Thorsten Hennig-Thurau, Victor Henning, Henrik Sattler, Felix Eggers, & Mark B. Houston

The Last Picture Show? Timing and Order of Movie Distribution Channels

Movies and other media goods are traditionally distributed across distinct sequential channels (e.g., theaters, home video, video on demand). The optimality of the currently employed timing and order of channel openings has become a matter of contentious debate among both industry experts and marketing scholars. In this article, the authors present a model of revenue generation across four sequential distribution channels, combining choice-based conjoint data with other information. Drawing on stratified random samples for three major markets—namely, the United States, Japan, and Germany—and a total of 1770 consumers, the empirical results suggest that the studios that produce motion pictures can increase their revenues by up to 16.2% through sequential distribution chain timing and order changes when applying a common distribution model for all movies in a country and that revenue-optimizing structures differ strongly among countries. Under the conditions of the study, the authors find that the simultaneous release of movies in theaters and on rental home video generates maximum revenues for movie studios in the United States but has devastating effects on other players, such as theater chains. The authors discuss different scenarios and their implications for movie studios and other industry players, and barriers for the implementation of the revenue-maximizing distribution models are critically reflected.

> "Ten years from now, we'll release a film, and you'll be able to consume it however you want."
>
> —Yair Landau, Vice Chairman of Sony Pictures (Smith 2005, p. 52)

Sequential distribution describes a marketing strategy that is designed to maximize producer income by making a product available to consumers in different markets in succession (Hennig-Thurau, Houston, and Walsh 2006; Vogel 2004). Sequential distribution is used mainly to market entertainment products, including electronic games and books (Lehmann and Weinberg 2000). A primary challenge facing practitioners and marketing scholars regarding sequential distribution strategy is when and in which order to enter sequential channels to maximize producer revenue.

This article addresses this challenge empirically by studying the motion picture industry, which relies heavily on sequential distribution (Eliashberg, Elberse, and Leenders 2006; Lehmann and Weinberg 2000). Traditional distribution for a film begins with a theater premiere, followed by a release to retail markets (rental or sale of DVDs), display on premium satellite or cable channels, and, eventually, television. Because revenues generated by nontheatrical markets exceed theatrical box office grosses (e.g., U.S. box office of $9 billion in 2005 compared with revenues of $24.9 billion through DVD/VHS sales and rentals; Entertainment Merchants Association 2006; Motion Picture Association of America [MPAA] 2006) and because new channels, such as video on demand (VOD), have entered the market, this traditional sequencing of channels has come under siege by film studios (Stanley 2005), which are articulating interest in opening nontheatrical channels earlier and are even changing the established order of channels. For example, Warner Bros. Entertainment chairman Barry Meyer publicly envisions major movies debuting "on DVD simultaneously with their theatrical release," proposing that future premieres "will be in Wal-Mart" (Bond 2005) and that theater revenues will be mere "added value." As a result, the window between the theatrical and home video release of a motion picture is shrinking (Saccone 2005), and consumers are able to (pre)order the DVD of a movie even before it has opened theatrically in some major export markets. Such fundamental shifts in sequencing strategies would almost certainly affect players, such as theater owners (Eliashberg, Elberse, and Leenders 2006; Vogel 2004). John Fithian, president of the National Association of Theater Owners, considers timing and order changes "the biggest threat to the viability of the cinema industry today" (Canadian Broadcasting Corporation 2006, p. 1). With the growth of alternative ways to watch films, will movie theaters soon see their "last picture show?"

The potential impact of timing and order changes on movie studio revenues and profits is unclear. The current industry discussion is clearly dominated by speculation based on proprietary consultancy reports for which the underlying data, assumptions, and analyses are not open for

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verification. For example, a JPMorgan report suggests that a simultaneous release of a film in theaters and on DVD would lead to an overall 36% increase in studio revenues (Snyder 2005). In terms of scholarly research, a limited number of researchers have studied the effect of changes in sequential distribution timing on studios (e.g., Lehmann and Weinberg 2000), but extant studies present either theoretical models of specific aspects of the sequential distribution process (Prasad, Bronnenberg, and Mahajan 2004) or empirical models that are based on aggregated prior market data (Frank 1994; Lehmann and Weinberg 2000). No research has yet modeled the multistage sequential chains that reflect normal marketplace conditions (i.e., involving three or more channels and two or more release windows that must be optimized simultaneously), and none has modeled the potential effects of order changes on studio revenues. Furthermore, previous research has not examined regional differences, despite the influence of cultural variables on the consumption of entertainment products (Hennig-Thurau, Walsh, and Bode 2004) and the importance of export markets for U.S. entertainment industries (about half of motion picture revenues come from non-U.S. markets; Omsyc 2002).

The goal of this article is to identify sequential distribution configurations that maximize movie studio revenues. The approach we employ here extends the extant literature in three ways. We (1) consider multiple channels that consumers face in reality; (2) use individual-level discrete choice consumer data that enable us to model potential market configurations, such as simultaneous releases in theaters and other channels (e.g., home video) whose economic appeal cannot be assessed by prior market data; and (3) account for country differences. Drawing from the extant literature on sequential distribution, we develop an integrative framework of sequential distribution's impact on studio revenues and use this framework to present a sequential distribution net present value (NPV) model. Combining a discrete-choice conjoint design with self-reported customer data, we apply our model to three leading motion-picture markets—the United States, Japan, and Germany—by drawing on random samples for each of these markets and 1770 consumers to allow for market-specific effects. We use the model to test systematically the effects of changes in the timing and order of the windows of the sequential distribution chain on consumer choices and, subsequently, movie studio revenues in the different countries. We isolate configurations of the sequential distribution chain that, under the given assumptions, provide optimal payoffs to the movie studio and differentiate our findings for different movie genres. We discuss these results and highlight potential obstacles that studios might face when changing the existing distribution structure.

Sequential Distribution of Motion Pictures: Literature and Conceptual Framework

Overview of Channel Timing and Order Research

Extant literature on sequential distribution that examines the optimal timing and order of channels is rare. The few existing studies on this topic have identified several sequential distribution chain characteristics, which we use as central elements of our conceptual model of sequential distribution (Frank 1994; Lehmann and Weinberg 2000; Luan 2005; Prasad, Bronnenberg, and Mahajan 2004). Although most authors recommend the current theater-to-home-video window to be shortened, no study accounts for today's multichannel nature of movie distribution in modeling the effect of window length changes.

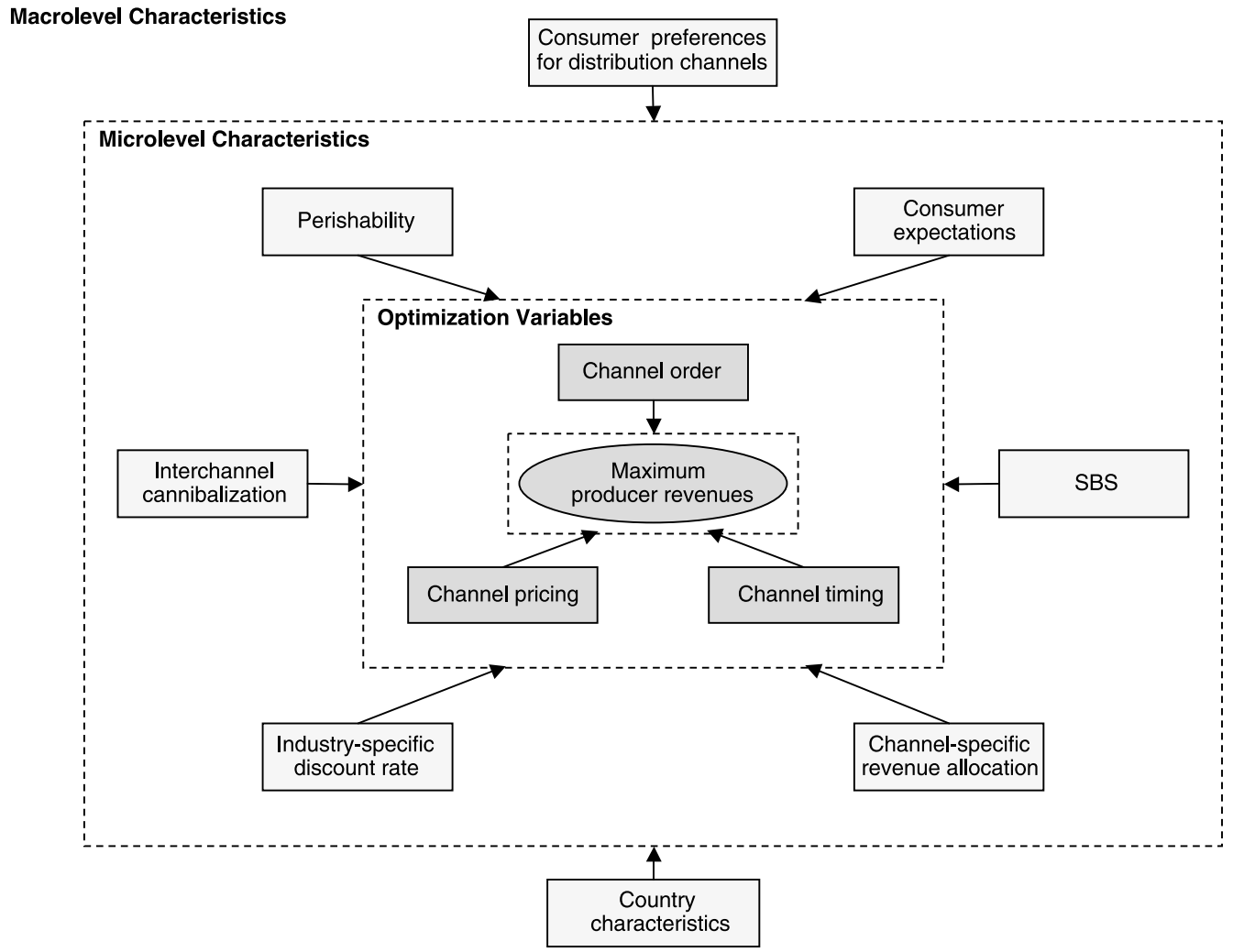
Moreover, no academic research has yet addressed the potential impact of order changes in the sequential chain on studio revenues. Most studies of sequential distribution treat the order of motion picture channels as fixed, and some argue that to open a movie in any channel other than theaters is "suicidal" (Frank 1994, p. 125). Essentially, two arguments are used in the extant literature to support the current sequence of motion picture channels. First, it is argued that products should be distributed first through channels that generate the "highest revenues over the least amount of time" and then cascaded down to markets that return less revenue per unit time (Eliashberg, Elberse, and Leenders 2006, p. 27). Second, the power to attract public "buzz" is viewed as exclusive to the theatrical channel (Lippman 2000). However, these arguments are being challenged by current market conditions. Beyond the overall higher revenues earned by films in ancillary markets, studio channel margins now are higher for DVD sales than for theater "sales" (Blume 2004; Cohen 2003; Vogel 2004). In addition, because other cultural products, such as music and books, are well known for their ability to stimulate media buzz for openings in retail stores, "[i]t isn't that radical a proposition that movies could follow that same path" (Gentile 2005). Consistent with these arguments, Eliashberg, Elberse, and Leenders (2006, p. 27) conjecture "that new movies on [pay-per-view] or VOD prior to the theatrical release could be sold to millions of viewers." Overall, these contrasting views suggest that an empirical examination of sequential channel order changes is merited.

