Coordinating on design standards: the role of editors

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Abstract

We model a process of designers developing competing prototypes and downstream firms selecting among them, and suggest an explanation for the power and influence of editors and tastemakers in this process. Total producer surplus in the industry is highest when designers produce a variety of prototypes and downstream firms coordinate on one design. However, without third-party intervention, sometimes designers prefer to herd on a design than to spread out, and sometimes downstream firms prefer to choose different designs than to coordinate. In either case, total producer surplus can be increased by the intervention of an editor, who comments on design prototypes. The editor's comments function as a coordination and commitment device that downstream firms are willing to commit to follow. By occasionally selecting a surprising, counterintuitive design as the 'winning' prototype, the editor can incentivize designers either to spread out and choose different designs or to herd and choose the same design. This result does not require the editor to have expertise in evaluating designs or direct influence over consumers. Individual firms have incentive to reduce payoff uncertainty by vertically integrating or acquiring information on trends, but these actions undermine the editor's coordinating role and so can ultimately be counterproductive.

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1 Introduction

In trend-driven industries like fashion, hits must be generated frequently and fast. For a product, shape, or color to become fashionable, it must be created by a designer, presented on the runway, translated into a retail product, and offered for sale to consumers by a retailer. But a key challenge for the fashion industry is to manage what sociologist Georg Simmel (1957) (p. 558) described as "the contrast between [fashion's] extensive, all-embracing distribution and its rapid and complete disintegration". In other words, a style must quickly become ubiquitous, but it cannot stay fashionable forever, and the cycle is short: fashion week runway shows take place every six months, and retailers overhaul their offerings at an equivalent rate. In choosing the products, interests in the industry are partly aligned—something must become fashionable each season, and prevailing trends matter to all—and partly at odds—designers want their design to become the hit, and all want the best terms from their clients and suppliers. In the face of the industry's rapid pace and subtle incentives, how do designers and retails choose which products to design and sell?

We argue that individual opinion leaders help solve the coordination problem. In particular, one distinguishing feature of the fashion industry, in common with other industries that thrive on 'hits', is the central role of individual opinion leaders. Fashion editors, and, in recent years, bloggers and website operators, comment on and critique runway shows and celebrity fashion choices, shaping the discussion about the season's designs. While there are many such players in the industry, a prime example is the editor of Vogue magazine, who has a uniquely substantial influence on the industry and on the fashions carried by retailers. Vogue is the dominant magazine of the fashion industry. Anna Wintour, Vogue's editor-in-chief since 1988, is popularly understood to wield such extraordinary influence in the couture fashion industry as to have been the subject of two recent movies, both fiction ("The Devil Wears Prada", 2006) and non-fiction ("The September Issue", 2009).

Our objective in this paper is to consider the process of design and development in settings where it is valuable for the industry to have varieties but ultimately coordinate on standards, and to suggest a possible explanation for the economic role of opinion leaders in these settings. While opinion leaders have long been recognized for their roles in the diffusion of innovation (Rogers, 1995), we have little understanding of the role of opinion leaders in generating superior outcomes for an industry. Why would the diverse players in a valuable industry, with competing interests and significant marketing strength, cede substantial power to an independent commentator like an editor?

We find that by making well-chosen announcements after designs have been showcased, the commentator can function as a commitment and randomization device to shape the choices made by the various parties, so as to increasse total producer surplus generated in the design and development process. This is true even if the commentator has no special expertise over others in evaluating designs and no special ability to influence consumer behavior.

It is important for marketing scholars to understand this phenomenon for three main reasons. First, our existing marketing models do not provide a framework for assessing when a central figure without direct power and with limited information can be influential. By applying and adapting ideas from the literatures on correlated equilibria (e.g. Aumann, 1974) and commitment devices (e.g. Dixit, 1982), we can improve our assessment of how trend-driven industries operate. Second, while trends exist in many industries, marketing scholars do not have a good understanding of the mechanism through which firms coordinate around a trend in a given industry. Third, this means we lack understanding of a fundamental aspect of marketing in an increasingly important part of the economy. Fashion and other trend-driven industries are growing rapidly. In the U.S. market, luxury goods represented $300 billion in sales in 2009 (Bellaïche et al., 2010); the fashion industry in China tripled in size in the decade to 2010, reaching almost RMB 400 billion (Lui et al., 2011). Our model provides one plausible mechanism for the role of editors motivated by our understanding of how this large and growing industry operates.

To address these issues, we develop a model of product prototyping and development: upstream designers will choose a prototype product, and then downstream retail firms will choose which among the prototypes to develop into finished products. The payoffs to each designer and downstream firm depend on what design they choose and on how many others also choose it. We make three assumptions on how the total amount of producer surplus by a design depends on the number of players who choose it. First, the probability of each product generating more surplus is generally known, but which design is truly superior is not known until the prototypes are made. Second, we assume that total producer surplus in the industry is higher when a diversity of prototypes are produced in the design stage. This captures several features of the industry together, including consumers having a preference for being able to uniquely attribute a final product to a single designer, and also competition among designs spurring better prototypes and licensing frictions and intellectual property disputes being easier to overcome if there is only one designer. Third, we assume that total producer surplus in the industry is higher when retailers coalesce around one design. This assumption reflects network effects in consumption, or benefits from standardization such as lower costs or reduced uncertainty. We also some standard assumptions on competition: that the split of the producer surplus generated by a design depends on how many others chose it: a designer earns a greater share of the surplus generated by their design if the other designer chose something different, and, similarly, a retailer earns a greater share of the surplus generated by a design if the other retailer chose something different.

This structure captures settings in which experimenting with many different prototypes at the design stage, and coordinating on a few standard designs at the final product stage are valuable at the industry level. Experimenting with many different designs can help discover the truly superior designs and realize any benefits from each design being attributable to a single source. Coordinating on standards can facilitate positive spill-overs in consumption.

In particular we apply the model to the motivating example of couture fashion. The industry is characterized by a short, frequent cycle of design and development centered around 'fashion week', which takes place in Milan, Paris, New York and London every six months. Fashion designers produce prototypes that are showcased at fashion week runway shows, and buyers for retail outlets choose which of these design ideas to develop into retail products. The structure we place on producer surplus is consistent with a fashion industry that thrives on the brand power of prominent designers and the buzz generated by fashion weeks—so that a diversity of designs is valuable—and on the consensus at the retail stage on a seasonal style to facilitate coordination among high status consumers on the new, 'fashionable' product. In translating the model to the fashion industry, we can be quite flexible about how to interpret the designs and final products. For example, at one extreme, we can view the prototypes as being precisely the set from which retail products are drawn; at another extreme, we can see the prototypes as more vague styles, which inspire a retailer's finished product. As long as the designer of a prototype benefits from its selection at the retail stage, any similar conception of a style is consistent with the model.

The object of our interest is the range of designs and finished products that are produced in the equilibrium of our model, and whether this outcome maximizes total producer surplus in the industry. We show that in such a setting as this, the outcome of the design and development game that maximizes total producer surplus is not always realized. This is due to potential conflicts between incentives at the industry level and incentives for individual designers and retailers. There are two distinct ways that an outcome that is inefficient for the industry can occur. First, designers may prefer to herd on a similar design—the one that is the likeliest to be the best—despite a diversity of designs being good for the industry. This can happen when designers want to avoid risks of having their design not adopted by retailers: herding on the same design guaranteed that the style of their design will be adopted at the retail stage, and so both designers will certainly earn a share of the value generated by that design. Second, retailers may prefer to choose different prototypes to develop into final products. This can occur if a retailer gains in bargaining power when they are the only buyer of a design, and this incentive may outweigh the share of a higher total surplus they would receive by selecting the same design.

In cases where the outcome is inefficient, we then ask whether and how an outside coordinator or commitment device can enforce an outcome that is superior for all players. To do so, we introduce a player, who we call the editor, that represents a commentator who is commonly agreed upon to be the key influential opinion leader in the industry. In luxury fashion, this is a role that has historically been attributed to Anna Wintour, the long-time editor-in-chief of the industry-leading Vogue magazine. In other settings this commentator could represent a prominent critic, or a standard-setting body that recommends technical standards. In our model, we focus on the case where there is only one editor. We do so because our research question is to examine how having an outside coordinator can help increase the total industry outcome. While the cases of having multiple editors can be interesting, our focus is not how competition between several editors changes a particular set of outcomes. Rather, we are interested in the general mechanism of how including outside editors can improve industry equilibrium outcomes. We assume that the editor earns a payoff proportional to the total producer surplus in the industry. This could be because the editor is a benevolent planner (such as we might hope from an industry standard-setting body) or because they have a self-interested stake in the health of the industry (for example, a magazine editor whose readership numbers and advertising revenue depends on the size of the industry).

The role of the editor in the model is to announce a 'winning' style after the designers have announced their product choices (e.g. at runway shows); retailers can choose in advance to commit to follow this recommendation. The editor's judiciously chosen announcement rule operates as a commitment device and a randomization device, and we show that this can enhance the total producer surplus generated in the industry in the presence of either source of inefficiency described previously. The mechanism is that the editor sometimes makes announcements that are surprising or contrarian in the sense that they run counter to the critical consensus following the design stage. In the case in which there would be inefficiently low diversity at the design stage, by occasionally selecting a design that has been revealed at the design stage to be inferior, the editor increases the incentive of designers to differentiate their designs rather than herding on the 'safer' design. In the case in which there would be a lack of coordination by retailers, by always announcing the product that was expected to superior—regardless of whether it turns out to be so at the design stage—the editor increases the incentive of designers to herd on the 'safer' design and so preclude the costly downstream miscoordination. In both cases, the downstream retailers do better by committing to follow the announcement, which captures the willingness of players in industries that require diversity of designs but downstream coordination to willingly be led by an interested but independent party. The key feature of the editor's announcement rule in both cases is that it is sometimes counter to either or both of the prevailing beliefs about trends or the critical consensus of the relative quality of designs. This is consistent with the observation that editors sometimes surprise the industry with their choices, and there is substantial uncertainty about choices. For example, Anna Wintour admitted in an interview "Even if I'm completely unsure, I'll pretend I know exactly what I'm talking about and make a decision" (Maza, 2013). We also note that while in the model we argue that given the incentives and capabilities of the editor, the editor does best by selecting winners according to carefully designed announcement rules to influence the behavior of designers and retailers. However, it is not crucial to our point that the editor make these announcements with consciously calculated probabilities. So long as the editor acts in a way consistent with the mechanism we propose, the same effect will occur. For example, an editor who tries to always identify the best designs but sometimes makes mistakes, or sometimes follows private, idiosyncratic tastes instead, would behave in much the same way as the calculating editor of our model, and so the conclusions we reach would remain valid.

While it is natural to assume that a fashion editor or critic has special expertise in evaluating designs, it is notable that our model demonstrates a value-enhancing role for this player *without* assuming any expertise. We also do not impose any assumptions on how the editor directly influence consumer behavior. Thus we demonstrate that the coordinating role is sufficient to justify the willingness of powerful players in a large industry to cede some of their autonomy and accept the influence of a key opinion leader. We might expect, though, that the role we suggest is more easily performed by a player in a mutually beneficial relationship with the industry: as well as aligning their incentives with the industry as a whole, their position can then include a degree of latent power and the means to sanction defectors (for example via the 'pulpit' of the editorial pages), bolstering their ability to perform this coordinating role. In sum, the editor is independent in the sense that she does not work for any manufacturer, designer, or retailer, but is far from disinterested. As Moeran (2006) notes (p. 730) in his article *More Than Just a Fashion Magazine*, "It is the fashion magazine that brings together producer and consumer, supply and demand." Borrelli (1997) (p. 253) emphasizes that the editorial columns in Vogue Magazine serve "to explore and define trends."

