The Effects of Real Options, Returns-to-Scale, Structural Changes, and Levels of Aggregation on the Cost-Revenue Relationship

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ABSTRACT. This paper extends the traditional, static cost and revenue model developed in manufacturing settings by studying four factors that moderate the cost-revenue relationship: real options, returns-to-scale, structural changes, and levels of aggregation. We use the motion picture industry as a research setting since it provides an interesting context for this type of research. For instance each product in the industry, a motion picture, is an experiential good with tractable costs and revenues. The critical costs to developing and marketing a successful motion picture are production and advertising costs. Using a sample of 1,695 motion pictures released between 1990 and 2003, we find that advertising costs – a result of the managerial exercise of real options – have a stronger association with revenues than do production costs – a first-stage investment. We also find that movies with larger costs have higher incremental revenues per cost, consistent with returns-to-scale. In addition, we discover that structural changes in the industry greatly affect the cost-revenue relationship during our observation period. Finally, we find that the cost-revenue relationship is stronger at a higher level of aggregation than at a lower level. In conclusion, our results indicate that the simple linear static model of cost-revenue relationship is limited.

I. INTRODUCTION

Fundamental to accounting is the relationship between costs and revenues (Paton and Littleton 1940). The traditional cost-revenue model, however, is based on manufacturing settings (e.g., Horngren et al. 1997; Kaplan and Atkinson 1998). In that model, costs are classified into fixed or variable relative to revenues, with the demand for commodity products being highly predictable. Modern economies, however, have been evolving from manufacturing to service, in which wealth and growth are driven primarily by intangible assets (Hand and Lev 2003). Trying to apply the traditional cost-revenue model to the service economy becomes problematic since there are a number of unique factors that moderate the relationship between costs and revenues.

The first factor that the traditional model ignores is real options. The service economy is very distinct from the manufacturing economy as demand is highly uncertain (Davis et al. 1999). Given highly uncertain demand, companies often build flexibility in their business models by incurring costs in stages. Such investment behavior has significant implications for the observed cost and revenue relationship (e.g., Kallapur and Eldenburg 2005).

The traditional model also ignores returns to scale. Products and services in the new economy are mostly based on intellectual capital and, therefore, have very low manufacturing costs (the printing cost of a book or the manufacturing cost of a DVD is trivial). In the new economy, a blockbuster product (e.g., iPod or the *Pirates of the Caribbean* motion picture) can easily achieve tremendous economies of scale (e.g., Hand 2003a). Moreover, returns-to-scale are enhanced by the increasing global integration of the world's economies and new communication technologies such as the Internet.

Third, the traditional cost-revenue model is overly simplistic in that it assumes that the relationship between cost and revenue is static, without considering the effects of technological and structural changes.

Finally, while the fixed/variable model is largely based on single product models, nearly all existing firms produce multiple products or provide a wide range of services. One key issue, then, involves the aggregation of costs and revenues, as is typically done in accounting for firm-level reporting purposes. However, there have been no studies of which we are aware relating to how the cost-revenue relationship may differ when costs and revenues are aggregated at different levels.

In summary, we believe that it is timely to investigate new models of cost behavior by exploring cost and revenue relationship in non-manufacturing settings (e.g., Banker et al. 2003; Kallapur and Eldenburg 2005). In this vein, the purpose of our study is to examine the cost-revenue relationship in an intellectually capital-intensive environment – the motion picture industry. The outputs of the motion picture industry – movies – are very distinct from commodity products as they are characterized by high demand uncertainty and rely on a number of intangible assets generated by a whole host of creative people (e.g., actors and directors). We consider both production and advertising costs as key determinants of motion picture revenues. Our analysis proceeds in several stages. In the first stage, we analyze the relationship between movie costs and revenues as the foundation case for the subsequent analyses. Next, we examine how real options in investment and returns-to-scale affect the observed relationship between cost and revenue in the first stage. We also examine how structural changes in the movie industry affect the observed cost and revenue relationship. Finally, we examine cost and revenue relationships when the costs and revenues are aggregated at different levels – at the product and firm levels.

Using a dataset of 1,695 movies released between 1990 and 2003, we find that both production and advertising costs are positively associated with movie revenues, which is consistent with the traditional efforts-outcomes link between costs and revenues. Further, we find that advertising costs have larger and more significant effects on revenues, which is consistent with predictions from real options theory. The results are robust even taking into account the endogeneity of advertising costs, in which advertising costs may be affected by production costs. Further, we find a weaker association for the cost-revenue relationship in movies with small production costs, compared to those with mid-range and large production costs. That is, there appear to be returns-to-scale for both production and advertising costs. Returns-to-scale, however, only exist in mid-range movies since there is no significant difference between big-budget movies and mid-range movies. Noticeably, even after controlling for returns-to-scale, the observed cost-revenue relationship is stronger for advertising costs than production costs.

Further, we find significant structural changes in the cost-revenue relationship in the interval 1990-2003. For production costs, the cost-revenue relationship was positive in the 1990-1996 period and became even stronger during the 1997-2003 period. Regarding advertising costs, the cost-revenue relationship was also positive in both periods but became weaker in the second half of the period. These findings are consistent with business press reports that Hollywood has over invested in advertising since the late-1990s and reduced the incremental benefits of additional advertising dollars (e.g., Hollywood Reporter 2000).

We also examine the cost-revenue relationship at two levels of aggregation; that is, at the product and firm (studio) levels. The cost-revenue relationship is much stronger when costs and revenues are aggregated at the studio level. Production and advertising costs explain 48 percent of the variation in movie revenues at the individual movie level, while at the studio level, production and advertising costs can explain up to 91 percent of the variation in movie revenues. This suggests that studying both product and firm-level costs is diagnostic and can lead to better overall information with which to make decisions.

This study extends the literature on cost and revenue relationships in a number of ways. First, this study contributes to the literature on cost behavior. Although Kaplan and Atkinson (1998) discuss the differences between *committed* costs and *flexible* costs, thereby using terms that better reflect contemporaneous cost behavior, there have been no empirical studies that examine how these two types of costs affect revenues. We also extend the use of the idea of real option theory as applied by Kallapur and Eldenburg (2005) in a hospital setting to our setting in which there is a clear split between production and advertising costs at different stages, allowing us to conduct a more direct test of real option theory on cost behavior. Our study also contributes to the accounting literature on returns-to-scale. Most studies on returns-to-scale are conducted in economics (an exception is Banker et al. (2003), who examine scale economies in the public accounting industry). In addition, this study also contributes to the literature on aggregation in accounting measurement (e.g., Arya et al. 2005). There are few empirical studies on aggregation and how aggregation affects observed relationships between efforts (costs) and accomplishments (revenues).