A Conceptual Framework for Studio Revenue Optimization

Drawing on extant research on sequential distribution, we present a conceptual framework for sequential distribution optimization. As Figure 1 illustrates, the framework postulates that maximum studio revenues depend on three optimization variables: the timing of distribution channels, the order in which these channels open, and the price for which the product is made available in each channel. Furthermore, it proposes that these optimization variables are influenced by several microlevel and macrolevel factors.

Microlevel factors. We argue that the revenue-maximizing channel configuration essentially depends on six microlevel characteristics of sequential distribution chains. These factors include four that are suggested by the extant literature—interchannel cannibalization, perishability, customer expectations, and success-breeds-success (SBS) effects—and two specific financial factors—the industry-specific discount rate and the channel-specific revenue allocation.

FIGURE 1
A Conceptual Framework of Sequential Distribution Revenue Maximization



With regard to interchannel cannibalization, we assume that the release of a movie in a second channel has the potential to cannibalize revenues from an existing channel because of consumers' willingness to switch between channels. Interchannel cannibalization was first discussed by Frank (1994), who models the interrelationships between theater visits and home video rental revenues and finds that cannibalization occurs if a film is released on video "too early." Lehmann and Weinberg (2000) also consider channel cannibalization between theater and video releases and suggest that the size of each market should determine the delay period. In addition, cannibalization is reflected by industry thinking that "[a] good movie is a good movie, regardless of where it's shown" (Bregman, qtd. in Arnold 2005). As Prasad, Bronnenberg, and Mahajan (2004) argue, cannibalization effects can be either complete or partial, depending on consumers' perceptions of substitutability between movie channels.

Regarding perishability, we draw on the work of Frank (1994), Lehmann and Weinberg (2000), and Prasad, Bronnenberg, and Mahajan (2004), who propose a "wear-out" effect, which exists if a film is "too old" when it is released in secondary channels. Adapting their argument, we assume that the revenues generated by movies in subsequent channels should be affected by the time elapsed since the movie was first available, with demand declining over time. This assumption is shared by industry executives, such as Bob Chapek, president of Buena Vista Home Entertainment, who compared a movie "to a melting ice cube. The longer it sits, the smaller it becomes" (Dutka 2005).

Regarding customer expectations, Prasad, Bronnenberg, and Mahajan (2004) argue that as studios shorten the time between a film's theatrical run and its rental availability, consumers will strategically defer their consumption of the movie in the first channel because they expect the movie to be available soon in another channel that they prefer for certain reasons (e.g., lower price, multiple viewings). Building on this, we assume that consumers have expectations regarding the release of a motion picture in subsequent channels and that these expectations will influence channel choice, such as passing up a theater visit in lieu of a later rental or purchase (Prasad, Bronnenberg, and Mahajan

2004). These expectations can be based on experience or on information from retailers and media (e.g., movie-related Web sites). For example, *Star Wars: Episode III* was the best-selling DVD on Amazon.com in Germany the week before the movie was released to German theaters; customers received e-mails from the online retailer inviting them to preorder the DVD for the new movie.

Regarding SBS effects, Prasad, Bronnenberg, and Mahajan (2004) demonstrate the existence of complementary effects between channels by linking the success of a movie in theaters to video revenues. We distinguish between multiple-purchase SBS and information-cascading SBS. In multiple-purchase SBS, an individual consumer pays to see a movie more than once, with the first viewing causing a desire for subsequent viewings (Luan 2005). Multiple purchasing will affect subsequent channel revenues until the movie can be purchased by the consumer (i.e., when the consumer can then view the film repeatedly without additional cost). In contrast, information-cascading SBS refers to the impact of a movie's success in one channel on other consumers' behavior in subsequent channels. Information-cascading SBS can be based on either personal experiences that are shared (i.e., word of mouth [Liu 2006] or informed cascades [DeVany and Walls 2002]) or box office results that are made public (i.e., uninformed cascades [DeVany and Lee 2001]). Although information-cascading SBS effects have so far been stirred by movies' theatrical releases, we argue that they could be similarly created in other channels, such as DVD sales or VOD, if movies were released there first. Empirical evidence for SBS in a movie context has been reported by Elberse and Eliashberg (2003) and Hennig-Thurau, Houston, and Walsh (2006).

Finally, distribution chain decisions are also influenced by specific financial factors. The industry-specific discount rate must be considered because future revenues need to be discounted because of risk and opportunity costs, which reduce the attractiveness of delayed channel openings. When the movie *Bubble* was the first to receive a simultaneous release in theaters, on DVD, and on pay-per-view in January 2006, its producer highlighted "the accelerated timetable for getting our money back" as an anticipated benefit (Bowles, qtd. in *Box Office Mojo* 2006). In addition, the revenue share the studio received in each channel constitutes a key criterion for the optimal sequential channel structure because revenues are divided among different players (e.g., theater chains, studios) in each channel, and the percentage that accrues to the studio differs across channels.

Macrolevel factors. The microlevel characteristics and the revenue-maximizing channel structure that can be derived from them are influenced by the macrolevel factors of channel preference and country. Specifically, microlevel characteristics are influenced by consumers' preferences toward distribution channels, such as movie theaters, DVD purchases, DVD rentals, and online downloading (Vogel 2004), all of which must be considered simultaneously. Channel preferences differ; whereas some consumers prefer going to the movies ("I love the mythos of the darkened theater"; customer statement in Puig 2005), others argue that "there's no place like home" (Clark 2005). This channel preference determines, among other things, the extent of interchannel cannibalization and perishability because strong preferences for a certain channel limit the degree of cannibalization among channels and reduce the impact of perishability on channel revenues. Another macrolevel factor we consider is country characteristics. A wealth of research suggests that consumers across countries differ in their decision-making processes. In a film context, cultural factors (e.g., Hennig-Thurau, Walsh, and Bode 2004) and informational factors (e.g., Elberse and Eliashberg 2003) might explain these differences. Such country characteristics affect consumers' expectations about the opening of secondary channels, as well as the extent of multiple purchasing and the role of word of mouth and charts for movie consumption. They might also affect the financial parameters of our framework.

An NPV Model of Movie Studios' Sequential Distribution Revenues

General Considerations

Using the sequential distribution framework described previously, we now develop an NPV model of movie studio revenues. In contrast to studies that focus on overall industry revenues and other shared outcomes (Frank 1994; Luan 2005), we view the revenues that each channel returns to the movie studio as decisive for determining the optimal sequential channel structure. This consideration is based on the notion that an individual firm's channel decisions are not made to maximize overall industry revenues but rather to generate maximum revenues for that individual player.

In our model, we argue that the revenues a movie generates are the result of consumers' choices among different channels when the movie becomes available. To cover the multichannel nature of motion picture distribution adequately, we include four channels among which the consumer can choose: movie theater consumption, DVD purchases, DVD rentals, and download-to-rent VOD.[1] In addition to consumer expectations regarding release dates that are modeled as known, the model accounts for the effects of interchannel cannibalization and perishability on consumer decision making because consumers can choose consciously among different channels, and it accounts for the respective opening dates in each channel in relation to the consumers' willingness to accept a consumption delay. By modeling channel preference at the individual consumer level as part of the customer's choice decision, the model also considers varying degrees of interchannel substitution. Moreover, the model accounts for interchannel effects; channel revenues are influenced by multiple-purchase SBS and both informed-cascading SBS (e.g., through word of

[1]We construe VOD as an umbrella concept that summarizes different media services under a common label. In this study, we focus on download-to-rent VOD, the dominant model when the empirical study was conducted, which allows consumers to watch a movie that has been downloaded from the Internet for a limited time (usually 24 hours). To increase readability, we use the terms VOD and download-to-rent VOD interchangeably.

mouth) and uninformed-cascading SBS (e.g., through box office data).

Because channel revenues do not flow back instantly after the channel's opening, we model the weekly percentage of the channel-specific revenue return as a function f(w) of the number of weeks w after opening. To estimate f(w), we used weekly revenue data for the studio movies released in 2005 provided by IMDbPro (for theaters), *Video Business* magazine (DVD rental), Nielsen VideoScan (DVD sales), and an anonymous Hollywood studio (VOD).[2] We fit different regression models to mirror these data, assuming that the weekly percentage of revenue return becomes zero after 78 weeks (i.e., 1.5 years), which was implied by the actual revenue distribution patterns. For theatrical revenues and DVD rental returns, log-linear functions fit best with the industry data, whereas for DVD sales, a multiplicative function had the best fit, and for VOD returns, a quadratic function had the best fit. In all cases, the fit was excellent, with R-squares ranging from .96 to .99. The functions appear in Figure 2.

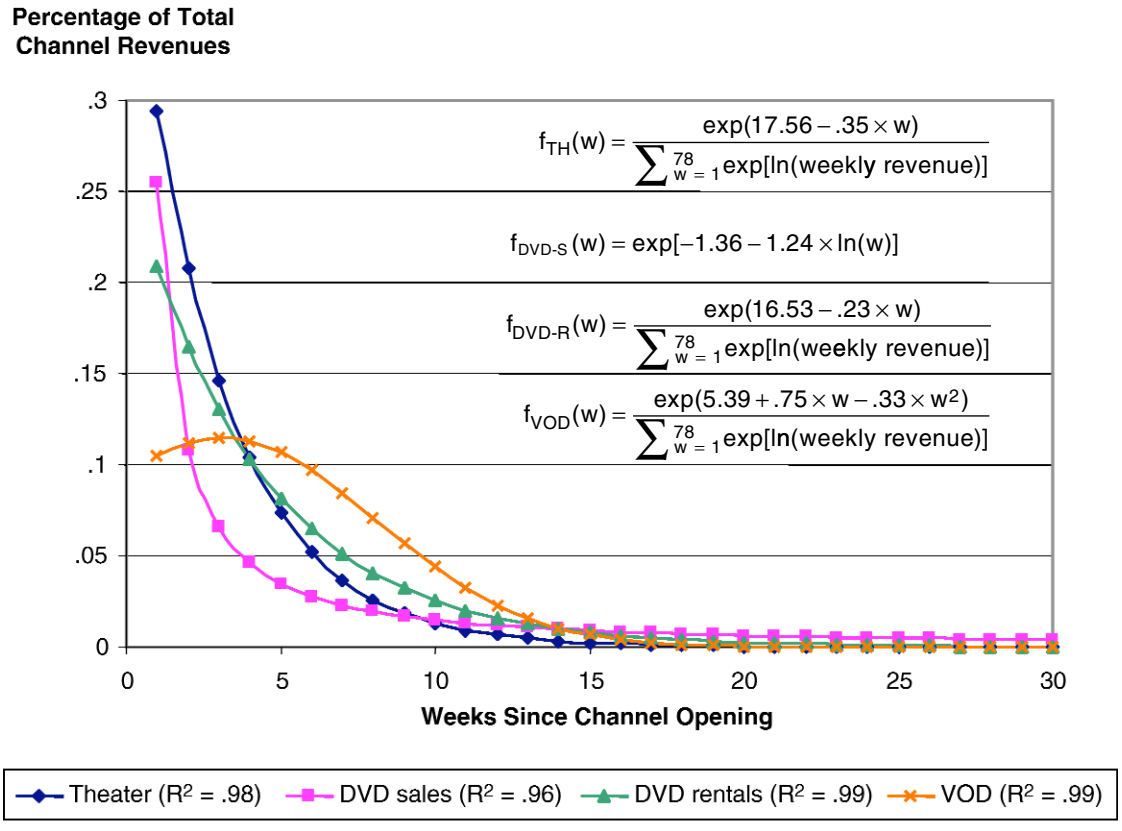
Formal Model Description

We formally describe the model as follows:

