chinese internet users. Interestingly, results differ substantially from Rob and Waldfogel (2007). Firstly, movie piracy is more widespread. In both samples, unpaid consumption amounts

to about three quarters of total movie consumption compared to 5% for the sample of U.S. college students in Rob and Waldfogel (2007). Secondly, the estimated displacement rate is between 0 and -0.14 and therefore much smaller than the one-to-one displacement effect found in Rob and Waldfogel (2007). In spite of large volumes of unpaid movie consumption, these results imply small damages from movie piracy in China. This big discrepancy between the results for the U.S. and China despite using a consistent methodology make clear that, firstly, there is still a lot of uncertainty when it comes to quantifying lost sales due to movie piracy, and secondly, that effects can vary substantially across countries.

The present paper adds to the literature in several ways. Firstly, while existing studies are based on “convenience samples,” we are the first to provide evidence that is representative of the internet-using population. Importantly, our relatively big sample also allows us to compare movie piracy behavior across different demographic groups. Secondly, our study covers multiple countries using an identical methodology. This allows for potentially interesting cultural and legal insights, especially given the drastically different results reported for the US and China by Rob and Waldfogel (2007) and Bai and Waldfogel (2012). Finally, our study is based on recent data and takes into account the rise of streaming services in the last years. Online streaming made the consumption of both legal and illegal content more convenient and therefore might have substantially affected the displacement rate.

3 Data

3.1 Online questionnaire

This paper builds on data from an online questionnaire that was conducted in September and October 2014.³ A total of 28,344 individuals from Germany, France, Spain, Poland, Sweden, and the UK were successfully interviewed concerning their movie consumption behavior.

Respondents were shown a list of 100 top box office movies. Out of these 100 movies, 30 were released in the year 2011, 35 in 2012, and another 35 in 2013.⁴ From this list, respondents were asked to select all movies they had seen. In a second step, they were asked to report *how* they saw a given movie the first and – for movies seen more than once – the second time they saw it:⁵ i) in the *cinema*, ii) by *legal download, streaming or video*, iii) on *DVD or Blu-Ray disk*, iv) via a *file-sharing or hosting site*, or v) on *TV (pay or free broadcast) or airplane*. In the following, we refer to “unpaid” consumption as movies seen using option iv) while “paid” consumption refers

³The data was collected by Ecorys as commissioned by the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs of the European Commission.

⁴The exact list of 100 movies shown to interviewees differed by country. In each country, the top box office movies released in 2011, 2012, and 2013 were shown.

⁵Since the questionnaire would have been too long otherwise, respondents who indicated to have seen more than 20 movies were only asked to indicate the mode of consumption for 20 randomly selected movies.

to movies seen using option i), ii), iii), or v).

In addition, respondents were asked about their sex, age, their education, and whether they worked. Moreover, respondents were asked to indicate whether their interest in films and series was *much lower*, *lower*, *same*, *higher*, *much higher* compared to other people.

We apply weights to the raw data to make the sample representative of the internet using population. Using data from Eurostat, we first calculate the internet using population⁶ for each of $6 \times 2 \times 10 = 120$ country-by-sex-by-age category cells. Weights are then obtained as the ratio of the share of the population versus the share of respondents in a given cell.

3.2 Descriptive statistics

Table 1 summarizes the respondents' characteristic data. Descriptive statistics on movie consumption are shown in Table 2. On average, individuals indicated to have seen 16.88 movies of the list of 100 top movies of which 1.969 – about 11.6% – were seen without paying for it. On average, only 4.42 movies – about 26% of movies seen – are reported to have been seen (at least) twice. That is, 74% are first viewings. This number is very close to the 78% of first viewings found by Rob and Waldfogel (2007). The ratio of unpaid to total consumption is very similar for second and first viewings. Columns (3) to (14) of Table 2 documents summary statistics by country. While there are modest differences in the average number of movies seen – it is in the range of 14.07 in Germany and 20.83 in Spain – unpaid movie consumption differs much more: average consumption ranges from 0.64 in Germany to almost seven times that number in Spain.

Table 3 reports statistics on the second consumption of a movie (rows) conditional on first consumption (columns). Firstly, the table confirms that only about 25% of movies are seen (at least) twice. Secondly, if a movie has been paid for at first consumption, second consumption is usually also paid; only about 7% of second viewings are unpaid ($\frac{1.9}{25.23}$). Thirdly, a surprising finding is that unpaid first consumption is often followed by *paid* second consumption. For movies that have been seen twice and where consumption was not paid for on the first view, about 50% of second viewings ($\frac{12.06}{23.41}$) were paid for. This can be seen as evidence for a “sampling effect.” According to Peitz and Waelbroeck (2006) sampling reveals product quality and helps consumers to make informed purchasing decisions. That is, consumers might use unpaid downloads to find out whether they actually like a movie and then buy this movie on DVD or see it in the cinema. Through this channel, unpaid consumption might actually stimulate movie sales.

Finally, Figure 1 documents that there are substantial differences in movie consumption across individuals. While almost 10% report not to have seen any of the listed movies, 20% of respondents are responsible for 52.4%

⁶We use the share of the population that has used the internet in the last 12 months based on the Eurostat table *isoc.ci.ifp.iu*.

of all viewings (241,647 of 460,825).

