

How Reliable is the Oberholzer-Gee and Strumpf paper on File-Sharing?

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Abstract: This is a detailed critique of the empirical findings, factual claims, and logic of the empirical examination of file-sharing by Felix Oberholzer-Gee and Koleman Strumpf. It is written for a general audience and provides details of calculations, data, and industry measurements that allow replication by the reader whenever possible.

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I. Introduction and Background

An academic paper on the impact of file-sharing by Felix Oberholzer-Gee and Koleman Strumpf (O/S) attracted an enormous amount of attention when it first appeared in March of 2004. The paper concluded that file-sharing has a minimal, if any, impact on the sales of recorded music. It was recently (February 2007) published as the lead article in the prestigious Journal of Political Economy (JPE).

O/S are aware that their conclusion—that file-sharing causes no reduction in record sales—contradicts conventional wisdom. Their conclusion is also inconsistent with most other academic studies of the subject although O/S argue otherwise in their paper.¹ Nevertheless, their results leave an extremely large elephant in the room—if not for file-sharing, why have record sales declined so precipitously?

I have [previously discussed](#) (Appendix H) some of what I believe to be the more general methodological problems with the O/S approach. Since O/S have not made their data available to other researchers it is not possible to examine the empirical details of their main regression results.²

Fortunately, O/S provide additional material in support of their conclusion. This additional material relies on publicly available data and, unlike their main results, is capable of being examined and replicated by other researchers. Such replication is the goal of this report.

O/S provide two kinds of additional material.

First, they conduct additional tests (“quasi experiments”) which they claim support their overall finding. In the following pages I attempt replications of their quasi experiments and conclude that contrary to their claims, none of their quasi experiment supports a conclusion that file-sharing has a benign impact on record sales.

Second, O/S provide factual details about the industry that appear to be consistent with their overall conclusion. Surprisingly, these ‘facts’ were almost never supported by reference to actual data. My attempts to verify many of these factual claims indicate that these O/S statements appear to be at variance with actual data.

A reader of the O/S paper will search in vain for documentation of many of their factual assertions or of details of how they constructed their quasi-experiments. The lack of

¹ For a general discussion of the impacts of file-sharing on the sound recording industry, including a discussion of the relevant economics literature, see Stan J. Liebowitz “File-Sharing: Creative Destruction or just Plain Destruction?” Journal of Law and Economics 49 April, 2006, p1-28.

² The economics profession has made some attempt in the last few years to require researchers to make their data available to others, in part because replication would seem to be a useful check on research and in part because of studies showing that economists had a habit of having their data immediately eaten by their dogs upon publication of their articles [see William G. Dewald, Jerry G. Thursby, and Richard G. Anderson “Replication in Empirical Economics: The Journal of Money, Credit and Banking Project,” American Economic Review, vol. 76(4), 587-603, September 1986]. Although requiring authors to make data available became the policy of the Journal of Political Economy in June of 2005, the O/S paper was submitted prior to that date. O/S have refused my multiple requests for their data.

documentation, both for the facts reported and for the construction of the quasi experiments, is one reason that the material below is so lengthy.³

The analysis below should be of interest to anyone interested in the impact of file-sharing. I have tried to make this material accessible to non-economists.

II. A Brief Roadmap

O/S conduct four ‘quasi experiments’ based on data that are either freely available or easily purchased. Our focus is not on whether the quasi experiments make sense, but how they were conducted and interpreted. The four experiments are listed below.

1. Compare record sales in the summer relative to the rest of the year and see if the relationship changes when file-sharing becomes popular. O/S claim that there is less file-sharing in the summer and thus summer sales should be less impacted by file-sharing than non-summer sales. O/S find that after file-sharing becomes popular summer records sales do not rise relative to non-summer sales and conclude that this supports their claim that file-sharing does not affect record sales.
2. Examine the share of record sales in the Eastern Time Zone relative to the rest of the country. O/S claim that Europeans file-sharers turn off their computers when they go to bed. Since American file-sharers on the East Coast have more waking hours in common with Europe they would then have more exposure to European files than would Americans on the West Coast. Thus the impact of file-sharing should be stronger on the East Coast and sales on the East Coast should fall relative to sales in the rest of the country.
3. Compare the relationship between monthly levels of file-sharing and monthly record sales. O/S conclude that although the relationship is negative, it is of no economic consequence.
4. Examine the change in record sales for different genres of music and compare these sales changes with the file-sharing intensity for each genre of music. O/S report that there is no relationship.

O/S also make several factual claims that would appear to support the conclusion that file-sharing does not harm record sales.

5. Sound recording sales have been flat or rising in major markets experiencing increases in file-sharing populations (consistent with their results).
6. A large portion of the US decline in sales was due to increases in the share of CDs distributed by more efficient retailers with smaller inventories (and thus not due to filesharing).

³ Obviously, if communications with O/S were available some resolution of these issues might be possible. O/S failed to reply to a request for more information that I made in March of 2005 and later O/S failed to respond to questions I posed in March of 2007.

7. The drop in US sales in 2005 was due entirely to one company suffering from poor management (meaning there is no general sales decline to explain).
8. Sales fell because they had been at unsustainably high levels due to consumers replacing their old LPs and cassettes with CDs but this replacement came to an end at about the time that file-sharing began.
9. Listening to sound recordings has been replaced by other forms of entertainment whose growth just happens to coincide with the growth of file-sharing making it appear as if file-sharing was linked to the decline in record sales.

We start by examining claim 5, above which goes to the heart of the question of whether there is a decline in record sales that even needs to be explained. Next we go on to points 1, 2, 6 and 3. Finally we work our way through the remaining claims (4, 7-9). I have chosen this order of presentation based on what I perceive to be the egregiousness of the claim relative to the effort required for the reader to work through the issue.

In this report I attempt to rigorously document all sources and explain in detail how the quasi-experiments are conducted. I also believe it is important to make it possible for any interested reader to check the facts for themselves so I try to provide access to data whenever possible.

III. Music Sales have been flat or rising in large markets with increasing file-sharing populations.

O/S state on page 37 (all page references to O/S are from the free [online version](#) of their paper):

“Second, music sales have been flat or even rising in major markets with a quickly growing file-sharing population. For example, in 2005 retail music sales rose in four of the five largest national markets.”

The claim is simple: contrary to conventional wisdom, the sound recording industry faces no sales crisis.⁴

Publicly available statistics from IFPI, the international organization that keeps track of record sales, however, present a starkly different picture. Table T0 shows the changes in sound recording sales from 1999-2005 in each of the top 10 markets (see Appendix A for details of the data). The average decline in (inflation adjusted) revenues for this group is a non-trivial 37% from 1999-2005 and the decline in units exceeds 26%.

Comparing these statistics with the O/S claim of increasing sales is not straightforward because they do not tell us to which “major markets” they refer. Of the 42 countries for which IFPI publish data, only Russia, South Africa, Greece, Turkey, and Argentina did

⁴ File-sharing could still have a negative impact on record sales by reducing what otherwise might have been an increase in sales, but we can let this point slip and just stick to the claim.

not have clear decreases in revenues from 2001-2005.⁵ These countries cannot, however, be considered major markets.

T0: 1999-2005 Market Changes		
	album units change	real retail revenue change
USA	-29.81%	-33.81%
Japan	-15.80%	-14.94%
UK	-7.89%	-12.38%
Germany	-42.54%	-44.45%
France	-8.78%	-26.67%
Canada	-28.10%	-49.73%
Australia	-17.52%	-36.31%
Italy	-37.64%	-46.07%
Spain	-50.24%	-57.83%
Netherlands	-25.88%	-48.08%

It is possible that O/S relied on a different data source, though I am not aware of one that tracks international sales. It is unlikely that a different data source would be superior to IFPI since IFPI data come from industry participants and are supposed to measure the entire industry. Some sources, like Nielsen SoundScan data in the US, only measure a portion of the market. Perhaps O/S merely mean that sales increased in some years in some countries, although this would seem to be a largely irrelevant claim that might easily mislead a reader.

What about their second sentence claiming that sales were up in 2005 in 4 of the top 5 markets? Again, the data do not support this claim. The top 5 markets are the US, Japan, UK, Germany and France. According to the IFPI, sales in Japan were up but sales in the other 4 countries were down in 2005 (See Table T2 on page 23).⁶

These statistics are publicly available. [Appendix A](#) (page 23) provides instructions and raw data, including a detailed attempt to figure out how O/S might have drawn their erroneous conclusions using IFPI data.

IV. Record Sales in the Summer

This is the first ‘quasi natural experiment’ we re-examine. O/S compare record sales in the summer relative to the rest of the year:

The first experiment involves variation over time. The number of file sharing users in the U.S. drops twelve percent over the summer (estimated from BigChampagne, 2006) because college students are away from their high-speed campus Internet connections. If downloads crowd out sales, we should observe that the share of albums sold in the summer increases following the advent of file-sharing. (p32)

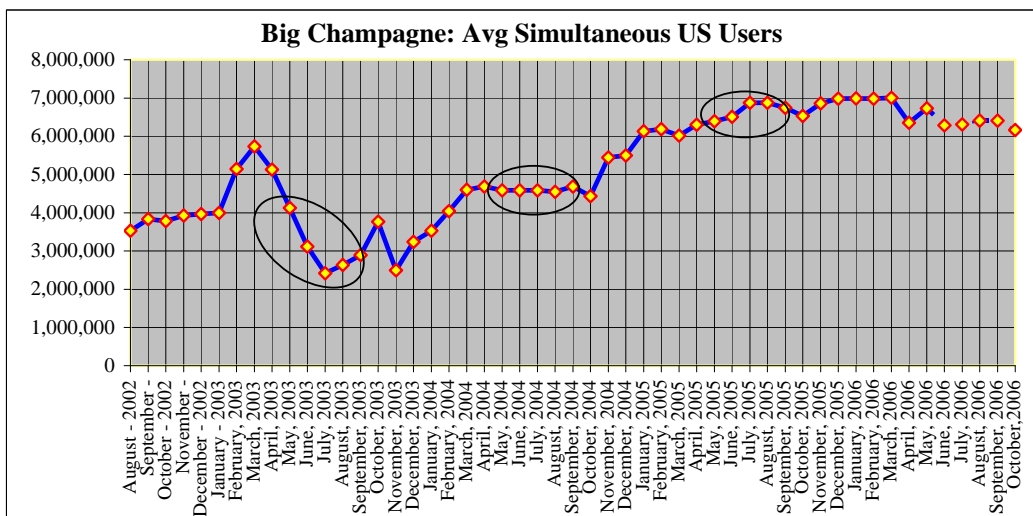
⁵ There is a simple chart in the 2006 IFPI book (which contains data for 2005) that gives overall results for all the countries in the sample from 2001-2005. I merely examined revenues based on local currencies with no inflation adjustment.

⁶ Moreover, it would be difficult to draw any conclusions from changes in only one year when file-sharing has been a force in the market since 2000.

O/S report that summer sales before file-sharing are about the same share of yearly sales as summer sales' share after file-sharing and conclude "that the introduction of widespread file sharing has had virtually no impact on summer sales" and therefore file-sharing has had no impact on sales.