$$(1)\quad NPV = \beta_{TH} \times \frac{\sum_{w} \frac{f_{TH}(w) \times R_{TH}}{(1+r)^{w}}}{(1+r_M)^{t_{TH}}} + \beta_{DVD\text{-}S} \times \frac{\sum_{w} \frac{f_{DVD\text{-}S}(w) \times R_{DVD\text{-}S}}{(1+r)^{w}}}{(1+r_M)^{t_{DVD\text{-}S}}} + \beta_{DVD\text{-}R} \times \frac{\sum_{w} \frac{f_{DVD\text{-}R}(w) \times R_{DVD\text{-}R}}{(1+r)^{w}}}{(1+r_M)^{t_{DVD\text{-}R}}} + \beta_{VOD} \times \frac{\sum_{w} \frac{f_{VOD}(w) \times R_{VOD}}{(1+r)^{w}}}{(1+r_M)^{t_{VOD}}},$$

[2]For DVD sales, theaters, and DVD rental, we were provided with aggregate-level information on the weekly revenue patterns of all 2005 studio releases. Because industrywide information was not available for the VOD channel, we relied on aggregate-level information on the VOD performance for one studio's 2005 movies. The VOD revenue data were monthly, and thus we interpolated them to weekly revenues. To predict the percentage of revenue return from the dollar revenues, we modeled and fore-

FIGURE 2
Revenue Distribution Over Time per Channel



Notes: The subscripts name the respective channel. TH = theater, DVD-S = DVD sales, DVD-R = DVD rental, and VOD = download-to-rent VOD.

where NPV is the studio's net present value of a movie and R represents the revenues of a movie generated through a specific channel, which are discounted with f(w) for the respective channel's rate of flow (see Figure 2). We use a weekly discount rate of .183%, which equals an annual industry-specific discount rate of r = 10%.[3] The monthly equivalent to r was represented by r_M, which is used to discount channel revenues to the opening of the first channel; t is the time difference in months between the opening of the first channel and the opening of the channel under consideration (i.e., window length); and β is the percentage of revenues allocated to the studio for each channel.

Revenues are generated through consumers' choices among the different channels, with choices x being a function of the channel attributes x = f(p, t, m, π), where p is the price consumers pay to see a movie; m is the medium (or channel); and π is a vector that reflects other factors, such as the language in which the movie is shown and the presence of bonus material. We model a consumer's individual choice given a set of channel alternatives with the multinomial logit model, as follows:

$$(2)\qquad x(i|J) = \frac{\exp(\theta_p p_i + \theta_t t_i + \theta_m m_i + \theta_\pi \pi_i)}{\sum_{j=1}^{J} \exp(\theta_p p_j + \theta_t t_j + \theta_m m_j + \theta_\pi \pi_j)},$$

where x(i|J) is a consumer's choice share for channel i in a specific scenario with J movie consumption alternatives (including an option not to see the movie in one of the given channel alternatives; i.e., to wait for the movie to be made available on television for free) and θ is a parameter vector that reflects the consumer's preference structure for the channel attributes.

Individual-level choice shares are complemented with individual-level SBS information. It is important to model multiple-purchase SBS and information-cascading SBS on an individual level because consumers might not be equally likely to react to these effects. Accordingly, we get complemented individual-level choice quantities x′, as follows:

$$(3)\qquad x'_{TH} = x_{TH} \times (1 + \gamma^{WOM}{}_{TH} + \gamma^{C}{}_{TH}) + \delta_{TH} \times x_{FC},$$

$$(4)\qquad x'_{DVD\text{-}S} = x_{DVD\text{-}S} \times (1 + \gamma^{WOM}{}_{DVD\text{-}S} + \gamma^{C}{}_{DVD\text{-}S}) + \delta_{DVD\text{-}S} \times x_{FC},$$

$$(5)\qquad x'_{DVD\text{-}R} = x_{DVD\text{-}R} \times (1 + \gamma^{WOM}{}_{DVD\text{-}R} + \gamma^{C}{}_{DVD\text{-}R}) + \delta_{DVD\text{-}R} \times x_{FC}, \text{ and}$$

$$(6)\qquad x'_{VOD} = x_{VOD} \times (1 + \gamma^{WOM}{}_{VOD} + \gamma^{C}{}_{VOD}) + \delta_{VOD} \times x_{FC},$$

where x is the choice share for the channel indicated by the subscript according to the multinomial logit model; γ represents channel-specific information-cascading SBS effects, where γ^{WOM} is the parameter for informed cascades (e.g., the percentage of movies seen in the respective channel exclusively due to word of mouth generated by previous channels) and γ^{C} is the parameter for uninformed cascades (e.g., the percentage of movies seen in the respective channel exclusively due to chart information from previous channels); δ_{TH}, $\delta_{DVD\text{-}R}$, δ_{VOD}, and $\delta_{DVD\text{-}S}$ are multiple-purchase parameters for theaters, DVD rental, VOD, and DVD sales, respectively; and x_{FC} represents the proportion of choice to see the movie in the channels that open first (equal to 0 if the movie is first made available through the channel under consideration).

Both information-cascading SBS parameters, γ^{WOM} and γ^{C}, become zero if the movie is first made available through the channel under consideration. With regard to the multiple-purchase parameters, δ_{TH}, $\delta_{DVD\text{-}R}$, and δ_{VOD} are zero if the movie is first made available through the respective channel or opens exclusively through DVD sales. In addition, we model the consumer's desire to rewatch the movie in a theater, on a rental DVD, or through VOD to be zero immediately after he or she consumes it for the first time in a different channel and then to rise gradually over time, following an exponential saturation function. Specifically, we set $\delta = a \times [1 - \exp(-.5 \times t)]$, where a is the channel-specific repeat consumption probability of the individual consumer—that is, the percentage of movies watched in the channel indicated by the subscript δ that were previously seen in other channels (x_{FC}). In addition, $\delta_{DVD\text{-}S}$ is zero if the movie is first made available through this specific channel (i.e., DVD sales). However, because the consumer's desire to own a movie is formed immediately after viewing it in a different channel and remains constant thereafter in our model until fulfilled, the multiple-purchase parameter for the DVD sales channel is time invariant at $\delta_{DVD\text{-}S} = a_{DVD\text{-}S}$.

We calculate the overall channel-specific revenues by taking the arithmetic mean of each channel's complemented choice quantity across all consumers (X′) and multiplying it by the respective channel price. For example, theater revenues can be calculated by $R_{TH} = p_{TH} \times X'_{TH}$. This information enables us to calculate the weekly return and the NPV of studio revenues. Appendix A contains an illustrative application of the model.

Model Assumptions

It is important to note that the model we described is based on several assumptions. In line with our studio perspective, we focus on studio-produced motion pictures and the conditions under which such movies are distributed. Specifically, we assume that motion pictures are released widely in theaters (the dominant distribution model) and do not distinguish between producers and distributors of motion pictures with regard to revenue maximization, because most

casted the revenues of the respective channel for up to 78 weeks and related each predicted weekly revenue to the total amount of revenues to obtain the required percentage for these channels. In the case of DVD sales, we were provided with weekly percentages.

[3]Although information on suitable discount rates for the valuation of movie studios is scarce, available sources cite annual discount rates of 9.0% for Sony Pictures (Sony 1997), 9.1% for Disney, 11.0% for MGM, and 11.8% for Pixar (Chalmers 2002). Thus, a discount rate of 10% seemed reasonable.

movies produced by a major Hollywood studio are distributed by sister companies over which the studio has complete control (e.g., Warner Bros. Pictures, Warner Bros. Pictures Domestic Distribution, and Warner Home Video are all subsidiaries of Time Warner Inc.). We also assume that consumers who want to see a movie in a channel that is already open are able to do so; that is, there are no shortages of screens at the theater or of DVD copies in rental stores and at retailers to limit consumption, and all movies are available through any channel. This is in line with the market efficiency hypothesis, which matches the reality of movie distribution well for wide studio releases (Hennig-Thurau, Houston, and Walsh 2006). Moreover, we assume that studio advertising is effective, with consumers being aware of new studio releases and making their channel choices deliberately, and that its effectiveness is the same for all channels. Consistent with the early announcement policy of new movies by studios and retailers, we assume that consumers have homogeneous expectations (i.e., knowledge) about the timing of new studio movies' releases in different channels, with these expectations matching the actual release dates. Furthermore, we assume that customers watch a movie in theaters only once, which corresponds with norms reported in industry information (Hindes 1998). We also assume that SBS is not exclusive to theatrical releases but exists for any channel in which a new movie is made available for the first time, and we assume that the allocation of revenues between studios and other players is constant over the course of a movie's release (i.e., the studio's share is identical in Week 1 and the weeks that follow). Moreover, because our focus is on customer preferences, we do not consider potential market barriers caused by other players, such as movie theaters, that might hinder studios' implementation of certain distribution models (but we discuss their impact subsequently). Finally, we exclude piracy from our model because the effect of such illegal consumption options on traditional distribution channels of motion pictures remains an unanswered question.

Research Design

To account for the existence of country factors and because of the enormous relevance of export markets for U.S. motion pictures (in 2005, cumulative foreign box office exceeded domestic theatrical revenues by 60%; MPAA 2006), we applied our model not only to the U.S. market but also to those of Japan and Germany, two film markets that are important and culturally diverse. These three countries constitute 56.4% of the worldwide theatrical market (MPAA 2003), and Japan and Germany are the world's third- and fourth-largest theatrical export markets, respectively. Furthermore, Japan is the second-largest home video market, with annual revenues of $5.5 billion, and Germany is the fifth-largest home video market, with annual revenues of $1.7 billion (International Video Federation 2004).