4 Estimation Strategy

The objective is to estimate the link between unpaid and paid movie consumption. The most simple approach is to ask whether respondents who report more unpaid viewings have fewer paid viewings. A simple regression framework is given by

$$paid_i^{1st} = \alpha + \beta unpaid_i^{1st} + \epsilon_i \quad (1)$$

where $paid_i^{1st}$ and $unpaid_i^{1st}$ are the number of (first) paid and unpaid viewings by individual i . The displacement rate is given by the coefficient estimate $\widehat{\beta}$. A problem with this specification is that individuals differ concerning their taste for watching movies. Since an individual who enjoys relatively more to watch movies is also likely to engage in more paid consumption, the error-term can be written as $\epsilon_i = \phi_i + e_i$ where ϕ_i is the individual i 's (unobserved) taste for watching movies. Since a higher ϕ_i is also likely to lead to more instances of unpaid movie consumption, $unpaid_i$ and the error term will be positively correlated, $corr(unpaid_i, \epsilon_i) > 0$, resulting in $\widehat{\beta}$ to be upward biased.

There are three different approaches to address this issue. Firstly, given that an instrumental variable is available that is strongly correlated with $unpaid_i^{1st}$ but not correlated with the error term ϵ_i , one can obtain an unbiased estimate of β by relying on two-stage least squares. As discussed in Section 2, some earlier papers use this approach with some success. Rob and Waldfogel (2006) and Zentner (2006), for example, use broadband access and internet sophistication as instruments for illegal (music) consumption.

Unfortunately, it is nowadays more difficult to find good instruments for illegitimate consumption of copyrighted material. In the last years streaming has become a popular way of legal consumption of movies (e.g., in the 1st quarter of 2016, Netflix was present in more than 190 countries). For recent data, an instrument based on broadband access would therefore violate the exclusion restriction since it would most likely affect paid movie consumption directly, and not only through unpaid movie consumption. Similarly, due to the rise of illegal streaming sites instead of peer-to-peer software (e.g., Napster), illegal downloading became more "user friendly." Internet sophistication is therefore probably not a valid instrument anymore.

A second approach is to add control variables to the regression that capture (at least some of) the variation in the interest for music across individuals. As discussed in Section 2.1, the online questionnaire this study is based on explicitly asks respondents about their interest interest in films. We can therefore extend regression

equation (1) as follows:

$$paid_i^{1st} = \alpha + \beta unpaid_i^{1st} + \gamma interest_films_i + \delta controls_i + \epsilon_i. \quad (2)$$

$interest_films_i$ represents a set of dummy-variables that capture an individual's relative taste for films and series on a scale from 1 ("much lower") to 5 ("much higher"). The vector $controls_i$ captures individual-specific demographic control variables: 5 education dummies, 10 age-category dummies, a female-dummy, 6 country dummies, and a dummy that captures whether a person is currently working or not.

A problem of this approach is that we can only account for *observable* differences in the taste for films that are actually reported in the questionnaire. If taste for seeing movies is varying in ways not captured by the set of dummy-variables $interest_films_i$, however, then the estimated coefficient $\widehat{\beta}$ will remain upward biased, that is, the rate of displacement will be underestimated.

We follow Rob and Waldfogel (2007) and address this problem by using a longitudinal approach. As explained in Section 2, for each movie we know not only whether and how an individual consumed it but also whether the movie was released in 2011, 2012, or 2013. Under the assumption that the paid or unpaid consumption of a movie mostly occurred directly after a movie was released, we can use this information to construct a data set of individual i 's paid and unpaid movie consumption by year. This quasi-panel then allows us to use panel data methods and to estimate individual fixed effects μ_i .

Let $paid_{iy}^{1st}$ and $unpaid_{iy}^{1st}$ be individual i 's paid and unpaid (first) movie viewings in year 2011, 2012, or 2013. Since we now have multiple observations for each individual, we can estimate the relation between paid and unpaid movie consumption from within-individual variation in movie consumption. The basic regression equation is given by

$$paid_{iy}^{1st} = \alpha + \beta unpaid_{iy}^{1st} + \mu_i + \theta_y + \epsilon_{iy} \quad (3)$$

where θ_y and μ_i account for vintage and individual fixed effects. Since individual fixed effects will account for all observed and unobserved individual differences as long as these are constant over time, the displacement rate given by the coefficient estimate $\widehat{\beta}$ should no longer be underestimated. The vintage fixed effects θ_y account for the possibility that paid consumption might be systematically higher for some vintages than for others. For example, it might be that individuals are more likely to remember to have seen more recent movies.

The same approach can be used to assess the effect of (first and second) unpaid movie consumption on second paid consumption

$$paid_{iy}^{2nd} = \phi + \kappa unpaid_{iy}^{1st} + \lambda unpaid_{iy}^{2nd} + \mu_i + \theta_y + \eta_{iy}. \quad (4)$$

That is, we estimate three different displacement rates: the effect of first unpaid consumption on first paid and second paid consumption (β and κ), and the effect of second unpaid consumption on second paid consumption (λ).

5 Results

5.1 Cross-sectional approach

Table 4 reports results using the cross-sectional approach. All regressions include controls for the respondent's interest in movies and other characteristics (age, education etc.) as well as country fixed effects. Column (1) shows that one unit of (first) unpaid consumption displaces about 0.28 units of (first) paid consumption. Columns (2) to (5) show disaggregated estimates by medium of consumption. The displacement rates we report here are substantially bigger in absolute value than what Rob and Waldfogel (2007) find using a similar cross-sectional approach (see Table 3 in their paper). It is also noteworthy that the estimated coefficients on the interest in films dummies are reasonable. According to column (1), in our sample an individual with *much higher* relative interest in films consumed about 16.5 more paid movies than individuals with *much lower* interest. We also find that we obtain much smaller coefficients (in absolute value) when not controlling for the respondent's interest in movies.⁷ This is in line with the hypothesis described in Section 3 that differences in taste for movies imply an underestimation of the rate of displacement.