Finally, this paper contributes to studies predicting motion picture success in management, marketing, and cultural economics. Forecasting financial success of a movie plagues film studio executives. Studios spend millions of dollars obtaining a screenplay, hiring stars, filming on location, and producing special effects only to often see a movie fail. This study shows that production and advertising costs can explain about 50 percent of the variation in box office receipts. Prior research in this area has largely ignored advertising costs, used outcomes of advertising efforts like opening theaters as proxies (Shugan 1999), or assumed that the effects of production and advertising costs are not separable (Ravid 1999). By considering both production and advertising costs, however, we are able to demonstrate that both types of costs actually do have differential effects on revenues. Moreover, this study also shows that models that relate costs with revenues in this industry need constant upgrading as structural changes in the industry are prevalent.

Section II introduces production and advertising costs and revenues in the movie industry followed by a discussion of the relevant literature in accounting on the cost and revenue relationship. In this section, we also present our hypotheses based on literatures on real options, returns-to-scale, structural changes, and measurement aggregation. Section III presents the sample and data. Section IV provides the results. Section V summarizes and discusses implications for research and practice.

II. LITERATURE

2.1. Costs and Revenues in the Motion Picture Industry

The focus of this research is the motion picture industry, which provides an ideal site to test the cost-revenue relationship because box office revenues and two categories of costs – production and advertising costs – are incessantly tracked by industry executives and experts and are also publicly available.

Products in this industry – motion pictures – are fashioned by a number of highly-talented people. For instance, a large part of production costs for a motion picture include the costs of screenwriters, actors, the director, cinematographers, set designers, make-up specialists, special effects wizards, and many other highly-trained individuals (Caves 2000). Movie production costs also include studio overhead (usually about 10 percent of direct production costs), and interest costs related to financing movies, but they exclude the share of box office revenues paid to actors or producers. Production costs are paid by production firms (for most studio movies) or are financed from banks and equity investors (for most independent movies). Production costs vary widely. According to the Motion Picture Association of America (MPAA 2006), movies distributed by the major studios cost $60 million, on average, in 2005, compared to $27 million in 1990.[1] A high-profile special-effects movie, such as *Titanic*, had production costs in excess of $200 million. Movie production costs have risen continually in recent years due to spectacular special effects in action and science-fiction movies and astronomical star salaries (Standard and & Poor's 2005).

The distributor typically incurs the advertising costs. For studio movies, the producer and distributor are identical or have the same parent company, but for independent movies, producers have to find their own distributors who are willing to pay for advertising. For movies financed by major studios, the advertising costs averaged $36.2 million per movie in 2005 (MPAA 2006), up from an average of $12 million in 1990. Figure 1 shows the number of movies released and their advertising expenditures in the U.S. from 1993 to 2000.

Producers, financiers, and distributors in the motion picture industry derive revenues from U.S. and foreign box office ticket sales, video cassette/DVD sales and rentals, merchandising, and licensing to cable and broadcasting TV networks and pay-per-view providers. According to Standard & Poor's (2005), domestic box office ticket sales were $9.5 billion in 2005 and domestic video/DVD sales and rentals were $24.1

[1] The so-called major studios are Paramount Pictures Corporation; Universal International Films, Inc.; Columbia TriStar Film Distributors, Inc.; Warner Brothers International Theatrical Distribution; Twentieth Century Fox International Corporation; and Buena Vista International, Inc.

billion. According to the same industry source, the domestic revenue that a movie generates for a studio is roughly 20 percent of a movie's total life-cycle revenue stream.

As in prior research (e.g., De Vany and Walls 2002, 1999, 1997, 1996; Eliashberg and Sawhney 1996), our study focuses on domestic box office receipts (or movie revenues). To capture a movie's domestic box office receipts, we use cumulative measures. The cumulative box office (CBO) is the total domestic box office revenues throughout the entire theatrical run of the movie. CBO is a key movie performance indicator in industry parlance that is carefully watched by movie industry executives, participants, consultants, observers, and the media.

2.2. Cost and Revenue Relationship

A basic tenet of accounting theory is that a firm will incur costs, such as buying machinery and hiring employees, in order to produce products or provide services which when sold will generate revenues. This concept is embedded in accounting's key *matching principle* that is concerned with the periodic matching of costs and revenues as a test-reading of economic accomplishment (Patton and Littleton 1940; Wolk et al. 2000). Thus, the expectation is that incurring costs and generating revenues are positively related. Hence, at the most basic level, the expectation is that:

Hypothesis 1a*: Production costs are positively associated with movie revenues*.

One would expect the same relationship to hold for advertising costs. However, advertising costs are different from production costs in that they can be flexible costs because they are incurred both before the release of the movie and after it has opened. Pre-release advertising conveys information about the movie and try to persuade potential audiences to see it (Elberse and Eliashberg 2006). Success at the box office during the opening weekend is often tied to spending tens of millions of dollars on advertising (Lippman 2002a, 2002b). Pre-release advertising also deter competition. Industry analysts believe that the success of *Independence Day*, for example, was due to its long-term approach to advertising, convincing rival studios to abandon head-to-head openings on the same weekend (McNary 1997).

After the opening, advertising expenditures are designed to maintain favorable awareness of the movie, ideally reinforced by positive word-of-mouth. Many successful movies are attributed to well-executed promotional campaigns. A good example is 2003's *Seabiscuit*. The movie had opening box office receipts of only $20 million, but grossed more than $93 million in total because of the studio's subsequent promotional campaign efforts (Holson 2003). Moreover, Prag and Cassavant (1994) find that advertising expenditures are a dominant determinant of a movie's subsequent rental income (usually about half the box office receipts). However, De Vany and Walls (1999) failed to find conclusive evidence on the positive effects of advertising costs on movie revenues and concluded that even a carefully-managed and expensive advertising campaign sometimes cannot change audiences' predetermined mindsets and improve a movie's chances of success. But although the evidence in this area is mixed, it is reasonable to expect, as a base line, that:

Hypothesis 1b*: Advertising costs are positively associated with movie revenues.*

2.3. Real Options

Traditional textbooks classify costs into fixed and variable (e.g., Garrison et al. 2003). This classification has limitations. In many industries, investments are made, and thus costs are incurred, in sequence. A more descriptive classification is committed costs vs. flexible costs (Kaplan and Atkinson 1998). Committed costs are incurred to acquire productive capacity. Committed costs are unaffected by how much the organization uses the committed resources. An example of committed costs is depreciation cost. Flexible costs are incurred after committed costs. An example of such flexible costs is costs that firms incur to deliver products to customers.