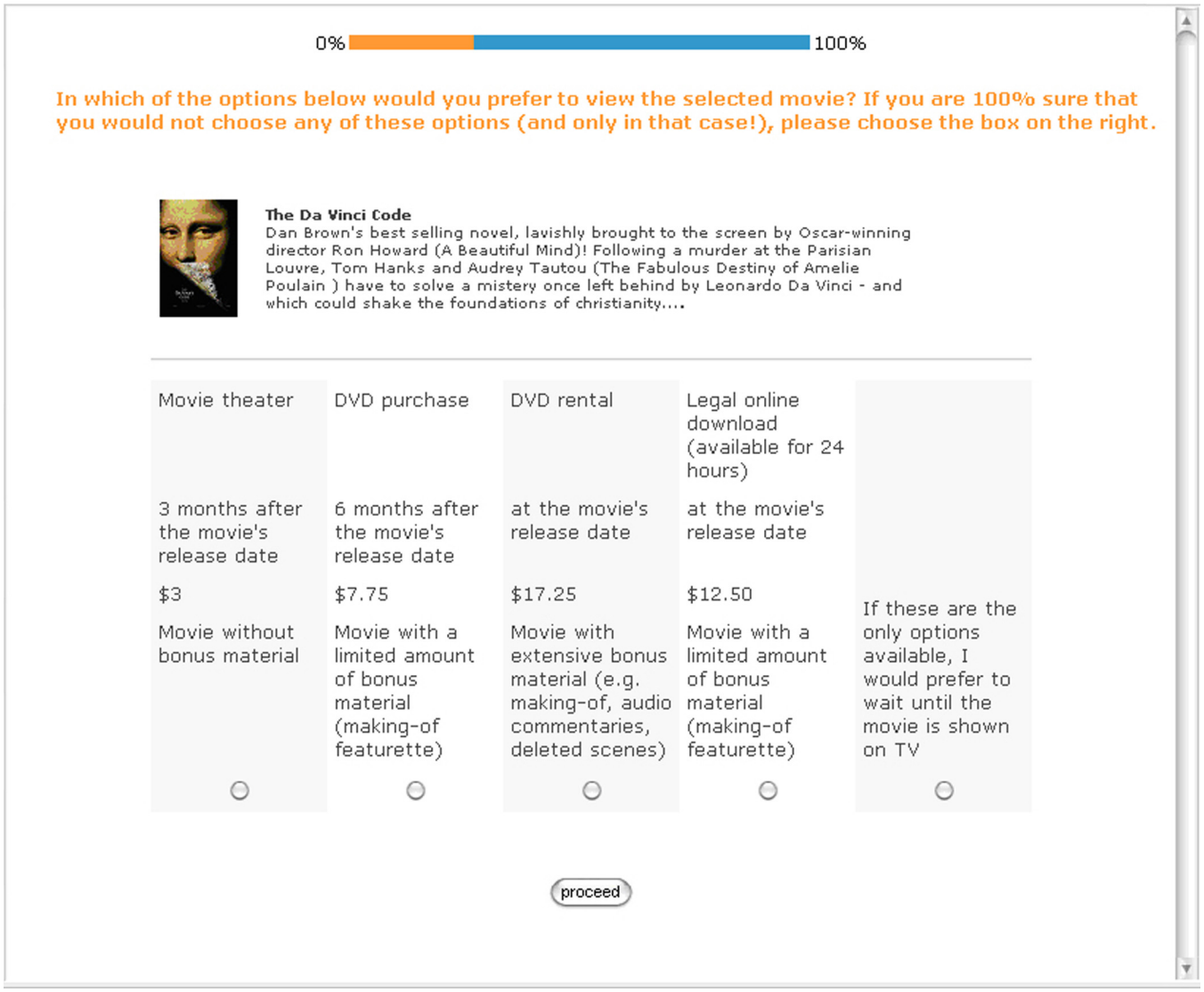
Stratified random samples of the U.S., Japanese, and German populations were drawn in cooperation with a global marketing research company. With age and gender as interlocked strata, 5094 consumers (United States = 1701, Japan = 1802, and Germany = 1591) were randomly selected from the research company's database, which mirrors each country's overall population, and they were invited by e-mail to fill out an Internet questionnaire and were offered $1 for participation. A total of 1859 consumers responded. For quality reasons, we eliminated respondents who completed the questionnaire in less than five minutes, leaving a sample of 1770 (n = 588 in the United States, for a response rate of 34.6%; n = 593 in Japan, for a response rate of 32.9%; and n = 589 in Germany, for a response rate of 37.0%). (Demographic characteristics of the subsamples are available on request.)

The questionnaire required respondents to participate in several discrete-choice tasks and to answer rating-scaled questions. To increase the realism of the choice tasks, respondents were first presented with nine upcoming motion pictures and were asked to choose the movie they were most interested in seeing.[4] Short descriptions of the nine movies' plots, directors, and stars were provided, as were posters and trailers. An additional option for respondents was to wait until all nine movies were shown on television and could be watched free of charge; consumers who voted for this option were excluded from the remainder of the questionnaire (Gilbride and Allenby 2004).

For the movie selected, seven choice sets embedded in a choice-based conjoint design were presented to the respondents (Louviere and Woodworth 1983; for conjoint work in channels contexts, see Wuyts et al. 2004). Each choice set contained four hypothetical channel options for watching the movie (i.e., conjoint stimuli) and a "no-consumption" option (Figure 3). Regarding conjoint attributes, each conjoint stimulus was described by four (U.S.) or five (Japan and Germany) attributes, and attribute levels varied systematically (Table 1). Specifically, the attributes used to generate conjoint stimuli in the U.S. questionnaire were (1) the channel through which the movie was consumed, (2) the timing of availability, (3) the price a consumer must pay to watch the movie, and (4) any additional content (e.g., deleted scenes, commentaries) made accessible to the consumer. As a result of pretesting and depth interviews with industry experts, we included the fourth attribute to increase realism. In Japan and Germany, we used identical attributes and levels (with price levels transformed into yen and euros, respectively). Because motion pictures are often presented in "dubbed" versions in theaters in these countries (i.e., movies are translated into Japanese or German), we included language in both cases as an additional attribute. We modeled attribute-level combinations, which might have resulted in improbable alternatives and respondent confusion, as prohibited pairs. We created stimuli and conjoint choice sets according to a computer-generated randomized design that accounted for the design principles (1) minimal overlap, (2) level balance, and (3) orthogonality (Huber and Zwerina 1996).

[4]The nine studio-produced movies, which cover a wide range of genres, were *Harry Potter and the Goblet of Fire*, *Jarhead*, *King Kong*, *Perfume: The Story of a Murderer*, *Pink Panther*, *The Chronicles of Narnia*, *The DaVinci Code*, *Wallace & Gromit: The Curse of the Were-Rabbit*, and *X-Men 3*. None had been released at the time of the data collection.

FIGURE 3
Example of Conjoint Task



Finally, respondents were asked to provide movie consumption-related responses, which we used as proxies for the SBS parameters. To calculate the multiple consumption parameters δ, respondents were asked what percentage of movies they had seen in theaters and had later bought or rented on DVD/home video or downloaded from the Internet for a fee (for full items, see Appendix B).[5] We modeled the exponential saturation function for the multiple consumption parameter for DVD rental and VOD to converge toward the multiple consumption value stated by the individual consumer for the respective channel. For the DVD sales channel, we set the multiple consumption parameter to be equal to the percentage of the individual consumer's DVDs that had been purchased after having watched a movie in theaters. With regard to information-cascading parameters γ^{WOM} and γ^{C}, respondents were asked what percentage of their DVD purchases, DVD rentals, and legal Internet downloads of movies they had not seen before in theaters was primarily triggered by information about the success of the movie in theaters (i.e., based on charts) or by personal information (i.e., based on word of mouth). Studio

[5]Because movies have always been released in theaters first, we could not ask respondents for an interchannel multiple consumption effect from home entertainment channels on theaters. Acknowledging that this is a limitation of the present study, we used the consumers' DVD rental behavior as a proxy for share simulations in which theaters are not the first channel, and we modeled consumers as being only half as likely to watch a movie in theaters after having watched it on DVD than vice versa, which can be considered a conservative assumption. With regard to theater-related SBS effects, we also adopted the respective DVD SBS parameters as a proxy for both theater-related SBS parameters in such scenarios. As we report subsequently, sensitivity analyses show that the results are reasonably robust to variations in the levels of these parameters.

TABLE 1
Attributes and Levels Included in Conjoint Study

Attribute	Description	Levels		
		United States	Japan	Germany
Channel	The channel (or medium) through which the movie is consumed	Movie theater, DVD purchase, DVD rental, legal Internet download	As in the U.S. design	As in the U.S. design
Timing	Time since the movie was first available for consumers through a legal channel	0 months, 3 months, 6 months, 12 months	As in the U.S. design	As in the U.S. design
Fee	The price a consumer must pay to access the movie of his or her choice	$3, $7.75, $12.50, $17.25, $22	400 yen, 1,175 yen, 1,950 yen, 2,725 yen, 3,500 yen	3 euros, 7.75 euros, 12.50 euros, 17.25 euros, 22 euros
Bonus material	The existence (or absence) of background information about a motion picture	Movie only, movie with a limited amount of bonus material (i.e., making-of feature), movie with extensive bonus material (i.e., several making-of features, deleted scenes, multiple audio commentaries)	As in the U.S. design	As in the U.S. design
Language options	The language options between which the consumer can choose	Not included	Choice between Japanese and English audio track, Japanese audio track only	Choice between German and English audio track, German audio track only

revenue shares were set according to industry information.[6] To minimize any impact of language on the results, we used a translation–back translation procedure for the Japanese and German questionnaires.

Results

Estimation and Validation of Conjoint Data

To compute the preference data variables x_{TH}, $x_{DVD\text{-}S}$, $x_{DVD\text{-}R}$, and x_{VOD}, we estimated individual-level partworths from the conjoint results through a Hierarchical Bayes routine (Arora and Huber 2001). We used 10,000 burn-in iterations and another subsequent 10,000 iterations to generate parameter estimates; we saved every 10th iteration. Each respondent's utility was represented by the mean utility across these 1000 draws.

We randomly generated five of the seven choice tasks and used them for partworth estimation, and we used the remaining two tasks for reliability and validity testing. With regard to test–retest reliability, we referred to the agreement between respondents' choices in the first and seventh choice tasks; the latter was a replication of the first task (Ghiselli, Campbell, and Zedeck 1981). With identical choices by 73.6% for the U.S. sample (four attributes per stimuli), 72.2% for the German sample, and 68.1% for the Japanese sample (both sets of five attributes), reliability is satisfactory for all three subsamples. To measure predictive validity, we draw on the aggregate choice shares of a holdout task and test the extent to which a model based on the partworths estimated through the Choice Tasks 1–5 is able to predict correctly the observed choice behavior within Choice Task 6 (the holdout task) (Huber et al. 1993). To obtain share predictions, we transformed the partworths into choice shares for the respective profiles using a logit transformation (Equation 2). Table 2 shows that the overall fit is good in all three countries; predicted shares are close to actual shares in terms of mean absolute error, root mean square error, and chi-square (Moore, Gray-Lee, and Louviere 1998) and clearly outperform the chance model, which assumes that each profile is equally likely to be chosen. The holdout scenario was identical to the predicted choice in 66.0% of the U.S. sample cases and in 73.0% and 64.4% of the Japanese and German cases, respectively.