We also consider an extension of the model that allows for vertical relationships between designers and retailers. In this extension we find that there is a short-run incentive for vertical integration (whereby designers and retailers merge or contract on their strategies), but it can reduce the overall producer surplus. As a result, there remains a value-enhancing role for the editor even after vertical integration, but the effectiveness of this role is partly undermined. Similarly, we show that there is a short run incentive for players to acquire information on underlying trends, but some types of information acquisition can again reduce industry surplus overall.

Although our focus and motivation in presenting the model is the fashion industry in general, and the role of magazine editors in particular, fashion is not the only trend-driven industry. For example, music and video games also have short product cycles and trends in demand. These industries also have their opinion leaders with a stake in the success of the industry, including DJs, bloggers, and (also) magazine editors. During the late 1960s and 1970s the New York based radio station WNEW 102.7 FM played a significant role in 'shaping the New York music scene'.[1] Host Pete Fornatale promoted the Beach Boys before they were fashionable; DJ Scott Muni was credited for popularizing the group Emerson, Lake & Palmer in America. [2] Thereby our model can be easily modified and applied to other trend-driven industries.

The rest of the paper is organized as follows: In section 2 we discuss how our paper fits into the broader literatures on correlated equilibria, commitment devices, fashion, and trends. In section 3, we present the benchmark model and make specific assumptions applicable in the fashion industry, and in section 4 we derive equilibria in this benchmark case. In section 5, we introduce the editor into the model and show the mechanism by which the editor plays a value-enhancing role. In

[1] ThehistoryofWNEW-FMhttp://cbswnewhd.wordpress.com/2009/06/15/the-history-of-wnewfm/

[2] http://www.keithemerson.com/MiscPages/RememberingScottMuni.html

sections 6 and 7 we discuss the incentives of the players to vertically integrate and to acquire more precise information over the true state of nature. Finally in section 8, we conclude with discussions of our main findings.

2 Related literature

It is well known that the possibility of making binding commitments can enhance players' payoffs in extensive-form games (following Schelling, 1960 and applications in industrial organization as in Dixit, 1982). In our model the editor allows players to commit to following the recommendation of a player whose interests are aligned with those of a social planner. This allows players to do better than in the equilibrium without commitment. While commitment is the key to the editor's role, in some cases the editor's recommendation shares some features with a randomization device as in the correlated equilibrium of Aumann (1974). In such cases, randomization in the editor's announcement creates the incentive for designers to mismatch their designs to the benefit of all.

Our model concerns the process by which the producers in a cyclical, trend-driven industry like fashion coalesce around given designs. We therefore do not explicitly model the consumers' side of the market. Possible theoretical foundations of trends and fashions on the consumer side of the market have been well-studied. Approaches include theories of rational 'herding' by consumers on some action even when it conflicts with the consumer's private information (Bikhchandani et al., 1992, Banerjee, 1992), theories of social learning that lead to convergence in behavior (Ellison and Fudenberg, 1995, Banerjee and Fudenberg, 2004, Gale and Kariv, 2003), and theories of fashion as a device by which consumers can better match with people like themselves (Pesendorfer, 1995, Kuksov and Wang, 2013). These approaches give a solid foundation for the notion that rational consumers can be willing to pay a premium to follow fleeting trends, for reasons that can go beyond simple explanations based on preferences and tastes.

Theories on firms' strategies in the specific context of the fashion industry generally involve particular assumptions on consumer demand, in keeping with this focus on the consumer side of the market. For example, in the model of Yoganarasimhan (2012), a fashion firm must decide whether to release product information in an environment in which consumers seek to use fashion products to signal taste or to display conformity with others. The structure of preferences is such that goods give consumers both consumption utility and a "social utility" obtained during random matches with other consumers that includes beliefs on the matched player's type and utility from conforming with the matched player. In a similar vein, Amaldoss and Jain (2005a,b, 2008) consider firms' pricing decisions in a variety of settings in which consumers are motivated by social preferences such as desires for prestige, uniqueness, leadership, assimilation, and conformity.

Kuksov and Wang (2013) consider firm pricing decisions in an environment in which consumers seek to use fashion products to signal that they belong to a group of desirable type. They find that higher prices facilitate separation of types of consumers, but that firms will nevertheless optimally price so as to attract positive demand from consumers of the less desirable type. As in our model, there is a "coordinator": in our model, this coordinator acts on the consumer side to facilitate coordination among consumers of a desirable type. These two roles are not mutually exclusive; on the contrary they are likely to be complementary, particularly for a player like an editor who is concerned with the overall health of the industry. It is quite plausible that such players would be concerned with both the production and consumption sides of the market.

Our model does not make strict assumptions on the demand side of the market. Instead, to focus on how up- and down-stream firms coordinate around trends, we take as given the notion that consumers are willing to follow trends, possibly at a premium, without explicitly modeling any one rationalization of this behavior. In doing this we capture with minimal structure what Pesendorfer (2004) calls the 'two key aspects of consumer demand for fashion goods'—that consumers pay a premium for fashionable goods that is not explainable solely by quality differences, and that what is fashionable changes frequently such that there are seasonal network effects in consumer demand for fashion. We can then focus on the problem of how an industry coordinates on the products that will ultimately become trends.

In more general literature on the fashion industry, Robinson (1961) provides an early review of the economics of fashion, Sproles (1981) discusses the nature of life cycles in fashion, Currid (2007) considers the role of gatekeepers and cultural intermediaries in propagating fashion, and Şen (2008) provides a detailed overview of the industrial structure.

3 Model

Our benchmark is a model of product prototyping and development. The players involved are two designers, D_1 and D_2, two retailers, R_1 and R_2, and Nature. There are two possible product designs A and B. In the couture fashion application, design prototypes correspond to styles showcased in the seasonal runway shows that characterize the industry, and the retailed products are those that are ultimately offered to consumers based on those styles. In our model, there are limited number of possible designs a designer can choose from. In reality, the entire set of possible designs is much larger. We can interpret the limited number of possible designs in the model in several ways. One is to see the possible designs as broad, general categories—a particular cut, color, or type of garment—so that a single design in the model can reflect a variety of designs in practice. Another interpretation is that some prior analysis, or commonly understood prevailing market conditions, has narrowed down the set of styles that designers would be interested in playing to a set of possible directions that is small relative to the number of designers.

Similarly, we carry this flexibility on what styles and products represent to the notion of what it means for two designers to choose the same design, or two retailers to choose the same product. We can interpret this quite generally, so that for two products to represent the 'same' design could capture a range of possibilities. Sameness could imply that the products belong to the same broad category or share some key features, or it could imply much greater similarity between the designs. In addition, at the retail stage, we can interpret two retailers selling the same product literally, but it is also possible to interpret this as the retailers selling products with similar characteristics and of similar style.

We assume designers are willing to have their product carried by the retailers. That means all else equal, a designer would prefer to allow retailer R_i to carry their product. In other words, we abstract from outside options for designers and retailers. For example, if a designer's style is not chosen by the retailers in the model, it is not sold. However, we should not take this to imply that in reality there are no alternative channels for a designer to promote their work. Similarly there are many routes by which a retailer can source products. As previously noted, the model is simplified to capture incentives for allowing an independent coordinating editor, rather than capturing the full and diverse range of interactions in the industry.

The order of play is as follows:

1. Nature chooses one of the products to be 'superior'. Let the probability that nature chooses product A be $\alpha > \frac{1}{2}$. Nature's choice is not observed by any player.

2. Designer D_1 chooses a prototype design $d_1 \in \{A, B\}$.

3. Designer D_2 observes the choice of designer D_1 and chooses a prototype design $d_2 \in \{A, B\}$.[3]

[3]Designers and retailers move sequentially, which gives a unique equilibrium prediction in pure strategies. With

4. Nature's choice is revealed to all players.

5. Retailer R_1 chooses a design $r_1 \in \{d_1, d_2\}$.

6. Retailer R_2 observes the choice of retailer R_1 and chooses a design $r_2 \in \{d_1, d_2\}$.

In Section 6 we analyze an extension of the model in which at least one retailer-designer pair is vertically integrated. That is, we consider contracts between upstream and downstream firms. However, we assume that there can be no contracting between designers or between retailers and we argue that contracts that specify that two players use designs that are the same or different are unlikely to be enforceable, for example because of the definition of a fashion design may be legally vague.

The parameter α can then be thought of as capturing underlying trends over those styles that are in a designer's choice set: there is a general understanding that one of the possible styles is more likely to be the superior one, but which is realized as superior is not perfectly known until the styles have been seen on the runway. We can think of the prevailing trends as giving a noisy signal to all players about the which style is likely to perform best that season. This signal could, for example, reflect the industry's (imperfect) understanding about what styles will be most popular with consumers in the coming season. $\alpha = \frac{1}{2}$ would mean that the signal is uninformative, so that the designs are thought equally likely to be the superior, and higher α means a more informative signal. In Section 7 below we consider the incentive for players to acquire a better signal—to increase α—and the relationship of this notion of a signal to aspects of the fashion industry.

Next we specify the payoff structure. The value generated by a design for its designers and retailers (that is, for 'the industry'), and how it is split among them, depends on the number of designers who chose it and on the number of retailers who chose it. If the inferior design is played by n_D designers and n_R retailers, it generates a total value of size $\pi_X(n_D, n_R)$; if the superior design is played by n_D designers and n_R retailers, it generates a total value of size $\gamma\pi_X(n_D, n_R)$, where $\gamma > 1$ represents the premium in the value generated by the superior product.

simultaneous moves, the same strategies would still form an equilibrium, although it would in general no longer be unique.

We impose the following structure on π:

$$\pi(n_D, 0) = 0 \tag{1}$$

$$\pi(n_D, 2) > 2\pi(n_D, 1) \tag{2}$$

$$\pi(1, r) > \pi(2, r) \text{ for } r > 0 \tag{3}$$

Equation 1 says that a product that is not chosen by either retailer generates no value. Equation 2 says that a product that is chosen by both retailers generates more than twice the value of a product chosen by one retailer. In fashion, Equation 2 reflects the case in which a product's value is inflated if it is widespread and 'fashionable'. This assumption reflects higher market valuation of a product that is ubiquitous and 'hot' compare to an array of disparate products. This is consistent with theories of fashion as a device by which consumers can better match with people like themselves (Pesendorfer, 1995, Kuksov and Wang, 2013). In general this could also reflect economies of scale in support or auxiliaries to the product, or network effects in adoption. Equation 2 is net of all effects; in particular, all else being equal, if the retailers choosing the same design intensifies retail competition (as, for example, in Besanko and Perry, 1994), this effect is outweighed by the inflated value to the widely retailed product.

Finally, equation 3 says that a product whose prototype is made by only one designer is more valuable than a product whose prototype is made by both designers. This reflects the value of 'brand identity' in the sense that consumers value being able to clearly identify the designer of a style. In other words, it captures the feature of the industry that there is value in having distinctive fashions associated with particular labels. In general this could also capture avoidance of costly intellectual property disputes.

To parameterize the model, we first normalize $\pi(2, 2) = 1$. Let $\pi(1, 2) = \rho$, with $\rho > 1$ a parameter reflecting the importance of diversity at the design stage. Let $\pi(1, 1) = \tau$, with $\tau < \frac{1}{2}$, an inverse measure of the importance of coordination at the downstream stage.

