Review of Economic Research on Copyright Issues, 2010, vol. 7(1), pp. 67-81

RADIO AIRPLAY, DIGITAL MUSIC SALES AND THE FALLACY OF COMPOSITION IN NEW ZEALAND

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Abstract. I examine the effect that radio airplay has on the sale of digital music in New Zealand. This effect is also likely to influence the behavior of various music industry participants, including the record companies, radio industry and listeners. I find that on an industry level, radio airplay has no significant effect on the sale of digital music. However, on average, an increase in radio airplay of a given song is predicted to increase sales of that song, which is the so-called exposure effect. The discrepancy between the aggregate and individual effects is explained by the existence of the fallacy of composition: An increase in the airplay of a particular song usually happens at the expense of another song's airplay, and so if more airplay does give greater sales of a given song, so less airplay will reduce the sales of competing songs, leading to ambiguous aggregate effects. It is also true that while individual songs compete with other songs for airplay, the radio industry competes with other activities and products consumed by listeners. Increases in the total airplay may not increase total sales, as the listener's decision regarding digital single purchase is now made with consideration of their non-music consumption goods, and budget and time constraints.

1. Introduction

Music copyright laws have a wide impact in New Zealand and overseas, due to the large number of people who participate in the music industry, and are important as they affect the amount of music that is produced and broadcast to listeners. This paper attempts to determine whether or not the producers of music are adequately compensated for their work. This issue is becoming increasingly relevant in policy, as illustrated recently by the lawsuit filed by the Phonographic Performance Company of Australia against gyms in Australia, demanding an increase in the fees they charged for playing music (O'Neill, 2009), and by a series of court hearings around the world attempting to determine the fair tariff that radio stations should pay for the music they broadcast.

I thank the managing editor for helpful comments, and above all the insightful comments and suggestions of a referee which have greatly improved this paper.

The relationship between radio and record sales is traditionally believed to be symbiotic, whereby radio promotes the sale of music while, at the same time, earning advertising revenue by increasing listenership through music broadcasts. More recently, empirical studies with U.S. data indicate that radio broadcast of music led to a decrease in record sales as a percentage of GDP during the Depression, while radio had no significant impact on record sales as a percentage of GDP in Britain over the last three decades (Liebowitz, 2004). Using U.S. data from 2004 and 2006, Dertouzos (2008) found airplay to have a positive effect on record sales.

The effect that airplay has on sales is important in determining whether the value to record companies of radio broadcasting their songs is positive or negative. A market failure could occur if radio airplay was found to lower sales and record companies were inadequately compensated by radio for this effect, as their incentive to produce music would be reduced relative to the socially efficient quantity (Liebowitz, 2004). If, on the other hand, radio airplay was found to promote sales, fees currently charged to broadcasters may not just affect the radio industry but the record industry as well (Dertouzos, 2008). Specifically, revenue-based fees are unlikely to affect the production of music as they represent a lump-sum transfer of revenue. Fees based on audience exposure would reduce the incentive to produce music by acting as a progressive marginal tax rate imposed on each unit of song produced and, in the process, also indirectly costing other music industry participants (Dertouzos, 2008).

In New Zealand, an estimated NZ$4.6 million is paid annually by the radio industry to music copyright holders through a non-profit collection agency called the *Phonographic Performance of New Zealand* (Thorne, 2009). PPNZ distributes broadcasting licences to various organizations that play music to public audiences, including radio, restaurants, shopping malls, amusement parks, dance classes, cinemas, swimming pools, and jukeboxes (see the PPNZ website at www.ppnz.co.nz). It is important to note that, at least for the case of radio broadcasting, the 'good' that is offered by collective rights organisations such as PPNZ is a blanket license to the entire repertory of songs. Thus, at least for the case of radio broadcasting of music from this repertory, it is of interest to collectives how broadcasting activity affects the sales of the entire repertory, not just sales of those elements that are chosen to be broadcast. That is, the collective is interested in the aggregate effect of airplay upon aggregate sales, not on specific individual effects of particular songs or collections of songs (e.g. LPs) from the repertory.

