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## Abstract

Continued lobbying by high-end, American designers for intellectual property-type fashion design protection has culminated in the proposed Innovative Design Protection and Piracy Prevention Act, intended to introduce EU standards. Using a sequential, 2-firm, vertical differentiation framework, we analyze the effects of protection on investment in innovative designs by high-quality ('designer') and lower-quality ('mass-market') firms when the mass-marketer may opt to imitate, consumers prefer trendsetting designs and firms compete in prices. We show that design protection, by transforming mass-marketers from imitators to innovators, may reduce both designer profits and welfare. The model provides possible explanations for the dearth of EU case law and the increase in designer/mass-marketer collaborations.

JEL-Code: D210, L130, O310, O340.

Keywords: intellectual property rights, fashion design protection, imitation, licensing.

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To refrain from imitation is the best revenge.
- *Marcus Aurelius*

# 1 Introduction

It is often argued that a strong intellectual property ('IP') framework is a prerequisite for attracting ongoing investment in large industries, as firms will only invest over time where they can be relatively certain of appropriating the returns to such investment. Indeed, this is the argument most often deployed in defense of the high levels of patenting and litigation in industries such as biotechnology and software. But this line of reasoning fails to explain the fact that some industries which attract considerable investment do not rely on IP protection to any significant degree. These 'low-IP' industries are perhaps best represented by the US fashion industry, where fashion designs themselves are only very lightly protected and copying is rampant yet economic activity continues apace.

However the 'patent-as-prerequisite' argument is increasingly advanced by the trade association of high end designers, the Council of Fashion Designers of America (CFDA), which has successfully lobbied for legislative attention, claiming that returns to investment are eroded by copying. The latest of the repeated attempts at a legislative solution is embodied in the proposed Innovative Design Protection and Piracy Prevention Act ('IDPPPA'), introduced by Senator Charles E. Schumer of New York in August 2010[1] which is intended to bring the IP for the US industry in line with the system currently existing in the EU. The Bill had not been put to vote by Committees by the end of the last Congressional session in December 2010, but is being re-considered in the current Congressional session.[2]

In this paper, we use a simple 2-firm, vertical differentiation framework to analyze the interaction of design imitation, consumer taste for trendsetting apparel and the potential effects of design protection. In the absence of design protection, a low-quality mass-market firm will imitate or *knockoff* the designer if the cost savings associated with imitation are sufficiently high and the knockoff is perceived sufficiently well.[3] Imitation has both positive and negative effects: on the one hand, if mass-marketers imitate they do not design novel collections; this leaves the designer as the single novel firm - the trendsetter. On the other hand, imitation allows the mass-marketer to cut into designer profits. The main result of the paper is that a design protection system may underperform the status quo, leaving both high-end and mass-market firms worse off and welfare lower relative to a no protection benchmark.

[1] Previous versions of similar legislation, collectively termed the Design Piracy Bills, were found in (i) House Bill 5055 of the 109th Congress (failed to advance in December 2006), (ii) House Bill 2033 and its Senate counterpart Bill, Senate Bill 195712, introduced in the 110th Congress in April and August 2007, respectively and (ii) House Bill 2196 and its Senate counterpart Bill, Senate Bill 3728, introduced in the 111th Congress in April and August 2010, respectively.

[2] A Preliminary hearing on the proposed Act took place on July 15, 2011 before the US House Subcommittee on Intellectual Property, Competition and the Internet.

[3] We interpret knockoff copying in line with Barnett et al. (2008): " 'mass-market' firms supply close imitations of successful originals to the broad middle of the market demand curve under different brand names and at various quality grades".

The intuition is that if imitation is suppressed, the mass-market firm faces a stark choice: fall behind in trend as well as quality and cede more of the market or spend more to hire in designers and produce novel collections. Under appropriate conditions, this landscape turns would be imitators into design innovators, stronger competitors to the high-quality, high-cost designers. The introduction of design protection may therefore have counter-intuitive effects. The model suggests that if the only effect of the design right is to allow for protection from knockoffs, designer firms may do better not to utilize the protection system at all, effectively sanctioning imitation. However, if the design right enhances the popularity of either the brand or the current collection sufficiently, both firms pursue this valuable asset and find themselves locked in a design arms race: each attempts to introduce trendsetting designs, with the result that the competing designs effectively cancel each other out in the market. We show that for certain model parameters licensing may provide a means to end the arms race, though even this outcome may not compare favorably with a no protection benchmark.

The model provides an alternative explanation for observed trends in the fashion industry, namely the lack of case law observed in Europe despite strong protection and the increase in designer/mass-marketer co-branded collections (so-called 'diffusion lines'). The model also suggests that protection may not be advisable for the US, as such protection may have negative implications for industry profit and welfare relative to the no protection case.

The rest of the paper is structured as follows: in Section 2, we briefly overview the legal framework for design protection in the EU and the proposed US measures. In Section 3, we provide a short discussion of the most related work in the economic and legal literature. In Section 4, we introduce the model setup. In Section 5, we solve the specification with exogenous qualities (reserving the discussion of endogenous quality for Appendix B). Section 6 concludes.

## 2 Legal Protection of Fashion Designs

The proposed IDPPPA was crafted after careful consideration of the recently amended European framework for design protection. We thus begin with brief overview of the current protection system in Europe.

### 2.1 Design Protection in Europe

The European Community Design Protection Regulation ('DPR') went into effect in all member states in March 2002. The DPR establishes 2 mechanisms for protection: (i) the unregistered community design (UCD), which applies from first disclosure of the design in the Community, including showing at trade fairs or in advertisements, and is valid for 3 years; and (ii) the registered community design (RCD), which requires filing of documents with the Office for Harmonization in the Internal Market (OHIM) and is valid for 5 years. The RCD is renewable up to an additional 4 times, meaning protection is available for a maximum of 25 years.