Comparing our results with real-world market data enables us to examine the external validity of our model. We applied our model and U.S. data to a situation that reflects actual market conditions observed at the time we conducted our analysis (U.S. benchmark model: $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, and $p_{DVD\text{-}S} = \$17.25$; Epstein 2005). We found that the studio revenues in this benchmark model match actual studio revenues per channel

[6]Specifically, we used the following shares: 50% of theater revenues (the remaining 50% go to the theater owner; Blume 2004; Vogel 2004), 60% of DVD sales (40% for the DVD retailer; Blume 2004; Cohen 2003; Manly 2005), 40% of DVD rental revenues (60% for the DVD rental company; Rentrak 2005), and 50% of VOD revenues (50% for the download company; Manly 2005; Sweeting 2005).

closely. Specifically, 23.7% of studio revenues are generated by theaters in our simulated benchmark model, whereas the studio shares of the actual theatrical revenues accounted for 25.3% (or $4.5 billion) of the studios' revenues in the United States in 2005. In addition, 19.2% of our benchmark model studio revenues stem from DVD rentals, mirrored in real-world DVD rental studio revenues of 19.2% ($3.4 billion), and 57.1% of the benchmark model studio revenues are generated by DVD sales, whereas actual DVD sales revenues constitute 55.5% ($9.8 billion) of the major studios' combined theatrical and home-viewing revenues (Entertainment Merchants Association 2006; MPAA 2006). This ability to reproduce current revenue patterns suggests reasonable external validity of the model and the applied conjoint procedure.

Sequential Distribution Chain Optimization: A Stepwise Approach

This research is the first to consider the timing of sequential distribution systems as a multiple-window problem that requires simultaneous optimization. Because several channel participants are involved, each of whom impose restrictions on the implementation of distribution chain changes, we decided to use a stepwise approach when applying our model to the data. Specifically, we test three different groups of scenarios, which differ in terms of restrictedness.

TABLE 2
Choice-Based Conjoint Prediction Accuracy for the Three Samples

		Predicted Shares	
	Actual Shares (Holdout)	Chance	Estimated Shares (Logit)
Movie theater	32.48	20.00	25.61
	32.04	20.00	29.96
	51.61	20.00	50.75
DVD purchase	16.84	20.00	17.13
	5.73	20.00	5.91
	9.85	20.00	8.49
DVD rental	36.05	20.00	40.70
	47.72	20.00	51.24
	22.75	20.00	25.09
Legal online	4.59	20.00	3.37
	4.89	20.00	1.58
	7.81	20.00	4.90
None	10.03	20.00	13.20
	9.61	20.00	11.31
	7.98	20.00	10.76

	Chance Model	Logit Model		Average Attribute Importance
MAE	11.4140	3.2399	Channel	36.96
	15.9060	2.1574		25.98
	13.7440	2.0475		30.70
RMSE	2.7572	.8972	Timing	12.96
	3.8122	.5528		13.90
	3.7455	.4922		16.62
Chi-square	38.0104	3.5839	Fee	42.44
	72.6629	7.5524		44.36
	70.1427	2.8917		41.96
			Bonus material	7.65
				7.50
				8.14
			Language options	N.A.
				8.26
				2.58

Notes: Values in the top row belong to the U.S. sample, values in the middle row to the Japanese sample, and values in the bottom row to the German sample. MAE = mean absolute error, and RMSE = root mean square error. N.A. = not applicable.

Scenario Group 1 retains the traditional order of movie distribution (i.e., $t_{TH} < t_{DVD\text{-}R}$, $t_{DVD\text{-}S}$, and t_{VOD}; $t_{DVD\text{-}R} \leq t_{DVD\text{-}S}$; and $t_{VOD} > t_{DVD\text{-}R}$ and $t_{DVD\text{-}S}$), paralleling previous work on sequential distribution in the film industry (e.g., Lehmann and Weinberg 2000). We carry out this first scenario group with prices for all channels held constant, and we allow DVD prices to vary.[7] Scenario Group 2 then lets movie studios freely decide when and in which order to open channels and how to price DVDs, with the exception that movies are not allowed to open elsewhere before being shown in theaters (i.e., $t_{TH} \leq t_{DVD\text{-}R}$, $t_{DVD\text{-}S}$, and t_{VOD}). This remaining restriction is then lifted in Scenario Group 3, in which any possible channel order is considered regardless of the potential obstacles that might hinder practical implementation.

Within each of the three scenario groups, we applied our model to all scenarios that met the respective constraints and calculated the studio's maximum NPV for each scenario. To avoid biases, we refrain from using interpolations between the attribute levels used in our conjoint design, but we use a complete enumeration approach instead. Given all constraints, Scenario Group 1 consists of four scenarios per country when DVD sales prices are fixed and 20 scenarios with flexible DVD sales prices. Scenario Group 2 contains 320 possible scenarios per country, and Scenario Group 3, the most flexible, contains 875 scenarios per country. We begin our analyses with the U.S. data and then replicate our approach with Japanese and German samples. Table 3 summarizes the three best configurations in terms of studio NPV for each scenario group and country, and Figure 4 compares the NPV of each group's top scenario with the respective benchmark model.

Scenario Group 1 results (United States). With fixed channel sequence and fixed prices, we find that the NPV of the current distribution configuration is optimal and cannot be increased by changes in the timing of distribution windows. Even when the pricing constraint is lifted for DVD sales (i.e., when DVD prices are allowed to fluctuate), the current theater-to-DVD window of six months remains superior for the studio. However, the results suggest that if the retail DVD price is set at $22 (versus $17.25), studio revenues increase by 2.1% compared with the benchmark configuration. Because consumer expectations now incorporate the higher DVD retail price, choice shares shift slightly away from retail DVDs toward theaters, rental DVDs, and VOD.

Scenario Group 2 results (United States). Removing all order constraints for home entertainment channels, except for not opening earlier than theaters, we observe major changes in terms of the channel structure that maximizes studio revenues. Under these conditions, studio revenues are maximized when movies are released simultaneously in movie theaters, on rental DVD, and in VOD, with DVDs being released for sale after a three-month window for a price of $22. In this scenario, studio revenues increase by 16.2% compared with the benchmark constellation. However, these studio revenue gains impose a heavy cost on movie theaters, which lose 40.1% of their revenues as a result of cannibalization. In addition to movie studios, the beneficiaries of this scenario are DVD retailers whose revenues increase by 49.6%.

When we examine the next-best scenarios under this constraint set, common patterns exist. The four revenue-maximizing configurations for studios all involve a simultaneous release in theaters and on rental DVD, with a DVD sales channel window of three months. Finally, the retail DVD price of $22 is common to the nine best scenarios, suggesting that DVDs are currently priced too low to maximize studio revenues. This result is consistent with the notion that "Wal-Mart, Best Buy, and other mass marketers are happily using DVDs and CDs as loss leaders and slashing prices to a level where even [rental chain] Blockbuster acknowledges it can't compete" (Amdur 2004).

Scenario Group 3 results (United States). Allowing theatrical releases to occur after other channels have been opened, we find that the most economically attractive scenarios remain unchanged from Scenario Group 2. Consequently, the results suggest that a delayed theater release is not optimal for studios, because the loss of shared revenues due to severe losses by movie theaters is not offset by increases in shared revenues from gains in the other channels. Considering the devastation such configurations would cause to movie theater chains without delivering additional revenues to the studios, channel order changes that shift theaters from the start of the distribution sequence do not appear to be a desirable strategy in the U.S. market.

Scenario analyses for foreign markets. In the restrictive Scenario Group 1 (with flexible DVD prices), strategy implications for Japan and Germany resemble those for the United States. In Japan, the optimal scenario employs a six-month DVD window, albeit with a slightly lower DVD retail price, and generates 1.4% more in studio revenues than the benchmark configuration. In Germany, a six-month DVD window also generates the highest revenues. By raising the retail DVD price to $22 in this scenario, studios can increase their revenues by 4.0%, while retaining the established channel order. However, when home entertainment timing constraints are removed in Scenario Group 2, the similarities between the U.S. and Japanese market simulations end. Although the settings now allow for simultaneous releases, the most attractive scenarios for studios retain theaters as the sole first channel. At the same time, the results for Japan suggest that narrowing the theater-to-DVD-sales window would increase studio revenues. Specifically, the five best scenarios in this group share the distinct pattern of releasing a movie in theaters first, opening the DVD sales channel after three months, and delaying the rental DVD release by another nine months, a configuration that, according to our results, would improve studio revenues by up to 11.6%. Contrary to the U.S. market, lower DVD retail prices increase studio revenues in Japan.

In Germany, the three revenue-maximizing configurations are essentially the same as in Japan, except that DVD

[7]We held prices constant because the focus of our analysis is on studio revenues, and all channels except DVD sales follow a revenue-sharing model in which the pricing decision lies with the respective final distributor and not with the studio (Van der Veen and Venugopal 2005).