O/S do not provide the details of the measurements behind their claim that file-sharing declines by 12% in the summer. One way to generate their result is to take a simple average of users for May through September (which is their set of summer months), in each of the three years of their data.⁷ If the average for these months is compared to the average for the other months of the year during this period, the average number of users is found to be 11.7% lower for the summer months, consistent with the statistic put forward by O/S.

Is this a reasonable conclusion for O/S to draw? A chart of the number of file-sharers over this time period is presented below.



A simple eyeball examination of the Big Champagne data in the accompanying chart reveals three complete summers in the data used by O/S (which runs from August 2002 until May of 2006).⁸ The chart shows no evidence of any summer decline in file-sharing in 2004 or 2005. The average decline of those three years is generated solely by a decline in one year, 2003. The key point is that you can't claim to have a seasonal effect that only shows up in one out of three years. There is no evidence that college students on vacation reduced file-sharing in the summers of 2004 or 2005.

⁷ A slightly more sophisticated version would be to run a regression of the number of peer-to-peer users on a summer dummy and to include a time trend. If you run such a regression the summer dummy is a negative 8.9% and is of borderline significance (13%). If summer is defined as June, July and August, the coefficient becomes 11.6% and also of borderline significance.

⁸ Big Champagne data begins in August of 2002. In their final quasi experiment O/S use Big Champagne data that extends to May of 2006. I include some more recent data, shown without the lines between data points, for completeness sake. Inclusion of the summer of 2006 doesn't strengthen the O/S claim or alter the criticisms of it.

Even the 2003 summer decline in file-sharing doesn't appear to be due to college students on vacation. First, the decline began in April when colleges and universities were still in session. Second, and more importantly, the RIAA announced its lawsuits against file-sharers in June of 2003 and it is likely that the lawsuits had some impact on file-sharing (see the April 2006 Journal of Law and Economics which contains a paper which finds a strong negative impact of the lawsuits on the number of file sharers).⁹

When the first summer is dropped from the analysis the summer file-sharing average becomes slightly (1%) *higher* than the average of non-summer months.¹⁰ In other words, even with college students on vacation the evidence shows no drop in file-sharing during the summer months.

If file-sharing is not lower in the summer there is no reason to expect a related change in record sales in the summer—in other words, this experiment is meaningless. Thus, it is no surprise when O/S discover that the yearly share of summer record sales has not changed from the period prior to file-sharing the summers after file-sharing.

Before leaving this topic we should note a related inconsistency between the assumptions made in this 'quasi experiment' and an assumption made in the primary regression analysis in the O/S paper. O/S claim for the case of the quasi-experiment that file-sharing decreases in the summer because college students lose their broadband connections during their vacation without any attention paid to younger students who are also on vacation in the summer. However, in the primary regression O/S use as a key instrumental variable the number of German students on vacation under the premise that file sharing would increase during German school holidays (such as Christmas). This increased filesharing, they argue, occurs because pre-university German students on vacation are more likely to be at home (not in school) and have their computers and file-sharing programs running more of the time, thus making it easier for Americans to download German music files.

In other words, in one part of the paper O/S assume that school holidays decrease file sharing and in another part of the paper they assume that school holidays increase file sharing. They support these contradictory claims by focusing on college students and ignoring younger students in one instance and by focusing on younger students and ignoring college students in the other. Since both countries have both high school and college students this should tell us (and O/S) that school holidays have no clear theoretical impact on file sharing.

Finally, [Appendix B](#) discusses in detail other claims by O/S that turn out to be incorrect or misleading, such as the claim that movie theater revenues had a similar decline as sound recording revenues in the same interval of time, the claim regarding the number of years that have had declines versus increases in record sales since file-sharing began, and the claim that the recent decline in American record sales is not unusual.

⁹ Bhattacharjee Sudip, Gopal Ram D., Lertwachara Kaveepan, and Marsden, James R. "Impact of Legal Threats on Music Sharing Activity: An Analysis of Music Industry Legal Actions" Journal of Law and Economics, 49:1 91-114.

¹⁰ In the regression analysis, removing the summer of 2003 also leads to a slight positive (but insignificant) coefficient for the summer months dummy.

V. East Coast versus West Coast

Another quasi-experiment involves exploiting the time difference between the East and West coasts. According to O/S:

A second experiment considers spatial variation. Recall that U.S. users download over a third of their music files from western European countries such as Germany and Italy. Because of time zone differences, such transfers are easier for East rather than West Coast users..... Despite the differences in the availability of files, sales have not noticeably varied across the country. In 1998, the last year in the pre-P2P period, the share of album sales in the eastern time zone was 43.9 percent. This share has hardly moved since then. In 1999–2002, the mean was 43.5 percent and the range was 42.7–44.0 percent. This is consistent with some common national factors, rather than file sharing, driving sales trends.

It is not obvious that the premise of this test (that the quantity of European files available plays a noticeable role in the ability of Americans to download files; that the number of files made available by European file-sharers declines at night; that Americans on the East Coast get better access to European files) is correct. Nevertheless, this section accepts the premise and merely attempts to replicate the results.¹¹

Table 1 provides an attempted replication of O/S using purchased Nielsen SoundScan data. Whereas they find that East Coast sales in 1998 represent 43.9% of national sales, I find they represent 44.6% of sales, which implies either that we disagree slightly about which cities are in the Eastern time-zone or that my calculations or theirs were less than perfect. Nevertheless, these numbers are in closer agreement than most of my attempted replications of their work. I also break down sales separately for the West Coast and for the combined Central and Mountain time zones, which I labeled “Middle” but which will be more heavily weighted toward the Central time zone with its larger population.

	East	West	Middle	East Share
1998	324,858	108,589	294,821	44.61%
1999	335,852	112,442	306,541	44.49%
2000	351,020	119,028	315,090	44.71%
2001	339,161	118,672	304,948	44.46%
2002	296,357	109,788	274,815	43.52%
2003	284,500	105,971	265,828	43.35%

O/S claim that a difference of 1.2 implies no real change in East Coast share between their 1998 value of 43.9 and 42.7, the lowest value they find (for an unnamed year). The East Coast shares I get for the years 1998 and 2002 do not show any larger difference (1.1=44.6-43.5).

¹¹ If you read the quoted paragraph carefully you begin to wonder whether the low 42.7 value was for the last year (with the greatest degree of file-sharing) and how large of a differential in sales growth would be required to drop the share from 43.9 to 42.7. O/S do not state which years accounted for the high and low shares.

Are O/S correct that the seemingly small decline in the East Coast share indicates no real difference between the East and West Coast in terms of their change in sales? The answer is “no”.

Table 2 shows the percentage change in sales for each area over slightly different periods of time. The pattern is similar for each period of time. Sales decline most on the East Coast, least on the West Coast and in the middle of the country sales decline by a middling value.

	East	West	Middle
1998-2002	-8.77%	1.10%	-6.79%
1998-2003	-12.42%	-2.41%	-9.83%
1999-2003	-15.29%	-5.75%	-13.28%
2000-2003	-18.95%	-10.97%	-15.63%

There are two points to note here.

First, even though the East Coast *share* did not appear to change much in Table 1, there was a considerable difference in sales *changes* between the East Coast and the other areas as seen in Table 2.

Second, given the O/S premise, the numbers in Table 2, rather than supporting the O/S conclusion, are consistent with the hypothesis that file-sharing harms record sales. After all, it is hard to imagine that the slightly improved ability of East Coast residents (relative to West Coast residents) to access European files could lead to a larger geographic difference in sales than the one measured.¹²

VI. Changes in retail distribution are responsible for decline in record sales

O/S claim that changes in retail distribution are responsible for a large portion of the decline in record sales in the US.

O/S state (including their footnote) on their page 39:

A first reason [for the decline in sales] is the change in how music is distributed. Between 1999 and 2003, more than 14 percent of music sales shifted from record stores to more efficient discount retailers such as Wal-Mart, possibly reducing inventories. As a result, album shipments, which are often cited to document the decline in the legal demand for music, fell much more than actual sales.³² [32 In the 1999–2003 period, the number of shipped albums fell by 301 million, but the number of albums that were sold declined by only 99 million.] (page 36)

¹² Overall population growth by area could not be generating these results. As measured by Nielsen DMAs, the West Coast share of population barely moved from 13.87% to 13.89% from 1998 to 2003 whereas the East Coast share of population fell very slightly from 42.09% to 41.87%. These changes are too small to have any notable impact on Table 2. However, many other factors might explain these results independent of the impact of European file sharers being more available, including pure chance.

Earlier versions of the paper made a slightly different claim:¹³

A first reason is the change in how music is distributed. Between 1999 and 2003, a fifth of music sales shifted from record stores to more efficient discount retailers such as Wal-Mart. About half of the RIAA's reported decline in CD shipments can be linked to the resulting reduction in store inventories. (p29 in October 2006 version).

Although O/S modified their earlier claim that inventory changes were responsible for about half of the sales decline, the footnote in the final published version claims that 2/3 of the decline (202/301) is not a real decline in 'sales' but only in shipments, implying that inventory changes are responsible for 2/3 of the decline.

O/S have committed three major errors in this one paragraph. First, evidence on album inventories held by retailers indicates that they have not fallen, contrary to the assertions made by O/S. Second, simple logic implies that it is virtually inconceivable that inventory changes could be responsible for a decline in shipments of the magnitude found in the tables such as T0. Third, the explanation put forward by O/S rests on a misunderstanding of the terms "shipments" and "sales".

[Appendix D](#) discusses the logic indicating why any plausible inventory changes could not have more than a trivial effect on sales. I demonstrate that even if there were unrealistically large inventory differences between big box retailers and other record retailers it would lead to a decline of, at most, one or two percentage points in sales over the entire period.

The second point is that actual measurements, [available on the web](#), indicate that inventory holdings of record retailers were essentially flat during the period where the share of big box retailers increased from 32% to 51%.¹⁴ Thus, the premise that the movement to big box stores has lowered inventory, which is the foundation of the claims by O/S, appears to be false. In other words, inventory changes appear incapable of explaining any of the sales decline.

Finally, RIAA 'shipments' attempt to measure the same thing that Nielsen SoundScan 'sales' attempt to measure. SoundScan "sales" measure the number of CDs sold by registered retailers when the barcode reader picks up such a sale.¹⁵ RIAA shipments include all of the above retailers plus record clubs, television and 800 direct selling, sales

¹³ This modification was made after I provided evidence to O/S and the editors of the JPE that the initial claim was incorrect.

¹⁴ From 1995 until 2002 data from the National Association of Recording Merchandisers indicates that inventory turns were: 3.9, 3.0, 4.4, 2.6, 3.2, 3.2, -, 4.4 (there were no data for 2001). We would expect to see an increase in turns if inventory were becoming smaller relative to sales. In addition, average returns, which is another measure of inventory management that would be expected to fall over this period if superior inventory controls were in place. Yet they were relatively constant, with values of 20.8, 18.1, 16.4, 15.2, 14.1, 16.4, -, 19.5 over this same period. Unfortunately, 2002 is the last year for which we have data (NARM stopped collecting it). The share of big box retailers is taken from RIAA statistics.