Columns (6) to (10) report the results when the number of paid second viewings is regressed on unpaid first and second viewings. The effect of unpaid first viewings is negative for all types of consumption. To the contrary, similar to what Rob and Waldfogel (2007) document in their Table 3, unpaid second viewings are estimated to have a positive effect.

When interpreted in a causal way, one unit of unpaid consumption decreases paid consumption by a total of 0.34 units ($= -0.281 - 0.0566$). On the other hand, each second-time unpaid viewing increases paid viewings by 0.169 units. As discussed in detail in Section 4, however, it is very likely that these simple cross-sectional results are subject to a bias.

⁷These regression results are available upon request.

5.2 Longitudinal approach

Table 5 reports results using the more appropriate longitudinal approach.⁸ Column (1) shows that one unpaid (first) view of a movie displaces about 0.42 paid (first) viewings. In absolute value, this estimate is about 50% larger than the one in the comparable cross-sectional regression shown in column (1) of Table 4. This is in line with the hypothesis that there exist unobservable differences in taste that are neither captured by the individual controls nor by the set of dummy-variables $interest_music_i$ and lead to biased estimates. Column (2) to (5) disentangle the effect for different types of paid consumption. The biggest share of reduced paid viewings is due to fewer visits to the movie theater.

Columns (6) to (10) show the effect on second paid movie viewings based on regression equation (4). Firstly, we find that one unit of second unpaid consumption replaces about 0.22 units of second paid consumption. More interestingly, however, one unit of first unpaid consumption leads to a small *increase* of about 0.05 second paid viewings. As mentioned in Section 3.2, this is evidence in favor of a “sampling effect.”

The estimates in Table 5 imply that one unpaid movie viewing reduces paid viewings by 0.37 units ($= -0.419 + 0.0457$). Each second-time unpaid viewing decreases paid viewings by 0.22 units. These displacement rates lie in between the finding of no displacement for Chinese internet users (Bai and Waldfogel, 2012) and the one-to-one rate of displacement found for a sample of U.S. college students (Rob and Waldfogel, 2007).

5.2.1 Results by country

Table 6 reports results based on the longitudinal approach by country. Columns (1) to (6) show that regarding first viewings displacement rates are relatively homogeneous across countries: the estimates are between 0.39 (Sweden) and 0.53 (Spain). Column (7) reports an alternative specification where all observations are included in the regression but we allow for the effect of $unpaid_{iy}$ to vary by country. Using this specification, we can formally test whether displacement rates differ across countries. We find that – with Germany as the baseline – displacement rates are only significantly different for Spain (higher in absolute value). There is no statistically significant difference for and France, UK, Poland, and Sweden.

Columns (8) to (14) show that the displacement rate for second paid viewings is also quite homogeneous across countries. The aforementioned sampling effect is small for all countries and for Germany and Sweden not even significantly different from zero. The displacement effect of second unpaid viewings on second paid viewings is between -0.13 and -0.39.

⁸Note that due to the panel structure of the data we now have three observations for each individual: movie consumption in 2011, 2012, and 2013. The total number of observations used in the regressions are therefore three times higher than in the cross-sectional approach in Table 4.

5.2.2 Differences across individuals

As described in detail in Section 3, there is a lot of individual heterogeneity in the data with regard to overall movie consumption. As documented Figure 1, 20% of individuals in the sample alone are responsible for 52% of total movies seen. Here we show evidence that respondents who consume a lot of movies therefore seem to have stronger tendency to substitute paid with unpaid consumption.

Table 7 reports estimates when individuals are grouped by quintiles according to their overall movie consumption. Column (1) and (2) document that for the bottom 80% of respondents, the displacement for first paid viewings is about -0.15 while it is -0.57 for respondents in the top 20%.

Columns (3) and (4) shows that a similar pattern exists for second paid consumption. Firstly, there is evidence of a sampling effect for individuals in the first four quintiles. One unit more unpaid first consumption leads to an increase of paid second consumption by 0.11 units. There is no evidence of such an effect for consumers in the top quintile. Moreover, for respondents in the 5th quintile second unpaid viewings displace more than twice as many second paid viewings than for respondents in the 1st to 4th quintile.

5.3 Lost sales

The estimates of the displacement rates can now be used for a back-of-the-envelope calculation of the sales lost due to unpaid consumption of movies. Table 8 shows estimated lost movie sales for the whole sample, by country, and by total movie consumption. Columns (1) to (4) shows the number of paid and unpaid first and second movie viewings. Columns (5) to (7) report the estimated displacement rates for first unpaid viewings on first and second paid viewings (β and λ in regression equations (3) and (4)) and for second unpaid viewings on second paid viewings (κ in regression equation (4)) based on regression equations (3) and (4). Column (8) reports the counterfactual additional units of paid consumption in the absence of unpaid consumption calculated as $\beta \times unpaid_{iy}^{1st} + \kappa \times unpaid_{iy}^{1st} + \lambda \times unpaid_{iy}^{2nd}$. The counterfactual total paid consumption in column (9) is then defined as the sum of columns (1) and (8). The lost sales in column (10) is the ratio of column (8) and (9).