TABLE 3
Top Scenarios from Scenario Groups and Countries

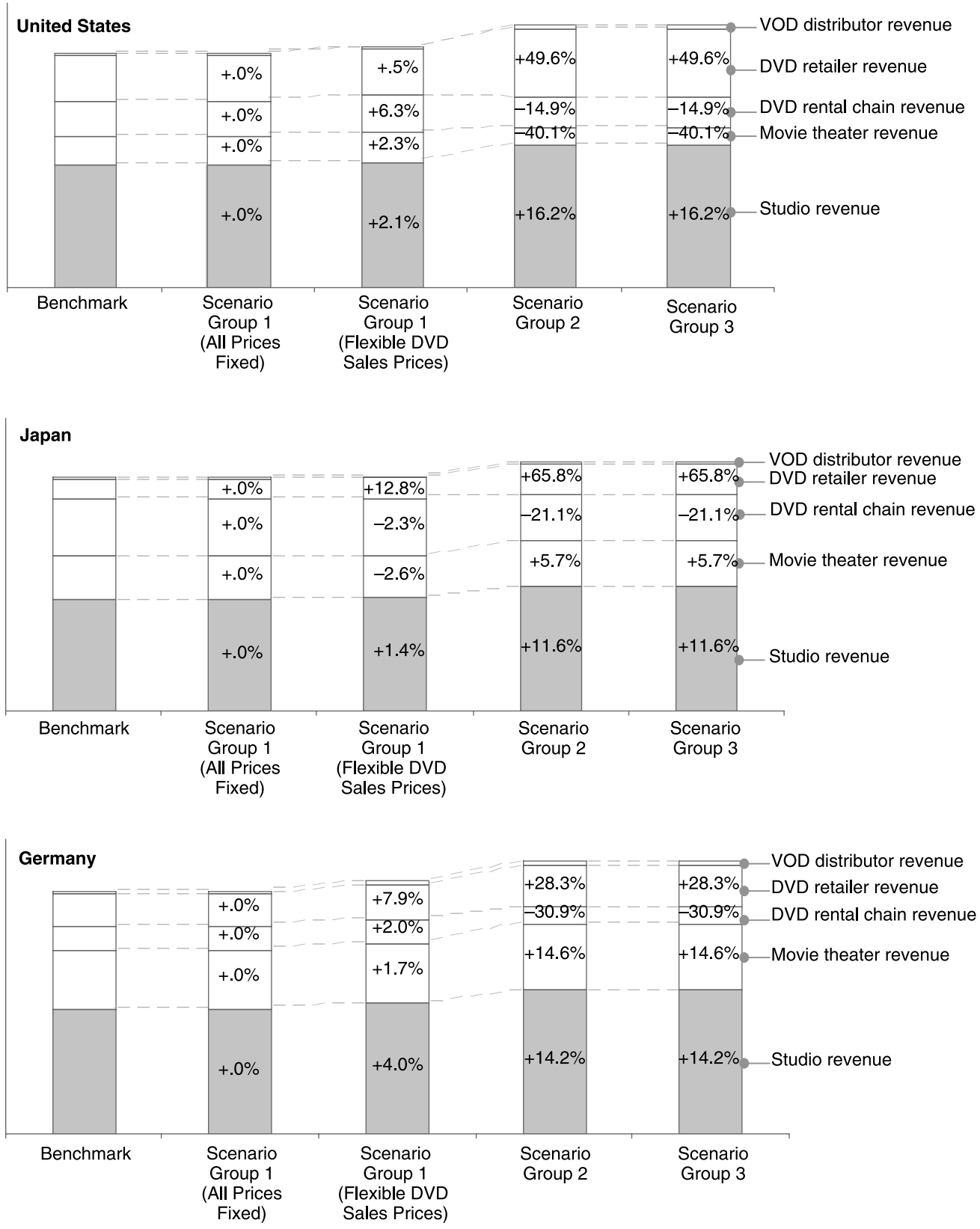
	Timing Restrictions	Pricing Restrictions	United States	Japan	Germany
Scenario Group 1 (with all prices fixed)	Movie theaters < DVD rental ≤ DVD sales < VOD	Movie theater = $7.75, DVD rental = $3.00, DVD purchase = $17.25 (Japan: $22.00), VOD = $3.00	(1)[a] $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $NPV^S = +.0\%$	(1)[a] $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $NPV^S = +.0\%$	(1) [a] $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $NPV^S = +.0\%$
			(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $NPV^S = -1.4\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $NPV^S = -2.1\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $NPV^S = -2.5\%$
			(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $NPV^S = -1.5\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $NPV^S = -2.1\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $NPV^S = -2.8\%$
Scenario Group 1 (with flexible DVD purchase prices)	Movie theaters < DVD rental ≤ DVD sales < VOD	Movie theater = $7.75, DVD rental = $3.00, DVD purchase ≥ $3.00 and ≤ $22.00, VOD = $3.00	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +2.1\%$	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +1.4\%$	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +4.0\%$
			(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +.0\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +.9\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +.2\%$
			(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$22$, $NPV^S = -.9\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 3$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +.5\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 6$, $t_{DVD\text{-}S} = 6$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +.0\%$
Scenario Group 2	Movie theaters = 0, DVD rental ≥ 0, DVD sales ≥ 0, VOD ≥ 0	Movie theater = $7.75, DVD rental = $3.00, DVD purchase ≥ $3.00 and ≤ $22.00, VOD = $3.00	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 0$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 0$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +16.2\%$	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +11.6\%$	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +14.2\%$
			(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 0$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +15.7\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +10.1\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 0$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +12.7\%$
			(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 0$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +15.6\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 0$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +8.1\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +12.7\%$

TABLE 3
Continued

	Timing Restrictions	Pricing Restrictions	United States	Japan	Germany
Scenario Group 3	Movie theaters ≥ 0, DVD rental ≥ 0, DVD sales ≥ 0, VOD ≥ 0	Movie theater = $7.75, DVD rental = $3.00, DVD purchase ≥ $3.00 and ≤ $22.00, VOD = $3.00	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 0$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 0$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +16.2\%$	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +11.6\%$	(1) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +14.2\%$
			(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 0$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +15.7\%$	(2) $t_{TH} = 3$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 0$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +11.1\%$	(2) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 0$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +12.7\%$
			(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 0$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 12$, $p_{DVD\text{-}S} = \$22$, $NPV^S = +15.6\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +10.1\%$	(3) $t_{TH} = 0$, $t_{DVD\text{-}R} = 12$, $t_{DVD\text{-}S} = 3$, $t_{VOD} = 6$, $p_{DVD\text{-}S} = \$17.25$, $NPV^S = +12.7\%$

[a]Benchmark scenario for the respective country; all NPV^S percentage increases/decreases are against this scenario.
Notes: t = time of release (months), p = price (dollars), TH = theater channel, DVD-S = DVD sales channel, and DVD-R = DVD rental channel.

FIGURE 4
Revenue Changes for Top Scenario per Group (in Percentage Compared with the Benchmark Model)



prices are higher and the timing of the VOD channel differs. Here, we find that the theaters and DVD retailers would also profit greatly from a three-month window for DVD sales and a 12-month window for DVD rental and VOD; the most attractive scenario would promise studios a revenue increase of 14.2%. DVD retailer revenues and theater revenues jump by 28.3% and 14.6%, respectively, while the rental chains' earnings plummet by 30.9%. Notably, the timing of the VOD release varies across the different revenue-maximizing scenarios, ranging from an immediate opening to a 12-month delay. Although the VOD channel performs better with a shorter release window, it does not exert much influence on the studios' revenues because of limited cannibalization. As with the U.S. market, lifting the final constraint in Scenario Group 3 does not change the results in Japan and Germany. The best scenarios remain those found in Scenario Group 2; the only exception is that the new second-best scenario in Japan suggests an exclusive VOD premiere, followed by a three-month window for theaters and DVD retail and a 12-month window for DVD rentals.

Sensitivity Analysis

Because respondents self-reported some of the information used for model estimation regarding their behavior under the current channel structure, we conducted a set of sensitivity analyses to determine how robust our results are with regard to these measures. Specifically, we systematically varied the individual responses for all self-reported behaviors (multiple consumption SBS, word-of-mouth-based SBS, and charts-based SBS) for each channel by +/–20%. Table 4 provides the results of these analyses, showing how variations in the measures affect the respective group-best scenario's NPV change in relation to the benchmark scenario. For example, under Scenario Group 2 conditions, a 20% increase of the multiple consumption parameter for DVD purchases in Germany would result in a studio NPV increase of 15.2% compared with the benchmark model (instead of 14.2% when the multiple consumption parameter for DVD purchases is not manipulated), whereas a reduction of the same parameter by 20% would result in an increase of 13% in studio NPV.

In general, the pattern and magnitude of the results are substantively robust to the parameter variations. Overall, the NPV growth in the group-best scenarios in which parameters are varied differs by less than 1% from NPV growth for the original parameters. A notable exception is the variation of the individual multiple consumption parameter for DVD purchases in U.S. Scenario Groups 2 and 3, in which a +/–20% variation leads to an NPV increase of 20.7% and 10.6%, respectively, compared with an increase of 16.2% under nonvaried conditions. Further support for the robustness of our results comes from the finding that the group-best scenario remains the best in 230 of 234 variations; we found changes in only 4 configurations, all of which involve a 20% *decrease* of the multiple consumption DVD purchase parameter. Specifically, in U.S. Scenario Groups 2 and 3, the DVD rental window is moved back to 12 months in the new revenue-maximizing scenario, and in the Japanese Scenario Groups 2 and 3, the new top scenario features a theatrical and DVD retail opening 3 months after the VOD premiere, and the DVD rental is delayed to a 12-month window.[8]

Accounting for Heterogeneity: The Impact of Movie Genres

The results reported so far assume that one distribution model is ideal for all movies. To account for potential heterogeneity that would undermine this assumption, we examined whether genre-specific distribution models might generate additional revenues for studios. We tested the revenue potential of such a genre-specific approach by applying a two-step procedure. First, we assigned the movies in our sample to genres by drawing on genre classifications by IMDbPro. This resulted in five genres (action, comedy, drama, fantasy, and thriller) with two movies in each genre (one movie was assigned to two genres). Second, we repeated the optimization process used to identify general revenue-maximizing distribution models for each of the five genres, considering only the respective subsample (e.g., only respondents who selected fantasy movies).

There appear to be differences in consumer preferences. In the United States, preferences toward rental channels are somewhat higher for comedies, and preferences toward theaters and DVD purchases are higher for action and fantasy movies, which implies moving forward rental channels for comedies and moving back the DVD rental channel behind the DVD purchase channel for action and fantasy movies. However, as a whole, genre effects on NPV outcomes are moderate, surpassing the general distribution model revenues by only .8% (United States), 1.6% (Japan), and 2.1% (Germany). Of (3 countries × 4 scenario groups × 5 genres =) 60 constellations, we found only one in which a genre-specific model outperforms the general model by more than 5% (Scenario Group 3 in Japan for action movies outperformed the general model by 5.5%). Given these relatively small revenues gains and considering that the implementation of genre-specific distribution models would likely cause consumer confusion (e.g., when new movies

[8]We conducted additional sensitivity analyses for the effects of potential changes in channel revenue functions and conjoint attribute utilities. Regarding channel revenue functions, modeling log-linear functions for all four channels does not change any winner scenario or NPV growth number. With regard to conjoint attribute utilities, we varied the different utilities on the individual consumer level by +/–20%, finding that the pattern and magnitude of the results are substantively robust to the variations. Specifically, the maximal reduction of NPV growth of any group-best scenario is only 1.8% compared with the respective benchmark scenario, and in 64 of the 72 varied conditions, the effect on NPV growth is less than 1%. The group-best scenarios remain the same as in the nonvaried condition in 62 of 72 variations. In addition to reflecting the high reliability and internal/external validity of the conjoint results already demonstrated through established conjoint validation methods, these further analyses show that within a reasonable range, potential changes in the consumers' perceived importance of channel characteristics (i.e., channel, timing, and price) should have only a limited effect on optimal distribution structures.