¹⁵ If you go to [SoundScan's home page](#) you can see that getting retailers to join their network is a high priority.

at concerts and sales at retailers who do not connect to SoundScan’s network.¹⁶ RIAA “shipments” are always larger than SoundScan “sales,” (which O/S must have seen to write their footnote 32) as can be seen in the Table 3.¹⁷

Apparently, O/S believe that the difference between the two represents inventory changes. But if that were true, inventory would have increased by 1.55 billion albums over this 8 year period.¹⁸ As a result, under the O/S interpretation, retailers would have *increased* their inventory holdings by more than two year’s worth of ‘sales.’ Such an increase is unreasonable on its face and is, in any event, inconsistent with the O/S claim that inventories were decreasing due to the increased market share of efficient big box retailers.

Units (000s)	SoundScan 'Sales'	RIAA 'Shipments'	difference
1998	728,268	1,036,100	307,832
1999	754,835	1,085,200	330,365
2000	785,138	1,038,900	253,762
2001	762,781	945,700	182,919
2002	680,960	850,800	169,840
2003	656,299	786,300	130,001
2004	695,737	787,957	92,220
2005	654,463	748,727	94,264

As it turns out, the reason that ‘sales’ and ‘shipments’ differ so substantially has nothing to do with inventories but is instead due entirely to the fact that SoundScan samples a smaller universe of sellers than does the RIAA. Since both sales and shipments attempt to measure the same thing, comparing the two tells us virtually nothing about inventory changes. It is unfortunate that O/S are writing about this topic without knowing the meaning of these essential industry definitions.

VII. Monthly comparison of sales and file-sharing

O/S run a regression relating the number of file-sharers to the sales of sound recordings as another ‘quasi experiment.’ They claim:

When we use monthly data from August 2002 to May 2006 (N=46) and define Sales and Users in millions (with respective sample means of 56.0 million and 5.0 million), the estimated [coefficient] = -0.427 with a robust standard error of 0.33. There is little evidence that growth in the number of users has had a statistically or economically significant effect on sales.³¹ [³¹ If file sharing were eliminated, the point estimates imply that monthly sales would increase by only 2.1 million.] (p 35)

The reader should also take note of the conclusions of O/S:

¹⁶ RIAA shipments are net of returns, meaning that unsold inventory that is returned to the record companies is not included.

¹⁷ I count albums in the RIAA statistics as all full length recordings, regardless of format, based on data from their web page. SoundScan numbers for 1999-2005 were purchased.

¹⁸ Each yearly difference between sales and shipments would need to be added to the ever increasing total stock of inventory.

Using 95 percent confidence bands we can reject a null that P2P caused a sales decline... greater than 24.1 million albums... Relying on our five most precise estimates, we conclude that the impact could not have been larger than 6.0 million albums.¹⁹ (first paragraph of conclusion)

First, note that a decline of 2.1 million per *month* (mentioned in O/S footnote 31 in the quote above) is outside of the 95 percent confidence band (24.1 million per *year*) in the concluding quote. A decline of 2.1 million *per month* implies a reduction of more than 25 million per *year* (based on the number of file-sharers in mid 2004). Basing the calculations on the up-to-date mid 2006 number of file-sharers suggests a yearly reduction of 34.5 million albums due to file-sharing.²⁰ Thus, these results are not consistent with the main regression results.

A value of almost 35 million albums per year lost to file-sharing is not enormous, but it is not zero. It represents a decline of approximately 5% of 1998 sales, to use the favorite pre-file-sharing year of O/S. Reductions of this magnitude amount to approximately 35% of the overall sales decline as measured by Nielsen SoundScan for the time period 1998-2006. It seems wrong to refer to this as not “economically significant.” Yet we know that O/S used the identical language for a 34 million unit decrease that they found in an earlier version of their paper based on a smaller sample.²¹

The O/S analysis has additional problems. I have tried to replicate the O/S regression analysis using what should be [identical data](#). I cannot get a coefficient as small as the one they report.

	[1] O/S Reported	[2] Replicated O/S	[3] Digital Singles @ 14:1	[4] Albums only
coefficient	-0.427	-0.64	-0.9129	-1.601
t-stat (robust)	1.294	0.96	1.39	2.500
Annualized Predicted Lost Album Sales in May 2006	-34,483,557	-51,507,289	-73,723,744	-129,266,517
% drop in sales from 1999 base	-4.57%	-6.82%	-9.77%	-17.13%
% of Total Sale Drop from 1999-2006 due to file sharing	27.57%	41.18%	58.95%	103.35%

¹⁹ This is from the first paragraph in their conclusion. Note, however, that when O/S refer to the percentage of lost sales due to file-sharing, they use the larger RIAA measure of sales even though their estimates are always based on the smaller Nielsen SoundScan estimates of sales and sales declines. This is illegitimate but does have the impact of making their results look smaller than they are (even though they are admittedly small in any case).

²⁰ The coefficient on the impact of the number of file-sharers on record sales is multiplied by the number of file-sharers to calculate the expected impact of file-sharing, but the number of file-sharers changes over time.

²¹ In the June 2005 version of their paper (page 32), O/S use a smaller sample (ending in March 2005) and find a coefficient of -.656 which would lead to a decline in sales of 2.8 million units per month (34 million units per year). Nevertheless, their wording to explain their results did not change between versions.

Table 4 presents results from my attempted replications of the O/S methodology (the complete regressions can be found in [Appendix E](#)). The first two rows report the regression coefficient and t-statistic from the regression. The third row reports the implied effect on sales based on the number of file-sharers in May 2006. The fourth row calculates this sales decline as a percentage of 1999 sales.²² The fifth row indicates the decline from file-sharing as a percentage of the decline that has occurred from 1999 through 2006 using Nielsen SoundScan data (which generate smaller absolute numbers—sales and sales declines—than RIAA or IFPI data).

Before we can discuss the regressions we need to discuss how one measures “album sales” in the iTunes age. The rise of iTunes has increased the sales of digital singles and it is not clear how these singles should be treated relative to albums.²³ It seems logical to convert singles to albums at the actual number of songs per CD (typically 14), as done in the third column.²⁴ As far as I can tell, O/S appear to have converted songs into albums at a 10:1 rate.²⁵

The first two columns of Table 4 reveal that my replication of the O/S regression yields a coefficient that is about 50% larger than the O/S coefficient although the coefficients should be identical in a replication. My replication implies that using their methodology, file-sharing has led to a decline in albums of about 7% which represents slightly more than 40% of the overall decline as measured by Nielsen SoundScan.²⁶ This is economically significant even though it is not statistically significant, meaning that under repeated sampling there is a reasonable chance (approximately one in three) of finding a coefficient this large even if the true impact might be as small as zero.

²² Based on my research, the last year not impacted in a serious way by file-sharing is 1999. If I had used O/S’ favorite comparison year, 1998, the calculated percentage declines would have been slightly larger. If I had used 2000 as the starting year, which seems appropriate based on SoundScan data (see my JLE article for more details) the percentage of the total drop would have been slightly smaller.

²³ I believe it is best to convert singles to albums at a ratio of 14:1 since the typical album contains 14 songs. This conversion ratio holds the quantity of music (songs) purchased by consumers constant as consumers switch from CDs to digital singles. It also holds (approximately) the dollars spent by consumers constant since the price of a CD is greater than that of a digital album but is similar to the cost of 14 digital singles. So from the consumer’s perspective of a budget constraint based on either time or dollars, 14:1 seems a good conversion rate. Alternatively, from a perspective of digital sales, converting these singles to albums at a ratio of 10:1 might make sense because a digital album on iTunes is generally ten times as expensive as a digital single. Finally, singles have historically differed from albums and have been treated as a separate market, which would imply leaving digital singles out of the analysis altogether.

²⁴ This 14:1 statistic comes from Figure 2 in Andrew Wechsler and George Schink “CDs: A Better Value than Ever,” LECG May 21, 2002 available at:

<http://web.archive.org/web/20040621120548/http://www.riaa.com/news/newsletter/pdf/CDValueStudy2002.pdf>

²⁵ I base this conclusion on O/S’s statement that album sales averaged 56.0 million units over the 46 months. Using a conversion rate of 10:1 (digital singles to albums) I get the same average value for sales. For albums only the sales average is 54.4 and including digital singles at 14:1 the sales average is 55.5.

²⁶ The reader with Excel can run this regression if you have installed your data analysis packs under “tools”. Go to the [raw numbers](#) appendix for the data if you want to run such an analysis. The t-statistic will be somewhat different because Excel doesn’t calculate robust standard errors, but the coefficient will be the same. The Y variable is “sales” and the X variables are number of file-sharers and the month dummies.

A regression with the conceptually superior measure of albums (@14:1) provides an impact more than twice as large as that reported by O/S. The regression results imply a decline of over 70 million albums in 2006 due to file-sharing which is approximately a 10% drop from 1999 sales levels. Approximately 60% of the overall decline in album sales would be explained by a decline of this size. Again, this is clearly an economically important result although again, it is not statistically significant, meaning in this case that under repeated sampling there is a one in six chance of generating this coefficient even if the true impact might be as small as zero.

Finally, the last column shows the results from using only full length album sales (digital or otherwise) but ignoring sales of singles. In this instance the regression implies that file-sharing leads to a 17% drop in sales which explains 103% of the decline (more than 100% means there would have been an increase in sales except for file-sharing). These results are economically important and statistically significant with the odds only one out of 50 of generating a coefficient this large under repeated sampling if the true result were as small as zero.

None of these results support the basic O/S hypothesis. In fact, they all support a view that file-sharing has an economically important and harmful impact on record sales which is contrary to the claims made by O/S. The degree to which we can have confidence in the correctness of these results, however, is often not as high as statisticians prefer before they believe a hypothesis of zero impact is disproved.²⁷

VIII. Differential Impacts on Genres

Another ‘quasi experiment’ is based on the reasonable claim that some genres of music are likely to be more prone to file-sharing than others. If file-sharing has caused the recent decline, heavily downloaded genres should experience more of a decline than other genres. O/S attempt to test whether genre sales are related to file-sharing:

A third experiment, which also provides a test of the dropout hypothesis, is to see whether download intensity influences long-run sales effect of file sharing growth after explicitly controlling for trends in music format popularity. [page 34]

They conclude that there is no relationship:

The estimated [coefficient] is not statistically significant using either download levels or downloads relative to purchases. For example, when we use mean downloads per album and control for genre sales levels, the estimated [coefficient] is 0.05 with a standard error of 0.52 (the mean for downloads is 61.2, and for sales growth it is -5.8).

Unfortunately, the O/S analysis is flawed in several important respects.

²⁷ I should note that the inclusion of an additional variable, the unemployment rate, makes the coefficient in any of these regression considerably larger than those in Table 4 and the coefficient in these cases is also statistically significant. But our point is merely to mimic O/S’s methodology, so as to check the reliability of their results, not to perform an independent study on the issue, which I have already done using better data (Stan Liebowitz, “Testing File-Sharing’s Impact by Examining Record Sales in Cities” mimeo 2007 available [here](#)). That study found that file-sharing caused more than 100% of the decline.