2. Theory

This paper examines the effect that radio airplay has on the sale of digital music. Innovations and improvements in internet access, software and digital players have increased the accessibility and relevance of digital music. The effect that radio has on digital music sales can be evaluated from two perspectives. On a 'global' level, one can consider whether the (hypothetical) absence of radio would result in increased, decreased or equal digital singles purchase than current consumption. On a marginal basis, the effect that additional radio airplay has on digital music consumption can be evaluated at any level of sales, and is determined by two main consumer effects, namely the exposure effect and the substitution effect.

The exposure effect is seen when radio acts as an advertising medium by allowing audiences to try out newly released music (Liebowitz, 2004). Listening to the radio is indicative of a tendency to enjoy music and suggests an increased likelihood of purchase. Current consumers are also likely to listen to the radio to help determine their next purchase. Radio can, therefore, be viewed as a complementary product to digital music, suggesting that increases in radio plays lead to increases in sales. While this exposure typically results in increased sales, it can also reduce consumption as consumers reach satiation faster (Liebowitz, 2004). Under the exposure effect, efficiency would require record labels to pay radio stations some form of compensation for playing their music.

The substitution effect arises when radio acts as an replacement for pre-recorded music, partly because consumers are constrained by the total amount of time available to listen to music (Liebowitz, 2004). The popularity and abundance of radio stations means a wide range of music genres are offered in the market, rendering radio a near-perfect substitute for pre-recorded music for many consumers. It also offers features such as "disk-jockey patter" (Liebowitz, 2007), and the opportunity to participate in competitions to win prizes. Furthermore, consumers typically face budget constraints on the income available for music consumption. Radio has relatively lower costs than pre-recorded music (Liebowitz, 2007), making it a more attractive alternative. The substitution effect predicts consumer demand favouring radio over digital music, and suggests that radio plays lower singles sales, in which case efficiency would require radio to pay record lables some form of compensation for the music that they broadcast.

On the other hand, in the case of digital music, mp3 players and iPods offer features such as large memory, portability, convenience, commercial-free listening, and the ability to arrange songs into different playlists, shuffle songs and self-select playlists. These features make radio relatively less attractive, and weaken the substitution effect it has on digital music.

The overall effect is expected to consist of both the substitution and exposure effects, with the dominating effect determining the direction of correlation between airplay and digital sales. For record sales, statistics from the U.S. suggest that the substitution effect might dominates the exposure effect because the average consumer spends more time listening to the radio than playing records, thereby suggesting a reduced preference for records (Liebowitz, 2004). The advantages that digital music offers over records, and the subsequent weakening of the substitution effect, means that the expected net effect is uncertain. This overall effect is important in determining whether the current price of broadcasting music is justified, namely whether it represents a 'fair' price.

2.1. **Causality.** The causality between radio and music sales can flow in either direction. We have already seen how airplay might come to affect sales (either negatively or positively). But now assume that recorded music consumers make purchasing decisions based on either previous exposure to the artists' music or genre preference. Interactive radio stations, such as 'the Edge', allow listeners to participate in voting for their songs to be in their Top 20 list (see the website of 'The Edge' at http://www.theedge.co.nz/Music/Top20Vote/tabid/78/Default.aspx). Digital music consumers are able to reflect their purchases in their choices for radio playlists. Thus, music sales allow radio stations to broadcast music that listeners would likely enjoy, thereby increasing listenership and advertising revenue for stations. Again, if causality were to flow from sales to airplay, efficiency would require that radio pay a fee to record companies based on the additional advertising revenue earned.

2.2. **Fallacy of composition.** The fallacy of composition is defined by Liebowitz (2004) as, "what may be true for individual observations is not necessarily true for the entire group" (p. 39). For example, a positive coefficient for the average individual song and negative coefficient for the set of songs broadcast by a radio station are not necessarily inconsistent. According to Liebowitz (2004), "increased play of one record must lead to a decreased play of other records", suggesting that songs within the set are substitutes (p. 39). In estimating the effect of airplay on sales for individual songs, the effects of a particular song's airplay on a different song's sales are not controlled. A positive coefficient for any given song in the set indicates that increasing the airplay of the selected song is accompanied by an increase in its sales, instead of other songs. On the other hand, increasing the aggregate level of airplay suggests that the radio station's music is competing for time and money with other activities the listener engages in. The effect of an increase in total airplay on total sales can be negative if the audience's budget and other preferences are considered.