The split of this value between designers and retailers again depends on the number of designers and retailers who chose design X. The share of value that flows to designers is $S_D(n_D, n_R)$, and the share to retailers is

$$S_R(n_D, n_R) \equiv 1 - S_D(n_D, n_R). \tag{4}$$

We put the following structure on how the value generated by a product is shared between designers and retailers: $S_D(2,2) < S_D(1,1) < S_D(1,2)$, reflecting that a larger share of the value generated by a product accrues to the designers' side if only one designer chose that style. This captures bargaining power between the two sides: bargaining power for the designer is greatest when two retailers both choose to turn the designer's style into a finished product. Since $S_D(n_D, n_R) = 1 - S_R(n_D, n_R)$ this implies that $S_R(2,2) > S_R(1,1) > S_R(1,2)$. Finally, assume that the share of the value going to each side is split equally within that side. For example, if both designers and both retailers choose the same design—so that $n_D = 2$ and $n_R = 2$—then each designer receives a payoff of $\frac{1}{2}S_D(2,2)\pi(2,2)$ and each retailer receives a payoff of $\frac{1}{2}S_R(2,2)\pi(2,2)$.

On the interpretation of the payoffs in general, we can be flexible about precisely how the designer earns money. For example, for a designer's style to be chosen by two retailers could mean in practice a range of possibilities for how the designer earns revenue, from those retailers directly paying the designer to produce a finished product, to the retailers creating a product inspired by the designer's style and the designer's earnings increasing via the prestige of having pioneered a fashionable style.

There is no ex post bargaining over surplus; in the couture fashion industry this reflects the short decision-making windows and rapid turnaround times. In general, by parameterizing the split of surplus between the designer and retailer sides, we can accommodate general situations in which renegotiation and coalition formation is impossible or constrained by considerations such as time, bargaining costs, or pre-existing contracts or norms. This also abstracts from possible hold-up problems. We therefore do not make precise assumptions on the structure of bargaining over surplus among the various parties. However, in the analysis below we highlight cases which are not renegotiation proof—which instead reflects a situation in which it is possible to freely negotiate shares among all parties after the downstream firms have made their choices—and the implications of this for equilibrium outcomes.

4 Equilibria

The game described in section 3 has a unique subgame perfect Nash equilibrium; the equilibrium outcome is parameter dependent. In all cases the designer who selects first always chooses A, the design that is more likely to be superior, and if the designers chose different products, the retailer that selects first always chooses the product that has been revealed in the design stage to be superior. There are three conditions that determine which outcome occurs in equilibrium:

$$\frac{\gamma\rho}{2\tau} > \frac{S_R(1,1)}{S_R(1,2)} \tag{5}$$

$$\frac{1}{2\gamma\rho}\left[\frac{\alpha\gamma}{1-\alpha}+1\right] < \frac{S_D(1,2)}{S_D(2,2)} \tag{6}$$

$$\frac{\alpha\gamma+(1-\alpha)}{2[\alpha\tau+(1-\alpha)\tau\gamma]} < \frac{S_D(1,1)}{S_D(2,2)} \tag{7}$$

If Equation 5 is satisfied, retailers prefer to match rather than mismatch. That is, in the case that both prototype designs were played, the retailer who chooses second prefers to match the first retailer and select the product that is revealed to be superior rather than mismatch and select the inferior product. If Equation 6 is satisfied, then if the retailers will prefer to match on the superior product, designer 2 prefers to mismatch and choose product B. If Equation 7 is satisfied, then if the retailers will mismatch when both designs are available, designer 2 prefers to mismatch and choose product B.

The following result characterizes the equilibrium of the game:

Proposition 1. *The fashion game has a unique subgame perfect Nash equilibrium outcome in which:*

i. *Designers choose different designs and retailers both choose the design that is revealed to be superior if Equations 5 and 6 are both true.*

ii. *Both designers choose the design that is more likely to be superior either if Equation 5 is true and 6 is false, or if Equation 5 is false and 7 is false.*

iii. *The designers choose different designs and the retailers choose different designs if Equation 5 is false and 7 is true.*

Case i. generates the largest total value of $\rho\gamma$: both designs are produced in the prototype stage, and the design that proves to be superior is selected by both retailers. In case ii. the expected total value is $\alpha\gamma+(1-\alpha)$: since both designers select the design that is more likely to be superior, both retailers must select this design. With probability α this design is the true superior and the value generated is γ, and with probability $(1-\alpha)$ the other design is the true superior and the value generated is 1. Case iii. generates the smallest total value of $\tau\gamma+\tau$: both designs are produced in the prototype stage, and each is selected by one retailer. The true superior generates value $\tau\gamma$ and the inferior τ.

From the point of view of the industry as a whole, cases ii. and iii. represent two distinct problems which can arise. First, it can be the case that retailers are willing to herd on the superior design, which is valuable since a product that is 'pushed' by both retailers becomes fashionable and has its value inflated, but, given this, designers are not willing to produce both designs. This arises when the second designer prefers the guarantee of being selected when matching the first design over the *chance* of being the sole winner when mismatching. Thus only one design is available, and the value created is depressed both by the inferior product sometimes being selected and by the cost in value when a design cannot be attributed to a single 'winning' designer.

Second, it can be the case that retailers prefer to mismatch, regardless of which outcome is truly superior. This can occur when a retailer gains more in bargaining power when being the sole buyer of the inferior design than splitting the inflated value of the superior product with the other retailer. Note that in the case in which there can be ex post negotiation on how to divide value among designers and retailers, this problem cannot arise, and so case iii. would not be an equilibrium of the game with ex post negotiation. In the next sections we discuss how value-enhancing interventions may proceed in each of these two cases.

Comparative statics on Equations 5 and 6 allow us to describe factors that make it more likely that the industry surplus-maximizing case i. is realized in equilibrium. For the outcome that maximizes total producer surplus to be realized in equilibrium:

i. fashionability (i.e. retailer matching) must be sufficiently important (small τ),

ii. unique attribution of designs must be sufficiently important (large ρ),

iii. the premium to the superior product design must be sufficiently large (large γ), and

iv. trends must be sufficiently unpredictable (α close to $\frac{1}{2}$).

There are two relevant features of this 'recipe' to foster the industry surplus-maximizing outcome[4]. First, the smaller is τ and the larger is γ, the higher the premium to downstream coordination over the downstream firms choosing different designs. Thus the incentive of the downstream retailers to

[4]Although we go on below to consider an editor who acts as a commitment device, another role they may play could be to to influence these parameters to foster a culture of fashionability and 'superstar' designers that is healthy for the industry.

coordinate on choosing the product that is revealed to be superior in the design stage is increased, and outweighs any motivation to mismatch to obtain a larger share of the smaller surplus that would result from mismatching. Second, the larger is ρ and the smaller is α, the larger is the premium to design diversity, but the less informative is the signal received by the players about which design will be truly superior. This combination gives designers the incentive to mismatch and choose different designs, hoping to be the single designer responsible for the downstream product adopted by both retailers, rather than matching the design of the other designer and guaranteeing a share of the smaller total producer surplus that would result[5]. It is worth noting, however, that there can be conflicting effects when these parameters change. For example, higher γ increases the incentive of retailers to match, but also reduces the incentive of designers to mismatch, since there is a greater cost to playing a design that is then found to be inferior.

5 The fashion editor as value-enhancing commitment device

In our benchmark model, we show that the industry profit maximizing equilibrium outcome is not always realized. In this section we introduce a player who we call the editor, who can make pronouncements during the design-and-retail process that players may commit to follow. This approximates the role and influence in the fashion industry of editors who lend their support to some products or designs. Of course, there are many and varied activities performed by editors and opinion leaders in general that we will abstract from in order to focus on this possible role. We do not claim that the possible role we propose is either the only function of editors or the only way that ideas progress from design to product. We will also abstract from a multiplicity of editors in an industry. Many players behaving in a similar way to the single editor in the model would be consistent with our argument, particularly in applications in which the space of possible designs is large or the market is broken into distinct niches. Overall, we show that having an outside editor may improve total industry surplus when design or retail inefficiency occurs.

We assume that the goal of the editor is to maximize total industry surplus. This is consistent with the editor being either a benevolent planner, altruistically interested in the health of the industry, or a self-interested party who earns a payoff proportional to total producer surplus. An example of the latter case, in which the editor does better when the industry is healthier, would be a magazine enjoying greater advertising revenue when the revenues earned by designers and

[5] We return to the implications of high predictability in trends—high α—in Section 7 below.

retailers are higher.

Consider a situation in which after the designers have chosen designs, an 'editor' announces one of the two designs to be the 'winner' (not necessarily the design that is superior). Do the retailers have incentive to cede power to the editor and commit in advance to select the design that the editor announces? Can this intervention by the editor be value-enhancing for the industry?

We formalize these questions by analyzing the following game:

1. Nature chooses one of the products to be 'superior'. Let the probability that A is chosen be $\alpha > \frac{1}{2}$. Nature's choice is not observed by any player.

2. Editor E chooses (and commits to) a rule that will generate their announcement.

3. Retailer R_1 observes the decision of E and chooses whether to commit to follow the editor's announcement.

4. Retailer R_2 observes the decision of E and R_1 and chooses whether to commit to follow the editor's announcement.

5. Designer D_1 observes the choices of the editor and retailers and chooses a prototype design $d_1 \in \{A, B\}$.

6. Designer D_2 observes the choice of the editor, retailers and designer D_1 and chooses a prototype design $d_2 \in \{A, B\}$.

7. Nature's choice is revealed to all players.

8. The editor makes an announcement according to the announcement rule.

9. If R_1 committed to follow the announcement, she does so, or else chooses a design $r_1 \in \{d_1, d_2\}$.

10. If R_2 committed to follow the announcement, she does so, or else observes the choice of retailer R_1 and chooses a design $r_2 \in \{d_1, d_2\}$.

The announcement rule could in general take many forms, and in particular could specify that no announcement be made in some cases. Note that while it is natural to imagine that the fashion editor would have some expertise in evaluating the quality of designs, we do *not* assume so here:

everyone can see the true nature of the designs after the runway stage. Thus the model will explain a possible role for an 'expert' even in the case in which there is no expertise.

5.1 Editorial intervention to diversify designers

A particularly problematic combination occurs when fashionability is very important, the predictability of trends is high, and designers have little bargaining power relative to retailers. This combination increases the likelihood of Equation 5 being true while Equation 6 is false: retailers are happy to match on a product to exploit fashionability, but the predictability of the superior product means that no designer is willing to produce the likely inferior design. The result is that with probability $(1-\alpha)$ the superior product is not designed, and the value to unique attribution of a design is lost. This is case ii. of Proposition 1. In this case, if retailers choose to commit to following the recommendation of the (revealed after the design stage), it can encourage the designers to mismatch and increase the total value generated.

Consider the following announcement rule. The editor will make no announcement unless both retailers have committed to follow it. If both retailers commit, then when both designs are played by the designers, the editor will announce product B whenever it is revealed to be superior. When product A is revealed to be superior, the editor will announce product B a fraction β of the time (where $\beta < \alpha$ by necessity), and will announce A with the remaining probability. We call this the β-announcement plan.

If retailers follow this announcement, then if designers mismatch, the designer playing B would be selected as the 'winner' with probability $(1-\alpha+\beta)$, although sometimes as the inferior product. The designer playing A would be selected as the 'winner' with probability $(\alpha-\beta)$, always with the superior product. Under such a plan, the probability of the product ultimately chosen by both retailers being the true superior is $(1-\beta)$, which is higher than in the previous game. And the premium ρ for unique attribution of a design would always be realized where it was not before. Thus the total surplus generated for the industry increases from $\alpha\gamma+(1-\alpha)$ under the previous game to $(1-\beta)\gamma\rho+\beta\rho$.