There is no limit to the number of designs per application and there is a 1-year grace period

in establishing novelty of the design, so that a designer can 'test the market' for up to a year (with rights under a UCD) before seeking the stronger protection of the RCD. These instruments have simultaneous effect across the 27 EU member countries. There are 3 requirements for design protection, namely (i) novelty (no identical design must have previously been disseminated); (ii) individual character (the item's impression on the buying public must be distinct from that made by any previous design); and (iii) inoffensiveness (the design should not constitute an offence against public morality).

Somewhat surprisingly, in spite the seemingly strong rights granted there has not been much case law relating to designs since the establishment of this framework. Legal scholars have offered various explanations for the lack of judicial decisions relating to the framework, including inter alia, that (a) standards of eligibility are somewhat low (novelty requires only that no *identical* design has been available) so that any attempt at meaningful protection standards may change this outcome; (b) infringement suits are initiated but parties regularly reach confidential settlements before trial, with settlements reported only in the most egregious cases (such as when luxury brand Chloé received around GBP12,000 from Topshop, which was ruled to have plagiarized its dungaree dress[4]); and (c) in general, agents in the EU are somewhat less litigious than in the US, so that cases are less frequent than might be expected under a similar set of rules in the US.

This lack of case law is, however, consistent with the results of our model: if the only effect of protection is to prevent knockoffs, then designers may do better not to utilize the system at all. In such cases, the design rights framework may remain under-utilized, with fashion leaders choosing to let imitation continue, in spite of the fact that such imitation erodes any novelty lead. Conversely, if protection carries sufficient additional benefits for firms, then designers will do best not to litigate but to agree licenses with would-be infringers. In either case, filings would be minimal.

### 2.2 Current and Proposed Protection in the US

As the current time, fashion design is largely outside of the realm of US IP law, falling into what is often termed IP's 'negative space', as the current IP categories allow for only a small portion of design elements to be protected[5]: Design Patents only protect "new, original and ornamental design for an article or manufacture"[6], where novelty and non-obviousness criteria are hard to satisfy for clothing and the approval process is lengthy; Copyright covers only "original works of authorship" and does not extend to items which have an "intrinsic utilitarian function"[7]; and Trademark and Trade Dress preserve only distinguishing words and symbols/devices used by an individual or a firm to identify its product but provides no protection to elements of the design itself.

The proposed IDPPPA is intended to fill this gap, suppressing 'knockoff' copying. This protection may be also be deployed between designers, blocking so called 'homage' or inspiration collec-

[4]Emil Dugan, Topshop Ordered to Destroy Dresses 'Copied from Chloé Design', THE INDEPENDENT, July 27, 2007.

[5]Spevacek (2009) provides a more detailed discussion of the challenges for design protection in current IP categories.

[6]35 U.S.C. §171 (2006)

[7]Id. §101

tions. Indeed, while imitation of high-end collections by mass market firms undoubtedly attracts more attention, designer produced homages - better quality knockoffs of past designs by fellow high-end houses - are not insignificant, with notable examples including the strong takeoffs by Helmut Lang and Alexander Wang of designs created by Rick Owens.[8] The difference, though, is that such designer-imitating-designer cases rarely reach the courts.[9]

**A Summary of the Proposed Innovative Design Protection and Piracy Prevention Act (IDPPPA)** The proposed Act would extend to fashion designs the existing protection for vessel hull designs. A fashion design is defined as "the appearance as a whole of an article of apparel, including its ornamentation"[10], with apparel defined as:

"(A) an article of men's, women's, or children's clothing, including undergarments, outerwear, gloves, footwear, and headgear;

(B) handbags, purses, wallets, duffel bags, suitcases, tote bags and belts; and

(C) eyeglass frames."[11]

Rights would be analogous to those provided under the European UCD, in that they would be valid for up to 3 years with no registration required. Instead, a designer can claim protection of an eligible design simply by marking the apparel as protected (tagging the item with the words 'protected design' or a to-be-approved symbol).[12] However, knowingly marking an ineligible design as protected would also carry penalties.

In theory, eligibility requires "a unique, distinguishable, non-trivial and non-utilitarian variation over prior designs"[13] and designs would be protected only from knockoffs which are "so similar in appearance as to be likely mistaken for the protected design"[14], though there is a real question as to how Courts will go about interpreting the unique and non-trivial criteria. Further, as currently laid out, the Act requires plaintiffs to show that the design meets all the criteria for protection and that the design was available for sufficient time and in sufficient locations that the alleged infringer could not reasonably claim to be unaware of its existence.

## 3 Related Literature

The status concerns and psychological motivations surrounding consumption of fashion goods have long been studied in economics, from the seminal works Veblen (1899) and Leibenstein (1950).

[8] Ruth La Ferla, Imitate that Zipper!, The New York Times, September 02, 2009.

[9] A notable exception is the 1994 suit by Yves Saint Laurent against Ralph Lauren for copying a black tuxedo dress first created by Mr. Saint Laurent in 1966, reported in Amy M. Spindler, A Ruling by French Court Finds Copyright in a Design, The New York Times, May 19, 1994.

[10] Text of HR 2196, 111th Congress (2010)

[11] Id.

[12] If designs are not marked, it would be significantly more difficult for a designer to seek relief, as written notice of the design protection would have to be provided the relevant parties before action could be taken.

[13] Text of S 3728, 111th Congress (2010)

[14] Id.

However the literature has focused on explaining fashion cycles and on the welfare and public policy impact of the associated consumption externalities, with less attention to the question of imitation.

Coelho and McClure (1993) incorporate status effects into the standard monopoly model and show that if consumers consider future as well as current period output by the firm, pricing behavior may be cyclical even with downward sloping demand. Pesendorfer (1995) models demand for fashion goods as driven by the desire to signal status in a matching game. Fashion cycles are driven by the fact that the composition of 'in' and 'out' groups change over time, so that the monopoly designer has the incentive to periodically make new signals. Frijters (1998) takes a similar approach in that fashion goods are used to signal status though here the status associated with the good is the average social standing of those also consuming the good. Again firms have the incentive to periodically create new designs as old ones lose signalling value. Bagwell and Bernheim (1996) and Corneo and Jeanne (1997) also focus on the use of fashion goods as signals of status.

