Short Paper

Are There Too Many Revivals on Broadway?
A Stochastic Dominance Approach

DAVID MADDISON

Department of Economics, University College London, Gower Street, London WC1E 6BT
E-mail: d.maddison@ucl.ac.uk

Abstract. According to many theater critics not only does Broadway produce too many revivals but there is an increasing tendency to produce revivals in preference to original shows. Nonparametric techniques are used to test for a trend in the proportion of new shows accounted for by revivals. These tests indicate that the proportion of revivals is indeed increasing over time. Using nonparametric techniques again to test for stochastic dominance it is difficult to argue that Broadway produces too many revivals. Although original productions on average run for longer, revivals are much less likely to close after only a small number of performances.

Key words: Broadway theater, stochastic dominance

1. Introduction

"I don't know of anybody that goes about looking for the cheapest play to result in the largest amount of profit and then deliberately go about producing it. I have never seen that happen."

Gerald Schoenfeld, Chairman of the Shubert Organization, America's largest commercial theatrical corporation, cited in Sponberg (1991).

In response to the work that has been done analyzing the film industry a number of authors, e.g., Reddy et al. (1998), Simonoff and Ma (2003), and Maddison (2004) have turned their attention to live theater. There are indeed numerous similarities between films and theater, most obviously in the way that the number of performances adjusts demand to fixed seating-capacity. Furthermore, it is clear that some of the processes by which a small number of films enjoy marked success whilst the majority are financial failures may also operate for live theatrical performances as well. Individuals cannot know the quality of the show in advance and base their choice about whether to see a particular show either on word of mouth or on the number of performances that a show has already achieved (on this see De Vany and Lee, 2001). Theatrical productions are just as exposed to critical comments as films and precisely the same question arises as to whether critics and prize-awarding committees actually influence the behavior of the theatergoing public (e.g., Eliashberg

and Shugan, 1997; as well as the papers by Reddy et al., 1998 and Simonoff and Ma, 2003).

There is however one important difference between films and theater. Theatrical performances are live performances and cannot be stored and then retrieved upon request. Depending on the underlying concept, reviving a theatrical production costs just as much as the original production. Furthermore, although films are occasionally re-released or are remade, revivals are infinitely more common in the theater. The reason for this is that re-released or remade films inevitably suffer from the fact that they compete against close substitutes in the form of privately held copies of the earlier work. In their studies of Broadway theater Simonoff and Ma (2003) and Maddison (2004) both find that original shows survive longer. Although this invites the question of why revivals are shown at all, paradoxically in recent years the number of revivals has actually outnumbered the number of original productions. According to most theater critics Broadway now produces too many revivals.

The trend toward revivals has been attributed to demographic changes in the theatergoing public and an ageing audience in search of nostalgia. Other people seem to believe that for whatever reason there are nowadays fewer great plays and musicals being written. Yet more have viewed this trend as a response to the sharply increased costs of staging a Broadway show making it more difficult to find financial backers willing to support what are claimed to be high-risk original productions (McNamara, 2001). Why are the costs so high?

The conventional view blames this on the inability of the performing arts to engineer cost savings due to the labor intensive nature of their activities and the limited scope for technological progress (Baumol and Bowen, 1966). Theater producers are also inclined to point to the inflexibility of the International Association of Theatrical Stage Employees and the American Federation of Musicians. In addition most of Broadway's houses are owned by either the powerful Shubert Organization, which owns 16 with a half interest in another or Nederlander Productions, with 9 theaters, or Jujamcyn Productions, with 5 theaters. Producers typically pay theater owners a percentage of the weekly gross takings and the salaries of the theater employees plus an additional flat rate weekly fee negotiated separately. These charges have gone up enormously in recent decades. For a discussion of these see Allen (1995); see also Loney (1995).

The purpose of this paper is to explore a little further the relationship between original productions and revivals. The first part of the paper simply subjects the claim that revivals form an increasing fraction of Broadway's output to an empirical test. The second part of the paper applies the concept of stochastic dominance to the question of whether Broadway produces too many revivals (or even not enough) when viewed from a financial perspective. The idea of stochastic dominance is that one project is preferred to another if there is always a higher chance of obtaining a more preferred outcome. The manner in which we test the proposition that one type of production stochastically dominates the other differs from the approach

taken by De Vany and Walls (2002) in their analysis of R-rated films. Specifically the approach taken here is nonparametric in nature and utilizes techniques more commonly encountered in the development literature used to compare the distribution of income for two populations or in agriculture where different crop yields have to be compared. The paper also tests for higher order forms of stochastic dominance as well. In order to answer both questions the paper takes advantage of a recently created database of Broadway theater productions.