Given this structure, it is possible that the editor can implement an outcome that increases the industry surplus:

Proposition 2. *Consider the case in which both designers choose the design that is likely to be superior in the equilibrium of the game without an editor. In the game with an editor, there exists a*

β-announcement plan such that retailers commit to following the editor's announcement, designers choose different designs, and industry surplus is greater than in the game without an editor, if

$$\frac{1}{2\gamma\rho}\left[\frac{\gamma(\alpha\gamma+(1-\alpha))+(\alpha+(1-\alpha)\gamma)}{\alpha+(1-\alpha)\gamma}\right]<\frac{S_D(1,2)}{S_D(2,2)}. \tag{8}$$

Equation 8 implies that the editor must select β, the weight on product B being chosen when it is the true inferior, to accomplish three things. First, β must be big enough that one designer must be willing to play design B, the likely inferior product, when the other plays A. Second, β must be small enough that one designer is willing to play design A when the other plays B. Third, β must be big enough that retailers prefer to commit to follow the announcement rather than play the equilibrium of the game without an editor. If Equation 8 is satisfied, then such a β exists.

It is important to note that if α is high, Equation 8 is more difficult to satisfy, and so the possibility of beneficial editorial intervention is lowered. Recall that α captures the preciseness with which designers and retailers know which of the available designs is likely to be superior before seeing the prototypes—that is, higher α means that trends in what product is likely to be a hit with consumers are more predictable. In Section 4 we saw that, in the benchmark game without the editor, if trends are too predictable, there is insufficient incentive for designers to experiment, and so valuable design diversity is lost. The same intuition applies in the game with an editor. If trends are too predictable, the incentives for the designers to both select the likely superior product can be too strong for the editor to be able to overcome with this intervention.

The editor, with the objective of maximizing industry surplus, will choose the smallest possible β. This β is

$$\beta^*=\frac{S_D(2,2)}{S_D(1,2)}\left[\frac{\alpha\gamma+(1-\alpha)}{2\rho}\right]-(1-\alpha)\gamma. \tag{9}$$

The value created by the editor—the difference in industry surplus between the case with and without the editor—is larger when β is smaller. Equation 9 shows that β is smaller when a designer has more bargaining power as a 'sole winner' compared to when both designers choose the same design, the value to unique attribution of designs is high, and the predictability of the superior design is smaller.

By combining the conditions in Proposition 1 that define when there is a need for editorial intervention to spread designers with the condition in Proposition 2 on when the intervention can be successful, we can completely characterize the conditions under which the editor using the β strategy can improve upon the equilibrium without an editor in which designers choose the same product:

$$\frac{\gamma\rho}{2\tau} > \frac{S_R(1,1)}{S_R(1,2)}, \tag{10}$$

$$\frac{1}{2\gamma\rho}\left[\frac{\gamma(\alpha\gamma+(1-\alpha))+(\alpha+(1-\alpha)\gamma)}{\alpha+(1-\alpha)\gamma}\right] < \frac{S_D(1,2)}{S_D(2,2)} < \frac{1}{2\gamma\rho}\left[\frac{\alpha\gamma}{1-\alpha}+1\right]. \tag{11}$$

These conditions are more readily satisfied when γ is high (so that the premium to the superior product is high) and τ is low (so that coordination downstream is important). The effect of α is ambiguous: the left hand constraint in Equation 11 becomes tighter, but the right hand constraint relaxes at a faster rate as α increases. The reason for the ambiguity is that while, as we have just noted, if α is too high it is impossible for the editor to design a β-announcement plan that will spread designers, it is also the case that higher α increases the need for editorial intervention to spread designers.

In the β-announcement plan, the editor is acting as a randomization device with commitment. The objective is to 'spread out' the designers, with both the benefit from the designers mismatching and the benefit that the truly superior design is ultimately chosen by the industry more often. This conception of the editor's role includes the important aspect that the announcement must be idiosyncratic to some degree: sometimes the editor must seem contrarian, in the sense of picking a 'winning' design that is inferior to another possible design. The result is particularly stark in our simple model since we have a small set of available designs, a single winner selected, and the true nature of designs is publicly known after prototyping. One way to translate this result into a richer real-world setting is to think of the real-world editor as picking a *set* of winning designs and there to be a general critical consensus on the designs from other industry experts or fashion blogs. The analog of the β-announcement rule would be for that editor to include in the winning set some designs that the general critical consensus feels to be poor. The seeming arbitrariness or contrariness of some of the editor's choices relative to the critical consensus can be a way to encourage diversity and risk-taking by designers.

We may also note that it is not crucial for this result that the editor *consciously* selects a β-announcement rule. Any behavior by the editor that functions in the same way would work in the same way and so would also be capable of rationalizing the power and influence of the editor. For example, it may be the case that the editor strives always to select the truly superior design—as revealed at the design stage—but occasionally makes mistakes, or is occasionally blinded by her idiosyncratic tastes, so that she sometimes selects a truly inferior design. These behaviors are both consistent with the (conscious) choice of announcement rule made by the editor in our model, and so are capable of functioning in the same way to spread out the choices made by designers, as in Proposition 2.

How the commitment to follow the editor's announcement is enforced is a question outside of the game structure. It may be that the editor has latent power over the players of this game; perhaps the retailers need access to the editor which can be denied if they commit and renege. Another possibility is that in a repeated version of this game, for the retailer to renege today could be punished in the game tomorrow. Both of these arguments have appeal in the context of the fashion industry: the design-and-development game takes place in each fashion 'season', several times a year, so that repetition is frequent, and anecdotal evidence suggests that the editors who pronounce publicly in the industry have a high degree of latent power to sanction other players. Finally, we reiterate that we have abstracted from any notion that the editor has special ability to evaluate designs or to influence consumers—although these are very plausible aspects of reality and may be beneficial, we have shown that they are not necessary attributes for the editor to function as a commitment device.

5.2 Editorial intervention to herd designers

Next we consider a similar intervention by the editor that can improve the total industry surplus in case iii. of Proposition 1. This is the case in which the designers chose different designs and the retailers chose different designs in equilibrium, which is the unique equilibrium outcome when Equation 5 is false and 7 is true[6].

In this case it is again possible for a similar action by the editor to increase total industry surplus. The 'problem' in this case is that retailers would prefer to choose different designs than to herd on the one product. For this reason the editor's intervention cannot simply induce the retailers to choose the same design, but instead focuses on encouraging the designers to choose the same design. The editor can accomplish this with the following announcement rule: whenever

[6] As we noted above, this problem can exist only in settings in which design choices and the division of surplus are not freely renegotiable after the design stage, since otherwise this possibility will not arise in equilibrium of the prototype and development game.

at least one retailer commits to follow the editor's announcement, announce the likely superior design, A, whenever it is designed by at least one designer, regardless of which design is revealed to be truly superior. We call this the A-announcement plan.

Proposition 3. *Consider the case in which designers choose different designs and retailers choose different designs in the equilibrium of the game without an editor. In the game with an editor, there exists a unique equilibrium such that the editor uses the A-announcement plan, retailers commit to follow the editor's announcement and designers both choose the design that is more likely to be superior, and in turn industry surplus is greater than in the game without an editor.*

Proposition 3 implies that there exists a value-enhancing role for the editor using the A-announcement plan if retailers' bargaining power is low when two retailers carry the same design picked by a single designer, and retailers' bargaining power is high when carry a design picked by both designers. Under these conditions, the second-mover retailer is always willing to commit to such a plan, and given this, the first-mover retailer is also willing to commit, and so designers are willing to both play design A. In Proposition 2, the editor's intervention was designed to spread out the designers by sometimes favoring the inferior product. In this case, the intervention is designed to herd the retailers on the likely superior to in turn herd the designers on the same. Absent the editor, the designers chose different designs because retailers chose different designs in the subsequent subgame, generating the worst-case total surplus. With retailers committing to follow the editor's announcement, designers are willing to match on the likely superior and avoid this worst-case. In this way the introduction of an editor eliminates the equilibrium outcome in which no product becomes 'fashionable' (in the sense of the payoff parameters of the game).

The editor's announcement in equilibrium here will match the design that was identified in advance to be more likely to be superior. The editor's recommendation will then in some sense confirm the prevailing sentiment, but it will *not* necessarily conform to the information on which design is truly superior which is revealed after the design stage. In this sense the 'surprise' of an inferior design being announced is more prevalent in this intervention than in the case of the β intervention. The retailer's decision could even in this case occur at the same time as the editorial announcement, since it does not require waiting for the true superior to be revealed in the design stage. As was the case in the intervention of Proposition 2, it is also not the case that the editor must be consciously choosing to enact this announcement rule. For example, it may be the case that the editor must commit to selecting a winning design *before* the designs are finalized, due to publishing constraints or relationships with designers, and so commits to selecting the likely superior design before the truth is known. This behavior is consistent with the announcement rule that was designed to herd the choices made by designers, and would justify the decision of downstream retailers to follow the announcement, just as the conscious choice of announcement rule would.

5.3 The editor's incentives

In the preceding sections we assume that the editor earns a payoff that is proportional to industry surplus. Since the players here are using a commitment device that is non-deterministic—the editor retains the right to make whichever announcement she chooses in the announcement stage—in this sense it is important that the editor is an insider. A proportional payoff could reflect higher sales of the editor's product or greater advertising expenditure in the editor's outlet. This naturally implies that the editor's strategic choice will match that of a benevolent planner in the same role. This is consistent with the role played by Vogue in the fashion industry, where "Vogue cannot pretend to be an observer... [it] has a vested interest in the health of the industry, the success of designers, the strength of retail sales" (Pogrebin, 1997).

The editor is not incorruptible in the one-shot game we have studied. It is possible that at least one of the players may have incentive to bribe the editor to influence the announcement after the retailers have committed to follow it. However, just as we argue above that a repeated version of the game would give the editor the means to discipline players who renege on commitments, repetition could similarly reduce the corruptibility of the editor, in both cases via traditional folk theorem arguments. The ability to sanction and be sanctioned over the long run is one possible reason why it is beneficial that influential editors be long-lived in the industry.

6 Vertical consolidation

In this section we consider an extension of the benchmark model in which designers and retailers are vertically integrated. That is, rather than two designers and two retailers, the players are two hybrid designer-retailers. This can represent either (unmodeled) contractual agreements between retailers and designers, or that both functions are performed by a single entity. We consider two separate cases: case one, the retail arm of each hybrid will be restricted to retail the design produced by its design arm; case two, the retail arm will be free to 'switch' and adopt a different retail product than was designed by its own design arm.

We can formalize the first case as follows:

1. Nature chooses one of the products to be 'superior'. Let the probability that A is chosen be $\alpha > \frac{1}{2}$. Nature's choice is not observed by any player.

2. Designer D_1 chooses a prototype design $d_1 \in \{A, B\}$.

3. Designer D_2 observes the choice of designer D_1 and chooses a prototype design $d_2 \in \{A, B\}$.

4. Nature's choice is revealed to all players.

5. Designer D_1 retails product $r_1 = d_1$.

6. Designer D_2 retails product $r_2 = d_2$.

Proposition 4. *In the game with two hybrid designer-retailers who are restricted to retail their own design, the unique equilibrium has both players design and retail A, the likely superior design.*

Vertical consolidation with retail commitment thus removes in equilibrium the best and worst outcomes from the case with separate designers and retailers. The case in which different design prototypes are produced and retailers herd is immediately ruled out by assumption, and the outcome in which different design prototypes are produced and retailers mismatch is never realized in equilibrium of the game with consolidation. This is driven by the incentive to mismatch at the design stage is lower once the designer is consolidated with a retailer. Where before a designer may have preferred to mismatch,reducing total surplus in order to increase her *share* of the surplus, there is now no such incentive. Consolidation thus mitigates the risk of drawing unfavorable parameters and ending up in the worst-case, at the cost of sometimes missing out on the higher payoff of the best-case.