The statistic in the above quote, that the mean of downloads is 61.2, is the first tip off that there might be problems with this analysis. Table 3 in the O/S paper, reproduced below, shows statistics in the bottom half of the table for “Album Level” downloads by genre. The first row shows that the weighted average for all genres is 70.1, which is obviously different than 61.2. The (unweighted) average of the “mean number of downloads” column over the 11 “genres” is 57.14. O/S do not explain how they calculate 61.2 as the mean number of downloads.

The more serious problem is that some of their genres are not really categories of music appealing to particular audiences. The genres used by O/S include “catalogue,” “new artists,” “current,” and “soundtrack.” “Catalogue” refers to albums older than 18 months. “New” refers to albums by new artists. “Current” refers to hit albums. “Soundtracks” are from movies. The soundtrack for the movie “The Little Mermaid” is not very similar, musically speaking, to the rap soundtrack from the movie “8 Mile” although both originally appeared in “soundtrack” but now are likely to appear in “catalogue.” The point is that they appeal to different audiences that are likely to have different downloading habits.

Only 7 of the genres in this list represent actual musical genres. The average download value of these 7 is 35.86, which is not close to the reported but mysterious average of 61.2. So we can be certain that at least some of the artificial ‘genres,’ if not all, were included in the O/S analysis. It is unclear what we might expect of these regressions with four of the eleven observations being musically, and therefore economically, meaningless, especially when the ‘current hits’ genre dwarfs so many of the others genres.

TABLE 3
DOWNLOADS BY GENRE

	# songs (# albums) in sample	Mean # of downloads	Std dev	Min	Max
Song level					
All genres	10271	4.645	21.462	0	1258
Catalogue	714	4.361	10.370	0	152
Alternative	1707	7.021	18.153	0	312
Hard	270	4.830	8.684	0	52
Jazz	261	0.333	0.920	0	7
Latin	309	0.550	2.927	0	28
New artists	711	0.609	7.039	0	184
R&B	2249	1.635	7.680	0	159
Rap	1227	0.920	4.887	0	82
Current	1342	17.182	51.286	0	1258
Country	913	1.974	6.382	0	128
Soundtrack	568	1.673	5.301	0	61
Album level					
All genres	680	70.162	158.628	0	1799
Catalogue	50	62.280	103.114	0	680
Alternative	117	102.436	122.794	0	674
Hard	19	68.632	82.899	0	264
Jazz	21	4.143	4.542	0	13
Latin	21	8.095	26.344	0	121
New artists	50	8.660	33.097	0	229
R&B	144	25.542	56.494	0	433
Rap	76	14.855	24.487	0	119
Current	83	277.807	333.935	2	1799
Country	66	27.303	51.649	0	344
Soundtrack	33	28.788	36.611	0	185

O/S attempt to control for genre level sales by including radio audience in their regression. This approach has two problems. First, how do you attempt to find a radio audience, as O/S claim to have done, for these non-music-style genres? What category of stations play songs from all genres that happen to be older than 18 months, or which category of radio stations plays only soundtracks, or which category of station would play “current hits” from the Billboard 200 list, which, when I was writing this report, included the soundtracks for “Dreamgirls”, “Disney’s Jump In!” and “Tyler Perry’s Daddy’s Little Girls”; Rap albums such as “Ludacris”, “Eminem Presents” and “Young Jeezy”; and other artists such as Nora Jones and Van Morrison? Second, radio genres do not match up well with record genres.²⁸ The combination of these problems means that the radio variable is likely to be quite noisy, in a statistical sense. O/S do not discuss these problems nor do they provide any explanation of how they created their radio variable.

O/S create a measure of downloading intensity (a ratio of downloads to sales) by genre but the measure is flawed by its construction. The flaw is the result of a decision by O&S to put the most economically important albums into the categories of “Top Current.” Although “Top Current” albums represent only 12% of the sample they account for 64% of the overall sales in O/S’s sample. But if the albums are classified as “Top Current” then they are not included in a *musical* genre.²⁹ As a result, this method of constructing the measure of genre downloading intensity removes the most successful albums from each genre.

Alternatively, the firm NPD reports download statistics by genre. Table 5 shows the O/S and the NPD download intensity numbers, which are linearly related to the ratio of downloads to sales.³⁰ Given the conceptual problems with the O/S statistics, the NPD numbers are preferable.

O&S Download Intensity		NPD Download Intensity	
hard	4.850	Rock	1.212
alternative	1.727	Alt/Modern	0.860
R&B	1.098	R&B	1.368
Rap	0.756	Rap/HipHop	2.842
Country	0.622	Country	0.813
jazz	0.378	Jazz	0.870
latin	0.587	Classical	0.400

The simplest comparison of file-sharing and sales changes by genre is to examine the correlation between them. Correlating file-sharing intensity by genre with sales changes for the seven musical genres yields the results in Table 6.

²⁸ For example (one of many), R&B sales are about ten times the size of Classical sales. Yet R&B in radio formats is listed in ‘remaining formats’ and the audience was too small to measure after 2001 (although the classical audience is measured without problem). Instead of its own category, R&B appears to be found in Urban AC (adult contemporary), whose audience is only three times the size of classical.

²⁹ They state in footnote 6 that for sampling purposes (deciding which albums to include) they classified albums into actual musical genres but when calculating statistics they used the original album genre classification, as seen in their Tables 1 and 3, which is the cause of the problems with their file-sharing measures.

³⁰ The raw O/S numbers are multiplied by 2000 to make them similar in size to the NPD numbers.

Table 6		
Correlations	File-sharing Intensity	
Sales change	O/S	NPD
99-05	-0.355	-0.397
00-05	-0.407	-0.648

The large negative correlation coefficients between file-sharing intensity and the sales decline contradict the conclusion reached by O/S that there is no relationship between genre file-sharing intensity and genre sales changes. Instead, these negative correlations indicate that more heavily downloaded genres also have the largest decline in sales, implying that file-sharing is detrimental to sales. These correlations are not statistically significant but that is to be expected with only 7 observations.

Instead of correlations, we can run regressions, as O/S did, to assess the strength of the relationships. The actual regressions as well as a discussion are available [in Appendix E](#). The results are the same as with the correlations: genres with high downloading intensity also have the largest decline in sales. They are even sometimes statistically significant. These results are inconsistent with the claims made by O/S that file-sharing has a benign impact on record sales.³¹

IX. The drop in US sales in 2005 was due entirely to one company suffering from poor management.

According to O/S:

...in the United States the entire drop in 2005 album sales is due to losses at a single firm, the recently merged Sony-BMG, which has experienced severe postmerger integration difficulties. If file sharing were responsible for the observed sales decline in the United States, we would not expect this activity to affect the products of only a single firm. (page 37)

As we have seen, the drop in record sales is a worldwide phenomenon that has lasted for over seven years. The Sony/BMG sales change in 2005 is largely irrelevant, since the problems of one company's performance, in one country, in one year, cannot explain the breadth of the decline. Nevertheless, it is informative, as a test of the O/S research methodology, to investigate O/S' claim about Sony/BMG more closely.

Although O/S do not document their claim, it is relatively easy to find [market share information](#) at websites reporting SoundScan market share data for 2004 and 2005.

³¹ Liebowitz (2007) available [here](#) examines the impact of file-sharing by genre using a completely different data set and approach. The result in that paper is that the most heavily downloaded genres suffer the greatest decline in cities with the highest Internet penetration, consistent with the belief that file-sharing harms record sales.

	2004	2005
UMG	29.59%	31.71%
SONYBMG	28.46%	25.61%
WMG	14.68%	15.00%
EMI	9.91%	9.55%
OTHERS	17.36%	13.18%

Table 7 gives the market shares for the four major record companies and the remaining share for a category of ‘others’ that includes dozens of smaller independents. O/S ignore this large chunk of the market classified as “others.”

Warner and Universal (UMG) increased share whereas Sony, EMI, and Others decreased, with the “Other” category having the largest decline by far. These market shares need to be multiplied by actual industry sales to determine how company sales changed. Using the total sales values provided by O/S on page 30 in the October 2006 version (because they failed to include these values in the final version of their paper), 681 million to 654 million, we arrive at sales changes shown in Table 8.

UMG	2.92%
SONYBMG	-13.58%
WMG	-1.87%
EMI	-7.45%
OTHERS	-27.09%

Sony/BMG did, indeed suffer from a large sales drop, but contrary to O/S’s claim, the decline is clearly not limited to a single firm. All firms except Universal suffered a decline. Even if O/S chose to ignore the comparatively small declines of EMI and WMG, they certainly should not have ignored the very large decline suffered by the independent record companies in the “others” category.

X. Change in converting LPs and cassettes to CDs.

O/S provide another reason that sales might have fallen since 1999:

A second factor is the ending of a period of atypically high sales, when consumers replaced older music formats with CDs. (p 36)

The RIAA first began reporting CD sales in 1983 (LPs and cassettes were the earlier formats). CDs surpassed cassettes as the leading format by 1992. It is not unreasonable to suggest that replacing old music on old formats with old music in new formats might have artificially increased sales through 1999 and then dropped off thereafter.

The claim, however, has two problems. First, O/S present no evidence to support their claim. Second, the claim appears to be false, as a simple test reveals. Sales of recordings older than 18 months are called “catalogue” and sales of recordings older than 36 months are known as “deep catalogue.” If a cause of unusually high sales was the replacement of old music into the CD format, and if this replacement had stopped after 1999 or 2000, as claimed by O/S, then the share of catalog and deep catalog should have declined after those years. Yet, as seen in Table 9, from 1999-2004 the share of catalogue increased

from 34% to 36% and the share of deep catalogue increased from 24% to 25%.³² In other words, the evidence does not support the claim that format replacement had artificially increased CD sales in the years preceding the advent of file-sharing.

<i>Table 9</i>	1999	2000	2001	2002	2003	2004	2005	2006
% sales catalogue USA	34%	34%	36%	37%	35%	36%	37%	38%
% sales 'deep' catalogue USA	24%	24%	25%	26%	25%	25%	25%	27%

XI. Increases in usage of other forms of entertainment.

There are certainly substitutes for listening to sound recordings (radio, for example) and it is not unreasonable for O/S to suggest that increased usage of other entertainment activities might reduce the purchase of sound recordings:

Perhaps more important than these developments is the growing competition from other forms of entertainment. A shift in entertainment spending toward recorded movies alone can largely explain the reduction in sales. The sales of DVDs and VHS tapes increased by over \$5 billion between 1999 and 2003. This figure more than offsets the \$2.6 billion reduction in album sales since 1999. Consumers also spent more on video games, where spending increased by 40 percent, or \$3 billion, between 1999 and 2003, and on cell phones. Teen cell phone use alone tripled between 1999 and 2003. (p36)

Unfortunately, O/S once again do not provide any documentation to support these claims.