Related to the classification of committed and flexible costs is real option theory. In essence, having an option means having the right, but not the obligation, to either buy or sell an underlying asset at a given price within a specified time period. By analogy, an investment in real option terms bears the right, but not the obligation, for a firm to make further investments or to delay or even to stop such investments (Dixit and Pindyck 1994). Kallapur and Eldenburg (2005) use real option theory to examine how the relationship between direct costs and the cost driver changes after a change in Medicare reimbursement policy.

Observing the motion picture industry, we believe that real option theory applies to, and has been used implicitly by, the movie industry for a long time. Of course, one direct application is when studios purchase an option to develop a film based on a bestseller book. But studios apply real option theory not only when they purchase copyrights; option theory also manifests itself when we observe how the studios produce, and then distribute, movies.

In the movie industry, there is high uncertainty regarding whether a movie is going to be a hit (De Vany and Walls 1997, 1999). In the economic literature, the relationship between uncertainties and investments has been studied intensively (e.g.., Dixit and Pindyck 1994; Carruth et al. 2000). Applied to firm’s investment decisions, real options provide the firm flexibility in a dynamic and uncertain environment. This flexibility is valuable due to the irreversibility of investments and the uncertain future (e.g., Bulan 2005). Regarding expenditures in the motion picture industry, once a movie is produced, the investment is committed (irreversible). Spending on advertising, however, need not be incurred with the same commitment and can be staggered depending on the movie's observed success or lack thereof (Lippman 2002a). Studios also have the ability to time the release of a movie and adjust advertising costs commensurate with the chosen timing (e.g., for releases during the so-called holiday season). In making these post-production decisions, studio managers commission industry consulting reports, such as about audience's expected response and other data.

In summary, production costs "committed" and essentially incurred to provide the "capacity" for movie exhibition. Advertising costs, on the other hand, are "flexible" and can be adjusted over the decision window based on any new information available to the decision makers. For this reason, we expect that:

Hypothesis 2*: Advertising costs have a stronger association with movie revenues than production costs do.*

2.4. Returns-to-Scale

The existence and magnitude of returns-to-scale has long been an important economic issue (e.g., Zellner and Revankar 1969; Zellner and Ryu 1998). The accounting literature generally acknowledges that returns-to-scale improve earnings. But cost and revenue analyses in accounting generally ignore returns-to-scale, with few exceptions, such as studies of returns-to-scale in the professional accounting sector or so-called CPA firms (e.g., Simunic 1980; Banker et al. 2003). Similar to the professional accounting sector, the motion picture industry relies on human capital and intellectual capital to create value. Prior studies have shown that successful investments in intangible assets can provide a source for returns-to-scale (e.g., Lev 2000; Hand 2002). We posit that there are economies of scale in the movie industry. We expect that:

***Hypothesis 3a**: The higher the production costs, the stronger the relationship between production costs and movie revenue.*

***Hypothesis 3b**: The higher the advertising costs, the stronger the relationship between advertising costs and movie revenue.*

2.5. Structural Changes

Technological changes often lead to changes in productivity and business models. For example, in their study of professional accounting firms, Banker et al. (2003) find that the relationship between inputs and revenues change over time. Equally so in the motion picture industry, Vogel (2001) discusses several forces that have affected the industry. These forces include (1) the emergence of large megaplex theaters; (2) the need for ever-larger capital pools to launch motion picture projects; and (3) technological advances in film making, advertising and audience research, as well as movie exhibition.

The emergence and proliferation of megaplex theaters and the high reliance on opening box office receipts probably are among the two biggest changes in the movie industry since the mid-1990s. Megaplex theaters with 20 or more screens at one location allow showing the same movie at half-hour intervals or less. Megaplex theaters also make it less risky to market big-event movies year-round because the theaters can handle ticket demand on their many screens. More seating capacity at individual theaters also has increased the flow of patrons into theaters, which potentially affects opening-weekend box-office revenues, although for this reason movie revenues now often decline more steeply after the opening weekend (Lippman 2002a).

Box office revenues over the past years demonstrate the increasing role that opening weekends play in a movie's fortunes. For each of the top 25 movies released in 1987, the opening weekend constituted 11 percent of total domestic box office revenues, and films were released on about 1,000 screens each. By 2001, for the top 25 films, the opening weekend was about 28 percent of total domestic box office revenues, and they were released on about 2,951 screens. In 2002, the opening weekend share was about one-third of the total domestic box office revenues (e.g., *Spiderman* went out to a near-record-breaking 3,615 theaters, where it played on 7,200 screens). Clearly, the opening box office receipts tend to be a larger percentage of the total box office than five or six years ago.

However, most movies take a huge drop in their second weekend after the opening (the most recent examples include *The Hulk* and *Terminator 3*). Furthermore, there are four to five movies opening every weekend. To fill seats and turn a profit, theater owners have little tolerance for empty seats. With so many movies available, they routinely move films from larger-capacity theaters to smaller ones during the second week. To draw audiences to a movie's opening weekend, studios spend more on television advertising, still considered the best way to bring in a large audience for the opening. All these factors illustrate the changing "opening box office" phenomenon.

A second major change in the 1990s is the increase in production and advertising costs of movies. In 1993, the average MPAA member movie production and advertising cost was $30 and 14 million, respectively; in 2002, it was $59 and 31 million. Corresponding to the increasing production and advertising costs, many studios have changed their production and distribution strategy. For example, Fox has a dichotomous movie strategy. Fox produces either expensive "event" pictures such as *Independence Day* or low-budget movies. Movies costing between $30 and 40 million are no longer produced (King, 1996). Further, in 2002, Sony Pictures sunk over $500 million in four movies alone. Lippman (2002a) notes that, "The strategy is driven partly by the studio's thirst for big hits, and partly by what Sony says are long-term industry trends, where theater owners call for easily promoted movies to stand out among the clutter of new titles every weekend."

In short, these and other changes have led some to call for a revised business model of the so-called "New Hollywood" (Scott 2002). The structural changes discussed above will affect the interpretation and extension of past studies and raise new questions. Therefore, we posit that:

Hypothesis 4a*:* *The relationship between production cost and movie revenue is different in the first and second halves of the 1990-2003 period*.

Hypothesis 4b*:* *The relationship between advertising cost and movie revenue is different in the first and second halves of the 1990-2003 period*.