However, the editor in the game of Propositions 2 and 3 is not only able to eliminate the worst-case outcome in the setting with unconsolidated players, but also preserve and enhance the range of parameters such that higher industry surplus, with a diversity of designs and then herding by retailers, can be realized. In this sense, vertical consolidation as an aid to coordination and commitment is inferior to the role of editor in the unconsolidated industry.

Next consider a game with consolidated players who can 'switch' from the design they prototyped at the retail stage:

1. Nature chooses one of the products to be 'superior'. Let the probability that A is chosen be $\alpha > \frac{1}{2}$. Nature's choice is not observed by any player.

2. Designer D_1 chooses a prototype design $d_1 \in \{A, B\}$.

3. Designer D_2 observes the choice of designer D_1 and chooses a prototype design $d_2 \in \{A, B\}$.

4. Nature's choice is revealed to all players.

5. Designer D_1 chooses a design $r_1 \in \{d_1, d_2\}$.

6. Designer D_2 observes the choice of designer D_1 and chooses a design $r_2 \in \{d_1, d_2\}$.

Proposition 5. *In the game with two hybrid designer-retailers who are not restricted to retail their own design, there exists an unique equilibrium that is parameter dependent:*

i. *Designer 1 chooses design A, designer 2 chooses design B, and both retail the true superior design if*

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) < \left[\frac{1}{2}S_R(1,2) + (1-\alpha)S_D(1,2)\right]\rho\gamma, \tag{12}$$

and either

$$S_R(1,2) > \frac{2\tau\gamma}{\rho}, \text{ and} \tag{13}$$

$$\frac{1}{2}S_R(1,2) + S_D(1,2) < \frac{1}{2}S_R(1,2)\gamma, \tag{14}$$

or

$$\frac{2\tau}{\rho\gamma} < S_R(1,2) < \frac{2\tau\gamma}{\rho}. \tag{15}$$

ii. *Designer 1 chooses design A, designer 2 chooses design B, and both retail A if*

$$S_R(1,2) > \frac{2\tau\gamma}{\rho}, \tag{16}$$

$$\frac{1}{2}S_R(1,2) + S_D(1,2) > \frac{1}{2}S_R(1,2)\gamma, \text{ and} \tag{17}$$

$$S_R(1,2)\rho > 1. \tag{18}$$

iii. *Both designers choose design A in all other cases.*

In one respect this outcome is similar to the outcome of Proposition 4, the case in which switching was not possible. The worst-case outcome from the unconsolidated game is again eliminated: since the hybrid designer-retailer earns both the designer and retailer's share of surplus, there is no incentive for a designer-retailer to mismatch at the retail stage in order to increase her share of surplus. However, in this case with switching, the outcome that maximizes industry surplus can occur in equilibrium, although the conditions for it are more restrictive than with unconsolidated designers (as in Proposition 1). This is because the loss to a designer-retailer from choosing a design that might not be chosen can be outweighed by the extra surplus they enjoy when a diversity of designs was produced.

In this game with consolidated designer-retailers and possible switching, it is again the case that an editor acting similarly to before can increase industry surplus. Again we consider a structure such that both retailers can precommit to follow the editor's announcement. While before the editor had to favor the true inferior design in making announcements, it can be sufficient to improve on the equilibrium outcome here for the editor to simply announce the true superior product, whichever it may be. The editor then acts as a pure commitment device; precommitment to the true superior constrains the designer-retailers in subgames in which they learn that their design is inferior. This makes mismatched designs followed by herding in the retail stage an equilibrium outcome for a greater range of parameters than in the game absent an editor. Formally:

Proposition 6. *In the game with two hybrid designer-retailers who are not restricted to retail their own design, consider the case in which both designers select A in the game without an editor. Further suppose the editor's announcement plan is to announce the true superior product whenever it has been played and when both designer-retailers have committed to follow the announcement, and to make no announcement otherwise. If*

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) < \left[S_R(1,2) + (1-\alpha)S_D(1,2)\right]\rho\gamma, \tag{19}$$

then the unique equilibrium in the subgame following the editor's announcement plan has both designer-retailers commit to follow the editor's announcement, choose different designs, and retail the true superior product.

Note that this is not in general the best the editor can do: it is possible at least in some cases for the editor to enact a β-announcement plan as before that does better. We have omitted this case for ease of exposition.

6.1 Incentives for vertical integration

In this section we demonstrate that it can be the case that a retailer-designer pair can do better by integrating (again either contractually or by a designer retailing its own products) than they would under the editor's β-announcement plan in the unconsolidated industry. This in turn can lead the second retailer-designer pair to consolidate, and thus leave industry surplus lower than before resulting in the equilibrium of Proposition 4 or Proposition 5.

Consider a game similar to the original case except that designer D_2 is consolidated with retailer R_2, who sells the design produced by D_2.

Proposition 7. *In the game in which designer 2 and retailer 2 are consolidated and sell the design produced by designer 2, then if*

$$\frac{S_R(1,1)}{S_R(1,2)} < \frac{\rho}{2\tau\gamma} \tag{20}$$

and

$$S_D(1,2) + \frac{1}{2}S_R(1,2) > \frac{\alpha\gamma + (1-\alpha)}{2\rho(\alpha + (1-\alpha)\gamma)}, \tag{21}$$

the unique equilibrium has the designers produce different designs and the retailers both retail the design produced by designer 2.

In this equilibrium, whatever design is played by the first designer, the second designer will choose the other, which in turn will be selected by both retailers. The payoff to the consolidated $D_2 - R_2$ is higher in this case than the payoff earned by the pair in the equilibrium of Proposition 2, the editor's β-announcement plan. The incentive for vertical consolidation is therefore not ruled out by the editor's intervention to increase industry surplus.

This leaves designer D_1 unselected, and with a payoff of zero. There are two possibilities. It can be the case that there is incentive for the second pair D_1 and R_1 to consolidate, or it can be the case that retailer R_1 prefers this equilibrium to consolidation, leaving D_1 effectively defunct. We can therefore see preventing such a sequence of consolidation as another potential role for the editor.

In sum, there is an incentive for upstream and downstream firms to vertically integrate, but that this can create a cascade of vertical integration that leaves all worse off than before. We may say informally that vertical integration is a 'safe' choice for a designer and retailer, since it gives an intermediate payoff with certainty, ruling out the possibility of larger gains or losses. This contrasts with an unintegrated industry with an editor, in which total industry surplus is always weakly higher than in the baseline case. Under vertical integration the editor can still perform a similar role as in the unintegrated industry, but with less effectiveness.

7 Incentive to predict trends

In all versions of the model discussed in earlier sections, it is the case that at least one player has private incentive to enhance the precision with which the true superior design can be identified—that is, to increase α. For example, in the β-announcement equilibrium, designer 1 'wins' the design tournament with probability $(\alpha - \beta)$, which is increasing in α. However, another pervasive feature of the model is that as this precision increases, the incentive for designers to differentiate in the design stage is undermined. Eventually, the equilibrium selection effect is to push the industry away from the surplus-maximizing outcome, and to make the value-enhancing intervention by the editor more difficult. The private incentive to acquire information thus can at best conflict with industry value, and at worst be counterproductive even for the party acquiring the information.

In contrast, a primitive assumption in our analysis was a set of possible designs—the set $\{A, B\}$—that was of the same order of magnitude as the set of designers. We can think of this as capturing a 'narrowing down' of the designs that are under general consideration for the season, implying that other designs outside this set are generally known to be inferior to those in the set. This rules out a case in which the true superior design may go 'undiscovered' even with maximal differentiation by designers.

The tension between these two considerations implies an industry-level sweet spot for information acquisition: narrowing down the set of possible designs to a manageable size is good for industry surplus, but narrowing down too far undermines the design tournament and is bad for industry surplus. This suggests the value of the influence of fabric makers and the trend forecasting industry in narrowing several seasons in advance the set of options from which designers will choose. The forecasting industry, which sells to various creative industries suggestions of what general concepts—a particular color, say—will be 'hot' in the coming seasons, in particular can seem to be somewhat arbitrary, but can nevertheless hold value in this way.

8 Conclusion

In this paper we investigate the role of editors in the process of an industry developing prototypes into retail products when trends are valuable. While we focus on the fashion industry, the model and structure can apply to other trend-driven industries such as music. We consider a process of upstream firms developing prototypes and downstream firms choosing among these prototypes, and show that in general industry surplus is not maximized by this process. There are two broad reasons. One is that upstream designers may prefer to produce the same design as each other rather than differentiating their prototypes, which guarantees the designer a share of the market but reduces valuable diversity in the design stage. Another is that downstream retailers may prefer to select different designs to sell rather than coordinate on a standard design, which increases the retailer's bargaining power over its design but sacrifices valuable standardization.

In both cases intervention by an editor can help increase industry surplus. The editor can make public pronouncements on which prototype the retailers should select, after the designs are revealed but before retailers select among them. We show that retailers have incentive to commit to follow these recommendations, and that this can raise industry surplus. Depending on circumstance, the editor's optimal recommendations can include various strategies. For example, if more design diversity is needed, the editor may occasionally recommend an *inferior* design to retailers, to encourage designers to make varied prototypes. If, however, more coordination by retailers on a particular design is needed, the editor may commit to recommending a particular design in advance in order to induce all designers to focus on it, thus preventing retailers from selecting different designs.

This editorial role is robust to vertical integration among design and retail operations within the industry. Nevertheless, another implication of our analysis is that vertical consolidation among designers and downstream firms can be good for the consolidating firms but bad for the industry by discouraging both design diversity at the prototyping stage and coordination at the retail stage. Industry efficiency and beneficial intervention by the editor are therefore harder to achieve after consolidation. A similar effect occurs with the incentive for designers and retailers to acquire better information about the value of different designs in advance. This information is valuable for an individual firm but again is harmful for the industry, since it reduces the incentive for designers to choose different designs.

In sum, the model we have developed thus suggests one justification for the level of power possessed by prominent editors who act as tastemakers in industries that rely on competitive prototyping and development. These players have a stake in the health of the industry but the source of their influence can seem mysterious. We show that their value extends beyond any talent they have in evaluating the products of the industry or in swaying consumers. Even if such players have no special expertise in analyzing designs or any ability to directly influence the choices made by consumers, they can still enhance producer surplus by acting as a 'smart' commitment device for the various players, and so firms may be willing to cede power to such a player, to the benefit of all.

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A Proofs

Proposition 1

Proof. We proceed by backward induction. In the final stage, retailer R_2 chooses a design $r_2 \in \{d_1, d_2\}$. If $d_1 = d_2$, this is degenerate and $r_2 = d_1 = d_2$. There are two further cases:

i. $d_1 \neq d_2$ and R_1 chose the design that was revealed to be superior. If R_2 also chooses the superior design, R_2 earns $\frac{1}{2}S_R(1,2)\gamma\rho$. If R_2 chooses the inferior design, R_2 earns $S_R(1,1)\tau$. Thus R_2 chooses to match R_1 and play the superior design if

$$\frac{\gamma\rho}{2\tau} > \frac{S_R(1,1)}{S_R(1,2)}, \tag{22}$$

and chooses the inferior design otherwise.

ii. $d_1 \neq d_2$ and R_1 chose the design that was revealed to be inferior. If R_2 also chooses the inferior design, R_2 earns $\frac{1}{2}S_R(1,2)\rho$. If R_2 chooses the superior design, R_2 earns $S_R(1,1)\gamma\tau$. Thus R_2 chooses to match R_1 and play the inferior design if

$$\frac{\rho}{2\gamma\tau} > \frac{S_R(1,1)}{S_R(1,2)}, \tag{23}$$

and chooses the superior design otherwise.