Payola, whereby record companies pay radio stations to broadcast their songs (Connolly and Krueger, 2006), does not necessarily stem from an aggregate positive effect of airplay on sales. Instead, it indicates that for some songs record companies perceive radio broadcasts to be more valuable in increasing sales than for other songs. The existence of payola in an industry, therefore, does not provide conclusive evidence that the recording industry as a whole benefits from and values radio broadcast of songs (Liebowitz, 2004).

2.3. **Effect of the song's release date.** The aggregate effect that radio has on sales is also expected to depend on the age of the songs. For songs from older decades, such as the 1950's or 1960's, owners of vinyl records use digital files as a means of preserving their music for play in the 21st Century. Digital sales are expected to be positively elastic or inelastic to radio broadcast of these songs, as purchasers largely tend to be listeners who are already familiar with the music. Over the last decade, digital music players such as Apple's iPod have experienced rapid increases in popularity. As newly released music seems to dominate the airwaves for the first few weeks, consumers with the latest technology are also likely to gain maximum exposure to songs from 2000 onwards, and hence are more likely to purchase recently released songs than older ones. The popularity of digital devices is a possible explanation for an expected positive effect of airplay on sales for songs from the last decade.

While this prediction can be tested by regression, the release dates for all of the songs in the data set used for this report could not be found. In addition, it appeared that none of the songs for which release dates were found is a New Zealand song. Excluding these data from the regression analysis would introduce a bias into the empirical results. New Zealand music may require less radio broadcasting in order to sell in New Zealand than does American or British music because musicians are able to perform live for fans much more easily across the country.

3. Data

An 'airplay' point for each song is an index measure of the amount of time that song has been played on the radio, with greater weight allocated for broadcasts to larger audiences. The variable 'sales' represents the number of units of digital music that have been sold, where each unit is one song. The dataset considers the sale to be zero if the price of the song is less than $1.50, which contributes to the large number of zero sales in the dataset, and increases the likelihood that the coefficient of airplay will be biased towards zero. Songs released after May 2007 (when the dataset begins) also have airplay and sales recorded as zero for the weeks before release, making it difficult to calculate a regression coefficient.

Figure 1 plots the aggregate sales and aggregate airplay for the same 7,961 songs over 87 weeks. Digital music sales trends upward over time from 4,532 units in the week ending 6 May 2007 to 63,241 units for the week ending 28 December 2008. The rapid growth in digital sales might be partly attributed to the development of mp3 players and iPods. In contrast, total airplay points for the radio industry do