2.6. Levels of Aggregation

The levels of aggregation in an accounting information system refer to the various levels at which accounting-related data and information are recorded and summarized. Aggregation is common in accounting measurement to present financial data succinctly at the level that accounting information disclosures are reported about – the firm. However, aggregation leads to loss of detail, and thus, can affect the interpretation of reported performance.

The traditional cost-revenue model in neoclassical economics is based on the notion of a single-product firm. Equally so, the notion of the single-product firm manifests itself in accounting through, or is the simple practical result of, aggregation of the financial information to the firm level. However, firms produce multiple products or provide numerous services in modern economies. It is therefore questionable whether the traditional cost-revenue model based on notions of, for example, fixed and variable costs, extends to multiple-product settings.

For example, we expect that during the course of aggregation, errors and noise in the cost-revenue relationship at the individual product level will cancel each other out. Thus, we expect cost and revenue relationship will increase as the level of aggregation increases.

***Hypothesis 5a**: The relationship between production cost and movie revenue is stronger at the studio level than at the individual movie level.*

***Hypothesis 5b**: The relationship between advertising cost and movie revenue is stronger at the studio level than at the individual movie level.*

III. METHOD

3.1. Sample

Our initial sample consists of 2,987 movies released between 1990 and 2003 listed by *boxofficeguru.com*. This source maintains a comprehensive box office database on movies released since 1989. We collect production and advertising costs for these movies from the *Motion Picture Investor*, a movie industry newsletter published by *Paul Kagan Associates*. We omit movies without corresponding production and advertising cost data, resulting in 1,695 remaining observations. A comparison of means of opening box office (OBO) and cumulative box office (CBO) receipts between the initial (N = 2,987) and final sample (N = 1,695), suggests that there is no systematic bias in our sample.

3.2. Variables

We use the following sources for data. *Boxofficeguru.com* reports total gross movie revenues (cumulative box office) as well as the opening and closing date of each movie's exhibition (which we use to determine the season in which the movie was released – see below). We gather data on production and advertising costs from *Motion Picture Investor*, which publishes movie production and advertising costs shortly after a movie is released and then updates the cost information in the next year. Table 1 summarizes our data sources by variable. We use the consumer price index (CPI) from the Federal Reserve Bank Minneapolis to deflate all dollar values to 1990-dollars.

Revenues, Costs, and Returns-to-Scale. We measure movie revenues as cumulative box office (***CBO***). CBO is the total domestic box office revenue for a movie throughout its entire theatrical run in the U.S. We obtain production (***PC***) and advertising costs (***MC***) from the *Motion Picture Investor* magazine. To capture returns-to-scale, we construct ***D_small*** as a dummy variable for a movie with production costs less than $30 million and ***D_big*** as a dummy variable for a movie with production costs greater than $100 million.

— Table 1 —

Period Dummies. To proxy for the changes that have affected the movie industry over time, we use a period dummy (***D_period***). Based on both the discussion of structural changes in the literature, we distinguish the early-1990s (1990-1996) from the late-1990s/early-2000s (1997-2003), with the first period as the base.

We also include several control variables in our analyses.

Distributors are responsible for advertising and distributing hard copies of movies to exhibitors (theaters). A movie may be distributed by one of the major studios or by independent companies (indies). When a major studio distributes a movie, it may signal its good quality, and hence, affect movie revenues and profitability. The movie industry generally distinguishes the seven major studios from all other distributors, which include mostly independent producers. Therefore, we control for distributor by using a dummy (***D_indie***), considering the major studios as the base.

Season of Release. There are differences in the numbers and revenue potentials of movies released across seasons, and there are also differences in consumer demand in different seasons. For instance, competition is strong in summer, but the available audience is high too. Radas and Shugan (1998) estimated seasonal revenue patterns for all major movies released between 1993 and 1995 (636 films) and found that the average box office was higher for movies released in the so-called high seasons (defined as the summer and Christmas seasons). Accordingly, we consider three seasons of release: summer, holiday (Christmas), and rest-of-the-year (non-holiday or normal) seasons. Following Vogel (2001), we define each period as follows: normal season (January-April and September-October), summer season (May-August), and holiday season (November-December). We use two dummy variables (***D_summer***, ***D_holiday***), with the normal season as the base.

Theaters. The number of theaters showing a movie is expected to positively correlate with box office receipts. Because of our focus on cumulative box office receipts, we use the largest number of theaters showing a movie during the movie's entire running period (***RT***) as a control variable.

3.3. Descriptive Statistics

Table 2 shows the time trend of production costs, advertising costs, and box office receipts. The mean CPI-adjusted cumulative box office receipts appear to have modestly increased from $35.81 million in 1990 to $37.75 million in 2003. However, production costs have increased nearly 70 percent from $19.54 to $32.87 million during the same period and advertising cost nearly doubled from $11.37 to $21.98 million, indicating significant cost increases even after controlling for inflation.

— Table 2 —

Table 3 shows the descriptive statistics for each of our variables and Table 4 presents their correlations.

— Tables 3 and 4 —

IV. RESULTS

4.1. Basic Cost-Revenue Model

To evaluate the basic model of the cost-revenue relationship in our motion picture setting, we run a log-linear regression of cumulative box office receipts on production and advertising costs shown in Table 5. The first model in Table 5, which shows the results without any of the control variables included, indicates that a 100 percent increase in ***PC*** results in a 24 percent increase in ***CBO***, while the same percentage change in ***AC*** generates an almost equal increase (99 percent) in ***CBO***. Including the control variables in Model 2 of Table 5 reduces the magnitudes of these effects but maintains roughly the same relative impacts: a 15 and 48 percent impact on ***CBO*** for every 100 percent increase in ***PC*** and ***AC***, respectively. These results support H1a and H1b.

— Table 5 —

4.2. Real Options

To evaluate the predictions of real options on the cost-revenue relationship, we run a two-stage regression. In the first stage, we regress ***AC*** on ***PC*** and other determinants of advertising costs and obtain the residuals from that regression (***AC_residual***). In the second stage, we then use ***PC*** and the residual from the first-stage regression (***AC_residual***) as explanatory variables in the ***CBO*** regression.

The first-stage regression in Table 6 indicates that a 100 percent increase in ***PC*** results in a 49 percent increase in ***AC*** and that production costs and the other determinants included in the regression explain 51 percent of the variation in advertising costs. The second-stage regression without control variables (Model 1) indicate that a 100 percent increase in ***PC*** generates a 75 percent increase in ***CBO***, while the same percentage change in ***AC*** generates a 98 percent increase in ***CBO***. Results from Model 2 with the control variables included again reduces the magnitudes of these effects but roughly maintains the same relative impacts: a 39 and 48 percent impact on ***CBO*** for every 100 percent increase in ***PC*** and ***AC***, respectively.