This completes the cases for the final stage.

In the preceding stage, retailer R_1 chooses a design $r_1 \in \{d_1, d_2\}$. Again if $d_1 = d_2$, this is degenerate and $r_2 = d_1 = d_2$. If $d_1 \neq d_2$, there are three possible cases:

i. If equations 22 and 23 are both true, then R_2 will play $r_2 = r_1$ for any r_1. R_1 prefers to select the true superior design if

$$\frac{1}{2}S_R(1,2)\gamma\rho > \frac{1}{2}S_R(1,2)\rho. \tag{24}$$

Since $\gamma > 1$, this condition is always satisfied.

ii. If equation 22 and 23 are both false, then R_2 will play $r_2 \neq r_1$ for any r_1. R_1 prefers to select the true superior design if

$$S_R(1,1)\gamma\tau > S_R(1,1)\tau. \tag{25}$$

Since $\gamma > 1$, this condition is always satisfied.

iii. If equation 22 is true and 23 is false, then R_2 will play $r_2 = r_1$ if r_1 is the true superior design, and R_2 will play $r_2 \neq r_1$ if r_1 is the true inferior design. R_1 prefers to select the true superior design if

$$S_R(1,2)\gamma\rho > S_R(1,1)\tau. \tag{26}$$

This is identical to equation 22 which is true in this case.

It cannot be that equation 22 is false while 23 is true, since for this to be the case would require

$$\frac{\rho}{2\gamma\tau} > \frac{\gamma\rho}{2\tau}, \tag{27}$$

which cannot be since $\gamma > 1$. Therefore the three cases are exhaustive, and retailer R_1 will always select the true superior design whenever both designs are available.

In the preceding stage, designer D_2 must choose a design $d_2 \in \{A, B\}$. There are four possible cases:

i. If $d_1 = A$ and equation 22 is true, then if D_2 plays A, D_2 will earn an expected payoff of $\alpha\left[\frac{1}{2}S_D(2,2)\gamma\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\right]$. If D_2 plays B, D_2 will earn $(1-\alpha)\left[S_D(1,2)\gamma\rho\right]$. Thus D_2 will match D_1 and play A if

$$\frac{1}{2\gamma\rho}\left[\frac{\alpha\gamma}{1-\alpha} + 1\right] > \frac{S_D(1,2)}{S_D(2,2)}. \tag{28}$$

ii. If $d_1 = B$ and equation 22 is true, then if D_2 plays A, D_2 will earn an expected payoff of $\alpha\left[S_D(1,2)\gamma\rho\right]$. If D_2 plays B, D_2 will earn $\alpha\left[\frac{1}{2}S_D(2,2)\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\gamma\right]$. Thus D_2 will play A if

$$\frac{S_D(1,2)}{S_D(2,2)} > \frac{1}{2\gamma\rho}\left[\frac{(1-\alpha)\gamma}{\alpha} + 1\right]. \tag{29}$$

This condition is true always.

iii. If $d_1 = A$ and equation 22 is false, then if D_2 plays A, D_2 will earn an expected payoff of $\alpha\left[\frac{1}{2}S_D(2,2)\gamma\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\right]$. If D_2 plays B, D_2 will earn $\alpha\left[S_D(1,1)\tau\right] + (1-\alpha)\left[S_D(1,1)\gamma\tau\right]$. Thus D_2 will match D_1 and play A if

$$\frac{\alpha\gamma + (1-\alpha)}{2\left[\alpha\tau + (1-\alpha)\gamma\tau\right]} > \frac{S_D(1,1)}{S_D(2,2)}. \tag{30}$$

iv. If $d_1 = B$ and equation 22 is false, then if D_2 plays A, D_2 will earn an expected payoff of $\alpha\left[S_D(1,1)\gamma\tau\right] + (1-\alpha)\left[S_D(1,1)\tau\right]$. If D_2 plays B, D_2 will earn $\alpha\left[\frac{1}{2}S_D(2,2)\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\gamma\right]$. Thus D_2 will play A if

$$\frac{S_D(1,1)}{S_D(2,2)} > \frac{\alpha + \gamma(1-\alpha)}{2\left[\alpha\gamma\tau + (1-\alpha)\tau\right]}. \tag{31}$$

This completes the second designer's stage.

Finally the preceding stage is the first in which designer D_1 must choose $d_1 \in \{A, B\}$.

i. If equations 22 and 28 are both true, then if D_1 plays A, D_2 will match and D_1 earns $\alpha\left[\frac{1}{2}S_D(2,2)\gamma\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\right]$. If D_1 plays B, D_2 will play A and the retailers will both select the true superior, so that D_1 earns $(1-\alpha)S_D(1,2)\gamma\rho$. Thus D_1 will prefer to play A if

$$\frac{1}{2\gamma\rho}\left[\frac{\alpha\gamma}{1-\alpha} + 1\right] > \frac{S_D(1,2)}{S_D(2,2)}. \tag{32}$$

This is equation 28, which is true in this case and so D_1 plays A for sure.

ii. If equation 22 is true and 28 is false, then D_2 will mismatch either choice by D_1 and the retailers will both select the true superior. D_1 thus earns $\alpha S_D(1,2)\gamma\rho$ by selecting A and $(1-\alpha)S_D(1,2)\gamma\rho$ by selecting B. Since $\alpha > \frac{1}{2}$, D_1 prefers to play A.

iii. If equation 22 is false, 30 is true, and 31 is false, then D_2 will match if $d_1 = A$ and will match if $d_1 = B$, and both retailers must then select the only available design. D_1 thus earns $\alpha\left[\frac{1}{2}S_D(2,2)\gamma\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\right]$ by selecting A and $\alpha\left[\frac{1}{2}S_D(2,2)\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\gamma\right]$ by selecting B. Since $\alpha > \frac{1}{2}$, D_1 prefers to play A.

iv. If equation 22 is false, 30 is false, and 31 is true, then D_2 will mismatch if $d_1 = A$ and will mismatch if $d_1 = B$, and retailers will select different designs. D_1 thus earns $\alpha\left[S_D(1,1)\gamma\tau\right] + (1-\alpha)\left[S_D(1,1)\tau\right]$ by selecting A and $\alpha\left[S_D(1,1)\tau\right] + (1-\alpha)\left[S_D(1,1)\gamma\tau\right]$ by selecting B. Since $\alpha > \frac{1}{2}$, D_1 prefers to play A.

v. If equation 22 is false, 30 is true, and 31 is true, then D_2 will match if $d_1 = A$ and mismatch if $d_1 = B$, and retailers will select different designs if possible. D_1 thus earns $\alpha\left[\frac{1}{2}S_D(2,2)\gamma\right] + (1-\alpha)\left[\frac{1}{2}S_D(2,2)\right]$ by selecting A and $\alpha\left[S_D(1,1)\tau\right] + (1-\alpha)\left[S_D(1,1)\gamma\tau\right]$ by selecting B. Thus D_1 will prefer to play A if

$$\frac{\alpha\gamma + (1-\alpha)}{2\left[\alpha\tau + (1-\alpha)\gamma\tau\right]} > \frac{S_D(1,1)}{S_D(2,2)}. \tag{33}$$

This is equation 30, which is true in this case.

It cannot be that equation 30 is false and 31 is false, since for this to be the case would require

$$\frac{\alpha\gamma + (1-\alpha)}{2\left[\alpha\tau + (1-\alpha)\gamma\tau\right]} < \frac{\alpha + \gamma(1-\alpha)}{2\left[\alpha\gamma\tau + (1-\alpha)\tau\right]}, \tag{34}$$

which cannot be since $\gamma > 1$. These cases are therefore exhaustive.

We can thus completely characterize the outcome in equilibrium in this game. D_1 plays A, the likely superior product. D_2 plays A if equation 22 is true and 28 is true, or if 22 is false and 30 is true, or else plays B. If $d_1 = d_2$ then on the equilibrium path both retailers play this design trivially. If $d_1 \neq d_2$, then R_1 plays the product that is revealed to be the true superior, and R_2 plays the true superior if equation 22 is true, and the true inferior otherwise. This completes the proof. □

Proposition 2

Proof. Note that if both retailers do not commit to follow the editor's recommendation, then the unique SPNE outcome of the game with the editor is identical that of the game without the editor.

Consider the case in which both retailers have committed to follow the editor's recommendation, and say that the editor has announced a parameter β. In this case all that follows the designers' choices is deterministic. In the stage in which designer D_2 must choose a design, there are two cases.

i. If D_1 picked A, then D_2 earns a higher payoff by selecting B than A if

$$(1-\alpha)S_D(1,2)\gamma\rho + \beta S_D(1,2)\rho \geq \frac{1}{2}\alpha S_D(2,2)\gamma + \frac{1}{2}(1-\alpha)S_D(2,2) \tag{35}$$

$$\beta \geq \frac{S_D(2,2)}{S_D(1,2)}\left[\frac{\alpha\gamma + (1-\alpha)}{2\rho}\right] - (1-\alpha)\gamma. \tag{36}$$

Denote this β as $\underline{\beta}_D$.

ii. If D_1 picked B, then D_2 earns a higher payoff by selecting A than B if

$$(\alpha-\beta)S_D(1,2)\gamma\rho > \frac{1}{2}\alpha S_D(2,2) + \frac{1}{2}(1-\alpha)S_D(2,2)\gamma \tag{37}$$

$$\beta < \alpha - \frac{S_D(2,2)}{S_D(1,2)}\left[\frac{\alpha + \gamma(1-\alpha)}{2\gamma\rho}\right]. \tag{38}$$

Denote this β as $\bar{\beta}_D$.

Next consider the preceding stage in which D_1 must choose a design. There are four possible cases.

i. Equations 36 and 38 are both satisfied. In this case D_2 will mismatch in either case, and so different designs will be played.

ii. Equations 36 and 38 are both not satisfied. In this case D_2 will match the design chosen by D_1, and so the same design will be played.

iii. Equation 36 is satisfied and 38 is not. In this case D_2 will match when D_1 plays B and mismatch when D_1 plays A. D_1 therefore prefers to play A if

$$(\alpha-\beta)S_D(1,2)\gamma\rho > \frac{1}{2}\alpha S_D(2,2) + \frac{1}{2}(1-\alpha)S_D(2,2)\gamma, \tag{39}$$

that is, if Equation 38 is satisfied, a contradiction. Thus in this case D_1 and D_2 each play B.

iv. Equation 38 is satisfied and 36 is not. In this case D_2 will match when D_1 plays A and mismatch when D_1 pays B. D_1 therefore prefers to play A if

$$(1-\alpha)S_D(1,2)\gamma\rho + \beta S_D(1,2)\rho < \frac{1}{2}\alpha S_D(2,2)\gamma + \frac{1}{2}(1-\alpha)S_D(2,2), \tag{40}$$

that is, if Equation 36 is not satisfied. Thus in this case D_1 and D_2 each play A.

To induce the designers to select different designs therefore requires that β satisfy both Equations 36 and 38. For there to exist a β such that both are satisfied requires that

$$\frac{S_D(2,2)}{S_D(1,2)}\left[\frac{\alpha\gamma + (1-\alpha)}{2\rho}\right] - (1-\alpha)\gamma < \alpha - \frac{S_D(2,2)}{S_D(1,2)}\left[\frac{\alpha + \gamma(1-\alpha)}{2\gamma\rho}\right] \tag{41}$$

$$\frac{1}{2\gamma\rho}\left[\frac{\alpha\gamma^2 + 2(1-\alpha)\gamma + \alpha}{\alpha + (1-\alpha)\gamma}\right] < \frac{S_D(1,2)}{S_D(2,2)}. \tag{42}$$

Since industry surplus is greater only in the case in which the designers select different designs, and since surplus in that case is decreasing in β, we can rule out $\beta > \underline{\beta}_D$ as dominated by $\beta = \underline{\beta}_D$ for the editor.