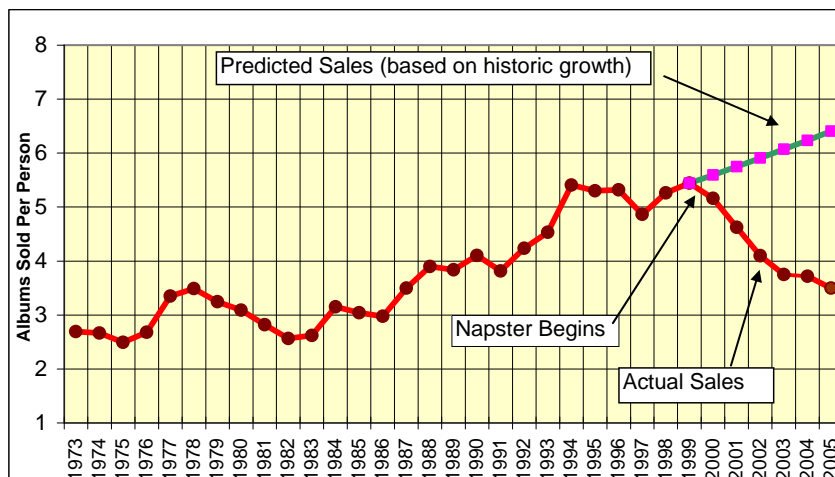
Listing possible alternative forms of entertainment is not, by itself, an economic explanation for the decline in record sales that has occurred. What matters is whether there was some important increased usage in some other substitute form of entertainment on or about the time that record sales began to fall (and coincidentally, when file-sharing began).

The decline in record sales in 2000 was sudden and dramatic and matches almost perfectly the growth in file-sharing (as I documented in my JLE article in April of 2006).

The following chart shows US historical record sales (full length albums).³³

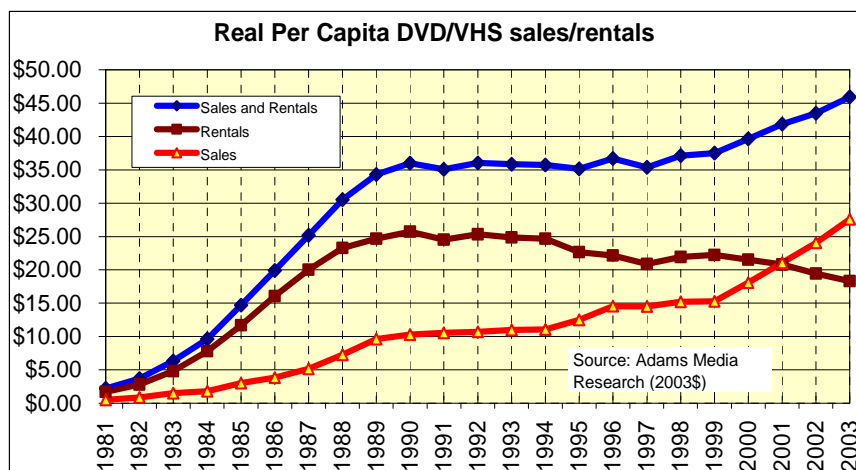
³² Catalog figures for 1998-2002 can be found and verified in the [NARM](#) report. The other numbers come from the IFPI based on some consulting I performed for them regarding the length of copyright in Europe, but those numbers begin in 1999 which is why 1999 is the start year in Table 9. Although not shown in Table 9, the 1998 catalogue value is 36% which is consistent with the conclusions in the text.

³³ These are unit sales reported by the RIAA. RIAA also appears to report revenues but these are merely an estimate based on list prices of CDs and not actual transaction prices. Units, therefore, are the more accurate statistic.



The next chart shows per capita expenditure on DVD/VHS rentals and purchase. Note three things with respect to video.³⁴ First, O/S discuss only *sales* of video and ignore video rentals, which were falling. Sales and rentals are close substitutes and should be included together. The combined sales and rentals statistics indicate only a small acceleration in growth after 1999 relative to previous growth.

Third, and most importantly, the major increase in prerecorded video expenditures occurred in the mid to late 1980s, an increase several times the order of magnitude of the recent increase, yet record sales do not appear to have been negatively impacted at that time. If sales of prerecorded movies have a large negative impact on record sales it should have shown up during the 1980s, but it did not.

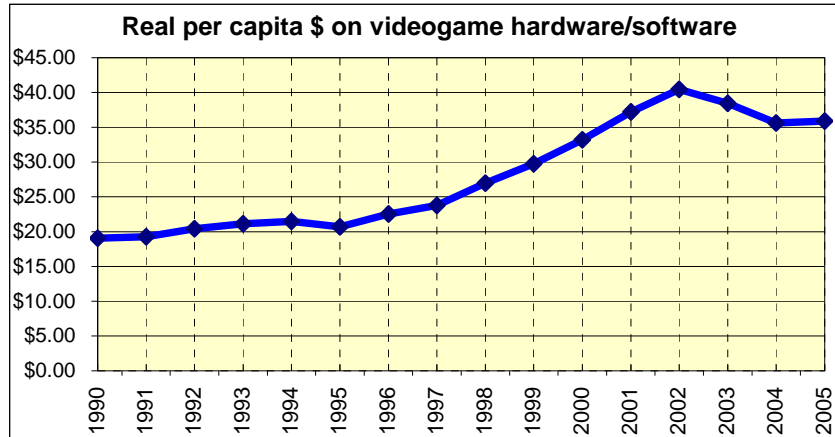


This analysis does not prove that DVDs are not responsible for some portion of the decline in CDs, but O/S present an incomplete and potentially misleading set of statistics.

In the case of videogames the evidence is also inconsistent with the claims of O/S. According to the Consumer Electronics Association, expenditures on videogame software and hardware increased at a fairly constant rate from 1996 until 2002 whereupon they

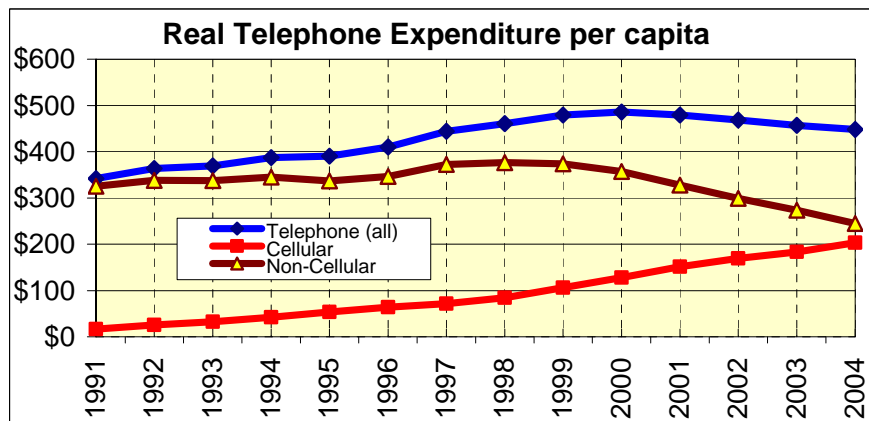
³⁴ The data in this chart come from Adams Media research, a leading provider of data to the industry.

stopped growing (in real dollars). The chart below shows that videogame sales increased through the mid to late 1990s (while record sales were growing) but were largely flat after 2001 (when record sales were falling). This trend is not consistent with the claim that videogames are responsible for the decline in record sales.



Finally, O/S claim that increased expenditures on cell phones might have contributed to the decline in record sales. Again their story is incomplete. Again, it misleads.

Overall spending on telephones has fallen since 2000, in real terms. According to the FCC, spending on cellular is up, but land line expenditures have fallen by more than cellular has risen.³⁵ Telephone spending increased during the 1990s while record sales were rising and then began to fall when record sales were falling. This is the opposite of O/S's claim.



XII. What O/S no longer Report

The March 2004 version of the O/S paper had a table which took the final regression results and split the sample of albums into quartiles based on sales of the album. The purpose of this table was to see if successful albums were differently affected by file-

³⁵ The data come from an FCC document found [here](#), Table 3.3 on page 3-5.

sharing than less successful albums. Their conclusion was that successful albums were positively affected by file-sharing whereas marginal albums were not. I copy the table below.

Table 13 – Downloads and Album Sales – Effects by Sales

	(I) 2 nd stage Δ sales for 1 st quartile sales	(II) 2 nd stage Δ sales for 2 nd quartile sales	(III) 2 nd stage Δ sales for 3 rd quartile sales	(IV) 2 nd stage Δ sales for 4 th quartile sales
Δ # downloads (instrumented)	-0.005 (0.009)	0.051 (0.021)*	0.084 (0.030)**	0.468 (0.307)
Polynomial time trend of degree six	yes	yes	yes	yes
Constant	-0.226 (0.268)	1.578 (0.612)*	3.301 (1.890)	45.159 (75.373)
Observations	2243	2397	2388	2388
Prob $F > 0$ on excluded instruments	0.000	0.000	0.000	0.000
Sargan test (p-value)	0.1749	0.2914	0.2628	0.4404

Robust standard errors in parentheses
* significant at 5%; ** significant at 1%

Although the coefficient for the most successful albums was only of borderline statistical significance, it implied a large positive economic impact (an increase of 60 million albums). O&S stated so at the time:

For the top quartile, downloads have a relatively large positive effect (150 downloads increase sales by one copy) though this is estimated rather imprecisely. These results are also inconsistent with the argument that file sharing is reducing sales of commercially important albums.

What they didn't seem to realize at the time was that the top quartile of albums represented the vast majority of industry sales and so the result for this quartile would basically be the result for the entire industry. The implication, of course, would be that file-sharing would have appeared to substantially benefit the sound recording industry, making the current sales decline even more mysterious.

I pointed this fact out to O/S and suggested to them that this result was so counterintuitive and inconsistent with the large decline in record sales that it probably indicated a problem with their estimation. Their response was to remove that table without any mention of its prior existence and to replace it with what seems to be an inferior analysis. Instead of using their straightforward measure of quartiles based on *actual* sales, the authors now use (in the bottom of their current table 10) a measure of *predicted* sales as an interaction variable in the regression and conclude, using this technique, that file-sharing does not have differential impacts based on album popularity. Using actual success instead of a rough proxy for success based on how well the performer's previous albums had done is likely to lead to a stronger test. O/S do not explain why they now believe the predicted success is a better variable than actual success

The regression analysis in the published version of the paper has added some new variables and so it is possible that the quartile results from the old paper would not hold anymore. However, the table was removed in the December 2004 version of the paper

which had virtually identical regressions to the previous version of the paper, so the switch occurred while the quartile results still held.

XIII. Conclusions

I have endeavored in this report to closely re-examine the portion of empirical evidence put forward by O/S that was amenable to such re-examination. It is probably something of an understatement to say that the O/S results did not hold up well under this reexamination.

O/S performed four quasi experiments. They claimed that each experiment supports their overall conclusion that file-sharing is not harmful to record sales. Upon closer examination and replicating the tests where possible, I find that three of the experiments support the opposite conclusion—that filesharing harms sales—and that the fourth was based on a false premise and is thus not informative.