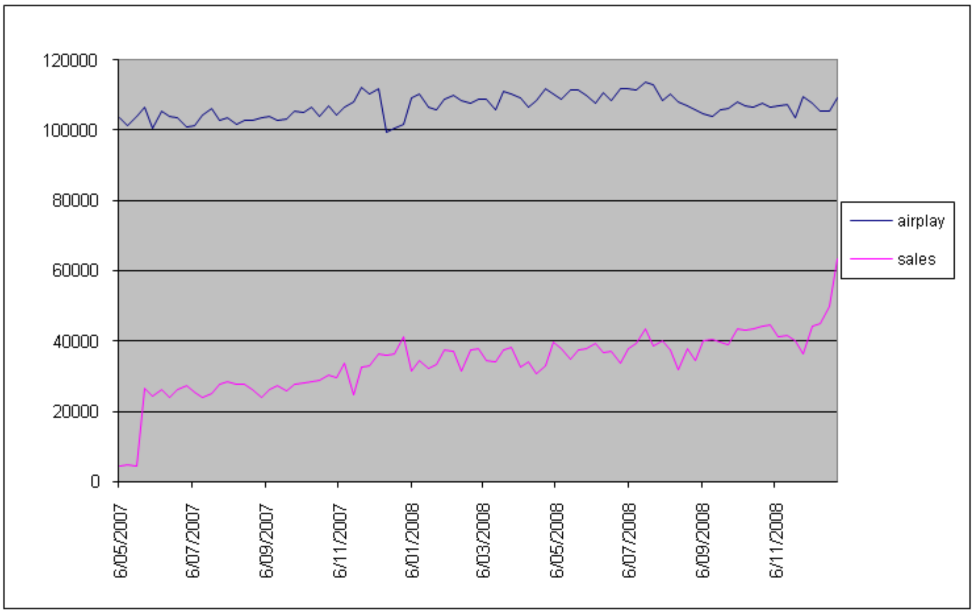

Figure 1. Data: Total Airplay and Total Sales

not move far from its initial level of 103,608. This relative stability of airplay could possibly be explained by the limited number of hours per day that radio stations have to broadcast music. This time constraint can be expanded by either trading with talk-radio or by increasing the availability of radio frequencies on which to broadcast.

As both lines follow a steady upward trend, the regression results need to be interpreted cautiously. Correlations between airplay and sales may simply indicate a linear association between the two, rather than a causal connection.

4. Model Specification, Estimation and Testing

4.1. **Granger-Causality.** A Granger-causality test can determine whether two or more variables arbitrarily move together. While Granger-causality may be established in either or both directions, there may still be some other underlying variable that 'causes' the movement in the variables. Granger-causality is a measure of predictability.

In this case the Granger-causality test was used to check whether sales drives airplay and also if airplay drives sales. The first test involved regressing sales on five lags of sales and five lags of airplay. Next, an F-test was applied to the lags of the explanatory variable, airplay, to check if they were jointly significant. Joint significance of the lags of airplay would imply that airplay Granger-causes sales. Similarly, the second test regressed airplay on lags of sales and lags of airplay to check if the lags of sales were jointly significant. Joint significance of these variables could be interpreted as sales Granger-causing airplay.

Causality for individual songs in the dataset was also tested. Two songs in the dataset on which to run tests for Granger-causality were chosen randomly. In order to keep the song selection unbiased, a random number generator on a scientific calculator was used. Songs were selected by their corresponding identification number, which were allocated alphabetically, only if they had a sufficient proportion (more than half the airplay and sales) of non-zero values. The two songs selected were 'Better Man' by Pearl Jam and 'She Moves in her Own Way' by the Kooks, numbers 5060 and 7020, respectively, in the dataset.

The Granger causality test on the song 'She Moves in her Own Way' was performed by regressing sales on five lags of sales and five lags of airplay, followed by regressing airplay on five lags each of sales and airplay, and evaluating subsequent F-tests. The Granger causality test on 'Better Man' was performed in an identical manner.

4.2. **Aggregate effect.** The Granger test produced a result that was inconclusive in either direction. It is, therefore, arbitrary which regression is chosen to be explored. For this report, the effect that extra airplay has on sales is determined by regressing total sales on total airplay. The total airplay points over all songs and total sales of all songs were calculated for each week, with each week's data constituting one observation in the regression. The model initially included four lags of airplay to consider the effect that song broadcasts in a given week might have on future sales. The delay effect considers that consumers may not demand the song in the week during which they hear it, so that the eventual purchase of the song may still be attributable to the original hearing. A lagged sales variable was also included in the model.

As all four lags were individually insignificant, an F-test checks the joint significance. As the resulting p-value was less than 0.05, all four lags were deleted. The final model has sales as the dependent variable, with only airplay and one lag of sales as the explanatory variables.

4.3. **Testing the fallacy of composition.** The fallacy of composition implies that the aggregate effect of airplay on sales may differ from the average effect obtained by individual regressions for each song. In order to check if the fallacy exists in this context, a regression of sales on airplay and one lag of sales was run for each individual song in the database. This model was specified to match the model which used aggregate values in order to enable direct comparison between the two models. The average coefficient of airplay was obtained by summing the airplay coefficient for each song and dividing this value by 7,961.