Next return to the retailers' decision to commit to follow the editor's announcement. For the retailers to earn a higher payoff under the β regime than in the equilibrium of the game without the editor (and, equivalently, the equilibrium in any subgame in which both retailers do not commit to follow the editor's recommendation) requires:

$$(1-\beta)\frac{1}{2}S_R(1,2)\gamma\rho + \beta\frac{1}{2}S_D(1,2)\rho > \alpha\frac{1}{2}S_R(2,2)\gamma + (1-\alpha)\frac{1}{2}S_R(2,2) \tag{43}$$

$$\beta < \frac{\gamma}{\gamma-1} - \frac{S_R(2,2)}{S_R(1,2)}\left[\frac{\alpha\gamma+(1-\alpha)}{\rho(\gamma-1)}\right] \tag{44}$$

Denote this β as $\bar{\beta}_R$. If β is below this threshold and also successfully induces the designers to mismatch, each retailer prefers to commit given that the other commits to follow the editor's announcement. For this to be the case it must be that $\underline{\beta}_D < \bar{\beta}_R$:

$$\frac{S_D(2,2)}{S_D(1,2)}\left[\frac{\alpha\gamma+(1-\alpha)}{2\rho}\right] - (1-\alpha)\gamma < \frac{\gamma}{\gamma-1} - \frac{S_R(2,2)}{S_R(1,2)}\left[\frac{\alpha\gamma+(1-\alpha)}{\rho(\gamma-1)}\right] \tag{45}$$

$$\frac{1}{2\gamma\rho}\left[\frac{(\gamma+1)(\alpha\gamma+(1-\alpha))}{\gamma+\gamma(\gamma-1)(1-\alpha)}\right] < \frac{S_D(1,2)}{S_D(2,2)}. \tag{46}$$

Thus if 8 and 46 are satisfied, the unique SPNE outcome of the game with the editor sees the editor set $\beta = \underline{\beta}_D$, the retailers commit to follow the editor's announcement, and the retailers choose different designs. Since the left hand side of equation 8 is greater than the left hand side of 46, the latter condition is satisfied whenever the former is. □

Proposition 3

Proof. As with Proposition 2, if neither retailer commits to follow the editor's recommendation, then the unique SPNE outcome of the game with the editor is identical that of the game without the editor. We know also that if only one retailer has committed to follow the editor's A recommendation, the other retailer will always prefer to choose B if it is available (since Equation 5 is false), and therefore the designers will choose different designs (since equation 7 is true).

If both retailers have committed to follow the editor's announcement, then play following the designers' choices is deterministic. Consider the choice of designer D_2. There are two cases:

i. If D_1 picked A, then the editor will announce A and retailers will select A. D_2 thus earns zero by choosing B (since $\pi(1,0) = 0$ by assumption) and earns a positive payoff by choosing A.

ii. If D_1 picked B, then D_2 earns a higher payoff by selecting A than B if

$$S_D(1,2)\rho(\alpha\gamma+(1-\alpha)) > \frac{1}{2}S_D(2,2)(\alpha+(1-\alpha)\gamma) \tag{47}$$

$$\frac{S_D(1,2)}{S_D(2,2)} > \frac{\alpha+(1-\alpha)\gamma}{2\rho(\alpha\gamma+(1-\alpha)}. \tag{48}$$

This is true for any parameters in the assumed ranges.

Next consider the choice of designer D_1 in the preceding stage. Since D_2 will choose A in either case, and since the editor will announce A whenever it is played, D_1 will earn zero by choosing B (again since $\pi(1,0)=0$ by assumption) and will earn a positive payoff by choosing A. Thus both designers will choose A in equilibrium of the subgame following retailers committing to follow the editor's recommendation.

Next consider to the retailers' decision to commit to follow the editor's announcement. First consider the decision by retailer R_2. There are two cases:

i. If R_1 did not commit, then if R_2 commits, the outcome in the following subgame will be for designers to choose different designs and retailer R_1 to select design B. If R_2 does not commit, then as in the game without the editor, both designs will be played by the designers and R_2 will ultimately play the true inferior design. R_2 thus prefers to commit since

$$S_R(1,1)\tau(\alpha\gamma + (1-\alpha)) > S_R(1,1)\tau. \tag{49}$$

ii. If R_1 did commit, then if R_2 commits, the outcome is as above with both designers playing A. If R_2 does not commit, the outcome in the following subgame will be for designers to choose different designs and retailer R_1 to select A. Since Equation 5 is false, R_2 will then prefer to play B. R_2 thus prefers to commit since

$$\frac{1}{2}S_D(2,2)(\alpha\gamma + (1-\alpha)) > S_R(1,1)\tau(\alpha + (1-\alpha)\gamma). \tag{50}$$

Thus R_2 prefers to commit to follow the editor's recommendation regardless of whether R_1 commits. The decision for R_1 in the preceding stage is therefore identical to case ii., and so R_1 prefers to commit. The unique equilibrium in the game in which the editor announces A whenever it is played is for both retailers to commit to follow the recommendation, and all parties to play A throughout.

Finally note that since Equation 7 is true, then retailers prefer to mismatch than to match on the true superior product when both designs are available. Since the equilibrium in any subgame in which both retailers do not commit to follow the editor's recommendation has designers mismatch and retailers mismatch, this means that there cannot be an equilibrium in the game with an editor in which the retailers commit to follow the editor's recommendation if both designs will go on to be played in equilibrium of the subsequent subgame. Thus the editor can do no better than the plan to announce A whenever it is played. □

Proposition 4

Proof. Since the designer-retailers are restricted to retail the same design, everything following the design stage is deterministic. In stage 3, D_2 chooses a design. There are two cases.

The first case is $d_1 = A$. If $d_2 = A$, D_2 earns $\frac{1}{2}(\alpha\gamma + (1-\alpha))$, while if $d_2 = B$, D_2 earns $\alpha\tau + (1-\alpha)\tau\gamma$, which is certainly lower. Thus $d_2 = A$ is the best response by D_2 if $d_1 = A$.

The second case is $d_1 = B$. If $d_2 = A$, D_2 earns $\alpha\tau\gamma + (1-\alpha)\tau$, while if $d_2 = B$, D_2 earns $\frac{1}{2}(\alpha + (1-\alpha)\gamma)$. Thus $d_2 = A$ is the best response by D_2 iff $2\tau > \frac{\alpha+(1-\alpha)\gamma}{\alpha\gamma+(1-\alpha)}$.

In stage 2, D_1 chooses a design. If $d_1 = A$, then $d_2 = A$ and D_1 earns $\frac{1}{2}(\alpha\gamma + (1\alpha))$. If $d_1 = B$, then if $d_2 = A$ D_1 earns $\alpha\tau + (1-\alpha)\tau\gamma$, while if $d_2 = B$ D_1 earns $\frac{1}{2}(\alpha + (1-\alpha)\gamma)$. Both payoffs are less than the payoff to $d_1 = A$. Thus the unique subgame perfect Nash equilibrium outcome is for both designers to play A. □

Proposition 5

Proof. In the last stage D_2 selects $r_2 \in \{d_1, d_2\}$. If $d_1 = d_2$ this is degenerate. If $d_1 \neq d_2$ there are four cases:

i. d_1 is revealed to be the true superior and $r_1 = d_1$. In this case $r_2 = d_2$ yields a higher payoff than $r_2 = d_1$ for D_2 if

$$\tau > \frac{1}{2} S_R(1,2)\gamma\rho. \tag{51}$$

ii. d_1 is revealed to be the true inferior and $r_1 = d_1$. In this case $r_2 = d_2$ yields a higher payoff than $r_2 = d_1$ for D_2 if

$$\tau\gamma > \frac{1}{2} S_R(1,2)\rho. \tag{52}$$

iii. d_1 is revealed to be the true superior and $r_1 = d_2$. In this case $r_2 = d_2$ yields a higher payoff than $r_2 = d_1$ for D_2 if

$$\left[\frac{1}{2} S_R(1,2) + S_D(1,2)\right] \rho > \left[S_R(1,1)\gamma + S_D(1,1)\right] \tau. \tag{53}$$

iv. d_1 is revealed to be the true inferior and $r_1 = d_2$. In this case $r_2 = d_2$ yields a higher payoff than $r_2 = d_1$ for D_2 if

$$\left[\frac{1}{2} S_R(1,2) + S_D(1,2)\right] \rho\gamma > \left[S_R(1,1) + S_D(1,1)\gamma\right] \tau, \tag{54}$$

which is true always.

In the preceding stage, D_1 selects $r_1 \in \{d_1, d_2\}$. If $d_1 = d_2$ this is degenerate. If $d_1 \neq d_2$ there are two cases:

i. d_1 is the true superior.

a) Equations 51 and 53 are true. In this case $r_1 = d_1$ yields a higher payoff than $r_1 = d_2$ for D_1 if

$$\tau\gamma > \frac{1}{2} S_R(1,2)\rho, \tag{55}$$

which is true since 51 is true.

b) Equations 51 and 53 are false. In this case $r_1 = d_1$ yields a higher payoff than $r_1 = d_2$ for D_1 if

$$\left[\frac{1}{2} S_R(1,2) + S_D(1,2)\right] \rho\gamma > \left[S_R(1,1) + S_D(1,1)\gamma\right] \tau, \tag{56}$$

which is true always.

c) Equation 51 is true and 53 is false. In this case $r_1 = d_1$ yields a higher payoff than $r_1 = d_2$ for D_1 if

$$\tau\gamma > [S_R(1,1) + S_D(1,1)\gamma]\,\tau, \tag{57}$$

which is true always.

d) Equation 51 is false and 53 is true. In this case $r_1 = d_1$ yields a higher payoff than $r_1 = d_2$ for D_1 if

$$\left[\frac{1}{2}S_R(1,2) + S_D(1,2)\right]\rho\gamma > \frac{1}{2}S_R(1,2)\rho, \tag{58}$$

which is true always.

Thus when d_1 is the true superior, if Equation 51 is true, the retailers mismatch by playing their own designs; if 51 is false, the retails match on d_1.

ii. d_1 is the true inferior.

a) Equation 52 is true. In this case $r_1 = d_1$ yields a higher payoff than $r_1 = d_2$ for D_1 if

$$\tau > \frac{1}{2}S_R(1,2)\rho\gamma, \tag{59}$$

that is, if 51 is true.

b) Equation 52 is false. In this case $r_1 = d_1$ yields a higher payoff than $r_1 = d_2$ for D_1 if

$$\left[\frac{1}{2}S_R(1,2) + S_D(1,2)\right]\rho > \frac{1}{2}S_R(1,2)\rho\gamma. \tag{60}$$

Thus when d_1 is the true superior, retailers match on d_2 if Equation 51 is false and 52 is true, or if Equations 52 and 60 are false. Retailers match on d_1 if Equation 52 is false and 60 is true. Retailers mismatch by playing their own designs if Equations 51 and 52 are true.