In the whole sample, 55810.9 unpaid first viewings displaced -20834.2 paid viewings ($-0.419 \times 55810.9 + 0.0457 \times 55810.9$).⁹ 15496.8 second unpaid viewings displaced -3435.7 paid viewings (-0.2217×15496.8). In total, 25269.9 paid viewings were displaced, a 4.38% loss of sales.

Table 8 also documents that lost sales due to unpaid consumption vary substantially across countries. While in Germany lost sales due to unpaid consumption amount to 1.65%, in Spain this figure is 10.41%. As discussed in Section 5.2.1, displacement rates are relatively homogeneous across countries. The big differences in lost

⁹The number of viewings can be non-integers since weights are applied as described in Section 3.1.

sales are primarily driven by the substantial differences in paid vs. unpaid consumption in different member states documented in Table 2.

The table also shows that lost sales differ very substantially across individuals. Table 7 shows that, when ranked according to their total movie consumption, the top 20% of respondents have a very high displacement rate: one unpaid first viewing displaces 0.56 units of paid consumption while this figure is 0.037 for the bottom 80% of respondents. In addition, Table 8 documents that the same 20% of respondents also account for the majority of unpaid movie viewings. Since lost sales are calculated as the product of the displacement rate and unpaid viewings, we find that this group of respondents is responsible for 22124.29 out of 23524.02 displaced movie sales in our sample, a share of 94%.

Table 9 documents lost sales when individuals are grouped according to various other criteria such as gender, age, education, or interest in movies. We find that men and women have quite similar displacement rates. However, men are more likely to not pay for a movie, which then also implies a higher displacement of movie sales. Regarding age we find an inverse U-shaped pattern. Unpaid movie viewings, the estimated displacement rate, and lost sales are low for minors, increase until reaching a maximum for the group of 18 to 24 year old, and then decrease again.

6 Concluding remarks

In this paper we reported estimates of lost movie sales due to movie piracy in Europe. Using an estimation approach first proposed by Rob and Waldfogel (2007), we found that for a sample representative of the internet using population in six major European countries one unit of (first) unpaid consumption displaces around 0.42 units of (first) paid consumption. Interestingly, we found evidence of a sampling effect: for movies that are seen more than twice, first unpaid consumption slightly *increases* paid second consumption. Since the sampling effect is very small, the overall effect of unpaid movie consumption on movie sales is clearly negative: during the time horizon we study, we find that unpaid consumption reduced movie sales by about 4.4%.

To the best of our knowledge, this is the first paper that provides a cross-country comparison of movie piracy using an identical methodology. Firstly, our estimated displacement rates are quite similar across countries. Nevertheless, since the share of unpaid movie consumption differ substantially across countries, we also documented big differences in lost sales across countries. While in Germany only about 1.65% of movie sales during the sample period were lost due to unpaid consumption this figure is 10.41% for Spain.

Another novel and important is that 94% of lost movie sales are due to the unpaid consumption of only 20% of consumers with the highest movie consumption. This small group of consumers, firstly, watches a lot more movies than the normal population, and secondly, is much more willing to substitute paid with unpaid movies.

Our findings have important implications for copyright policy. We find support for “incomplete displacement,” that is, a displacement rate smaller than one-to-one. This suggests that at least some of the movies that are consumed without pay would not have otherwise been purchased. This is in line with the view that unpaid movie consumption may sometimes lead to socially beneficial transactions. Nevertheless, our results show that lost sales due to movie piracy are substantial. The estimates that we provide can help policy makers to assess the efficient use of public resources to be spent on copyright enforcement of movies. In particular, since we find that virtually all the lost sales of movies are due to a very small group of individuals, most damages of movie piracy could therefore potentially be prevented with well targeted policies. Finally, the big differences in unpaid movie consumption across EU Member States that we documented in this paper suggest that institutional differences, especially regarding copyright law and its enforcement, might substantially affect lost sales. To explore this further is an interesting avenue for future research.