While imitation of fashion designs has to date been less well investigated, three recent works address that question. Caulkins et al. (2007) uses an optimal control model to analyze choices by a fashion leader firm facing multiple imitators in a one-dimensional product space and shows that, depending on the level of design cost, it may be optimal for the leader to never innovate, to innovate once or to constantly innovate, cycling so as to stay ahead of imitators. Jorgensen and Di Liddo (2007) uses a 2 period discrete time model to analyze optimal timing of entry by designers into mid-range markets in response to imitation, modelling the high-end and mid-class segments as separate markets, in which demand depends on brand power. Bekir et al. (2010) looks at the closely related issue of when luxury designers act to drive counterfeiters out of production, concluding that luxury providers will not act to completely remove counterfeiters as these firms may increase profits to luxury designers if designers are able to appropriate revenues from the infringing counterfeiting and the presence of counterfeiters induces snob effects.

However, without exception these models assume that fashion is driven by designer products and that imitators have little to no ability to transform themselves into branded competitors who then influence design. Inclusion of both the expanded strategic choice for mass-marketers and the design protection question distinguish the current work. We believe the ability of mass-marketers to influence trends is realistic, as the rising influence of street-wear and urban fashion on pop culture has fuelled growth of lower quality, high-volume brand families, certain of which now rival high-end operators in both asset base and supply chain dominance.[15] This is having a knock-on effect on the products of high-end designers themselves, which would suggest that rather than solely making trends designers may also be refining and reflecting them.

This paper is also related to the literature on product differentiation with consumption externalities. Recent papers focus on horizontally related industries with network effects (Ghazzai and Lahmandi-Ayed (2009), Baake and Boom (2001)) and snob effects (Grilo et al. (2001)). Consump-

[15] One clear example is Swedish retailer H&M Hennes & Mauritz AB; in fiscal 2010, the H&M group earned operating profit of SEK 24.7BN, equivalent to approx USD 3.5BN; this compares well to the operating performance of the entire Fashion and Leather Goods division of LVMH, a stable of 10 luxury brands including Louis Vuitton, Fendi and Marc Jacobs, which earned EUR 2.6BN, equivalent to USD3.4BN.

tions externalities in vertical differentiation has been taken up in Lambertini and Orsini (2002) and Lambertini and Orsini (2005) which analyze welfare and regulation in monopoly and duopoly cases, respectively. However they analyze the effects of the status effect on firm qualities and profits and examined welfare and taxation implications of the existence of such effects, while this paper attempts to analyze the interaction of taste for novelty, imitation and IP policy.

The ongoing legislative attempts at design protection have also inspired a large legal literature on fashion goods and IP policy, with several recent papers focusing squarely on the potential effects of the proposed legislation (Hedrick (2007), Preet (2008), Spevacek (2009), Beltrametti (2010)) though the opposing viewpoints are perhaps best summarized by, on the one hand, the arguments in Hemphill and Suk (2009b), (2009a) that rampant copying is impeding innovation in fashion and that greater IP protection should be applied, and on the other, by the arguments in Raustiala and Sprigman (2006), (2009) that IP protection will harm fashion firms, as imitation boosts profits by establishing anchors (the set of current designs representing what is 'in fashion') and helping to speed up the fashion cycle by diffusing trends.

# 4 Model Setup

We explore a sequential game in which two vertically differentiated, single product apparel firms compete in prices in the market. The vertical differentiation model seems most appropriate for the analysis of fashion firms, as the industry lends itself to broad ordering of preferences on both objective (quality of fabric and ornamentation) and subjective (branding) grounds, with such preferences reinforced by heavy advertising and magazine editorial coverage. The high quality firm (the 'designer' firm, denoted D) faces a lower quality firm (the 'mass marketer', denoted M) which can choose to imitate the designs produced by the high-end firm (to *knockoff*), to produce its own mainstream design (we also term this an 'ordinary' design) or to produce its own novel design (to *differentiate*) each season.

We do not focus on explaining the length or persistence of fashion trends in this effort, simply assuming instead that each firm introduces a new product, which may or may not consist of novel designs, each season.[16] This seems a realistic description, as individual designers do largely conform themselves to the relatively rigid industry calendar in respect of introduction of designs (runway shows) and delivery of new collections into stores, and as not every season is characterized by novelty in fashion designs (with some seasons' designs heavily inspired by the past).

Design protection allows right-holders the legal means to preclude sale of, or to appropriate revenues earned from, any design approximating the protected one. Such rights would reach not simply knockoffs but also potentially any future 'homage' designs and would apply to all classes of rivals. Protection is costless, and is assumed valid for 2 periods, outliving the presence of the design on the market.[17] Any protection decision is observable. Only novel designs may receive protection,

[16]The single product may also be referred to by the fashion industry term *collection*. We will use the term collection and design interchangeably.

[17]This would be the reality if anything like the 3 year term proposed in the IDPPPA is realized.

implying that novelty is observable to the Courts. This rules out any attempt by a mass-marketer firm to seek protection for a knockoff.

Design rights may also provide additional benefits to the firm over and above the protection of the current season design. Indeed, ownership of such assets can positively influence consumer perception of the brand, certifying the design as innovative and/or marking the firm as a true seasonal trendsetter, and thereby increase the *effective* product differentiation. Thus, a firm, independent of quality, may gain from protecting a novel design.