Real options theory predicts that different costs are differentially associated with revenues. An F-test of the difference in magnitude of the effects of ***PC*** and ***AC*** on ***CBO*** shows that the effect of ***AC_residual*** is significantly larger than that of ***PC*** in both Models 1 and 2, thus suggesting that advertising costs have a stronger association with revenues than production costs, consistent with H2.

— Table 6 —

4.3. Returns-to-Scale

To evaluate whether returns-to-scale affect the cost-revenue relationship, we split the sample into three groups. The motion picture industry press often classifies movies based on the size of production costs. According to a recent *Wall Street Journal* article, there are three categories of movies: *low-budget* movies with production costs lower than $30 million (in 2005); *mid-range* movies with production costs between $30 and 100 million; and *big-budget* movies with production costs above $100 million. We use two dummy variables to represent this classification, ***D_small*** and ***D_big***, with mid-range movies as the base. We also expect different costs to show different patterns of returns to scale.

To test these return-to-scale predictions, we run a log-linear regression of cumulative box office receipts on production and advertising costs, as well as their interaction with the size dummies. In Table 7, we again perform the analyses with and without control variables and we also control for the endogeneity of advertising costs.

Table 7 shows that smaller movies exhibit a weaker cost-revenue relationship than mid-range movies, as the interaction terms, ***PC x D_small*** and ***AC x D_small*** are both negative and significant. On the other hand, big-budget movies have a similar cost-revenue relationship to those of mid-range movies, as the interaction terms, ***PC x D_big*** and ***AC x D_big*** are both not significantly different from zero. In other words, compared to low-budget movies, mid-range and big-budget movies have larger incremental revenues per additional percentage of increase in spending. Thus, there is evidence of returns-to-scale among mid-range and big-budget movies for both production and advertising costs, supporting H3a and H3b.

— Table 7 —

4.4. Structural Changes

To evaluate the effects of structural changes in the industry on the cost-revenue relationship, we split the sample into two periods: 1990-1996 and 1997-2003. We use a dummy variable to represent the sample partitioning, ***D_period***, with the period 1990-1996 as the default. We also expect that structural changes have different effects on the cost-revenue relationship for different costs; production and advertising costs.

Table 8 shows the regression results following the same procedures as detailed above. The results from the fully-inclusive model indicate that ***PC*** exhibits a positive relationship with ***CBO*** in the earlier period (0.36) and an even stronger positive relationship in the second period (0.36 + 0.10). In other words, the cost-revenue relationship for production costs appears to have become significantly stronger over time. Therefore, we did not find support for H4a. In contrast, the effects of ***AC*** on ***CBO*** seem to have significantly declined over time. Even though we did not have a basis for predicting the direction of the effects of changes over time on the cost-revenue relationship for production and advertising costs, we observe significant changes over time consistent with H4a and H4b. It is also worth noting that despite the observed diminished effect over time of advertising costs on movie revenues, advertising costs also appears to lose dominance relative to production costs in terms of their effects on CBO in the second period (***AC*** = 1.11 and ***PC*** = 0.36 in 1990-1996 vs. ***AC*** = 0.43 and ***PC*** = 0.46 in 1997-2003), which diminishes the support for H2 when considering structural changes over time.

— Table 8 —

4.5. Levels of Aggregation

To evaluate whether levels of aggregation affect the observed cost-revenue relationship, we analyze the data first at both the movie (product) and studio (product) level in Table 9. Due to data constraints at the studio level, this regression model only controls for distributor and period dummy.

The results at the movie level are similar to those reported in earlier tables; that is, ***PC*** and ***AC*** are significantly associated with ***CBO*** with ***AC*** having the greater effects. This model explains 48 percent of the variation in ***CBO***. Also at the studio level do ***PC*** and ***AC*** exhibit similar associations with revenues. However, the studio-level model explains 91 percent of the variation in ***CBO***. In other words, aggregation increases the explanatory power of costs. We interpret these results as evidence of stronger cost-revenue relationships at higher levels of aggregation, consistent with H5a and H5b.

— Table 9 —

V. DISCUSSION AND CONCLUSIONS

The cost-revenue relationship is a central concept in management accounting. We argue that real options, returns-to-scale, structural changes, and level of aggregation are moderating factors that affect the cost-revenue relationship particularly in situations of high demand uncertainty. We test these conjectures using production and advertising costs and box office revenues from a sample of movies released in the U.S. between 1990 and 2003.

Estimating a log-linear function for revenues, we find that both production and advertising costs are positively associated with movie revenues, consistent with the accounting assumption that effort (cost) is associated with outcomes (revenue). Studios incur production and advertising costs in two stages. Thus, they have real options on whether and how much to invest in advertising to attract an audience. We find that advertising costs, a type of discretionary investment, have stronger association with revenues than production costs, a type of committed cost. This evidence is consistent with the predictions of real option theory. We also find that returns-to-scale cause different cost and revenue relationships for different sizes of costs. In addition, structural changes in the industry cause changes in the observed cost-revenue relationship over time. Finally, at different aggregation levels (movie and studio), the strength of the relationship of costs and revenues is different as well. Overall, our results indicate that the simple linear static model of costs and revenues in traditional cost accounting is limited.

Our findings also have implications for managers in the motion picture industry. We show that by using a large sample of data from reliable sources, it is possible to build a basic model that can lead to predictions about the relative levels of movie revenues. This idea runs somewhat counter to the William Goldman's well-known quote about predicting motion picture success "that in Hollywood no one knows anything" (Goldman 1989).

REFERENCES

Arya, A., J. Fellingham, and D. Schroeder. 2004. Aggregation and Measurement Errors in Performance Evaluation. *Journal of Management Accounting Research* 16: 93-105.

Atkinson, A., R. Banker, R. Kaplan, and S. M. Young. 1997. *Management Accounting*. Upper Saddle River, NJ: Prentice Hall.

Banker, R. D., H. Chang, and R. Cunningham. 2003. The public accounting industry production function. *Journal of Accounting and Economics* 35: 255-281.

Bulan, L. T. 2005. Real Options, irreversible investment and firm uncertainty: New Evidence from U.S. Firms. *Review of Financial Economics* 14: 255-279.

Canterbery, E. R., and A. Marvasti 2001. The U.S. motion picture industry: An empirical approach. *Review of industrial Organization* 19(1): 81-98.