O/S also report numerous statistics purporting to explain either why the sound recording sales decline is not unusual, not large, not universal or can be explained by some other factors. These factual claims, made with no citations or references, were either false, misleading, or incomplete.

I have attempted to conduct my analyses in this paper carefully and document all sources and data. I have also tried to make these results understandable to non-specialists in economics. For that group in particular this analysis should help dispel the myth, often held by non-academics, that peer review in leading journals, by itself, necessarily insures the accuracy of the published material.

The fact that the portion of the O/S analysis that is open to public scrutiny fares so poorly and that the errors are not random but all seem to support the O/S thesis suggests that readers should take great care when weighing the O/S results based on data that O/S have not made publicly available and that are not amenable to replication.

Appendix

A. Measuring the Change in sales in various countries:

It should be easy to determine the simple factual claim regarding music sales in major markets during the rise of file-sharing. Although we are not told what data O/S have used to back up their statement, when someone wants to compare record sales in different countries they generally check out data from the IFPI (International Federation of the Phonographic Industry) which reports on worldwide record sales. The IFPI data can be purchased in its yearly reports (“The Recording Industry: World Sales”) on [its web site](#). Some data on the site can be downloaded for free.

The first table below, T1, provides IFPI statistics (based on the purchased data book) on sales in the top 10 markets from 1999 until 2005, ordered by the size of the sound recording market (this is the same as Table T0 in the main report). Table T2 repeats this for just the change from 2004-2005.

T1: 1999-2005 Market Changes			T2: 2004-05 market changes		
	album units change	real retail revenue change		album units change	real retail revenue
USA	-29.81%	-33.81%	USA	-7.90%	-5.30%
Japan	-15.80%	-14.94%	Japan	3.02%	1.94%
UK	-7.89%	-12.38%	UK	-0.82%	-5.46%
Germany	-42.54%	-44.45%	Germany	-3.60%	-1.56%
France	-8.78%	-26.67%	France	-5.24%	-4.24%
Canada	-28.10%	-49.73%	Canada	-5.33%	-4.32%
Australia	-17.52%	-36.31%	Australia	-4.30%	-12.33%
Italy	-37.64%	-46.07%	Italy	-4.84%	-1.73%
Spain	-50.24%	-57.83%	Spain	-8.71%	-8.47%
Netherlands	-25.88%	-48.08%	Netherlands	-13.10%	-18.27%

The column titled “album units change” is the percentage change in the number of full length albums of any format (cassette, CD, LP, etc). The real retail revenue is the change in retail revenue, adjusted for inflation,³⁶ which is an adjustment that economists are trained to make (it might make sense to also adjust units sold by population changes, but we have not done that).³⁷

³⁶ Inflation adjustments are from the Cleveland Fed’s web page: <http://www.clevelandfed.org/research/Inflation/World-Inflation/Index.cfm>.

³⁷ There are two minor points here. First, album units do not include digital single downloads (although they do include digital albums) which would make the measured unit declines a few percentage points larger than the true declines. On the other hand, the revenue figures include not only digital downloads but also include ringtones (the songs that play when your cell phone rings), which are not substitutes for normal prerecorded music and do not belong in this analysis. Ringtones add a few percentage points to revenues, so the revenue losses are actually larger than shown. The overall impact of these factors on the 99-05 table is too small to impact the discussion in any important way.

Each of the top ten markets has had a considerable decline in units and revenues from 1999 to 2005. The first sentence in the O/S quote about sales rising in major markets is certainly not supported by these data.

What about the second sentence (relating specifically to 2005) in the O/S quote? From Table T2 we can see that each of the top 10 countries, except for Japan, had a decline in both units and revenues from 2004 to 2005. So how can O/S make their assertion that four of the top five had increases?

Look at the following charts which are in [documents freely downloadable from the IFPI](#). If you compare the [2005](#) and [2004](#) retail value numbers in US\$ (highlighted by the dark ovals in the diagram) it might appear to someone uninitiated in economics that sales are going up in many of these countries, including 4 of the top 5.³⁸ This seems like a good candidate for providing the basis of the O/S claim. But take a look more closely at the data for 2005. There is a “% Change” column (red oval) which shows declines from 2004 to 2005 even when a comparison with the 2004 numbers seems to indicate that sales might be rising.

Top 10 Markets Retail Value		
Country	\$US Million	% Change
US	12,153	2.6%
Japan	5,168	-1.8%
UK	3,509	-1.6%
Germany	2,149	-4.2%
France	1,979	-14.8%
Australia	717	-6.1%
Canada	694	-4.7%
Italy	652	-7.9%
Spain	573	-12.5%
Netherlands	508	-7.4%
Top 10 Total	28,102	-1.9%
Top 10 % of World	83.6%	

Figure 3: Total Music Sales by Market in 2005 (physical & digital, values in millions)

	Trade Revenues 2005				Retail Value 2005		
	US\$	Local Currency	% Change	% Digital	US\$	Local Currency	
1 USA	7,012	USD	7,012	-3%	9%	12,269	12,269
2 Japan	3,718	JPY	409,845	1%	7%	5,448	600,497
3 UK	2,162	GBP	1,189	-3%	3%	3,446	1,895
4 Germany	1,457	EUR	1,166	0%	3%	2,211	1,769
5 France	1,248	EUR	999	-2%	2%	1,990	1,592
6 Canada	544	CAD	659	-3%	3%	732	886
7 Australia	440	AUD	576	-10%	2%	674	883
8 Italy	428	EUR	343	0%	4%	669	535
9 Spain	369	EUR	295	-5%	1%	555	444
10 Brazil	265	BRL	645	-12%	1%	394	958
11 Mexico	263	MXP	2,863	10%	<1%	412	4,487
12 Netherlands	246	EUR	197	-14%	2%	431	345
13 Switzerland	206	CHF	257	-3%	1%	267	334
14 Russia	194	RUB	5,477	-37%	-	388	10,961
15 Belgium	162	EUR	129	-7%	2%	262	209
16 South Africa	159	ZAR	1,010	10%	<1%	254	1,618
17 Sweden	148	SEK	1,107	-9%	2%	240	1,795
18 Austria	139	EUR	111	-5%	3%	285	228
19 Norway	133	NOK	857	-12%	1%	253	1,627
20 Denmark	113	DKK	679	-2%	1%	180	1,080
Other	1,387			-8%	6%	2,096	
Total	20,795			-3%	5%	33,455	

One problem with just comparing the \$US columns in these tables is that it is incorrect to compare retail values in different countries using US dollars when the value of the dollars changes from year to year. Because conversion rates between the dollar and other currencies change each year, sales could be falling in a country but if that country's currency is rising against the dollar, sales measured in dollars might appear to be rising.

A second problem is that there is no control for inflation in these numbers.

³⁸ The specific 2004 retail value for the US in the Table was a mistake that was corrected the 2005 book (but not shown here).

Table T3 provides my best guess about how O/S might have arrived at their second sentence.³⁹ These are the numbers for 2004-2005 from the publicly available online documents (which come from the tables immediately above), measured first in US dollars (which we know to be misleading), then measured in the home currency and then [adjusted for inflation using data from the Cleveland Fed](#).⁴⁰ The two left hand column merely reproduce results from the immediately previous tables and the third column calculates the change from the 2004 to the 2005 values in the first two columns and the results match the general claim made in O/S's second sentence since 4 out of the top 5 countries have increases). Of course, this is a misleading and incorrect comparison of sales. The fourth column is based on the local currency (which appears in the 2004 and 2005 public IFPI reports linked above) and is superior to the previous column since it does not use a possibly misleading conversion to US dollars. Here we find that 4 out of 9 countries show an increase in sales. But this still leaves out inflation. Finally, the right hand column then performs an inflation adjustment (using the Cleveland Fed statistics on inflation by country) and now only 1 out of 9 countries shows an increase. So what starts out with 4 of the top 5 markets having increases ends up, when properly measured, with only 1 of the top 5 and 1 of the top 9 markets having a sales (revenue) increase from 2004 to 2005. Note that the adjustments made in this table are taught in introductory economics courses.

T3: Change in sales, 2004-2005						
	2004 US \$	2005 US \$	Sales Change in \$US	Sales change measured in local currency	2005 local inflation	inflation adjusted sales change
USA	12,153	12,269	0.95%	0.95%	3.40%	-2.45%
Japan	5,168	5,448	5.42%	7.40%	-0.30%	7.70%
UK	3,509	3,446	-1.80%	-1.80%	2.80%	-4.60%
Germany	2,149	2,211	2.89%	1.63%	2.00%	-0.37%
France	1,979	1,990	0.56%	-0.70%	1.70%	-2.40%
Canada	694	732	5.48%	-1.76%	2.20%	-3.96%
Australia	717	674	-6.00%	-9.41%	2.70%	-12.11%
Italy	652	669	2.61%	1.23%	1.80%	-0.57%
Spain	573	555	-3.14%	-4.29%	3.40%	-7.69%

B. How many years of sales decline were there? How about Movies? Is the current decline unusual?

These are less important "facts" and thus are relegated to the Appendix but minor points but the O/S presentation here is typical of the rest of their analysis.

Years

³⁹ O/S state, in their penultimate version of the paper (October 2006), that France had an increase of 7.5% for the year 2005. O/S's claim most likely came from this [IFPI](#) report dated October 2005, indicating a 7.5% increase in unit sales in France, but as noted in the report, these values were based on about 40% of the year's sales. The final 2005 statistics for France, according to the IFPI, indicated a decline of 5.2% in units.

⁴⁰ These numbers are slightly different than those in table T2 because they are from slightly different IFPI documents which provide slightly different statistics and handle digital sales differently.

Here is the O/S statement about years with increased and decreased record sales: “According to SoundScan, album sales increased in three of the seven years over this period [1999-2005], in contrast to movie ticket sales which rose in only two years.”

First note (in Table 3 on page 10) that RIAA statistics show a decline in every year since 1999, except for one (2004). In my April 2006 JLE I report on the growth of Napster. It began in a very small way in late 1999 and didn’t really grow to any significant size until the second half of 2000, which is when the RIAA half-year data on record sales begin to show a decline. SoundScan record sales peaked in 2000, not in 1999 and it seems reasonable to take 2000 as the starting point with SoundScan data and go forward from that point.

O/S claim that there were 7 years (of measured album sales *changes*) after 1999.⁴¹ Since the data end in 2005 they either meant 6 years or they are including the 1998-1999 change which is obviously improper since there was virtually no filesharing in 1999. Table 3 above indicates that sales fell in each year after 2000, except for 2004, the same year that the RIAA-measured sales did not fall (and the year that was impacted by the RIAA lawsuits). Although that table does not give data for 2006, [this story](#) shows that sales fell again in 2006, even including all digital singles at 10 tracks=1 album. So sales rose in 1 of 6 years, not 3 of 7 as O/S claim.⁴²

Nevertheless, it doesn’t really matter whether sales rose in each an every year or not. What counts is the size of the overall decline and whether there were large deviations from the trend, not minor upticks. Note that both real revenues and units sold fell significantly during this period, as Table T1 indicates.