TABLE 4
Results from Sensitivity Analyses

Parameter Varied by +/–20%	United States	Japan	Germany
Scenario Group 1 (with all prices fixed)	**Baseline: .0%**	**Baseline: .0%**	**Baseline: .0%**
Multiple consumption DVD purchase	.0% (.0%)	.0% (.0%)	.0% (.0%)
Multiple consumption DVD rental	.0% (.0%)	.0% (.0%)	.0% (.0%)
Multiple consumption VOD	.0% (.0%)	.0% (.0%)	.0% (.0%)
Word-of-mouth-based DVD purchase	.0% (.0%)	.0% (.0%)	.0% (.0%)
Word-of-mouth-based DVD rental	.0% (.0%)	.0% (.0%)	.0% (.0%)
Word-of-mouth-based VOD	.0% (.0%)	.0% (.0%)	.0% (.0%)
Charts-based DVD purchase	.0% (.0%)	.0% (.0%)	.0% (.0%)
Charts-based DVD rental	.0% (.0%)	.0% (.0%)	.0% (.0%)
Charts-based VOD	.0% (.0%)	.0% (.0%)	.0% (.0%)
Scenario Group 1 (with flexible DVD purchase prices)	**Baseline: 2.1%**	**Baseline: 1.4%**	**Baseline: 4.0%**
Multiple consumption DVD purchase	2.6% (1.4%)	1.0% (1.8%)	4.8% (3.2%)
Multiple consumption DVD rental	2.1% (2.1%)	1.4% (1.4%)	4.0% (4.0%)
Multiple consumption VOD	2.1% (2.1%)	1.4% (1.4%)	4.0% (4.0%)
Word-of-mouth-based DVD purchase	1.9% (2.2%)	1.5% (1.3%)	3.9% (4.1%)
Word-of-mouth-based DVD rental	2.1% (2.0%)	1.4% (1.4%)	4.0% (4.0%)
Word-of-mouth-based VOD	2.1% (2.1%)	1.4% (1.4%)	4.0% (4.0%)
Charts-based DVD purchase	2.0% (2.2%)	1.5% (1.2%)	4.0% (4.1%)
Charts-based DVD rental	2.1% (2.0%)	1.4% (1.5%)	4.0% (4.0%)
Charts-based VOD	2.1% (2.1%)	1.4% (1.4%)	4.0% (4.0%)
Scenario Group 2	**Baseline: 16.2%**	**Baseline: 11.6%**	**Baseline: 14.2%**
Multiple consumption DVD purchase	20.7% (10.6%)[a]	11.2% (12.1%)[a]	15.2% (13.0%)
Multiple consumption DVD rental	16.0% (16.5%)	11.6% (11.6%)	14.2% (14.1%)
Multiple consumption VOD	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Word-of-mouth-based DVD purchase	15.9% (16.5%	11.9% (11.3%)	14.2% (14.2%)
Word-of-mouth-based DVD rental	15.5% (17.2%)	11.2% (12.0%)	14.0% (14.4%)
Word-of-mouth-based VOD	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Charts-based DVD purchase	16.0% (16.5%)	12.0% (10.9%)	14.2% (14.1%)
Charts-based DVD rental	15.7% (16.8%)	11.2% (12.1%)	14.0% (14.4%)
Charts-based VOD	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Scenario Group 3	**Baseline: 16.2%**	**Baseline: 11.6%**	**Baseline: 14.2%**
Multiple consumption DVD purchase	20.7% (10.6%)[a]	11.2% (12.1%)[a]	15.2% (13.0%)
Multiple consumption DVD rental	16.0% (16.5%)	11.6% (11.6%)	14.2% (14.1%)
Multiple consumption VOD	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Multiple consumption theater	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Word-of-mouth-based DVD purchase	15.9% (16.5%	11.9% (11.3%)	14.2% (14.2%)
Word-of-mouth-based DVD rental	15.5% (17.2%)	11.2% (12.0%)	14.0% (14.4%)
Word-of-mouth-based VOD	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Word-of-mouth-based theater	16.2% (16.2%)	11.6% (11.6%)[a]	14.2% (14.2%)
Charts-based DVD purchase	16.0% (16.5%)	12.0% (10.9%)	14.2% (14.1%)
Charts-based DVD rental	15.7% (16.8%)	11.2% (12.1%)	14.0% (14.4%)
Charts-based VOD	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)
Charts-based theater	16.2% (16.2%)	11.6% (11.6%)	14.2% (14.2%)

[a]Under these conditions, the former group-best scenario became the second-best channel configuration by a small margin.

Notes: Numbers before the parentheses are the group-best scenario NPV in relation to the benchmark scenario NPV when the respective parameter is increased by 20%. Numbers in parentheses are the group-best scenario NPV in relation to the benchmark scenario NPV when the respective parameter is decreased by 20%.

combine elements of two or more genres that have different distribution patterns; e.g., *Evan Almighty*, the $250 million sequel to *Bruce Almighty*, is described by its studio as "a spectacle fantasy and also a comedy"; Muñoz 2006), we focus on the general distribution approach when we discuss potential implications for the movie industry.

Discussion and Implications

This study uses a multi-indicator approach that features hierarchical Bayes choice-based conjoint information for the intertemporal prediction of market shares. We apply an NPV model of movie studio revenues across complex and multiwindow sequential distribution chains and find that by adjusting the configuration of distribution channels and the price of DVDs, motion picture studios could, all else being equal, boost their revenues by 16.2% (or $3.5 billion) in the United States alone. Moreover, we demonstrate that consumers' channel preferences and movie consumption decisions differ among three major markets (the United States, Japan, and Germany), thus offering insights into how studios might fine-tune distribution strategy by country.

Implications for Research and the Motion Picture Industry

Our results suggest that the movie industry's current distribution model is not optimal in terms of revenue generation. Our key implication is that studio revenues can be increased by changing both the timing and the order of distribution windows. The channel configuration that performs best in the United States includes making a film simultaneously available in theaters, as a DVD rental, and through VOD, followed three months later in the DVD sale channel at a price of $22. According to our findings, if this configuration were to be used to distribute motion pictures in the United States, studios would receive only 12.2% of their total revenues from theaters (versus 25.3% in 2005) and only 14.1% from DVD rentals (versus 19.2% in 2005), but contributions from DVD sales would soar to 73.6% (from 55.5% in 2004).

Our results suggest that recent industry speculation about simultaneous channel releases, called a "death threat" by theater owners (Stanley 2005), would indeed be devastating for movie theaters. However, such a change might be financially attractive to movie studios and DVD retailers if executed in the U.S. market, though externalities must be considered if the theater channel were to be irreparably damaged; we discuss this in more detail subsequently. This type of simultaneous-release approach is not equally promising for studios in the major export markets of Germany and Japan, in which the interchannel cannibalization of theater revenues would not be offset by DVD sales growth to the same extent as in the United States. In these markets, our results indicate that the optimal U.S. configuration would lead to a studio revenue gain over the benchmark of only 1.8% in Germany and even a revenue loss of 5.8% in Japan.

The results also imply that an exclusive "Wal-Mart premiere" is not the most promising option for studios. In none of the three countries examined in our study do the empirical results suggest that theaters should be shifted away from the start of the distribution chain. An examination of the channel market shares and revenues suggests that an exclusive movie opening in DVD retail stores would not take full advantage of multiple-purchasing behavior, because many of the consumers who would buy the DVD in such a retail-premiere scenario would also have bought it after having first consumed the movie in theaters (or other rental channels).

The results also suggest that the timing of the VOD channel has little influence on studio revenues. There appears to be a distinct consumer segment for VOD, but the size of the market is not strongly affected by moving the VOD release forward. For example, whereas the market share for VOD is 4.4% in the benchmark scenario, it grows only to 5.3% when a movie is initially released on VOD alongside theaters and DVD rentals in the studio revenue-maximizing U.S. scenario. Note that this is the case even though our model assumes that all movies are available through all four channels (which is not the case in reality for VOD), which signals a somewhat limited growth potential for the channel. Still, Apple Chief Executive Officer Steve Jobs's vision of offering movies through online downloads at the same time they hit retail shelves has been likened to "walking into a lion's den" (CinemaNow Chief Executive Officer Curt Marvis; Grove 2005).

Our findings underscore why potential changes to traditional channel sequences are currently at the center of Hollywood's attention and the subject of rancorous debate. To maximize studio revenues, radical changes to the extant movie distribution model are proposed, and substantial shares of business are shifted among the various players. Most glaringly, U.S. theaters stand to lose 40% of their revenues, whereas DVD retailers' revenues could increase by approximately 50%. Similarly, in the configurations that maximize studio payoff, Japanese and German DVD rental chains would face revenue losses of 21% and 31%, respectively, and their retailing counterparts' respective revenues could jump by 66% and 28%. These results raise the question whether U.S. theater chains or Japanese and German video rental chains would be able to scale down their operations, or whether such scenarios would be fatal. If novel distribution strategies were to trigger the disintegration of entire industry branches, such as theatrical exhibition in rural areas, this outcome not only would be a financial setback for studios but also would have widespread consequences, such as a disastrous loss of cultural heritage and jobs.

How could theaters adapt to such changes? One reaction might be for theaters to diversify into multichannel operations, transforming themselves into "one-stop shops" in which audiences can watch a theatrical exhibition and rent or buy the DVD afterward (perhaps receiving discounts for multiple channel consumption). Another reaction to changes to the traditional distribution model seems less speculative. Changes will be met with fierce resistance by the respective industry players that perceive a threat to their stakes. North American "[t]heater owners have already lambasted Disney [Chief Executive Officer] Bob Iger for even mentioning that he might reconsider the windows approach," and "Wal-Mart,… the country's largest DVD retailer, will go bat-crazy" over attempts to change the DVD business model in favor of VOD (Grove 2005). Studios experienced a hint of what might happen when the simultaneous release of the film *Bubble* in multiple channels was widely met with boycotts by theaters (Canadian Broadcasting Corporation 2006). Therefore, it is important to stress

that our results do not include the costs that might arise from distribution model transformations, such as lost revenues caused by the boycotting of movies by theater chains or image deterioration as a result of media debates. Could such resistance be broken by the studios? One approach would be to offer theaters compensation for accepting shorter distribution windows (e.g., a higher revenue share) (Grove 2006). We ran additional sensitivity analyses to determine how changes in revenue allocation would affect the attractiveness of our optimal distribution model in the United States. We found that an allocation of 60% of box office grosses to theater owners (versus 50%) would have a limited effect, with the revenue-maximizing structure remaining the same and studio revenues still being 13.4% higher than in the benchmark scenario.

A potential alternative would be to search, post hoc, for configurations in which every market participant gains revenues (or at least does not lose any). Our simulations suggest that such scenarios exist in the United States and Germany, but we do not identify such a "win–win" configuration for the Japanese market. In the United States, a three-month theatrical-to-DVD-retail window with a higher DVD retail price, followed by the DVD rental and VOD releases another three months later, lifts studio revenues by 7.3% over the benchmark. This growth goes hand in hand with increases in revenues of 11.1% for DVD retailers as a result of the shorter window. DVD rentals and VOD gain 4.5% and 7.5%, respectively, because of the higher DVD price, which provides them with marginal gains in choice shares, while theater revenues are not cannibalized. The German win–win scenario appears similar, with the exception of the VOD window being 12 months. The outcome here would be a 7.6% revenue increase for studios, revenue growth of 19.1% for DVD retailers, marginal benefits for rental chains, and no changes for theaters and VOD. Although these scenarios promise no negative effects for all parties involved, implementation would likely be met with resistance because it requires breaking with the industry tradition of opening the rental channel before (or simultaneously with) the retail channel. Rental chains would likely resist a change that promises no gains for them but moves them further down the distribution chain. However, because DVD retailers are the cobeneficiaries in every studio revenue-maximizing configuration identified in our analyses, the studios should have powerful allies in retailing giants, such as Wal-Mart (United States) and the Metro Group (Europe).