The p-value for each regression was obtained using the coefficient and standard error values for each regression, which were extracted using *Stata*. From these, individual t-statistics were generated, enabling the p-values to be calculated by altering the formula $pvalue = 2(1 - T(df, |t|))$ for *Stata*'s use, as per Maarten Buis' suggestion (Buis, n.d.). A significance count was performed on the data by counting the number of coefficients whose p-value was less than or equal to 0.05. Regressions for which no p-value could be computed were not included in this count.

The distribution of coefficients was also found by counting the number of positive and negative coefficients obtained in the regressions. Subset ranges were then created to compare how many results were significant for coefficients near zero, or highly negative or positive. Significance tilting in either direction could reduce the accuracy of the mean coefficients. As the insignificant coefficients are not distributed evenly across the range of coefficients, they do not balance each other, resulting in a mean coefficient that is positively biased. In this case, a mean of the significant coefficients would also need to be calculated.

The average coefficient of airplay was compared to its corresponding aggregate value. A difference that is large relative to these two values implies that the industry-wide effect of airplay on sales does not reflect the same effect for individual songs. The existence of payola in this case would, therefore, not suggest that the recording industry benefits from radio broadcasts of their songs.

5. Empirical Analysis

5.1. **Granger causality.** The results of the three Granger causality tests are summarised in Table 1. The column on the left lists the regressions used, the first being the aggregate values, followed by the two randomly drawn songs in the database. The values in the cells refer to p-values obtained from running joint F-tests on the lags of the causal variable.

5.2. **Aggregate regression.** The effect of aggregate airplay on aggregate sales was determined by regressing sales on airplay and one lag of sales. The total number of observations used in this regression is 86 for 87 weeks. The adjusted R-squared is 0.75, indicating that well over 70% of the change in sales is explained by movements in either current airplay or the previous week's sales. Table 2 shows the results obtained from this regression: the coefficient for airplay obtained is 0.24, and has a p-value of 0.12. The 95 % confidence interval is -0.06 to 0.53.

Table 1: Granger Causality Test p-values		
Regression	$A \to S$	$S \to A$
Aggregate	0.73	0.41
Song 1	0.40	0.15
Song 2	0.07	0.02*

* indicates significance at the 5% level.

A = airplay, S = sales, and $X \to Y$ reads "X Granger-causes Y".

Song 1 = 'She Moves in Her Own Way', song 2 = 'Better Man'

Table 2: Aggregate Regression for Sales			
	Airplay	Sales 1	Constant
Coefficient	0.236	0.827	-18746.39
Standard Error	0.15	0.06	15157.82
t-statistic	1.59	13.89	-1.24
p-value	0.12	0.00*	0.22
95% Confidence Interval	-0.06 to 0.53	0.71 to 0.95	-48894.69 to 11401.91

Aggregate regression by OLS. *indicates significance at 5% level

5.3. **Fallacy test.** The mean coefficient for airplay obtained from running a regression for each song is 0.04. As this value is derived from adding individual coefficients and dividing by the total, 7,961, an accompanying average p-value could not meaningfully be obtained.

The coefficients obtained from the individual regressions are plotted in Figure 2. The number of positive coefficient values is 4,071, while the number of negative coefficient values is 3,826. The graph shows a large amount of variability in the coefficient values. Furthermore, less than one-quarter of the results, 1,883 of a total 7,961 is significant. The large variability in coefficient values and low proportion of significant results means it is difficult to determine if the calculated mean reflects the effect of airplay on sales for individual songs.

Table 3: Distribution of Significance of Airplay Coefficient				
Coefficient ranges	Significant	Insignificant	no p-value	total
less than -2.5	0	2	0	2
between -2.5 and 0	75	3,749	0	3,824
equal to 0	0	0	64	64
between 0 and 2.5	1,796	2,248	9	4,053
between 2.5 and 5	9	6	0	15
greater than 5	3	0	0	3
Total	1,883	6,005	73	7,961