The remainder of the paper is organized as follows. The next section describes the data source used in the analysis. The third section describes a nonparametric test for trends in the fraction of new Broadway theater productions accounted for by revivals. The fourth section provides further discussion on the concept of stochastic dominance including a series of nonparametric test results derived from the data set. The final section concludes.

2. Data Sources

All data are taken from the recently constructed Internet Broadway Database (henceforth IBDB). This database provides information on almost every show performed on Broadway in recent years. Information contained in the IBDB is derived primarily from theater programs (in most cases from a production's opening night) and from the League of American Theaters and Producers archives. All shows are placed in one of three broad categories: musical, play, or special. Specials are defined as any production not typically theatrical in nature and often presented for a limited run and are not analyzed here.

Productions are also classified according to whether they are originals or revivals. An original production obviously describes a show that appeared for the first time on Broadway. A revival is a subsequent production of a show usually with a different creative staff. Note that a show, which opened elsewhere and then transferred to Broadway, is classified as an original under this definition.

The IBDB includes the official opening date of a production and the total number of performances, excluding previews. Performance counts do not include benefit performances. The data are described in Table I and include all those plays or

Table I. Description of the dataset[a]

Variable	Mean	Std. Dev.	Min.	Max.
Musical	0.313	0.463	0	1
Original	0.739	0.439	0	1
Year	1978.019	12.078	1960	2003
Performances	198.835	485.658	1	7485

[a]*Source:* See text. Note that for some observations the number of perfprmances was censored because the play was ongoing.

Table II. The distribution of performance counts for Broadway shows[a]

	Mean	Median
Original plays 1960–2001	132	44
Revived plays 1960–2001	76	53
Original musicals 1960–1987	352	77
Revived musicals 1960–1987	232	73

[a]*Source:* See text.

musicals recorded on the IBDB database that opened between 1960 and 2003 for which complete records are available. Note that 1,887 observations are available for analysis and that these observations include 28 shows whose performance counts were censored by virtue of being ongoing.

Table II describes the distribution of performance counts for Broadway shows. It is clear that musicals tend to run for longer than plays. It is also evident that in all cases the mean number of performances exceeds the median number of performances pointing to the skewed distribution of performance counts. The question of whether original shows enjoy longer runs than revivals however depends on whether one judges by reference to the mean or the median. A small number of original shows appear to have had very long runs. The median values by contrast are much closer. Note that these calculations involve only those plays that opened between 1960 and 2001 and those musicals that opened between 1960 and 1987.

Leaving aside the characteristics of individual shows, in the financial year 2000/2001 Broadway shows generated $ 4.4 billion in spending for the economy of New York and supported 40,000 jobs (League of American Theaters and Producers, 2002). Ticket sales amounted to 11.9 million while the typical theatergoer was 43.7 years of age with an income of $105,000. Only 22.3% of theatergoers were from New York itself (League of American Theaters and Producers, 2003).

3. Are Revivals Becoming More Prevalent?

Consistent with the nonparametric approach taken elsewhere in the paper this section considers the question of whether revivals are becoming more prevalent using a nonparametric test for trends. Separate tests are provided for plays and musicals and the productions are ordered by the year in which they opened. Using the test described by Cuzick (1985), the results strongly suggest that the proportion of new shows accounted for by revivals is indeed increasing. For plays the test statistic (which is distributed as a standard normal variable) is 8.23 while for musicals it is 6.29 both of which are of course, highly significant. Table III illustrates the trends in the share of revivals over time.

Table III. Trends in the prevalence of revived shows[a]

Time period	Revived plays as a fraction of all new plays	Musical revivals as a fraction of all new musicals
1960–1969	0.152	0.047
1970–1979	0.296	0.230
1980–1989	0.298	0.261
1990–1999	0.429	0.380
2000–2003	0.457	0.368

[a]*Source.* See text.