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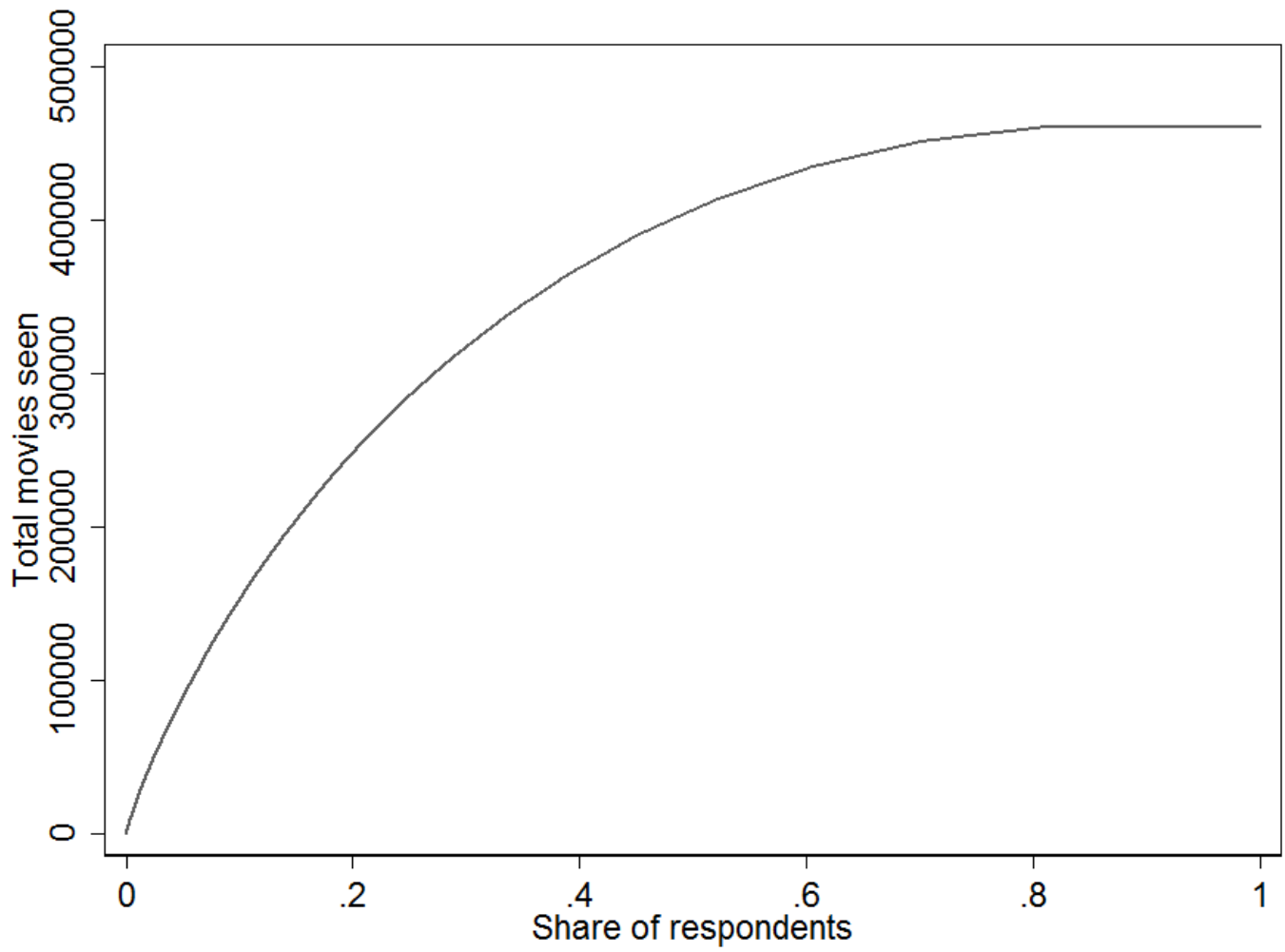


Figure 1: The figure shows the share of respondents versus the total number of movies seen (not counting second viewings).

Table 1: Respondents' characteristics

	(1)	(2)	(3)	(4)	(5)
	N	mean	sd	min	max
<i>Gender</i>					
Male	28,344	0.501	0.500	0	1
Female	28,344	0.499	0.500	0	1
<i>Age category</i>					
14 years old	28,344	0.0174	0.131	0	1
15 years old	28,344	0.0177	0.132	0	1
16 years old	28,344	0.0179	0.132	0	1
17 years old	28,344	0.0178	0.132	0	1
18-24 years old	28,344	0.146	0.353	0	1
25-34 years old	28,344	0.221	0.415	0	1
35-44 years old	28,344	0.213	0.409	0	1
45-54 years old	28,344	0.191	0.393	0	1
55-64 years old	28,344	0.108	0.310	0	1
65-74 years old	28,344	0.0503	0.219	0	1
<i>Interest in movies*</i>					
Much lower	28,344	0.0631	0.243	0	1
Lower	28,344	0.159	0.365	0	1
Same	28,344	0.398	0.490	0	1
Higher	28,344	0.272	0.445	0	1
Much higher	28,344	0.108	0.311	0	1
<i>Education</i>					
Primary school or none	28,344	0.0154	0.123	0	1
Lower secondary education / intermediate qualification	28,344	0.160	0.366	0	1
Upper secondary education / full maturity certificate	28,344	0.311	0.463	0	1
Further education (diploma, certificate etc)	28,344	0.175	0.380	0	1
Higher education (university bachelor, master, PhD)	28,344	0.339	0.474	0	1
<i>Working</i>					
Yes	28,344	0.578	0.494	0	1
No	28,344	0.422	0.494	0	1

Notes: The table summarizes the respondents' characteristics. * The question is phrased as "Compared to other people, how would you describe your interest in films and series?" Weights are applied as described in Section 3.1.