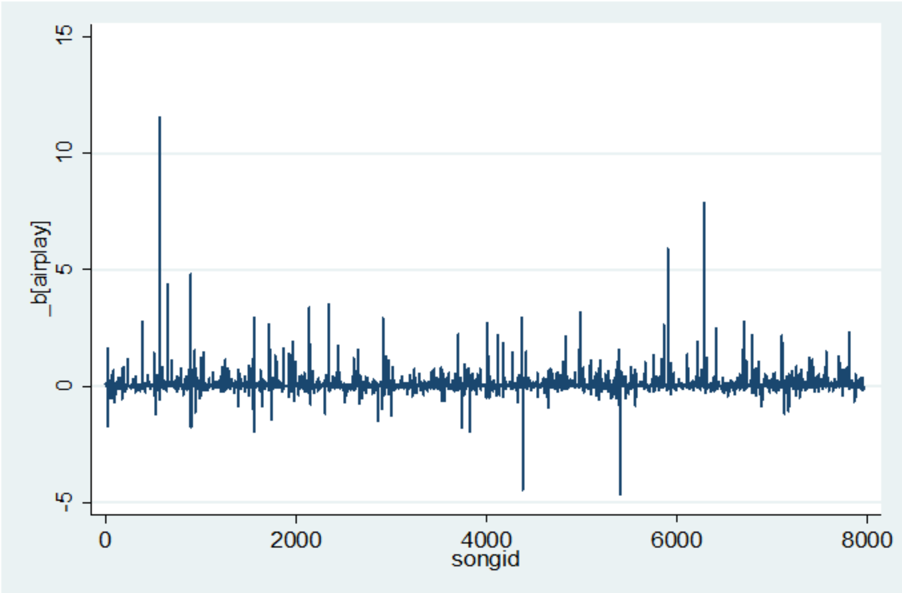

FIGURE 2. Coefficient of Airplay for Individual Songs

Table 3 displays the distribution of significant results across the range of values. There are eighteen regressions for which the coefficient of airplay is at least 2.5, of which twelve regressions produce significant results. Of these eighteen regressions, there are three regressions for which the coefficient is at least 5, of which all are significant. In contrast, there are two regressions with a coefficient value of at most -2.5, neither of which is significant. There are 3,752 insignificant regressions that produce a negative coefficient, compared with only 2,254 insignificant positive coefficients. The obtained mean coefficient does not consider the upward tilt in significance, as illustrated in Figure 3.

Insignificant results can be interpreted as having no conclusive effect on the dependent variable. As a lack of significance suggests a coefficient of zero, this allows an upper bound of the mean to be calculated by setting the insignificant negative coefficients to zero. The mean of the significant regressions is calculated by summing only the significant coefficients, and dividing by the total 7,961 songs, in which case the significant mean coefficient obtained is 0.036.

5.4. **Analysis of Granger-causality.** The null hypothesis for the Granger causality test is that there is no causality, and is not rejected if the F-test for joint significance produces a p-value greater than 0.05. In the test of airplay Granger-causing sales, the resulting p-value is 0.73, which is substantially greater than 0.05. This indicates that the lags of airplay are jointly insignificant, suggesting that airplay