Carruth, A., A. Dickerson and A. Henley. 2000. What do we know about investment under uncertainty? *Journal of Economic Surveys* 14(2): 119-153.

Caves, R. E. 2000. *Creative Industries: Contracts between Art and Commerce*. Cambridge, MA: Harvard University Press.

Cooper, R., and R. Kaplan. 1998. *The Design of Cost Management Systems: Text, Cases, and Readings.* Upper Saddle River, NJ: Prentice Hall.

Davis, M. M., N. J. Aquilano, and R. B. Chase. 1999. *Fundamentals of Operations Management.* 3rd ed. Boston: Irwin McGraw-Hill.

De Vany, A. 1999. Uncertainty in the movie business: does star power reduce the terror of the box office. Unpublished working paper, University of California, Irvine.

De Vany, A., and W. D. Walls. 1996. Bose-Einstein dynamics and adaptive contracting in the motion picture industry. *Economic Journal* 106(439): 1493-1514.

De Vany, A., and W. D. Walls. 1997. The market for motion pictures: Rank, revenues, and survival. *Economic Inquiry* 35(4): 783-797.

De Vany, A., and W. D. Walls. 2002. Does Hollywood make too many R-rated movies? Risk, stochastic dominance, and the illusion of expectation. *Journal of Business* 75(3): 425-451.

De Vany, A., and W. D. Walls. 2002. Motion picture profit, the stable Paretian hypothesis, and the curse of the superstar. Working paper, University of California, Irvine.

Dixit, A., and R. Pindyck.1994. *Investment under uncertainty.* Princeton, New Jersey: Princeton University Press.

Dolfsma, W. 1997. A status quo in the economics of art and culture? A view of some recent developments. *Economist* 145(2): 243-254.

Einav, L. 2002. Seasonality and competition in time: An empirical analysis of release data decisions in the U.S. motion picture industry. Working paper, Stanford University.

Elberse, A., and J. Eliashberg. 2002. The drivers of motion picture performance: The need to consider dynamics, endogeneity, and simultaneity. *Proceedings of the Business and Economics Scholars Workshop in Motion Picture Industry Studies*. Florida Atlantic University.

Elberse, A., and J. Eliashberg. 2006. Advertising and expectations: the effectiveness of pre-release advertising for motion pictures. Working paper, Harvard Business School.

Eldenburg L., and Kallapur. 1997. Changes in hospital service mix and cost allocations in response to changes in Medicare reimbursement schemes. *Journal of Accounting and Economics* 23: 31-51.

Eliashberg, J., and M. S. Sawney. 1996. A parsimonious model for forecasting gross box-office revenues of motion pictures. *Advertising Science* 15(2): 113-131.

Eliashberg, J., and S. S. Mohanbir. 1994. Modeling goes to Hollywood: Predicting individual differences in movie enjoyment. *Management Science* 40(September): 1151-1173.

Garrison, R. H., E. W. Noreen, and E. Noreen. 2003. *Managerial Accounting* (10^{th} ed.) New York: McGraw-Hill.

Goldman, William. 1989. *Adventures in the Screen Trade*. Los Angeles: Warner Books.

Greene, W. H. 2000. *Econometric Analysis* (4^{th} ed.). Upper Saddle River, NJ: Prentice Hall.

Hand, J. R. M. and B. Lev (eds.) 2003. *Intangible Assets: Values, Measures, and Risks.* New York: Oxford University Press.

Hand, J. R. M. 2003a. The increasing returns-to-scale of intangibles. In Hand, J. R. M. and B. Lev (eds.) *Intangible Assets: Values, Measures, and Risks*. New York: Oxford University Press: 303-334.

Hand, J. R. M. 2003b. The new economy: Pricing of equity securities. In D. Jones (ed.) Handbook of Economics in the Electronic Age. Academic Press.

Hollywood Reporter. 2000. Beating the high price of filmmaking (May 6).

Holson, L. M. 2003. Disney wins summer race at box office with 2 big hits. *New York Times* (September 1): F1.

Horngren, C., G. Foster, and S. Datar. 1997. *Cost Accounting: A Managerial Emphasis.* Upper Saddle River, NJ: Prentice Hall.

Ittner, C. D., and D. F. Larcker. 2001. "Assessing Empirical Research in Managerial Accounting: A Value-Based Management Perspective," *Journal of Accounting and Economics* (2001): 349-410.

Kallapur, S., and L. Eldenburg. 2005. Uncertainty, real options, and cost behavior: Evidence from Washington State Hospitals. *Journal of Accounting Research* 43 (5): 735-752.

Kaplan, R., and A. Atkinson.1998. *Advanced Management Accounting*. Upper Saddle River, NJ: Prentice Hall.

Kaplan, R. S. 1983. Measuring Manufacturing Performance: A New Challenge for Managerial Accounting Research. *The Accounting Review* 58 (4): 686-706.

King, T. 1996. Movies: Fox's hottest story line is studio-revival plan. *Wall Street Journal* (June 21): B1.

Lev, B. 2000. New math for a new economy. *Fast Company* (January-February).

Lev, B. 2001. Intangibles: Management, measurement, and reporting. Brookings Institution Press.

Lippman, J. 1995. Movies: Young readers get hard sell for movie. *Wall Street Journal* (August 4): B1.

Lippman, J. 2002a. Record debut for 'Spider-Man' signals Hollywood's new rules. *Wall Street Journal* (May 6): A1.

Lippman, J. 2002b. Sony counts on being rescued by movie heroes – Studio spends big in hopes 'Spider-Man,' 'Men in Black 2' will be huge box-office hits. *Wall Street Journal* (March 8): B1.

Litman, B. R. 1983. Predicting success of theatrical movies: An empirical study. *Journal of Popular Culture* 15 (Spring): 159-175.

Lukk, T. 1997. *Movie Advertising: Opening the Picture and Giving It Legs.* Los Angeles: Silman-James Press.

McNary, D. 1997. Hunting 'super' buzz studios to kick off ad campaigns for films during Sunday's game. *Los Angeles Daily News* (January 25): B1.

Motion Picture Association of America (MPAA). 2006. *U.S. Entertainment Industry: 2005 MPA Market Statistics*. www.mpaa.org.

Nash, J. R., and S. R. Ross. 1996. *Cinemania - The Motion Picture Guide.* News America Publishing.

Noreen, E., and N. Soderstrom. 1994. "Are overhead costs strictly proportional to activity? Evidence from hospital service departments." *Journal of Accounting and Economics* 17: 255-278.