### 4.1 Firms

We consider a duopoly case with single-product designer offering a quality $s_d$ and the mass-marketer offering quality $s_m$, with $s_d > s_m > 0$. Each firm seeks to maximize profits, $\pi_i = (p_i - c_i)q_i - F_i$, where $p_i$ refers to the price, $q_i$ to the output and $c_i$ to the marginal cost of firm $i$.

Marginal cost of production is increasing in quality, taking the form $c_i = \frac{s_i^2}{2}$ to reflect the more luxurious fabric, ornamentation and/or more labour intensive production costs associated with high end apparel.

Firms also face fixed costs of apparel production each season, representing the overheads associated with each collection (inter alia, design and/or sketching time and sample production). Fixed costs are denoted by $F_i$. Mainstream or ordinary designs, defined as those which rely on past influences and do not themselves constitute an artistic advance in fashion, have no novelty and have $F_i^o = 0$. Novel designs are associated with higher costs, $F_i^n > 0$, as producing a novel collection requires that designers conduct more research to ensure the relevant design elements do indeed comprise a non-trivial design advance. Thus, in selecting a design strategy the firm also selects a fixed cost level.

As the mass-market firm moves second, it faces a novelty cost disadvantage - in producing a novel design it must ensure that it invents around all existing designs, including any new designs presented by the designer firm in the same period. As such, $F_m^n > F_d^n$.

We are interested in potential effects of design protection on firms' design innovation and as such restrict attention to cases where firms can feasibly opt in or out of producing a novel collection. We therefore consider fixed costs of producing novel collections which are strictly positive but low enough that the profit earned by the low quality firm is non-negative even if the firm does not maintain a novelty lead.[18]

**Assumption 1** *Fixed costs are strictly positive but sufficiently low that a mass-market firm may feasibly produce a novel collection even in the absence of a novelty lead:* $F_d^n < F_m^n \in (0, \pi_m^{nl})$

where $\pi_m^{nl}$ refers to M's profit if neither or both firms produce novel, protected collections (and therefore no novelty or protection lead applies).

[18] An alternative interpretation would be that we confine attention to large firms, for which the cost of hiring a design team is a small percentage of earnings.

### 4.1.1 Imitation by Mass-market Firms

Producing a knockoff allows M to mimic the *look* (but not the branding) of D's collection. If M chooses to knockoff, it is able to avoid some of the season-specific fixed costs associated with producing an original collection (for example, it can save by hiring a smaller or lower-quality design team, or by reducing design time as it simply reverse-engineers D's patterns). This is reflected in $F_m^{im} = \kappa F_m^n$. In what follows, we set $\kappa = 0$, so that producing a knockoff collection incurs the same (zero) fixed cost as producing a mainstream collection.

## 4.2 Consumers

Consumers are heterogeneous in the marginal willingness to pay for quality, $\theta$, distributed uniformly on $[\underline{\theta}, \bar{\theta}]$ where $\underline{\theta} = (\bar{\theta} - 1)$ and $\bar{\theta} > 1$. The mass of consumers is normalized to 1.

By assumption, each consumer has a unit demand for fashion goods each period and buys from either of the firms. Formally,

**Assumption 2** *Throughout, $\bar{\theta}$ is restricted such that there is full market coverage.*

This assumption simplifies the exposition.

A trend is set if there is a single novel design in the current selling period (season). Consumers have a preference for trendsetting (or novelty-leading) apparel, reflected in the increased utility associated with such a product. The rationale for this is not fully explored here, though such a phenomenon is consistent with a Pesendorfer (1995) interpretation that owning a trendsetting design in the relevant period allows a customer to signal higher status (in this case, to signal herself a 'fashionista').

We stress again that the trendsetting status of a design in a season is judged *relative to* the rival firm: a collection is perceived as novelty-leading if and only if the rival has not also produced a novel collection. If neither firm produces a novel design, the firms compete only on quality, as in the standard vertical differentiation framework. Similarly, if *both* firms produce a novel design, then indeed the entire consumer population has access to new designs and there is no design novelty leader conferring status.[19] In this case, the effective distance between the firms' products is again reduced to the quality differential.

Consumers buying from firm $i$ if $i$ has produced a novel design while $j$ has not enjoy a net surplus of $U_i = \theta s_i + n_n + \lambda n_{ipr} - p_i$, where $s_i$ denotes the quality of firm $i$, alternatively construed as its brand or location in product space; $n_n \in \{0, 1\}$ denotes an indicator function representing an effective design novelty lead (or trend lead) over a trailing rival, with $n_n = 0$ if neither (both) firm(s) is (are) novel; and $n_{ipr} \in \{0, 1\}$ denotes an indicator function representing an effective protection lead over a trailing rival, with $n_{ipr} = 0$ if neither firm protects or both firms protect a novel design. Thus, if firm $i$ has produced a novel design and firm $j$ has not, consumers buying from firm $i$ enjoy

[19] Analogous reasoning would extend to a single-product monopoly firm (though not considered here): investing in novelty would mean all consumers have access to the novel design and could not signal status.

a net surplus equal to $U_i$ and consumers buying from firm $j$ enjoy a net surplus equal to $U_j$ where:

$$U_i = \begin{cases} \theta s_i + 1 + \lambda - p_i & \text{if firm i has protected the novel design,} \\ \theta s_i + 1 - p_i & \text{if firm i has not protected the novel design,} \end{cases}$$

$$U_j = \begin{cases} \theta s_j + (1-\gamma) - p_j & \text{if firm j knocks off i's novel design,} \\ \theta s_j - p_j & \text{if firm j produces a mainstream design,} \end{cases}$$

The effects of design novelty and protection are additive in the utility function, reflecting the underlying assumption that consumers enjoy possessing the latest, on-trend design whether this latest item is marketed by a designer or not: whether the brand that produces the single trendy item for the season is a designer such as Gucci or a mass-marketer such as Topshop, consumers' willingness to pay for the novel item rises by 1. Knockoffs provide increased utility to mass-market customers as they allow such consumers to participate in the status-conferring trend by displaying a lesser version of the novel item.