Table 2: Summary of movie viewings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Whole Sample		Germany		UK		Spain		France		Poland		Sweden	
	First	Second	First	Second	First	Second	First	Second	First	Second	First	Second	First	Second
Seen (2013)	5.878	1.534	5.083	1.283	6.369	1.701	7.126	1.833	5.603	1.523	6.041	1.608	5.730	1.265
Seen (2012)	5.534	1.426	4.475	1.064	6.693	1.788	7.174	1.885	3.930	1.020	7.221	1.981	5.222	1.152
Seen (2011)	5.472	1.461	4.507	1.109	6.161	1.779	6.525	1.680	5.355	1.483	5.605	1.467	5.218	1.258
Seen (total)	16.88	4.421	14.07	3.457	19.22	5.268	20.83	5.398	14.89	4.026	18.87	5.056	16.17	3.674
Paid	14.81	3.874	13.35	3.291	17.93	4.805	16.48	4.327	12.35	3.314	15.26	4.285	12.81	2.945
Cinema	5.955	0.320	4.741	0.173	6.771	0.365	8.052	0.472	6.456	0.297	4.772	0.532	3.349	0.235
Streaming	2.271	0.743	1.581	0.442	2.493	0.788	3.135	1.095	1.672	0.726	3.334	1.027	3.732	0.944
DVD	3.481	1.692	3.698	1.646	5.202	2.430	2.473	1.371	2.180	1.448	2.643	1.126	3.585	1.233
TV	3.100	1.119	3.329	1.030	3.469	1.222	2.817	1.390	2.045	0.842	4.508	1.600	2.145	0.532
Unpaid	1.969	0.547	0.648	0.166	1.239	0.463	4.239	1.072	2.349	0.712	3.433	0.772	3.169	0.730
Unpaid/Seen	11.66%	12.37%	4.61%	4.80%	6.45%	8.79%	20.35%	19.86%	15.78%	17.69%	18.19%	15.27%	19.60%	19.87%
Respondents	28,344		4,881		4,448		4,758		4,798		4,770		4,689	

Notes: The table summarizes first and second instances of movie consumption for the whole sample and by country. Weights are applied as described in Section 3.1.

Table 3: Mode of second viewings conditional on first viewings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Second viewings						
	Seen	Unpaid	Paid	Cinema	Streaming	DVD	TV
Seen	25.03%	2.92%	22.11%	1.87%	4.06%	9.65%	6.54%
Paid	25.23%	1.90%	23.33%	1.94%	4.19%	10.41%	6.80%
Cinema	28.68%	2.57%	26.11%	3.18%	4.21%	12.41%	6.31%
Streaming	23.58%	1.87%	21.71%	1.48%	12.55%	4.17%	3.52%
DVD	27.34%	1.86%	25.48%	0.87%	2.04%	18.91%	3.65%
TV	17.85%	0.76%	17.08%	1.12%	1.06%	1.84%	13.06%
Unpaid	23.41%	11.35%	12.06%	1.28%	2.98%	3.36%	4.44%

Notes: The table reports the mode of second viewing of a movie (columns) conditional on first viewing (rows). Weights are applied as described in Section 3.1.

Table 4: Cross-sectional regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	First viewings					Second viewings				
	Total paid	Cinema	Streaming	DVD	TV	Total paid	Cinema	Streaming	DVD	TV
Unpaid first viewings	-0.281*** (0.0131)	-0.0847*** (0.00851)	-0.0855*** (0.00588)	-0.0704*** (0.00670)	-0.0402*** (0.00629)	-0.0566*** (0.00842)	-0.0105*** (0.00261)	-0.0140*** (0.00368)	-0.0488*** (0.00532)	0.0168*** (0.00405)
Unpaid second viewings						0.169*** (0.0165)	0.0127** (0.00512)	0.0495*** (0.00721)	0.0914*** (0.0104)	0.0152* (0.00794)
<i>Relative interest in movies</i>										
lower	1.629*** (0.403)	0.391 (0.261)	0.115 (0.180)	0.320 (0.206)	0.803*** (0.193)	0.341 (0.238)	-0.0637 (0.0739)	-0.0586 (0.104)	0.236 (0.150)	0.227** (0.115)
same	5.481*** (0.368)	1.951*** (0.238)	0.688*** (0.165)	1.334*** (0.188)	1.507*** (0.176)	1.199*** (0.218)	-0.118* (0.0675)	0.155 (0.0951)	0.634*** (0.137)	0.528*** (0.105)
higher	11.07*** (0.384)	4.226*** (0.249)	1.872*** (0.172)	2.752*** (0.196)	2.223*** (0.184)	2.685*** (0.227)	-0.0367 (0.0704)	0.400*** (0.0991)	1.423*** (0.143)	0.899*** (0.109)
much higher	16.51*** (0.438)	7.061*** (0.284)	3.062*** (0.196)	4.362*** (0.224)	2.028*** (0.210)	5.527*** (0.259)	0.310*** (0.0803)	1.013*** (0.113)	3.082*** (0.163)	1.122*** (0.125)
Country fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Individual controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344
R-squared	0.171	0.106	0.061	0.070	0.025	0.070	0.011	0.028	0.048	0.016

Notes: The table reports estimates of the effect of unpaid movie consumption on different modes of paid movie consumption using the cross-sectional approach. Columns (1) to (5) show the effect of unpaid first viewings on paid first viewings. Columns (6) to (10) show the effect of unpaid first and second viewings on paid second viewings. All specifications include country fixed effects and individual controls (gender, age, education, whether the respondent works). The method of estimation is weighted least squares. Standard errors are shown in parantheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 5: Longitudinal regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	First viewings					Second viewings				
	Total paid	Cinema	Streaming	DVD	TV	Total paid	Cinema	Streaming	DVD	TV
Unpaid first viewings	-0.419*** (0.00942)	-0.218*** (0.00723)	-0.0550*** (0.00480)	-0.0775*** (0.00579)	-0.0690*** (0.00535)	0.0457*** (0.00603)	0.00632*** (0.00171)	0.0113*** (0.00290)	0.00429 (0.00424)	0.0238*** (0.00362)
Unpaid second viewings						-0.222*** (0.0104)	-0.0229*** (0.00294)	-0.0645*** (0.00498)	-0.0792*** (0.00729)	-0.0551*** (0.00622)
Individual fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Vintage fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	85,032	85,032	85,032	85,032	85,032	85,032	85,032	85,032	85,032	85,032
Number of individuals	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344	28,344
R-squared	0.042	0.025	0.005	0.003	0.004	0.010	0.002	0.004	0.004	0.002