Noreen, E., and N. Soderstrom. 1997. "The accuracy of proportional cost models: evidence from hospital service departments." *Review of Accounting Studies* 2: 89-114.

Paton, W. A. and A. C. Littleton. 1940. *An Introduction to Corporate Accounting Standards.* American Accounting Association.

Paul Kagan Associates. 1990-2001. *Motion Picture Investor*.

Prag, J., and J. Cassavant. 1994. An Empirical Study of Determinants of Revenues and Advertising Expenditures in the Motion Picture Industry. *Journal of Cultural Economics* 18(3): 217-35.

Ravid, S. A. 1999. Information, blockbuster, and stars: A study of the film industry. *Journal of Business* 72(4): 463-492.

Ravid, S. A., and Basuroy, S. 2004. Managerial objectives, the r-rating puzzle, and the production of violent films. The Journal of Business 77 (2): 155-192.

Scott, A. J. 2002. *On Hollywood: The Place, The Industry*. Princeton, NJ: Princeton University Press.

Shugan, S. 1999. Pre-concept new product forecasting. Working paper, University of Florida.

Shugan, S. 2000. Recent research in the motion picture industry. *Proceedings of the Business and Economics Scholars Workshop in Motion Picture Industry Studies* (October): 65-86.

Simonoff, J. S., and I. R. Sparrow. 2000. Predicting movie grosses: Winners and losers, blockbusters and sleepers. *Chance* 13(3): 15-24.

Simunic, D. A. 1980. The pricing of audit services: Theory and evidence. *Journal of Accounting Research* (Spring): 161-190.

Smith, L. 2003. Studios do battle to make it bigger. *Los Angeles Times* (December 1): E1.

Standard & Poor's (2005). *S&P Industry Surveys: Movies & Home Entertainment* (March).

Vogel, H. L. 2001. *Entertainment Industry Economics: A Guide for Financial Analysis* (5th ed.). New York: Cambridge University Press.

Wolk, H., M. Tearney, and J. Dodd. 2000. *Accounting Theory: A Conceptual and Institutional Approach*, Fifth Edition. South-Western College Publishing.

Zellner, A., and H. Ryu. 1998. Alternative functional forms for production, cost and returns to scale functions. *Journal of Applied Econometrics* 13: 101-127.

Zellner, A., and N. Revankar. 1969. Generalized production functions. *The Review of Economic Studies* 36: 241-250.

Zufryden, F. 1996. Linking advertising to box office performance of new film releases: An advertising planning model. *Journal of Advertising Research* 6 (July-August), 29-41.

Table 1

Variable Definitions and Data Sources

VARIABLES		Data Source
CBO	Cumulative box office revenues	www.boxofficeguru.com
PC	Production cost	Motion Picture Investor
AC	Advertising cost	Motion Picture Investor
D_period	Dummy for one of two periods of release (*D_period* (1997-2003), base = *1990-1996*)	www.boxofficeguru.com
D_indie	Dummy for independent distributor (base = *major studios*)	MPAA membership www.boxofficeguru.com
D_summer, D_holiday	Dummy for two of three seasons of release (summer and holiday, base = *normal season*)	www.boxofficeguru.com
RT	Widest running theaters	www.boxofficeguru.com

CBO (cumulative box office) is total domestic box office revenue throughout the entire theatrical run of the movie. ***PC*** (production cost) and ***AC*** (advertising cost) are movie production and advertising costs, respectively, as reported by *Motion Picture Investor*. We use the consumer price index (CPI) to deflate ***CBO***, ***PC***, and ***AC*** to 1990 dollars. ***D_period*** is a dummy variable for a movie released in the years 1997-2003. ***D_indie*** is a dummy variable for a movie released by an independent studio. To control for season of release, we use two dummy variables (***D_summer*** and ***D_holiday***) to capture whether the movie has been released in the summer season (May-August) or holiday season (November-December), respectively, as opposed to the normal season (January-April and September-October). ***RT*** is the largest number of theaters exhibiting a movie during its entire theatrical running period.

Table 2
Trends in Movie Costs and Revenues

	Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	N	107	111	101	98	136	115	122	127	126	128	145	130	182	166
CBO	Mean	35.81	31.82	34.17	35.09	27.94	33.55	29.00	37.25	36.86	32.91	37.52	39.83	35.77	37.75
	Median	19.74	19.23	18.97	22.55	16.01	21.13	16.95	23.79	22.53	17.56	25.05	23.93	20.71	24.47
	StdDev	46.89	35.76	39.34	45.00	36.40	32.65	38.63	53.92	36.84	39.44	39.03	43.08	46.13	43.79
PC	Mean	19.54	19.15	21.23	17.14	20.18	24.96	27.65	32.29	31.72	28.65	30.18	29.44	33.14	32.87
	Median	17.50	17.27	18.91	13.52	17.64	21.44	25.41	26.06	27.26	25.10	24.29	25.11	29.06	24.86
	StdDev	11.32	12.32	11.13	11.98	12.57	19.08	13.88	25.47	20.75	20.82	25.12	21.40	24.01	24.50
AC	Mean	11.37	11.27	12.68	11.28	11.52	12.64	16.02	16.44	18.57	18.19	16.19	16.56	20.40	21.98
	Median	11.50	10.56	11.18	10.40	10.58	11.58	15.83	16.29	18.04	19.61	15.18	16.21	19.47	20.60
	StdDev	5.93	5.20	5.95	6.16	5.54	6.30	4.23	5.19	8.20	8.77	8.58	6.19	5.56	6.25

CBO, ***PC***, and ***AC*** are deflated to 1990 dollars using the consumer price index (CPI).

Table 3
Descriptive Statistics

Variable	N	Mean	Std Dev	1 Pct	Q1	Median	Q3	99 Pct
CBO ($million)	2167	34.36	41.65	0.86	9.11	20.53	43.83	200.01
PC ($million)	1695	26.68	20.02	2.18	12.5	21.43	34.99	95.89
AC ($million)	1695	15.55	7.31	1.6	10.4	14.98	20.03	35.66
D_small	2224	0.59	0.49	0	0	1	1	1
D_big	2224	0.03	0.18	0	0	0	0	1
D_period	2224	0.7	0.46	0	0	1	1	1
D_indie	2224	0.29	0.45	0	0	0	1	1
D_summer	2224	0.32	0.47	0	0	0	1	1
D_holiday	2224	0.18	0.39	0	0	0	0	1
RT	2210	1904.62	888.39	73	1275	1960.5	2556	3669

D_small is a dummy variable for a movie with inflation-adjusted production costs less than $30 million and ***D_big*** is a dummy variable for a movie with production costs greater than $100 million.