In the preceding stage, D_2 selects $d_2 \in \{A, B\}$. There are two possible cases:

i. $d_1 = A$.

a) Equations 51 and 52 are true. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \tau(\alpha + (1-\alpha)\gamma), \tag{61}$$

which is true always.

b) Equations 51 and 52 are false and 60 is true. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \alpha\left[\frac{1}{2}S_R(1,2)\gamma\rho\right] + (1-\alpha)\left[\frac{1}{2}S_R(1,2)\rho\right] \tag{62}$$

$$S_R(1,2)\rho < 1. \tag{63}$$

c) Equations 51, 52 and 60 are false. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \alpha\left[\frac{1}{2}S_R(1,2)\gamma\rho\right] + (1-\alpha)\left[\frac{1}{2}S_R(1,2)\gamma\rho + S_D(1,2)\gamma\rho\right] \quad (64)$$

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \frac{1}{2}S_R(1,2)\gamma\rho + (1-\alpha)S_D(1,2)\gamma\rho. \quad (65)$$

d) Equation 51 is false and 52 is true. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if 65 is true.

These cases are exhaustive for $d_1 = A$.

ii. $d_1 = B$.

a) Equations 51 and 52 are true. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\tau(\alpha\gamma + (1-\alpha) > \frac{1}{2}(\alpha + (1-\alpha)\gamma). \quad (66)$$

b) Equations 51 and 52 are false and 60 is true. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\alpha\left[\frac{1}{2}S_R(1,2)\rho\right] + (1-\alpha)\left[\frac{1}{2}S_R(1,2)\rho\gamma\right] > \frac{1}{2}(\alpha + (1-\alpha)\gamma), \quad (67)$$

that is, if Equation 63 is false.

c) Equations 51, 52 and 60 are false. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\alpha\left[\frac{1}{2}S_R(1,2) + S_D(1,2)\right]\gamma\rho + (1-\alpha)\left[\frac{1}{2}S_R(1,2)\gamma\rho\right] > \frac{1}{2}(\alpha + (1-\alpha)\gamma), \quad (68)$$

which is true always.

d) Equation 51 is false and 52 is true. In this case $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_1 if

$$\alpha\left[\frac{1}{2}S_R(1,2) + S_D(1,2)\right]\gamma\rho + (1-\alpha)\left[\frac{1}{2}S_R(1,2)\gamma\rho\right] > \frac{1}{2}(\alpha + (1-\alpha)\gamma), \quad (69)$$

which is true always.

These cases are exhaustive for $d_1 = B$.

Finally, in the preceding stage D_2 selects $d_2 \in \{A, B\}$.

a) Equations 51, 52 and 66 are true. In this case D_2 will play A for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1.

b) Equations 51 and 52 are true and 66 is false. In this case D_2 will play $d_2 = d_1$ for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1.

c) Equations 51 and 52 are false and 60 and 63 are true. In this case D_2 will play $d_2 = d_1$ for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1.

d) Equations 51, 52 and 63 are false and 60 is true. In this case D_2 will play $d_2 \neq d_1$ for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1.

e) Equations 51, 52 and 60 are false and 65 is true. In this case D_2 will play $d_2 = d_1$ if $d_1 = A$ and $d_2 \neq d_1$ if $d_1 = B$, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1 since Equation 65 is true.

f) Equations 51, 52, 60 and 65 are false. In this case D_2 will play $d_2 \neq d_1$ for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1.

g) Equation 51 is false and 52 and 65 are true. In this case D_2 will play $d_2 = d_1$ if $d_1 = A$ and $d_2 \neq d_1$ if $d_1 = B$, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1 since Equation 65 is true.

h) Equations 51 and 65 are false and 52 is true. In this case D_2 will play $d_2 \neq d_1$ for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$ for D_1.

Thus in the unique subgame perfect Nash equilibrium:

1. $d_1 = A$, $d_2 = B$, and the players herd on the true superior product in the retail stage either if Equations 51, 52, 60 and 65 are false, or if Equations 51 and 65 are false and 52 is true.

2. $d_1 = A$, $d_2 = B$, and the players herd on A in the retail stage if Equations 51 and 63 are false and 60 is true.

3. $d_1 = A$, $d_2 = A$ in all other cases.

□

Proposition 6

Proof. Say that both designer-retailers have committed to follow the editor's announcement. Play in the retail stage is therefore deterministic provided that at least one designer-retailer plays the true superior product. In the second design stage, D_2 chooses $d_2 \in \{A, B\}$. There are two cases:

i. $d_1 = A$. $d_2 = B$ yields a higher payoff than $d_2 = A$ for D_2 if

$$\left[\frac{1}{2}S_R(1,2) + (1-\alpha)S_D(1,2)\right]\rho\gamma > \frac{1}{2}(\alpha\gamma + (1-\alpha)). \tag{70}$$

ii. $d_1 = B$. $d_2 = A$ yields a higher payoff than $d_2 = B$ for D_2 if

$$\left[\frac{1}{2}S_R(1,2) + \alpha S_D(1,2)\right]\rho\gamma > \frac{1}{2}(\alpha + (1-\alpha)\gamma). \tag{71}$$

In the preceding stage, D_1 chooses $d_1 \in \{A, B\}$. There are three cases:

i. Equations 70 and 71 are true. In this case D_2 will play B regardless of the choice by D_1. D_1 thus prefers to choose A since Equation 71 is true.

ii. Equations 70 and 71 are false. In this case D_2 will play $d_2 = d_1$ regardless of the choice by D_1. D_1 thus prefers to choose A.

iii. Equation 70 is false and 71 is true. In this case D_2 will play A regardless of the choice by D_1. D_1 thus prefers to choose A since Equation 70 is false.

Thus if Equation 70 is false, the unique equilibrium in the design subgame is for both to play A; if Equation 70 is true, the unique equilibrium in the design subgame is $d_1 = A$, $d_2 = B$.

In the preceding stage, D_2 chooses whether to commit to follow the editor's announcement. If D_1 has not committed, this choice by D_2 is irrelevant. If D_1 has committed, D_2 commits if she will earn a higher payoff in the subgame following commitment, which is (weakly) true in all cases: if Equation 70 is false, the equilibrium outcome is identical in the cases with and without commitment; if Equation 70 is true, the equilibrium outcome is mismatched designs in the subgame with commitment and matched designs in the subgame without commitment. Since Equation 70 is true in the latter case, D_2 earns a greater payoff by committing than not.

In the preceding stage, D_1 chooses whether to commit to follow the editor's announcement. D_1 commits if she will earn a higher payoff in the subgame following commitment, which is (weakly) true in all cases: if Equation 70 is false the reason is identical to that of D_2; if Equation 70 is true, the equilibrium outcome is mismatched designs in the subgame with commitment and matched designs in the subgame without commitment. Since Equation 70 is true in the latter case, this implies that Equation 70 is true and so D_1 earns a greater payoff by committing than not. □

Proposition 7

Proof. In final retail stage $r_2 = d_2$ by assumption. In the preceding stage R_1 chooses $r_1 \in \{d_1, d_2\}$. If $d_1 = d_2$ this is degenerate. If $d_1 \neq d_2$ there are two cases:

i. d_1 is the true superior. If R_1 chooses $r_1 = d_1$, he will be alone on the true superior design; if $r_1 = d_2$ he will match R_2 on the true inferior design. R_1 thus earns a higher payoff by playing d_1 if

$$S_R(1,1)\tau\gamma > \frac{1}{2}S_R(1,2)\rho. \tag{72}$$

ii. d_1 is the true inferior. If R_1 chooses $r_1 = d_1$, he will be alone on the true inferior design; if $r_1 = d_2$ he will match R_2 on the true superior design. R_1 thus earns a higher payoff by playing d_1 if

$$S_R(1,1)\tau > \frac{1}{2}S_R(1,2)\rho\gamma. \tag{73}$$

In the preceding stage, D_2 chooses $d_2 \in \{A, B\}$.

i. $d_1 = A$.

a) Equations 72 and 73 are both true. $d_2 = A$ yields a higher payoff than $d_2 = B$ if

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \tau(\alpha + (1-\alpha)\gamma), \tag{74}$$

which is true always.

b) Equations 72 and 73 are both false. $d_2 = A$ yields a higher payoff than $d_2 = B$ if

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \alpha\left[S_D(1,2) + \frac{1}{2}S_R(1,2)\right]\rho + (1-\alpha)\left[S_D(1,2) + \frac{1}{2}S_R(1,2)\right]\rho\gamma. \tag{75}$$

c) Equations 72 is true and 73 is false. $d_2 = A$ yields a higher payoff than $d_2 = B$ if

$$\frac{1}{2}(\alpha\gamma + (1-\alpha)) > \alpha\tau + (1-\alpha)\left[S_D(1,2) + \frac{1}{2}S_R(1,2)\right]\rho\gamma. \tag{76}$$

ii. $d_1 = B$.

a) Equations 72 and 73 are both true. $d_2 = A$ yields a higher payoff than $d_2 = B$ if

$$\tau(\alpha\gamma + (1-\alpha)) > \frac{1}{2}(\alpha + (1-\alpha)\gamma). \tag{77}$$

b) Equations 72 and 73 are both false. $d_2 = A$ yields a higher payoff than $d_2 = B$ if

$$\alpha\left[S_D(1,2) + \frac{1}{2}S_R(1,2)\right]\rho\gamma + (1-\alpha)\left[S_D(1,2) + \frac{1}{2}S_R(1,2)\right]\rho > \frac{1}{2}(\alpha + (1-\alpha)\gamma), \tag{78}$$

which is true always.

c) Equations 72 is true and 73 is false. $d_2 = A$ yields a higher payoff than $d_2 = B$ if

$$\alpha\left[S_D(1,2) + \frac{1}{2}S_R(1,2)\right]\rho\gamma + (1-\alpha)\tau > \frac{1}{2}(\alpha + (1-\alpha)\gamma). \tag{79}$$

In the preceding stage, D_1 chooses $d_2 \in \{A, B\}$.

a) Equations 72, 73 and 77 are true. In this case $d_2 = A$ for any d_1. $d_1 = A$ yields a higher payoff than $d_1 = B$ if

$$\frac{1}{2}S_D(2,2)(\alpha\gamma + (1-\alpha)) > \tau(\alpha + (1-\alpha)\gamma)S_D(1,1). \tag{80}$$

b) Equations 72 and 73 are true and Equation 77 is false. In this case, d_2 will match d_1 for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$.

c) Equations 72 and 73 are false and Equation 75 is true. In this case d_2 will play A for any d_1, and if $d_1 \neq d_2$, d_1 will not be retailed. Thus $d_1 = A$ yields a higher payoff than $d_1 = B$.

d) Equations 72, 73 and 75 are false. In this case d_2 will mismatch d_1 for any d_1 and retailers will never retail d_1. Thus both A and B yield a payoff of zero for D_1.

e) Equations 72, 76 and 79 are true and Equation 73 is false. In this case $d_2 = A$ for any d_1. $d_1 = A$ yields a higher payoff than $d_1 = B$ if

$$\frac{1}{2}S_D(2,2)(\alpha\gamma + (1-\alpha)) > \tau(1-\alpha)\gamma S_D(1,1). \tag{81}$$

e) Equations 72 and 79 are true and Equations 73 and 76 are false. In this case d_2 will mismatch d_1 for any d_1. Since d_1 will be retailed only if it is the true superior, $d_1 = A$ yields a higher payoff than $d_1 = B$.

f) Equations 72 and 76 are true and Equations 73 and 79 are false. In this case d_2 will match d_1 for any d_1, and so $d_1 = A$ yields a higher payoff than $d_1 = B$.

This completely characterizes equilibrium strategies. Thus if Equations 72 and 75 are false, the equilibrium outcome is for designers to mismatch and retailers to herd on the design chosen by D_2. In particular, it is an equilibrium outcome for d_1 to choose B, d_2 to choose A, and both retailers to choose d_2. □