Notes: The table reports estimates of the effect of unpaid movie consumption on different modes of paid movie consumption using the longitudinal approach. Columns (1) to (6) show the effect of unpaid first viewings on paid first viewings. Columns (7) to (10) show the effect of unpaid first and second viewings on paid second viewings. All specifications include individual- and vintage fixed effects. The method of estimation is weighted least squares. Standard errors are shown in parantheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 6: Longitudinal regressions by country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	First paid viewings							Second paid viewings						
	Germany	UK	Spain	France	Poland	Sweden	All	Germany	UK	Spain	France	Poland	Sweden	All
<i>1st unpaid</i>	-0.427*** (0.0369)	-0.459*** (0.0307)	-0.532*** (0.0149)	-0.399*** (0.0195)	-0.446*** (0.0176)	-0.386*** (0.0168)	-0.427*** (0.0303)	0.0317 (0.0239)	0.0571*** (0.0203)	0.0258** (0.0101)	0.0331*** (0.0126)	0.0552*** (0.0116)	0.00916 (0.0104)	0.0317 (0.0199)
UK							-0.0318 (0.0375)							0.0254 (0.0246)
Spain							-0.105*** (0.0353)							-0.00586 (0.0231)
France							0.0283 (0.0355)							0.00137 (0.0233)
Poland							-0.0195 (0.0377)							0.0235 (0.0247)
Sweden							0.0406 (0.0469)							-0.0225 (0.0310)
<i>2nd unpaid</i>								-0.142*** (0.0410)	-0.389*** (0.0318)	-0.254*** (0.0172)	-0.132*** (0.0210)	-0.228*** (0.0224)	-0.152*** (0.0203)	-0.142*** (0.0341)
UK														-0.247*** (0.0410)
Spain														-0.112*** (0.0396)
France														0.0100 (0.0396)
Poland														-0.0857* (0.0444)
Sweden														-0.00977 (0.0575)
Observations	14,643	13,344	14,274	14,394	14,310	14,067	85,032	14,643	13,344	14,274	14,394	14,310	14,067	85,032
Individuals	4,881	4,448	4,758	4,798	4,770	4,689	28,344	4,881	4,448	4,758	4,798	4,770	4,689	28,344
R-squared	0.048	0.036	0.143	0.189	0.166	0.064	0.099	0.011	0.018	0.028	0.043	0.042	0.008	0.025

Notes: The table reports estimates of the effect of unpaid movie consumption on paid movie consumption by country using the longitudinal approach. Columns (1) to (7) show the effect of unpaid first viewings on paid first viewings. Columns (8) to (14) show the effect of unpaid first and second viewings on paid second viewings. All specifications include individual- and vintage fixed effects. The method of estimation is weighted least squares. Standard errors are shown in parantheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 7: Longitudinal regressions by movie consumption

	(1)	(2)	(3)	(4)
	First paid viewings		Second paid viewings	
	1st to 4th quintile	5th quintile	1st to 4th quintile	5th quintile
1st unpaid	-0.153*** (0.0143)	-0.566*** (0.0166)	0.115*** (0.00726)	0.00769 (0.0133)
2nd unpaid			-0.110*** (0.0135)	-0.264*** (0.0221)
Individual fixed effects	YES	YES	YES	YES
Vintage fixed effects	YES	YES	YES	YES
Observations	68,832	16,200	68,832	16,200
Individuals	22,944	5,400	22,944	5,400
R-squared	0.005	0.151	0.009	0.018

Notes: The table reports estimates of the effect of unpaid movie consumption on paid movie consumption for individuals in the 1st to 4th and 5th quintile of total movie consumption. Columns (1) and (2) show the effect of unpaid first viewings on paid first viewings. Columns (3) and (4) show the effect of unpaid first and second viewings on paid second viewings. All specifications include individual- and vintage fixed effects. The method of estimation is weighted least squares. Standard errors are shown in parantheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Table 8: Displaced sales for the whole sample, by country, and by respondents' total consumption of movies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1st viewings		2nd viewings		Displacement rate			Counterfactual		Lost sales
	Paid	Unpaid	Paid	Unpaid	1st on 1st (β)	1st on 2nd (κ)	2nd on 2nd (λ)	Additional	Total	
Whole sample	419680.26	55810.87	109815.70	15496.82	-41.90%	4.57%	-22.17%	24269.86	553765.81	4.38%
<i>Country</i>										
Germany	109282.00	5306.93	26943.17	1355.17	-42.69%	3.17%	-14.21%	2290.04	138515.22	1.65%
United Kingdom	122101.16	8433.90	32714.63	3151.71	-45.87%	5.71%	-38.95%	4614.94	159430.73	2.89%
Spain	59481.87	15302.29	15619.33	3868.55	-53.20%	2.58%	-25.37%	8727.14	83828.34	10.41%
France	72670.30	13819.35	19493.27	4191.11	-39.86%	3.31%	-13.21%	5605.77	97769.33	5.73%
Poland	41999.57	9449.68	11793.96	2124.36	-44.64%	5.52%	-22.78%	4180.22	57973.75	7.21%
Sweden	14145.36	3498.72	3251.34	805.92	-38.63%	0.92%	-15.19%	1441.98	18838.68	7.65%
<i>Total movie consumption</i>										
1st to 4th quintile	202367.51	20849.00	46806.93	5602.61	-15.26%	11.51%	-11.02%	1399.73	250574.17	0.56%
5th quintile	217312.75	34961.87	63008.78	9894.20	-56.57%	0.77%	-26.42%	22124.29	302445.81	7.32%