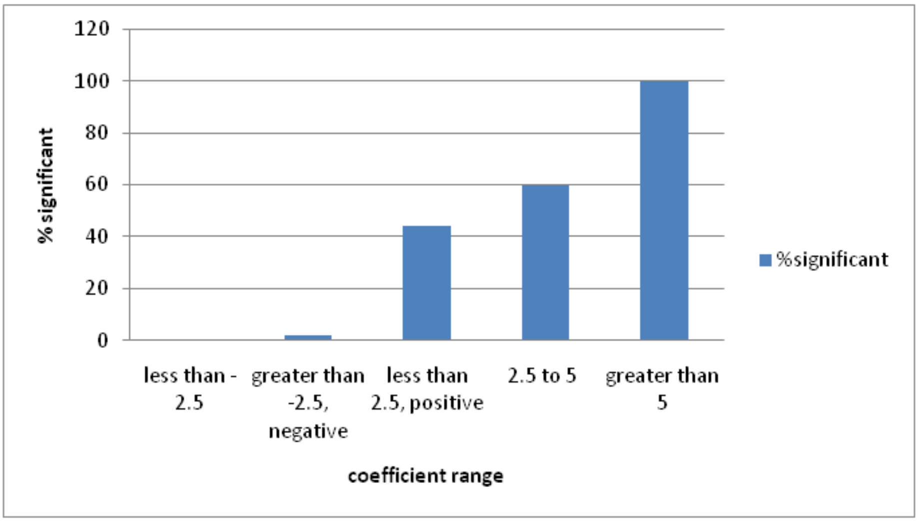

FIGURE 3. Distribution of Significance of Coefficients

does not Granger-cause sales. The p-value of 0.41 from an F-test on the lags of sales also exceeds 0.05, implying that sales do not Granger-cause airplay. As the null hypothesis cannot be rejected in either case, Granger-causality between aggregate sales and aggregate airplay does not work in either direction, so that neither can predict the other.

For the song 'She Moves in Her Own Way', with sales as the dependent variable, an F-test on the lags of airplay produces a p-value of 0.40, which exceeds 0.05 and indicates a lack of evidence that airplay Granger-causes sales. An F-test on the lags of sales with airplay as the dependent variable results in a p-value of 0.15, which also exceeds 0.05, thereby suggesting no evidence that sales Granger-causes airplay. For this song, Granger-causality does not run in either direction.

For the song 'Better Man', with sales as the dependent variable, an F-test on the lags of airplay produces a p-value of 0.07, which exceeds 0.05, and indicates that there is no evidence that airplay Granger-causes sales. With airplay as the dependent variable, an F-test on the lags of sales results in a p-value of 0.02, which is less than 0.05. This result is significant because it implies that sales Granger-causes airplay, but not the reverse.

5.5. **Analysis of aggregate regression.** The coefficient for airplay of 0.24 is interpreted as a one-hundred point increase in airplay points being accompanied by an increase in digital music sales of 24 units. However, the accompanying p-value for this coefficient exceeds the 0.05 significance level at 0.12. The coefficient value also lies within the 95% confidence interval, suggesting that the null hypothesis that airplay has no effect on sales cannot be rejected.

5.6. **Analysis of the fallacy test.** The positive value of 0.035 obtained for the mean coefficient indicates that there are songs in the database for which increased airplay is associated with increased sales. However, it is unclear whether it is the case that most songs enjoy increased sales from increased airplay, or that only a few songs enjoy a large increase in sales when airplay increases.

Furthermore, the distribution of significance of the individual coefficients indicates that negative coefficients are more likely to be insignificant from zero. This suggests that using these insignificant values to obtain the mean coefficient value underestimates the effect that increased airplay has on increasing sales for the average song. However, the possibility that airplay does not affect sales for these songs with an insignificant coefficient still remains.

The mean coefficient obtained from summing only the significant coefficient values is 0.036, which is close to the mean of 0.035. A one-hundred-point increase in airplay for the average song is expected to be accompanied by an increase in sales of roughly 3.5 units for that song. As this value is less than one-sixth of its aggregate counterpart of 0.24, the aggregate effect does not accurately reflect the average individual effect, suggesting the fallacy of composition. A one-hundred-point increase in the aggregate airplay of the songs in the dataset is not expected to significantly affect the total sale of those songs, suggesting that at an aggregate level, music radio neither promotes nor replaces digital music to listeners.

The existence of payola in the industry does not constitute evidence for the theory that industry-wide radio broadcasting promotes music sales. The aggregate coefficient for airplay is 0.24 and is insignificant, implying that airplay has no effect on sales. The weak correlation between airplay and sales for the average individual song suggests that payola would not be effective in raising sales for the average song. However, the range of coefficients produced in the individual regressions suggests that payola might be beneficial for some songs.

6. Policy Considerations

6.1. **Implications.** The insignificant coefficient for airplay obtained in the aggregate regression means the effect that airplay has on sales cannot be determined. As the null hypothesis assumes a zero effect, an inability to reject this null hypothesis means that airplay has no effect on sales. Based on this result, the efficient fee charged to radio stations in order to correct for damages to sales is zero (that is, outside of any fee that should be paid in exchange for the use of music by radio stations to generate advertising revenue).