4. Do Revivals Stochastically-Dominate Original Productions?

First-order stochastic dominance involves the relationship between two probability distributions. Let the possible financial returns from projects A and B be described by statistical distributions A and B. Payoff distribution A first-order stochastically dominates payoff distribution B if for every possible payoff, the probability of getting a payoff that high is never better in B than in A. Alternatively put, one statistical distribution dominates another if its cumulative distribution always lies to the right of the second distribution. For an elementary treatment of stochastic dominance see Huang and Litzenberger (1988).

Stochastic dominance attempts to divide projects into efficient and inefficient ones using minimal assumptions concerning the individual investors' preferences. Given that there is no obvious reason for any systematic difference between revivals and originals in terms of either production costs or in terms of ticket prices, the finding that one kind of production statistically dominated the other in terms of the number of performances would be a strange finding. In effect it would suggest that Broadway theater backers consistently fail to notice that one kind of production is superior to another in terms of the financial reward.

First-order stochastic dominance is the appropriate test if the only thing that one is willing to assume about individual investors is that they prefer more to less. Second-order stochastic dominance is the appropriate test if one is willing to assume that individual investors always prefer more to less but at a diminishing rate. One distribution second-order dominates another if the area under the cumulative distribution never exceeds the area under the second cumulative distribution. The less discerning the criteria employed the more difficulty in unambiguously placing particular investments in one or other category. As is widely known, if first-order statistical dominance holds then higher orders of statistical dominance will also hold.

One way in which tests for stochastic dominance can be done is to use moment-based tests founded on specific distributional assumptions. For rules relating to particular statistical distributions and a related discussion see Pope and Ziemer

(1984). Recently De Vany and Walls (2002) have made distributional assumptions to address the question of whether R-rated movies are stochastically dominated by G, PG, and PG13 rated movies in terms of their rates of return. Using Kolmogorov–Smirnov tests they show that the probability distribution function for the rate of return closely resembles the Pareto distribution. Then, using the estimated value of the Pareto exponent they are able to test for stochastic dominance. They determine that R-rated movies are stochastically dominated by G-rated movies. Furthermore, if consideration is limited to those movies that gross more than $ 40 million then R-rated movies are stochastically dominated by every other ratings category. These findings beg the question as to why Hollywood produces so many R-rated movies.

An alternative approach that avoids making any distributional assumptions (and the one preferred here) is to test for first-order stochastic dominance by observing whether the empirical cumulative distribution functions cross at any point. Second-order stochastic dominance can be checked not by comparing the empirical cumulative distribution functions but by examining the areas under the distribution. The empirical cumulative distribution functions for original versus revived plays and for original and revived musicals are displayed in Figures 1 and 2, respectively. A broken line represents the empirical cumulative distribution function for revivals and a solid line represents the distribution for original shows. Both pairs of distributions clearly cross pointing to the failure of first-order stochastic dominance. These diagrams also confirm the frequently made assertion that putting on a revival represents a risk-averse strategy. Revivals are much less likely to close after only a small number of performances. One explanation for the observed trend toward revivals is simply that individual investors have become more risk-averse over time.
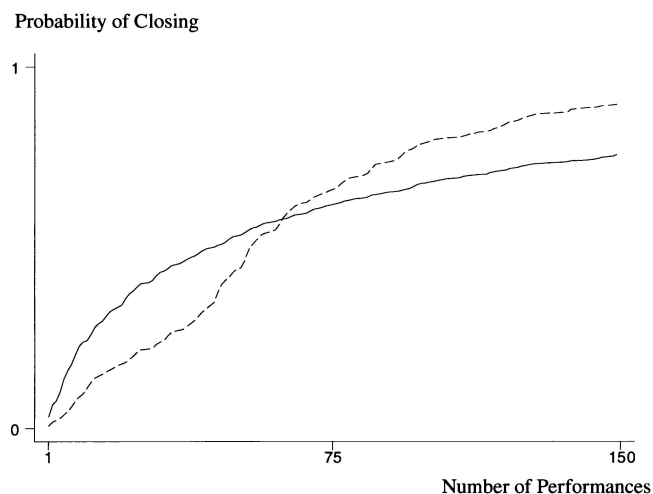
Figure 1. The empirical cumulative distribution function for Broadway plays 1960–2001 (detailed view).

Probability of Closing

Figure 2. The empirical cumulative distribution function for Broadway musicals 1960–1987 (detailed view).