Movie Industry Comparison

Although O/S wish to imply that the movie industry suffered a similar decline in its theaters (implying that the record decline is not unusual), such is not the case. If you look at movie [revenue data](#) you will see that nominal (no inflation adjustment) movie theater receipts didn’t fall by the nominal 18% experienced by music albums but instead rose by 21% from 1999-2005 even while being cannibalized by DVDs and home theaters, which was just an alternative source of revenues for movie producers. Real (inflation adjusted) movie theater revenues were approximately constant with a very small rise from 1999 to 2005 and a very small fall from 2000 to 2005 as opposed to the 30% decline in real album revenue. Total [admissions](#) are about the same in 2005/2006 as they were in 1999/2000 as opposed to the 31% decline in unit sales of sound recordings.⁴³ The movie theater results, therefore, look nothing like those for album sales.

However, since movie admissions rose only in 2001 and 2002 we can give credit to O/S for getting a fact correct even if the net result of the fact is to mislead the reader.

Is the Current Decline Unusual?

⁴¹ Since their paper was completed before 2006 was over they cannot have had data for changes in album sales for more than 6 years after 1999. Also, sales fell from 2005 to 2006, as they did for every year since 2001 except for 2004.

⁴² Even if you start with the change from 1998 to 1999, sales fell in 2001, 2002, 2003 and 2005, which I count as four, not three.

⁴³ All recording industry numbers are based on RIAA statistics.

Finally, O/S claim that “While real revenues have fallen 28 percent over 1999–2005, real revenue fell 35 percent during the collapse of disco music in 1978–83.”

There are two problems with this claim.

First, although RIAA seem to provide statistics about revenues the same way they provide statistics about unit sales, a careful reading of the data construction indicates that the RIAA does not provide revenue *measurements* at all. The RIAA only measures units sold. Revenues are *estimated* based on list prices, making the revenue statistics of questionable value, particularly if list prices and margins are changing. Given the gyrations in oil prices (used to make vinyl) occurring during the earlier downturn, the ongoing switchover to cassettes, and galloping inflation, we have no idea whether list prices reflected actual purchase prices or not during this period and therefore whether actual transaction revenues fell by anywhere near the amounts listed.

Second, the 1978-83 decline occurred during a gut wrenching recession (unemployment over 10%) and after a period of outsized inflation (up 49% in the 78-82 interval). Second, and more important, O/S, in spite of their claim, do not know how much real revenues fell because we do not have reliable revenue figures. All we know with any confidence is that the quantity of full length albums (per capita) fell by 18% from a peak in 1978 to a nadir in 1982, compared to a 31% decline from 1999 through 2005.⁴⁴

The 78-82 decline was surely severe, but all we can say with any confidence is that it was only about half of the current decline and it occurred during a major recession.⁴⁵

⁴⁴ The only historical data come from the RIAA.

⁴⁵ We do not know the full reason for the depth of the 78-82 decline. The recession almost certainly played a part. Another possibility consistent with most research on file-sharing would be the growth in cassette recorders and copying which came about during this period. Or perhaps, as O/S suggest, it was the death of disco.

C. Regression of Album Sales on File Sharing

Regressions of Album Sales on File-sharing			
	Digital Singles @ 14:1	Digital Singles @ 10:1	Albums
# file-sharers	-0.9129	-0.6378	-1.6007
	(0.174)	(0.346)	(0.018)
dec	61,472,800	61,574,000	61,219,900
	0.000	0.000	0.000
nov	12,398,100	12,343,500	12,534,800
	(0.001)	(0.001)	(0.001)
oct	1,284,330	1,180,760	1,543,260
	(0.782)	(0.800)	(0.739)
sep	-866,918	-875,156	-846,322
	(0.858)	(0.858)	(0.860)
aug	-1,092,300	-1,146,140	-957,685
	(0.820)	(0.812)	(0.842)
jul	-1,185,240	-1,200,190	-1,147,850
	(0.730)	(0.735)	(0.721)
jun	4,248,130	4,212,390	4,337,460
	(0.464)	(0.467)	(0.456)
may	-2,157,740	-2,240,240	-1,951,500
	(0.517)	(0.502)	(0.561)
feb	-393,132	-519,282	-77,759
	(0.932)	(0.911)	(0.986)
mar	4,154,730	4,089,270	4,318,360
	(0.410)	(0.436)	(0.346)
apr	2,922,570	2,805,030	3,216,440
	(0.359)	(0.389)	(0.294)
Constant	53,175,600	52,299,200	55,366,900
	0.000	0.000	0.000
Observations	46	46	46
R-squared	0.913	0.911	0.917
p values based on robust standard errors in parentheses			

D. Why Inventory Problems could not have led to the sales decline

Let's stack the deck in favor of O&S: assume that inventories are equal to 100% of sales at non-discount retailers and 0% at discount retailers. If discount retailers increase their market share by 4% in a year (approximately what O/S claim) sales by manufacturers to retailers would fall by 4% during that year since the 100% in inventories for 4% of the stores would no longer be required.⁴⁶ But sales by manufacturers would rebound to their old level the next year unless discount retailers took another 4% of the market. So with these assumptions there would be a 4% reduction in sales for each year where discount retailers increase their market share by 4%. Note that this 4% is not cumulative—it is a reduction for the year which keeps getting repeated each year as long as the market share of discounters increases in this manner, which would obviously end when the share of discounters equaled 100%. Note that even in this scenario, which is extremely favorable to O&S, the decline is only 4%, and is not anywhere near half of the 30% decline in albums reported in Table T1.

But of course the actual facts are nowhere as generous toward O&S as this example. The main problem is in the size of the inventories. Non-discount retailers do not have inventories equal to 100% of sales. According to statistics from the National Association of Recording Merchandisers, inventories of sound recordings make up from 1/4 to 1/3 of yearly sales. Using the more generous 1/3 value cuts the yearly sales decline due to inventory reduction by 2/3. So we are down to inventory improvements reducing sales by a maximum of slightly over 1% per year during this transitional period.

But we are still assuming that big box retailers have zero inventories, which is clearly giving them too much of an advantage. In fact, the average industry inventory turn ratio (which is highly variable) was identical (4.4) in 1997 and 2002 (the year the data stopped being collected by NARM) and the average for the years 95-98 was 3.5 as opposed to the 99-2002 average of 3.6 although big box market share increased from 28.2% to 50.7% during this period.⁴⁷ So, the evidence indicates that not only is the assumption of zero inventories for big box retailers too strong, but it implies that big box retailers have inventories that are about the same as non-discount retailers.

⁴⁶ O/S originally claimed that the share of big box retailers increased 20% instead of 14.5% but made the change after I notified the journal editor of this mistake.

⁴⁷ These numbers come from the 2002 and 1999 publications NARM Annual Survey.

E. Regressions of genre sales change on genre file-sharing intensity.

	1999 - 2005 Change in Sales by Genre						2000 - 2005 Change in Sales by Genre					
NPD Downloading Intensity	-0.0608	-0.0519					-0.1397	-0.1246				
	(0.140)	(0.187)					(0.022)	(0.032)				
O/S Download Intensity			-0.0884	-0.0822					-0.0871	-0.0915		
			(0.197)	(0.229)					(0.129)	(0.134)		
O/S Total Downloads					-0.0031	-0.0027					-0.0028	-0.0030
					(0.470)	(0.530)					(0.412)	(0.424)
Change in Radio Audience		-0.0762		0.0964		0.1125		-0.1300		-0.0676		-0.0484
		(0.447)		(0.858)		(0.835)		(0.283)		(0.864)		(0.903)
Constant	-0.0250	-0.0297	0.1703	0.1500	0.1536	0.1279	0.0365	0.0284	0.0917	0.1059	0.0685	0.0796
	(0.760)	(0.730)	(0.500)	(0.525)	(0.603)	(0.658)	(0.689)	(0.760)	(0.654)	(0.601)	(0.774)	(0.746)
Observations	7	7	7	7	7	7	7	7	7	7	7	7
R-squared	0.158	0.202	0.126	0.133	0.081	0.09	0.42	0.484	0.165	0.17	0.093	0.096

Robust p values in parentheses

Here are the results of regressions run on the seven genres available.⁴⁸ Percentage change in sales was the dependent variable. File-sharing *intensity* per genre and the change in radio audience for each genre (as best I can measure it) are the independent variables.⁴⁹

Table 6		NPD Download Intensity	O/S Download Intensity	O/S Total Downloads
without radio	99-05	-17.27%	-42.89%	-31.39%
with radio	99-05	-14.74%	-39.87%	-27.83%
without radio	00-05	-39.72%	-42.25%	-29.01%
with radio	00-05	-35.40%	-44.37%	-30.54%

The numbers in Table 6 indicate the size of the sales decline that would occur if a genre with no file-sharing was to have an increase in file-sharing equal to the genre with the highest degree of file-sharing. The amounts in this table are all economically important. Only the shaded cells are statistically significant, however.

⁴⁸ O/S only report the results for a regression using total files shared by genre, not file-sharing intensity, although the results are close between the two. Since sale growth is measured as a rate and is thus size independent, it makes sense for the file-sharing variable to be size independent as well.

⁴⁹ O/S also use (and report on) a file-sharing variable measuring the total number of files shared per genre, not scaled by usage. Such an unscaled measure seems inappropriate.

F. Replicating their monthly data

I already had information on the number of file-sharers from Big Champagne which should be identical to what was used by O/S. I purchased data on monthly sales of albums (including digital albums) from Nielsen SoundScan. The average value for sound recording sales in my data is 54.4, not the 56.0 reported by O/S, so there appeared to be a difference in measured album sales (my measure of users had an average value of 5.0, consistent with their average).

I concluded that O/S must have included digital *singles* in their measurements. Although singles have historically been a different market than albums, it is not unreasonable to suggest that digital singles are competing with albums since, on digital sites such as iTunes, all songs on albums are included as singles, not just a small sample of songs as used to be the case for physical singles. So I incorporated data on digital singles into the analysis.

The inclusion of digital singles creates a measurement issue, however. This has to do with the issue of how to convert singles into albums. Because digital albums normally cost \$10 whereas singles cost \$.99 there is a temptation to convert at a ratio of 10:1. However, since digital albums are merged with CDs even though CDs have higher prices, the methodology implicitly used to merge digital albums with CDs is based on the number of songs and not the price. That means, for the sake of consistency, that we should convert singles into albums at a ratio of 14:1, which is the current average number of songs per CD. When I do this I still do not get the average number of albums to match O/S. When I do the conversion at 10:1, the averages match, so that is what I presume O/S did.

The data listed in Appendix G only include the 10:1 conversion since the number of albums and the number of singles are data from Nielsen SoundScan and are proprietary numbers that cannot be reproduced for free. If I included any other conversion factor the reader would be able to determine the raw Nielsen number of albums and singles which is why I do not include such numbers.