We now turn to the interpretation of the two key model parameters, $\lambda$ and $\gamma$. The parameter $\lambda \geq 0$ reflects the consumer perception of the design protection attached to a novel design. If $\lambda = 0$, consumers value only novelty, and protection does not itself associate with any additional benefit. If $\lambda > 0$, however, consumers interpret protection favorably and derive increased utility from possession of the apparel. This is the case if such rights certify the design as truly original or burnish the design credentials of the fashion firm. We therefore interpret $\lambda > 0$ to mean that protection enhances the popularity of the current season design, the perceived brand/position of the innovating firm, or both.

The parameter $\gamma \in (0, 1)$ reflects the perceived distance between the original design and a knockoff and may be interpreted as the novelty lead of an original design in the presence of imitation. If $\gamma$ is close to zero, the knockoff is viewed as almost identical to the high quality good in appearance (though there is still an obvious quality difference - as a result of differences in fabric or ornamentation - reflected in $s_i$) and any novelty advantage held by the designer is almost fully eroded. Conversely, if $\gamma$ is close to 1, the knockoff is so poor a reproduction of the original design that it is not perceived to be associated with the trend at all and the designer enjoys almost the full extent of the novelty gap.

### 4.3 Welfare

If both firms enjoy positive demand and the marginal consumer (the consumer indifferent between buying the high-end and the mass-market good) has a marginal utility of quality given by $\theta^*$, consumer surplus ('CS') and welfare ('W'), respectively, are equal to:

$$CS = \int_{\underline{\theta}}^{\theta^*} U_m d\theta + \int_{\theta^*}^{\bar{\theta}} U_d d\theta \tag{1}$$

$$W = CS + \pi_d + \pi_m \tag{2}$$

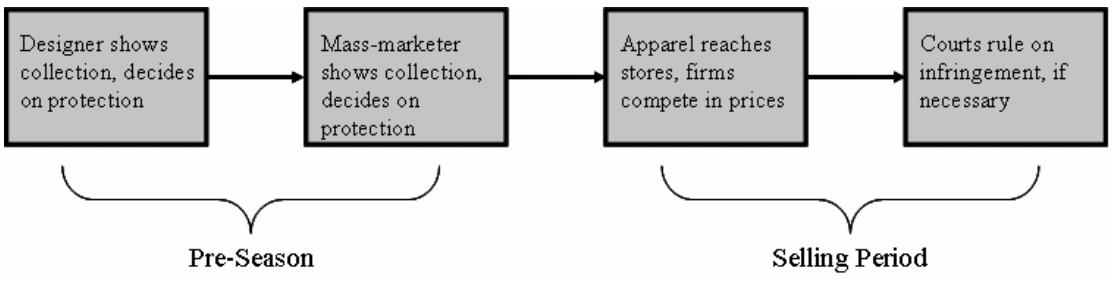


Figure 1: Sequence of the game

### 4.4 Timing

The game proceeds in four steps. Period 0, the pre-season, and period 1, the selling period or *season*, are each divided into 2 sub-periods:

- Period 0.1: the designer chooses quality, decides if to produce a mainstream design or novel design and, if it elects novelty, whether or not to protect the design. At the end of this subperiod, the designer presents its collection (the range of apparel items based on its design) to the public: the real-world analogy is that D puts on a runway show.
- Period 0.2: the mass market firm chooses quality and decides whether to knockoff the designer firm, market its own mainstream design or its own novel design and, if it chooses to be novel, whether or not to protect the design.
- Period 1.1: the firms deliver designs to the market and compete in prices.
- Period 1.2: any cases of infringement are litigated in Court.

This timing captures the reality that while high-end designers show collections months in advance of the relevant season, typically mass market firms do not. These firms instead produce their collections later, and therefore have the opportunity to knockoff designer efforts. As such, knockoffs may reach the market at the same time as originals. The order of moves in the game is illustrated in Figure 1.

We assume that the availability of design protection is announced to the firms at the start of the game and that design protection is perfect. If M imitates, it is required to transfer to the designer all revenue earned from sale of the knockoffs as damages.

The structure of the game is common knowledge and there is complete information.

## 5 The Model with Exogenous Quality

Let us proceed with the additional assumption that firm quality is exogenously given. This setup of interest for two reasons: firstly, we believe this framework best encapsulates the challenge for existing fashion firms when considering whether to protect designs for a particular selling season. The fashion industry is characterized by heavy investment in establishing and re-enforcing firms'

market positions, with the aim of fixing the firm's brand in the minds of consumers. As such, product quality may be viewed as effectively fixed on a *season to season* basis for existing firms.

Secondly, the market sees high-end designers facing competition and threats of imitation from competitors right across the quality spectrum: from the value segment of the market (low end, high volume operators such as Forever 21 and Primark as well as the higher quality fast fashion firms such as Zara and H&M), from the mid-priced segment (including aspirational brands, such as Banana Republic, Ann Taylor and Whistles) and even from the premium segment (other designers, both small, independent design houses as well as respected rival high-end brands) and it is of interest to explore the effects of protection for various levels of mass-market quality. We therefore normalize firm qualities $s_d$ and $s_m$ to 1 and $\beta$, respectively, with $0 < \beta < 1$.[20]

### 5.1 The no protection benchmark

First consider the case if no protection for fashion design applies. At stage 0.2, M must decide if to produce a mainstream collection, knockoff or produce a novel collection. A novelty lead makes a firm's product more attractive to consumers and fixed costs of novelty are assumed to be sufficiently low that novelty is always feasible, so that if M can take such a lead (that is, if D has produced a mainstream collection), it has an incentive to spend more and create a novel collection.