The no-crossing criterion, however, does not account for the problem of random variation and a number of researchers have therefore proposed statistical tests in order to establish whether one distribution dominates another at any given order to a statistically significant extent. Tse and Zhang (2003) conduct a Monte Carlo simulation intended to establish the power of some of the available tests reaching the conclusion that the test of Davidson and Duclos (2000) is the most powerful. Note that although these tests are usually given the task of comparing the income distributions of two different populations they serve equally well in the task set out above of comparing the distribution of performances for original and revived shows.

Davidson and Duclos showed that under the null hypothesis their test statistic is asymptotically distributed as a standard normal variable. But to test for stochastic dominance the null hypothesis has to be examined over the full support. Because this is impossible Bishop et al. (1991) suggest that one calculate test statistics for a number of grid points. According to Bishop et al., a distribution dominates another if at least one of the test statistics evaluated at any grid point is positive and statistically significant and none of the tests evaluated at any other grid point are negative and statistically significant. If none of the tests are statistically significant or if at least one of the tests is statistically significant while at least one of the other tests is negative and statistically significant then stochastic dominance does not hold. Two methods of determining grid points are commonly used, those that divide the samples into equal numbers of observations and those that leave the grid points evenly spaced. Although the number of grid points is arbitrary many studies use deciles for lack of clear guidance. This test is now used to test for first- and second-order statistical dominance using grid points based on deciles.

Table IV. Tests of stochastic dominance for original and revived Broadway plays 1960–2001[a]

Percentile	Number of performances	Test for first-order stochastic dominance	Test for second-order stochastic dominance
10	5	6.91	6.27
20	10	6.47	7.31
30	20	6.72	7.22
40	33	6.36	7.46
50	48	3.36	7.03
60	65	−0.84	5.43
70	96	−3.80	2.75
80	153	−6.65	−0.46
90	300	−7.44	−4.02
100	1819	−1.00	−6.34

[a]*Source.* See text.

Given that the test statistic is asymptotically distributed as a standard normal variable it is clear from the test statistics provided in Tables IV and V that there is no evidence that original productions dominated revivals or vice versa. Furthermore, even though the sample size is relatively small Tse and Zhang's Monte Carlo analysis using an almost equivalent sample size shows that the tests are able to make the right decision almost every time, at least for first-order stochastic dominance. The implication is that, judging from a financial perspective, Broadway probably does

Table V. Tests of stochastic dominance for original and revived Broadway musicals 1960–1987[a]

Percentile	Number of performances	Test for first-order stochastic dominance	Test for second-order stochastic dominance
10	5	2.83	2.25
20	9	3.00	2.91
30	21	1.19	2.44
40	47	0.08	1.47
50	75	−0.45	0.79
60	120	−0.51	0.33
70	239	−1.81	−0.71
80	463	−2.34	−1.58
90	787	−3.50	−2.01
100	7485	−1.00	−1.36

[a]*Source.* See text.

not produce an excessive number of revivals. There is, however, some ambiguity in the case of whether revived Broadway musicals statistically dominate original productions at the second order. The test is significant at the 5% level of confidence but not at the 1% level of confidence. The implication is that opportunities to arbitrage production dollars between different types of shows have been eliminated. However, since financial data are not available for Broadway shows, it is impossible to say how well the duration of a show approximates the financial rate of return on the original investment.

5. Conclusions

Nonparametric techniques are available to test for stochastic dominance of statistical distributions. Using these techniques it is difficult to argue that Broadway produces too many revivals, at least from the financial perspective. What is clear, however, is that the number of revivals expressed as a fraction of all new productions is increasing markedly over time. It is also clear that, although original productions on average run for longer, revivals are much less likely to close after only a small number of performances.

Future work might care to deal with the question of precisely which shows are revived, when they are revived, and why. If one believes that shows are revived primarily on economic grounds then presumably this means that the projected revenues exceed the projected costs by a sufficient margin. Projected revenues might be inferred from the number of performances by previous productions of the show while costs are determined by among other things cast size. The determinants of revivals might also be obscured by the fact that even the most successful shows are unlikely to be revived immediately and old shows risk becoming obsolete. Such work would shed further light on the extent to which Broadway productions are governed by economic considerations.

Acknowledgments

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