Table 4
Correlations

	CBO	*PC*	*AC*	*D_small*	*D_big*	*D_period*	*D_indie*	*D_summer*	*D_holiday*	*RT*
CBO		0.56	0.61	-0.31	0.36	0.02	-0.15	0.17	0.15	0.56
PC	0.55		0.69	-0.68	0.65	0.25	-0.23	0.13	0.17	0.62
AC	0.68	0.69		-0.55	0.40	0.41	-0.25	0.16	0.12	0.79
D_small	-0.40	-0.86	-0.58		-0.23	0.01	0.26	-0.06	-0.11	-0.33
D_big	0.25	0.36	0.31	-0.23		0.09	-0.07	0.09	0.08	0.25
D_period	0.02	0.23	0.45	0.01	0.09		0.09	-0.04	0.00	0.36
D_indie	-0.25	-0.30	-0.26	0.26	-0.07	0.09		-0.06	-0.03	-0.33
D_summer	0.14	0.10	0.16	-0.06	0.09	-0.04	-0.06		-0.32	0.10
D_holiday	0.17	0.19	0.12	-0.11	0.08	0.00	-0.03	-0.32		0.02
RT	0.70	0.62	0.79	-0.33	0.25	0.32	-0.31	0.10	0.02	

Pearson (Spearman) correlation above (below) the diagonal.

Table 5
Basic Cost-Revenue Model

	log(CBO)	
	Model 1	Model 2
Intercept	-3.38***	0.96
	(0.57)	(0.64)
log(PC)	0.24***	0.15***
	(0.04)	(0.03)
log(AC)	0.99***	0.48***
	(0.05)	(0.06)
D_indie		0.12***
		(0.05)
D_summer		0.36***
		(0.04)
D_holiday		0.53***
		(0.05)
Log(RT)		0.69***
		(0.05)
Adj. R^2	0.43	0.51

Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Table 6
Real Options Hypothesis Test

	log(AC)	***log (CBO)*** Model 1	Model 2
Intercept	8.19***	4.22***	4.91***
	(0.24)	(0.44)	(0.44)
log(PC)	0.49***	0.75***	0.39***
	(0.01)	(0.03)	(0.03)
log(AC)_residual		0.98***	0.48***
		(0.05)	(0.06)
D_indie	-0.15***		0.04
	(0.03)		(0.05)
D_summer	0.06***		0.39***
	(0.02)		(0.04)
D_holiday	-0.01		0.52***
	(0.03)		(0.05)
Log(RT)			0.69***
			(0.05)
Adj. R^2	0.48	0.42	0.51
F-value for coefficient comparison between *log(PC)* and *log(AC)_residual*		18.3***	3.07*

Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Results of a two-stage regression to address the endogeneity of advertising costs. The first-stage regression (OLS) estimates ***log(AC)_residual*** (the residual of regressing ***log(AC)*** on the predictors), which then becomes a predictor for the second-stage regression with ***log (CBO)*** as the dependent variable.

Table 7
Returns-to-Scale Hypothesis Test

		log (CBO)	
	log(AC)	Model 1	Model 2
Intercept	8.72***	1.08	3.12**
	(0.79)	(1.51)	(1.40)
D_small	-0.57	8.39***	6.76***
	(0.90)	(1.71)	(1.59)
D_big	5.41	3.75	-0.38
	(4.81)	(9.26)	(8.54)
log(PC)	0.46***	0.93***	0.48***
	(0.05)	(0.09)	(0.08)
log(PC) x D_small	0.03	-0.51***	-0.41
	(0.05)	(0.10)	(0.09)
log(PC) x D_big	-0.29	-0.19	0.03
	(0.26)	(0.51)	(0.47)
log(AC)_residual		1.28***	0.86***
		(0.10)	(0.09)
log(AC) _residual x D_small		-0.39***	-0.55***
		(0.11)	(0.10)
log(AC)_residual x D_big		0.10	0.18
		(0.40)	(0.37)
D_indie	-0.15***		-0.02
	(0.03)		(0.05)
D_summer	0.06***		0.34***
	(0.02)		(0.04)
D_holiday	-0.01		0.47***
	(0.03)		(0.05)
Log(RT)			0.73***
			(0.05)
Adj. R^2	0.48	0.45	0.53

Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Results of a two-stage regression to address the endogeneity of advertising costs. The first-stage regression (OLS) estimates ***log(AC)_residual*** (the residual of regressing ***log(AC)*** on the predictors), which then becomes a predictor for the second-stage regression with ***log (CBO)*** as the dependent variable.

Table 8
Structural Changes Hypothesis Test

	log(AC)	***log (CBO)*** Model 1	Model 2
Intercept	7.15***	3.84***	5.30**
	(0.38)	(0.72)	(0.69)
D_period	2.81	0.28	-1.88**
	(0.45)	(0.89)	(0.83)
log(PC)	0.54***	0.78***	0.36***
	(0.02)	(0.04)	(0.05)
log(PC) x D_period	-0.15***	-0.02	0.10**
	(0.03)	0.05)	(0.05)
log(AC)_residual		1.83***	1.11***
		(0.08)	(0.09)
log(AC)_residual x D_period		-1.02***	-0.68***
		(0.10)	(0.10)
D_indie	-0.18***		0.09**
	(0.02)		(0.05)
D_summer	0.08***		0.35***
	(0.02)		(0.04)
D_holiday	0.01		0.47***
	(0.03)		(0.05)
Log(RT)			0.72***
			(0.05)
Adj. R^2	0.55	0.48	0.56

Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Results of a two-stage regression to address the endogeneity of advertising costs. The first-stage regression (OLS) estimates ***log(AC)_residual*** (the residual of regressing ***log(AC)*** on the predictors), which then becomes a predictor for the second-stage regression with ***log (CBO)*** as the dependent variable.

Table 9
Levels of Aggregation Hypothesis Test

	Product-Level ***log (CBO)***	***Studio-Level*** ***log (CBO)***
Intercept	-8.15***	-5.71
	(0.67)	(1.04)
log(PC)	0.20***	0.22*
	(0.04)	(0.12)
log(AC)	1.32***	1.12***
	(0.05)	(0.14)
D_indie	0.16**	0.39**
	(0.05)	(0.14)
D_ Period	-0.53***	-0.41***
	(0.05)	(0.08)
Adj. R^2	0.48	0.91
N	1,609	115

Standard errors in parentheses; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Product represents regressions using product-level data. ***Studio*** represents regressions using studio-level data.