If taking a lead is not possible (if D has produced a novel design), then M must decide between maintaining and closing the novelty gap. If it produces a mainstream collection and trails in design, its product is less attractive to consumers than D's trendsetting offering (trailing is equivalent to increasing $\gamma$ to 1). The result is that M must lower its price and has lower market share. However, at the same level of fixed cost - zero - M could partially close D's novelty gap by producing a knockoff collection. This allows the firm to adopt some elements of the novel design, free-riding on D's design investment. Producing a mainstream collection is therefore always dominated by imitation for the mass marketer.

Optimal prices and payoffs if M imitates are given by:

$$p_d^{im} = \frac{1}{6}\left(2 + \beta^2 + 2\gamma + 2(1-\beta)(1+\bar{\theta})\right) \tag{3}$$

$$p_m^{im} = \frac{1}{6}\left(1 + 2\beta^2 - 2\gamma - 2(1-\beta)(-2+\bar{\theta})\right) \tag{4}$$

$$\pi_d^{im} = \frac{((1-\beta)(1+\beta-2(1+\bar{\theta}))-2\gamma)^2}{36(1-\beta)} - F_d^n \tag{5}$$

$$\pi_m^{im} = \frac{((1-\beta)(1+\beta+2(2-\bar{\theta}))-2\gamma)^2}{36(1-\beta)} \tag{6}$$

The importance of trendsetting status in the market to designers is clear: if M either trails or imitates, D maintains a lead in novelty, which allows the designer firm to set higher prices and earn higher profits than it would absent a novelty lead. Designer prices and profits are increasing in the

[20]Note that this assumption is not crucial for the results, as findings for the specification with endogenous qualities are qualitatively similar. We present the model with endogenous qualities in Appendix B.

size of the lead, alternatively interpreted as the perceived imperfection of the knockoff (recall that the larger is $\gamma$, the less well-received is the knockoff).

If instead M chooses to produce its own novel collection, the firm can fully extinguish D's novelty lead and eliminate the designer's trendsetting edge (equivalent to reducing $\gamma$ to 0), though to do so it must incur positive fixed costs. Optimal prices and payoffs if M is novel are given by:

$$p_d^{nov} = \frac{1}{6}\left(2 + \beta^2 + 2(1-\beta)(1+\bar{\theta})\right) \tag{7}$$

$$p_m^{nov} = \frac{1}{6}\left(1 + 2\beta^2 - 2(1-\beta)(-2+\bar{\theta})\right) \tag{8}$$

$$\pi_d^{nov} = \frac{((1-\beta)(1+\beta-2(1+\bar{\theta})))^2}{36(1-\beta)} - F_d^n \tag{9}$$

$$\pi_m^{nov} = \frac{((1-\beta)(1+\beta+2(2-\bar{\theta})))^2}{36(1-\beta)} - F_m^n. \tag{10}$$

With no novelty gap, average prices are unchanged though designer prices and payoffs are lower (the firm can no longer attract the trendsetting premium) and mass-market prices and payoffs are higher. At stage 0.2, then, M will compare the payoffs under imitation and under novelty and will imitate only if the increased profit associated with producing a novel collection exceeds the increased fixed cost spend required, or if:

$$\frac{\gamma(-5+\beta(4+\beta)+\gamma+2\bar{\theta}(1-\beta))}{9(1-\beta)} \geq F_m^n. \tag{11}$$

The mass-marketer will knockoff the designer's collection otherwise. The better is the consumer perception of the knockoff (the lower is $\gamma$), the more attractive is imitation as a strategy for any mass-marketer. However, this threshold profit requirement is non-monotonic in mass market quality. Indeed, for moderate levels of $\gamma$, lower quality M-firms may prefer to knockoff a novel designer while higher quality M-firms may elect to produce novel collections.

We can more formally establish the critical quality levels for the mass marketer's decisions. If we define the following:

$$\beta_1 = -\frac{-9F_m^n + \sqrt{81F_m^n - 4\gamma^2(\gamma-(-3+\bar{\theta})^2) + 36F_m^n\gamma(-3+\bar{\theta})} - 2\gamma(-2+\bar{\theta})}{2\gamma} \tag{12}$$

$$\beta_2 = \frac{9F_m^n + \sqrt{81F_m^n - 4\gamma^2(\gamma-(-3+\bar{\theta})^2) + 36F_m^n\gamma(-3+\bar{\theta})} + 2\gamma(-2+\bar{\theta})}{2\gamma} \tag{13}$$

$$\beta_3 = -2 + \bar{\theta} + \sqrt{-2\gamma + (-3+\bar{\theta})^2} \tag{14}$$

for moderate levels of $\gamma$, $\beta_1 \leq \beta_2 < \beta_3$ and we have the following Lemma:

**Lemma 1** *If it faces a designer with a novel collection, the mass marketer will imitate iff* $\beta \in (0, \beta_1]$ *or* $\beta \in (\beta_2, \beta_3]$ *and will produce a novel collection otherwise.*

**Proof**: See the Appendix

Such a specification is illustrated in Figures 2 and 3, which are drawn assuming $\bar{\theta} = 1.4$, $\gamma = 0.21$

and $F_m^n = 0.05$.