G. Raw Numbers: Data relating monthly file-sharing and record sales

date	Album sales singles@10:1	file- sharers	dec	nov	oct	sep	aug	jul	jun	may	apr	mar	feb
Aug-02	59548000	3,525,393	0	0	0	0	1	0	0	0	0	0	0
Sep-02	42038000	3,833,852	0	0	0	1	0	0	0	0	0	0	0
Oct-02	55759000	3,778,338	0	0	1	0	0	0	0	0	0	0	0
Nov-02	63189000	3,929,814	0	1	0	0	0	0	0	0	0	0	0
Dec-02	102115000	3,967,191	1	0	0	0	0	0	0	0	0	0	0
Jan-03	51302000	3,992,356	0	0	0	0	0	0	0	0	0	0	0
Feb-03	49153000	5,144,685	0	0	0	0	0	0	0	0	0	0	1
Mar-03	44244000	5,731,877	0	0	0	0	0	0	0	0	0	1	0
Apr-03	45489000	5,127,449	0	0	0	0	0	0	0	0	1	0	0
May-03	51368000	4,127,373	0	0	0	0	0	0	0	1	0	0	0
Jun-03	44325000	3,113,631	0	0	0	0	0	0	1	0	0	0	0
Jul-03	52931000	2,418,593	0	0	0	0	0	1	0	0	0	0	0
Aug-03	43614000	2,630,960	0	0	0	0	1	0	0	0	0	0	0
Sep-03	43869000	2,891,645	0	0	0	1	0	0	0	0	0	0	0
Oct-03	58012000	3,764,032	0	0	1	0	0	0	0	0	0	0	0
Nov-03	66548000	2,498,431	0	1	0	0	0	0	0	0	0	0	0
Dec-03	107341000	3,239,298	1	0	0	0	0	0	0	0	0	0	0
Jan-04	57527000	3,528,419	0	0	0	0	0	0	0	0	0	0	0
Feb-04	55266000	4,039,989	0	0	0	0	0	0	0	0	0	0	1
Mar-04	47710000	4,603,571	0	0	0	0	0	0	0	0	0	1	0
Apr-04	58787000	4,688,988	0	0	0	0	0	0	0	0	1	0	0
May-04	45159000	4,589,255	0	0	0	0	0	0	0	1	0	0	0
Jun-04	58670000	4,583,920	0	0	0	0	0	0	1	0	0	0	0
Jul-04	47638000	4,584,111	0	0	0	0	0	1	0	0	0	0	0
Aug-04	46945000	4,549,801	0	0	0	0	1	0	0	0	0	0	0
Sep-04	54704000	4,687,536	0	0	0	1	0	0	0	0	0	0	0
Oct-04	43962000	4,435,395	0	0	1	0	0	0	0	0	0	0	0
Nov-04	60911000	5,445,275	0	1	0	0	0	0	0	0	0	0	0
Dec-04	118458000	5,500,314	1	0	0	0	0	0	0	0	0	0	0
Jan-05	42365000	6,129,512	0	0	0	0	0	0	0	0	0	0	0
Feb-05	50710000	6,183,636	0	0	0	0	0	0	0	0	0	0	1
Mar-05	59735000	6,016,247	0	0	0	0	0	0	0	0	0	1	0
Apr-05	42805000	6,297,457	0	0	0	0	0	0	0	0	1	0	0
May-05	45315000	6,390,327	0	0	0	0	0	0	0	1	0	0	0
Jun-05	57479000	6,508,351	0	0	0	0	0	0	1	0	0	0	0
Jul-05	43878000	6,872,768	0	0	0	0	0	1	0	0	0	0	0
Aug-05	43294000	6,871,308	0	0	0	0	1	0	0	0	0	0	0
Sep-05	53502000	6,747,591	0	0	0	1	0	0	0	0	0	0	0
Oct-05	44382000	6,530,408	0	0	1	0	0	0	0	0	0	0	0
Nov-05	55975000	6,858,477	0	1	0	0	0	0	0	0	0	0	0
Dec-05	115023000	6,978,715	1	0	0	0	0	0	0	0	0	0	0
Jan-06	44840000	6,986,980	0	0	0	0	0	0	0	0	0	0	0
Feb-06	51035000	6,978,098	0	0	0	0	0	0	0	0	0	0	1
Mar-06	58969000	7,002,830	0	0	0	0	0	0	0	0	0	1	0
Apr-06	45706000	6,357,582	0	0	0	0	0	0	0	0	1	0	0
May-06	44466000	6,729,812	0	0	0	0	0	0	0	1	0	0	0

H. Other and Older Criticisms

From : “Pitfalls in Measuring the Impact of File-sharing on the Sound Recording Market.” CESifo Economic Studies Vol. 51, 2-3/2005, pp. 435-473. [Found here](#). [Discusses older version of O/S paper but still relevant]

The paper by Oberholzer and Strumpf (O&S) uses records as the unit of analysis. Unlike almost everyone else, Oberholzer and Strumpf were allowed access to actual downloads logs on a server that was part of a file sharing system. They then matched music downloads to the recordings where the songs appeared. Using data from SoundScan on recordings they then compared the downloads of songs to the sales of songs over a seventeen week period. The creation of this data set was a substantial effort requiring much work and creativity. Whether it can be used to determine the impacts of file-sharing, however, is another question.

There are two potential problems. First, can an analysis using records as the units of observation provide information about the impacts on the entire industry, as opposed to the impacts on individual recordings? Assuming that this first problem is not an issue, a second obstacle exists – there is a serious simultaneity problem in the data because popular songs are going to be both heavily purchased and heavily downloaded. Overcoming such a simultaneity problem is no easy task.

More problems with the unit of analysis: Potential fallacy of composition

To make this concern concrete, imagine that we wished to learn what the elasticity was for the wheat industry. What would happen if we estimated the elasticity of demand for each of the firms within the industry and then assumed that the elasticity for the industry was the average of the elasticities of its constituent parts? We all know, and teach our students, that industry elasticity is much lower than the elasticity facing the firms because there are fewer close substitutes for consumers at an industry level than there are at the firm level. This would be an example of the fallacy of composition that sometimes occurs when going from constituent parts to the whole.

A similar compositional problem would occur with respect to advertising at the firm level versus advertising at the industry level. The advertising analogy is particularly useful apropos record sales due to the fact that downloading, sales, and popularity are all related in some sense to the ‘buzz’ that surrounds a recording, part of which is directly due to advertising.

Assume that downloading increases the sales of a record. Perhaps downloading creates a buzz for record x and people buying records buy those records with buzz. Or perhaps downloading allows consumers to sample a high quality recording such as x, leading to an increase its sales. In this example, heavy downloading makes recording x more successful than lightly downloaded recording y.

A regression using downloads to explain sales would return a positive coefficient, assuming that all other simultaneity problems were overcome. After all, increases in downloads, by assumption, lead to an increase in the sales of the downloaded recordings in this example. But that does not mean that downloads increase overall record sales. A positive coefficient could be entirely consistent with record sales being severely harmed by downloads and thus couldn’t answer the question about the overall impact of downloading.

The sampling story, discussed above, is a case in point. Sampling might lead to greater sales for those recordings providing higher quality, but it is likely to lead to an overall decrease in record sales as discussed above. Any informational aspect of downloading separate from sampling, if there were one, has a similar result. Political advertising clearly increases the market share of individual candidates (increases their ‘buzz’), but it need not, and probably has not historically increased total voter turnout. Yet a regression on individual advertising campaigns would show that when candidates increase their spending they generate a higher share of votes (or higher poll numbers).

Liebowitz (2004a) shows a similar result for the impact of radio broadcast on record sales. Although radio play obviously has a positive impact on market share of individual records, and would be expected to have positive coefficient in a regression of radio broadcast impact on the sales of individual records, its impact on overall record sales appears to be zero or negative.

Still, the existence of compositional difficulties is not proven but merely suggested. Nevertheless, the methodology of O&S is suspect and should be treated with caution.

Their conclusions versus their results

O&S suggest that their results indicate that file-sharing has no impact on the sales of sound recordings because they emphasize their most ‘pessimistic’ results. I read their paper differently and believe that a more appropriate representation of their results would be to conclude that file-sharing has a positive impact on sound recordings.

O&S begin their regression analysis by looking at their universe of approximately 650 recordings and the relationship of sales to downloads (their Table 11). As a benchmark they run a regression with sales as the dependent variable and downloads as an independent variable (using musical genres as additional independent variables). The coefficient on downloads is 1.07 and statistically significant. Of course, this coefficient is infected by the simultaneity problem mentioned above, implying that the coefficient is biased upward.

In an attempt to solve the simultaneity problem, O&S use several instrumental variables related to the length of songs on the albums, which they argue are appropriate instruments in a first stage regression with downloads as the dependent variable. In the second stage of their two stage regression the coefficient on fitted downloads (with sales as the dependent variable) is significantly positive, at 1.467. Strangely, the use of instruments that were supposed to control for the upward bias in the coefficient on downloads actually leads to an increase in the coefficient. It would appear that the instruments are completely failing to control for the simultaneity, yet the diagnostics relied upon by Oberholzer and Strumpf do not warn of this failure.

Given parameters used elsewhere in their paper, the coefficient in this instrumented regression translates into additional sales of 198 million albums caused by file-sharing. This result would imply, if taken seriously, that file-sharing has led to an increase in sales on the order of 25% of year 2003 sales. Given the actual decline since year 2000 of almost 300 million units, this positive impact of file-sharing is rather difficult to accept as being even remotely plausible. O&S tend to skip quickly by this result, however.

Their Table 12 adds weekly information into the mix, allowing O&S to use a fixed effects model. Since the fixed effects model includes a dummy for each sound recording, some of the simultaneity is taken care of merely by the use of the fixed effects model. The coefficient on downloads drops from 1.193 to .28. However, there is still simultaneity going on week to week since records are more and less popular over time. Again, O&S introduce several instruments in an attempt to solve the simultaneity problem.⁵⁰ The second stage coefficient on downloads, in their two preferred models, are close to zero, taking on values of -.014 and +.088. The -.014 implies that it would take 5000 downloads to decrease sales by 1 album, a number they have repeated several times when describing their results. The “preferred” measurement (.088) would translate into a gain due to downloading of 12 million albums, which is quite small.

There is an important conceptual error in using these regressions to calculate the overall impacts, however. These regressions give each record album equal weight in the analysis. This would not be appropriate to answer a question about the overall impact of downloads on sales unless the impact of downloads on sales was the same for high selling records as it was for low selling records. O&S accidentally test this assumption in their Table 13 where they find that the impact of downloads is higher for albums in the top quartile of sales than it is for less popular albums. Since the top quartile of albums represent the large majority of total sales (85%), giving equal weight to all albums causes O&S to come to erroneous conclusions regarding the overall impact of downloads.

In their table 13, the quartile of largest sellers has a coefficient of .468 (t=1.52). This coefficient implies an increase of 63 million albums due to downloading. Although the level of statistical significance is slightly below traditional norms, this is not the ‘zero’ impact that O&S emphasize in their conclusions.

⁵⁰ One of these variables is the number of German schoolchildren on holiday, which can be viewed as either a choice of subtle inspiration or one bordering on the ridiculous. I tend toward the latter view and the reader can see my webpage for more details <http://www.utdallas.edu/~liebowitz/intprop/germankids.htm>.