Altogether, this study integrates the sparse research on interchannel effects relevant to the optimization of sequential distribution chains into a coherent model. Our model builds on characteristics of sequential distribution systems that prior research has identified. Industries that rely on distribution windowing could tailor our framework and empirical approach to their context. For example, the major record label Sony BMG recently introduced sequential distribution to the music industry, a strategy that Booz Allen Hamilton consultants recommended (Bhatia, Gay, and Honey 2001). Other entertainment goods producers that already employ windowing, such as book publishers and computer game developers, may benefit financially from examining the general characteristics we derived herein to gain insights into how to refine their distribution models and increase revenues.

Limitations, Future Research Opportunities, and Conclusion

In addition to our modeling assumptions, this study has some limitations. We do not consider the impact of distribution chain changes on piracy. Next to sequential distribution, piracy is the movie industry's most important concern (Hennig-Thurau, Henning, and Sattler 2007) and has been described by the MPAA (2004) as "the greatest threat to the economic basis of moviemaking in its 110-year history." Industry executives have expressed concern that advanced releases on DVD or VOD might increase piracy because high-quality digital versions of movies would be accessible to potential pirates earlier in the distribution chain (*The Economist* 2002). However, this effect might be limited in size because illegal copies of nearly all new movies are already available in file-sharing networks before or during their theatrical run (Byers et al. 2004). Effective copy protection measures would certainly reduce the studios' risk associated with closing the window between theaters and home channels. Future studies should examine the impact of channel configuration on piracy.

Although our model optimizes studio revenues, it ignores the costs of producing, marketing, and distributing motion pictures. Although production costs will be largely unaffected by distribution chain changes, an increase in the number of DVDs sold might create economies of scale that would lower costs per DVD and increase studio profit margins. However, considering the first-copy-cost character of motion pictures with limited variable costs, revenue optimization should be a good proxy for profits. Still, further research could integrate cost and margin information.

It is important to stress that our empirical model does not explicitly consider implementation barriers to channel restructuring. Although we identify problems that would be associated with the modification of channel configurations, uncertainty remains, including the costs that might be incurred through negative responses by channel partners that have been alienated. Our win–win constellations would probably cause less resistance from other industry players and might be considered an acceptable compromise for all involved.

Although this article is the first to model more than two channels, our findings are limited insofar as we include only download-to-rent VOD, not download-to-own VOD. However, we assume that the results would remain fairly stable, given the limited role of VOD for movie revenues and the small preferences of the respondents in our study toward VOD. The same could be said for other channels we do not consider (e.g., mobile devices). In addition, we preferred a multinomial choice scenario, asking consumers for their "first choice" in terms of watching a new movie, over a multivariate conjoint approach, because the latter would have required that consumers anticipate their choice behavior over time, but we do not test our model against a multivariate alternative.

We model revenue allocation between different parties as constant over time, which is true for most channels considered, but studios' share of box office grosses often decreases with the time a movie is available in theaters. Given that the intrachannel flow of revenues remains constant across distribution models, this should not affect our results. However, theater owners should be aware that if movies were shown in their venues for a shorter period in a new distribution model, the theatrical share of revenues would decrease because the percentage of weeks that generate less-than-average revenues would increase. However, this is based on neither theory nor data. Similarly, although the assumption that consumers have "perfect expectations" on release times is logical, this will not be the case for every consumer or any movie release. Information asymmetries might allow studios to issue films earlier in secondary channels than consumers expect; however, consumers will learn and adapt their expectations accordingly, anticipating future movies to be released earlier than announced by studios.

Although we account for key market variables, we do not control for all factors that might affect the results. For example, we do not consider movie quality, which can stimulate word of mouth (Liu 2006). That said, we believe that the potential for studios to differentiate distribution on the basis of quality is limited, because a later release of "good" movies and an earlier release of "bad" movies will affect customers' expectations. Audiences might even act strategically, staying away from theaters to prompt studios to open secondary channels earlier. Furthermore, our results do not consider seasonality, movie competition at release, or cross-country influences (e.g., the impact of U.S. results on Germany results; see Elberse and Eliashberg 2003). Optimal structures might differ as a result of these factors, and thus we suggest that the role of these factors needs to be tested in future work.

The choice-based conjoint design reveals consumer preferences for currently nonexisting, but possible scenarios. However, the SBS parameters are based on self-reports of previous consumer behavior in traditional sequential distribution sequences. Although sensitivity analyses show that the self-reported data affect the results only to a limited degree, we acknowledge that no objective data are available on how SBS might evolve in different channel structures, leaving this as a challenge for further research. Although our samples contain movies from major genres and though we found only limited genre-specific differences in terms of revenue-maximizing distribution models, it would be laudable to replicate our findings with a different (and larger) set of movies.

In conclusion, our results suggest that the current sequential distribution configuration in the motion picture industry does not maximize revenues for the studios that produce movies. Channel configurations play an important role in motion picture success. Although theaters will not see their "last picture show" immediately, theater owners and movie audiences are almost certain to face significant changes in the near future.

Appendix A
Illustrative Model Calculation[9]

Consider a scenario with J = 5 channel alternatives:

1. Theater visit (= m_{TH}) at the movie's release date (i.e., t_{TH} = 0 months, at price p_{TH} = \$12.50).
2. DVD rental (= $m_{DVD\text{-}R}$) at the movie's release date (i.e., $t_{DVD\text{-}R}$ = 0 months, at price $p_{DVD\text{-}R}$ = \$7.75).
3. DVD sales (= $m_{DVD\text{-}S}$) 3 months after the movie's release date (i.e., $t_{DVD\text{-}S}$ = 3 months, at price $p_{DVD\text{-}S}$ = \$22).
4. VOD (= m_{VOD}) 12 months after the movie's release date (i.e., t_{VOD} = 12 months, at price $p_{DVD\text{-}S}$ = \$3).
5. Waiting for the movie to be released on television (the no-consumption option).

Given this set of alternatives and a consumer's preference structure, Option 1 might obtain choice shares of x(TH|J) = .25. Thus, of 100 movie consumption occasions, this consumer would visit the theater 25 times. Likewise, choice shares for the remaining channels might be x(DVD-R|J) = .15, x(DVD-S|J) = .45, and x(VOD|J) = .05. Consequently, 10% of choice shares would be allocated to the no-consumption option. In this case, x_{FC} will be represented by the choice shares for theaters and DVD rental because both channels open simultaneously at the movie's release date ($t_{TH} = t_{DVD\text{-}R} = 0$ months); that is, x_{FC} = x(TH|J) + x(DVD-R|J) = .4. Thus, if a consumer typically buys a DVD of a movie he or she has seen before in other channels in 10% of the cases ($\delta_{DVD\text{-}S} = a_{DVD\text{-}S} = .1$), the multiple-purchase effect will increase the choice shares for DVD sales by 4%. Likewise, if the consumer buys a DVD in 5% of the cases exclusively because he or she heard from other people that it was a success ($\gamma^{WOM}_{DVD\text{-}S} = .05$) and in 15% of the cases exclusively because of favorable chart information ($\gamma^{C}_{DVD\text{-}S} = .15$), the information-cascading SBS effect would result in an increase in choice shares of $x_{DVD\text{-}S} \times (\gamma^{WOM}_{DVD\text{-}S} + \gamma^{C}_{DVD\text{-}S}) = .45 \times (.05 + .125) = 9\%$. The total updated choice share would then be $x'_{DVD\text{-}S} = .45 \times (1 + .05 + .15) + .1 \times .4 = .58$.

With the price for a theater visit being p_{TH} = \$12.50 and if we assume that the mean choice share for theaters across all consumers is .2, the expected revenue of theaters would be $R_{TH} = \$12.50 \times .2 = \$2.5$. Multiplying by 100 gives a better interpretation of this result (i.e., the expected theater revenue from 100 movie consumption occasions, given the specific scenario of available channel alternatives). According to the over-time revenue distribution function f(w) we estimated for theaters (see Figure 2), after the first week, 29.37% of the \$2.5 would flow back to theaters. This proportion then needs to be discounted with the weekly discount rate of .183%—that is, (\$2.5 × .2937)/1.00183. The second week would produce another 20.74% of the total revenue that needs to be discounted for two weeks—that is, (\$2.5 × .2074)/$(1.00183)^2$. We simulate the revenue return for up to 78 weeks in this manner. Adding up these discounted values gives the present value of the theater-

[9]Note that for readability reasons, this example does not contain further channel attributes π.

specific revenues. To obtain the perspective of the studio, these present values need to be multiplied by the percentage of revenues that are actually allocated to the studio (see Table 3) and discounted again for the time of the window length if the channel does not open at the movie's release date (i.e., if t > 0 month; see Equation 1).

In this example, theaters open at the movie's release date (i.e., $t_{TH} = 0$). Thus, the weekly discounted present values do not need to be discounted again. Multiplying the present values by 50% (i.e., the percentage of theater revenues allocated to the studio) eventually gives the theater-specific component of the studio's NPV of the movie in Equation 1.

APPENDIX B
SBS Questions

Multiple Consumption SBS	In general: What proportion of all movies you have seen in a movie theater …
DVD purchase	Did you later also purchase on DVD? ___%
DVD rental	Did you later also rent on DVD in a video store? ___%
Download-to-rent VOD	Did you later also download from a legal internet service (e.g., MovieLink, CinemaNow) for a fee? ___%
Word-of-Mouth-Based SBS	
DVD purchase	Of all DVDs you have purchased so far, what proportion of those did you purchase because you missed the movie in theaters, but heard from friends or acquaintances it was good? ___%
DVD rental	Of all DVDs you have rented from a video store so far, what proportion of those did you rent because you missed the movie in theaters, but heard from friends or acquaintances it was good? ___%
Download-to-rent VOD	Of all movies you have downloaded from legal online services so far, what proportion of those did you download because you missed the movie in theaters, but heard from friends or acquaintances it was good? ___%
Charts-Based SBS	
DVD purchase	Of all DVDs you have purchased so far, what proportion of those did you purchase because you missed the movie in theaters, but it was a huge box office success? ___%
DVD rental	Of all DVDs you have rented from a video store so far, what proportion of those did you rent because you missed the movie in theaters, but it was a huge box office success? ___%
Download-to-rent VOD	Of all movies you have downloaded from legal online services so far, what proportion of those did you download because you missed the movie in theaters, but it was a huge box office success? ___%

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