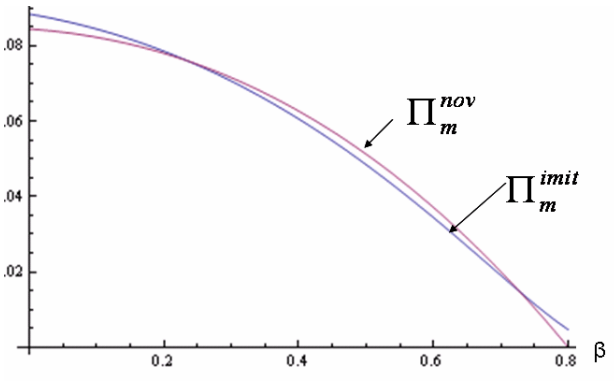


Figure 2: M profit with novel D

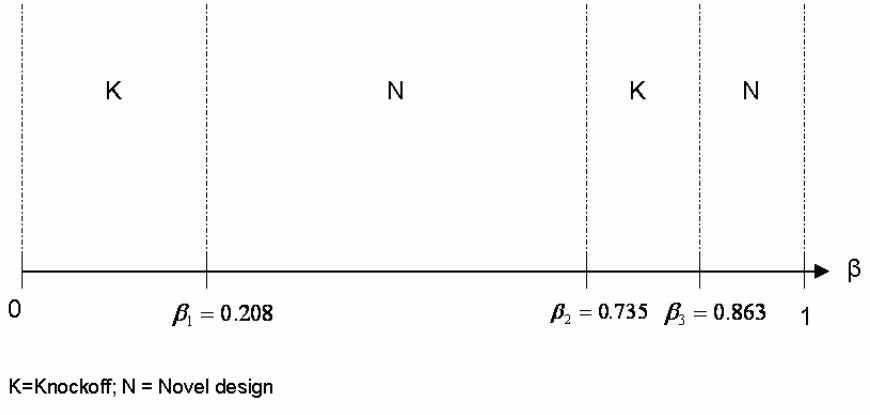


Figure 3: M Choices with novel D

The intuition is that for a given quality differential, closing the designer's novelty lead allows M to expand market share slightly while charging a higher price on all units. A low quality M serves only a small share of the market, and even with novelty does not extend this very much; also producing a novel collection would see prices rise only slightly from a low level: the returns to novelty do not compensate for the increased spend. For mid-quality firms, the ability to expand share and to charge a higher price over more units is more valuable, and thus novelty is preferable. In the range of moderate-to-high quality, the quality differential is more narrow; even knocking off the designer, M has significant market share. As such, the returns to novelty would not compensate for additional fixed cost spending. For the highest quality competitors, however, the quality differential is narrow enough that the firms are approaching horizontal competition; any novelty lead by D is sufficient to allow D to capture the whole market. The mass-marketer will never imitate.

Thus while the implications of the model are in line with observed outcomes in the market, that with designers producing novel collections, very low quality mass-marketers brands may prefer to imitate while aspirational brands and close high-end designers produce their own novel collections, the mechanism here is somewhat different.

Note that for low values of $\gamma$, $\beta_2$ and $\beta_1$ converge and decline toward zero and $\beta_3 \to 1$: the better is consumer perception of a knockoff, the more likely it is that *any* mass-market firm prefers to imitate the designer.

At stage 0.1, the designer firm, aware that M will find it preferable to invest in novelty if it does not, chooses to invest in novelty.

Summarizing the foregoing and defining:

$$\hat{\theta} = \frac{5 + 2(2-\beta)\beta - 2\gamma}{2(1-\beta)} \tag{15}$$

$$\hat{\gamma} = \frac{1}{2}\left(2 + \beta - 2\beta^2 + 2\beta^3\right) \tag{16}$$

we have:

**Lemma 2** *Provided there is full market coverage and both firms operate, (i.e., if $\bar{\theta} < \hat{\theta}$ and $\gamma < \hat{\gamma}$), the designer firm always produces a novel collection. In the absence of design protection, the mass marketer imitates iff $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$ and produces its own novel collection otherwise.*

**Proof**: See the Appendix

If D leads in novelty, it can increase prices and profits over an imitating M: the novel designer good is more coveted, and the knockoff is relatively less attractive to consumers. Consistent with arguments set forth in Hemphill and Suk (2009b), imitation by M hurts the designer firm, as knockoffs erode the designer's novelty lead.

### 5.2 The effect of Design Protection when $\lambda = 0$

Let us now consider the case with design protection is available. If $\lambda = 0$, consumers value only novelty and design protection carries no additional benefits. The assumption of perfect patent protection means that if design protection is utilized, imitation is no longer a profitable strategy for the mass market firm: perfect protection means that D will win any court action and M will be forced to transfer all profit to the designer as damages; the payoff associated with knockoffs is reduced to zero.

At stage 0.2, if M faces a mainstream collection by D, it does better to present a novel design and open a design lead. If it cannot take a lead, however, (i.e., if D has produced a protected, novel collection) M must now decide only between producing a mainstream collection or producing a novel collection. If it chooses the former, it trails in novelty (equivalent to setting $\gamma = 1$); M will lose market share to the designer and face downward pressure on price, as its product would be less attractive to consumers than D's novel design. If M chooses the latter, it can close the design gap (equivalent to setting $\gamma = 0$), and enjoy both higher market share and price relative to the former case, though it must cover the fixed cost. Given the assumption that novelty is always feasible, M will do better to invest in novelty. The mass-market firm will react to a protected design by itself choosing novelty, though it is indifferent between protecting and not protecting its design.

The key question for the designer is therefore: given such reactions by M, is it optimal to utilize the design protection system? If D does protect, we have seen that M will also invest in novelty. Prices and profits will be given by (7) through (10). If, however, the designer chooses not to protect, there is no impediment to imitation and we are in a situation equivalent to the no-protection benchmark case. As we have seen, M does better to imitate if $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$ and equilibrium prices and profits will be given by (3) through (6). For such values of $\beta$, choosing protection leaves D worse off than the no protection benchmark: (5) exceeds (9).

As such, the designer will either be worse off (for relevant $\beta$) for or indifferent to use of the system, and will therefore not to protect any novel design in the current season. We summarize in the following:

**Lemma 3** *If design protection is available and $\lambda = 0$, the designer firm does not protect its novel design. The mass marketer imitates iff $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$, and produces its own novel collection otherwise.*

The intuition is that while imitation narrows D's novelty gap, it does not entirely erode it; as such, while the designer would be better off if it could fully suppress imitation *and M continued to trail*, in fact M will never choose to fall behind in novelty if knockoffs are proscribed. If the designer utilizes the protection system, the result is a complete erosion of its novelty lead. Because the designer earns higher profit being imitated than it earns facing a novel mass-marketer collection, the rational response is to not make use of the system.