For individual songs, the results of the Granger-causality tests and fallacy of composition checks both indicate that increasing airplay is associated with increased sales for some songs. Efficiency would require radio stations to charge recording companies a fee for promoting these songs (payola). For a few songs, increasing airplay is associated with decreasing sales, suggesting that efficiency would require radio stations to receive compensation from recording companies for these songs.

As it is difficult to predict which songs benefit from radio broadcast before their release, charging record companies fees for only some songs is impractical. However, when radio stations are under-compensated, their incentive to broadcast music is reduced. This ultimately harms the singers in the industry for whose songs airplay and sales are positively correlated. A superior solution would be for radio stations to devise a screening mechanism to classify the songs into groups based on whether or not they are likely to benefit from radio airplay.

6.2. **Caveats.** Limitations of the research were due mainly to difficulties in obtaining relevant New Zealand data. Data on weekly sales of mp3 players and iPods across New Zealand would allow for digital sales increases, resulting from a surge in the growth of such technology, to be controlled in the analysis, and reduce the likelihood of obtaining biased coefficients.

Increasing the sample size would increase its validity, especially for the individual regressions. The data for airplay and sales cover a time-span of 87 weeks. This means that in running the 7,961 individual regressions with a one-week lag of the dependent variable, only 86 observations could be used for each regression, suggesting that the coefficients obtained from these regressions may not be efficient. Moreover, abnormal events in either the digital music industry or the radio industry during that time may affect the validity of the results. Increasing the number of observations to two years would help to reduce the impact of any such significant events.

The arbitrary truncation in the dataset, whereby sales at a price of under $1.50 are registered as zero means that the estimated coefficient for airplay is likely to be biased towards zero. This problem could be avoided by having the sales of each song registered in the dataset as independent of the price at which it is sold. The average price of each song across the different digital music sales websites could then be included in the dataset to control for any price effects that may distort the airplay coefficient.

For songs that had not been released before the beginning of the data set, both airplay and sales are represented by zero for a given week. A large number of such (0,0) points makes it difficult to compute a regression coefficient, as the points will be clustered at the origin. Furthermore, many of these points do not communicate the value of radio airplay to digital sales of a song. Removing these (0,0) points would avoid this problem, but the large number of such points in the dataset means that the filtered dataset would be small. Sorting out which points are informative and which are not would require the week of release of each song. Removal of the informative data points could also distort the coefficient results.

The accuracy of the mean coefficient for an individual song could be increased. The main obstacles faced when calculating this value are that not all regressions produce significant results. Including only significant results in the mean is a possible solution. Calculating the mean over the entire 7,961 regressions assumes that an insignificant coefficient is equivalent to a coefficient of zero. However, the significance count used to determine which results are significant is arbitrary in that coefficients with a p-value of 0.05001, for example, are deemed insignificant, while those with a p-value of 0.05 are counted. As a result, many regressions that are nearly significant have been excluded from the calculation of the mean. As insignificance is more common with negative coefficient values, this implies that the mean could suffer from upward bias. For this reason, the calculated significant mean coefficient is provided as an upper bound for the mean.

7. Concluding Remarks and Future Research

As mentioned above, an interesting study would involve checking the effect that airplay has on sales for songs from different decades. Coefficient differences across decades may then be explained by the level of technology that exists in recording music for that decade.

The decade of a song's release may also be correlated with the genre to which that song belongs. Consider the 1960s, when rock and roll was immensely popular, or the 1980s, when pop music dominated. Genre is another characteristic of the song that is likely to have an impact on the effect of airplay on sales. Mainstream current pop music would be expected to be more reliant on radio broadcasts to promote their music than music catering to niche markets, such as alternate, hard rock music. Coefficient differences across genres are also likely to arise from how devoted a fan base the music within that genre attracts.

The relationship between the positivity of a coefficient and its significance suggests that Granger-causality may also have a similar distribution across individual songs. By performing tests on each song to establish the direction of Granger-causality, these results can be compared with the coefficient of airplay obtained through individual regressions. If Granger-causality is more likely to be established for songs with a significant positive airplay coefficient, this would provide evidence that radio airplay is positively correlated with sales of digital music.

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