Notes: The tables documents estimated displaced movie sales due to unpaid consumption. Columns (1) to (4) shows the number of paid and unpaid 1st and 2nd viewings. Columns (5) to (7) report the estimated displacement rate of 1st unpaid on 1st paid, 1st unpaid on 2nd paid, and 2nd unpaid on 2nd paid viewings based on regression equations (3) and (4). Column (8) reports the counterfactual additional paid viewings in the absence of paid viewings. Column (9) reports the counterfactual total paid viewings, i.e., the sum of column (8) and column (1). Column (10) reports the lost sales defined as the ratio of column (8) and (9). Weights are applied as described in Section 3.1.

Table 9: Displaced sales by respondents' characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1st viewings		2nd viewings		Displacement rate			Counterfactual		Lost sales
	Paid	Unpaid	Paid	Unpaid	1st on 1st	1st on 2nd	2nd on 2nd	Additional	Total	
<i>Gender</i>										
Male	217253.66	35208.65	60181.20	10095.39	-40.05%	6.74%	-23.06%	14054.94	291489.81	4.82%
Female	202426.59	20602.22	49634.51	5401.43	-45.89%	0.93%	-21.73%	10435.98	262497.09	3.98%
<i>Age category</i>										
14 years old	8106.28	479.02	2391.25	187.93	-32.20%	6.43%	-17.51%	156.34	10653.87	1.47%
15 years old	9006.77	682.59	2606.23	199.04	-41.70%	9.04%	2.51%	217.94	11830.95	1.84%
16 years old	9881.85	1403.52	3042.95	491.45	-45.75%	2.93%	-13.16%	665.67	13590.47	4.90%
17 years old	9831.99	1652.20	3078.85	601.48	-50.18%	0.89%	-25.00%	964.72	13875.56	6.95%
18-24 years old	75350.46	15950.80	24408.75	4660.30	-47.87%	3.59%	-25.58%	8255.61	108014.82	7.64%
25-34 years old	111226.49	18037.20	30415.46	4676.83	-39.68%	6.65%	-26.23%	7185.16	148827.11	4.83%
35-44 years old	94299.80	10905.90	22604.82	3120.60	-39.13%	4.47%	-14.04%	4217.92	121122.55	3.48%
45-54 years old	67939.16	5334.47	15567.24	1307.22	-39.06%	-0.14%	-21.29%	2369.11	85875.51	2.76%
55-64 years old	25686.23	1104.79	4523.06	195.78	-27.12%	5.40%	-14.27%	267.91	30477.20	0.88%
65-74 years old	8351.23	260.38	1177.09	56.18	-32.24%	-4.45%	13.58%	87.88	9616.20	0.91%
<i>Education</i>										
Primary school or none	4134.09	483.24	1023.07	155.84	-44.56%	14.26%	-32.56%	197.17	5354.33	3.68%
Lower secondary education	58580.39	5233.08	16332.24	1730.14	-43.85%	2.55%	-5.57%	2257.95	77170.58	2.93%
Upper secondary education	129479.49	19191.64	36314.24	4916.51	-41.20%	3.16%	-19.11%	8240.27	174034.00	4.73%
Further education	78508.40	8627.35	20988.17	2510.35	-41.31%	11.00%	-36.80%	3539.02	103035.59	3.43%
Higher education	148977.88	22275.56	35157.98	6183.98	-42.38%	3.58%	-21.52%	9973.38	194109.23	5.14%
<i>Working</i>										
Yes	256053.59	32445.86	65936.28	9557.48	-41.42%	6.30%	-25.20%	13805.26	335795.13	4.11%
No	163626.67	23365.01	43879.43	5939.34	-42.68%	2.05%	-17.04%	10504.15	218010.25	4.82%
<i>Interest in movies</i>										
Much lower	11686.99	1200.08	2811.64	346.05	-41.55%	21.09%	-35.77%	369.34	14867.96	2.48%
Lower	39190.48	3915.41	9465.89	1290.96	-33.51%	10.24%	-3.83%	960.51	49616.88	1.94%
Same	145708.11	16538.30	34978.22	4266.82	-31.21%	4.81%	-25.01%	5432.76	186119.09	2.92%
Higher	147416.97	20672.28	37889.13	5310.22	-44.72%	2.37%	-23.55%	10006.10	195312.19	5.12%
Much higher	75677.71	13484.80	24670.82	4282.77	-53.26%	3.92%	-22.02%	7595.41	107943.95	7.04%

Notes: The tables documents estimated displaced movie sales due to unpaid consumption. Columns (1) to (4) shows the number of paid and unpaid 1st and 2nd viewings. Columns (5) to (7) report the estimated displacement rate of 1st unpaid on 1st paid, 1st unpaid on 2nd paid, and 2nd unpaid on 2nd paid viewings based on regression equations (3) and (4). Column (8) reports the counterfactual additional paid viewings in the absence of paid viewings. Column (9) reports the counterfactual total paid viewings, i.e., the sum of column (8) and column (1). Column (10) reports the lost sales defined as the ratio of column (8) and (9). Weights are applied as described in Section 3.1.