One result of the model therefore is that if the design right allows for suppression of imitation but the right itself carries no added value for consumers, high-end designers may decline to use the protection system. This provides one possible explanation for the dearth of case law with respect to the DPR in the EU: designers simply do not assert protection against imitators (except in very limited cases).

And the implication for US policymakers considering the IDPPPA is that while establishing such a system would not necessarily leave firms any worse off relative to the current no-protection landscape, the legal framework may remain under-utilized as designers seek to maintain novelty leads. As such, resources invested in establishing the design protection system may not be fully justified.

### 5.3 The effect of Design Protection when $\lambda > 0$

If $\lambda > 0$, the very ownership of a protected design carries benefits for firms in the relevant selling season. Consumers enjoy possessing the trendsetting item but, over and above that, receive pleasure from knowing the product to have been certified as the original or from knowing that the company has been certified a trendsetter.

As we have seen in the preceding sub-section, protection by D suppresses imitation and at stage 0.2, a mass-marketer facing a novel, protected collection from D finds it preferable to produce a novel collection. However with $\lambda > 0$ the mass-market firm now also finds it beneficial to protect its

design, closing both the novelty and protection gaps. M reacts to novelty with novelty and here, it also reacts to protection with protection: both firms make use of the design right system. Optimal prices and profits are again given by (7) through (10).

In the foregoing case, the designer could avoid the erosion of its novelty lead simply by declining to use the system. Could a similar strategy be applied here? If the mass-market firm faces a designer which has produced a novel collection but has declined to protect it, M could choose to save on fixed costs and knockoff, earning a payoff equal to (6); it could invest in novelty without protecting, closing D's novelty gap, earning a payoff equal to (10); or it could invest in novelty and protect its design, thereby opening up a protection lead over the designer. In this last case, optimal prices and payoffs are given by:

$$p_d^{im} = \frac{1}{6}\left(2 + \beta^2 - 2\lambda + 2(1-\beta)(1+\bar{\theta})\right) \tag{17}$$

$$p_m^{im} = \frac{1}{6}\left(1 + 2\beta^2 + 2\lambda - 2(1-\beta)(-2+\bar{\theta})\right) \tag{18}$$

$$\pi_d^{im} = \frac{((1-\beta)(1+\beta-2(1+\bar{\theta}))+2\lambda)^2}{36(1-\beta)} - F_d^n \tag{19}$$

$$\pi_m^{im} = \frac{((1-\beta)(1+\beta+2(2-\bar{\theta}))+2\lambda)^2}{36(1-\beta)} - F_m^n. \tag{20}$$

In this last case, participation by both firms is only guaranteed for sufficiently large quality differential, or for $\beta < \beta_4 = 1 + \bar{\theta} - \sqrt{\bar{\theta}^2 - 2\lambda}$ (see Appendix). If a higher quality mass-marketer opened a protection lead it would capture the whole market. It is straightforward, then, that all such M firms have a clear incentive to seek a protection lead. Within the range of quality differentials in which both firms operate given a protection lead to M (i.e., $\beta \in (0, \beta_4]$), (20) exceeds (6) only if $\lambda$ is sufficiently high, specifically if:

$$\lambda > \hat{\lambda} = \frac{1}{2}(3\beta^2 + 3\sqrt{-4F_m^n(-1+\beta)+\beta^4} - 2\gamma). \tag{21}$$

If $\lambda > \hat{\lambda}$, *all* mass-marketers would prefer investing in novelty and taking a protection lead over a designer which has a novel, unprotected design. This critical value is decreasing in the fixed cost of novelty, as expected, but interestingly is *increasing* in mass-marketer quality, $\beta$. The model suggests it is the lowest quality M firms that are most likely to invest in novelty and protect designs if protection is valuable to consumers and the designer firm does not itself protect. This is because the protection lead, by raising the overall attractiveness of the firm's apparel to consumers, compensates for for low quality. This effect is most important for the lowest quality firms.

If $\lambda > \hat{\lambda}$, whether the designer produces a mainstream collection, produces a novel collection which it does not protect or produces a novel collection which it does protect, the mass-marketer is better off producing a novel, protected collection - investing in novelty and using the design right system is a dominant strategy for the mass-market firm. The designer, making its choice at stage 0.1, is aware that M will produce a novel, protected collection if the benefits associated with protection are sufficiently high; its best response is to likewise produce a novel, protected collection in such

cases. Neither firm maintains a novelty lead or a protection lead and equilibrium prices and profits are described by equations (7) through (10).

If $\lambda \in [0, \hat{\lambda}]$, ownership if the design protection is not valuable enough to drive mass-marketers with quality in the relevant ranges of $\beta$ away from the knockoff strategy. The designer can avoid complete erosion of its design lead if it declines to use the protection system. We are again in a situation which parallels the no protection benchmark; if protection is not utilized, there is no legal impediment to imitation and equilibrium prices and profits are given by (3) through (6).

We summarize in the following:

**Lemma 4** *If design protection is available and $\lambda > \hat{\lambda}$, the designer and the mass marketer both produce novel collections and choose to protect their respective designs.*

So if design protection is very valuable to a firm, unsurprisingly, the system is more likely to be used. But does the design protection system generate the expected benefit to the designer when it is used? Recall that if $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$, the equilibrium outcome in the no protection benchmark is that the mass-marketer produces a knockoff collection. This leaves the designer with an effective novelty lead, $\gamma$, that is less than one but strictly positive.

If design rights sufficiently enhance the popularity of a novel collection or the reputation of the design house, we have shown that suppressing imitative activity leads all mass-marketers to become design innovators. The effect is to eliminate any novelty lead and to reduce the competitive landscape to the standard vertical differentiation case. This in fact leaves the designer firm worse off relative to the no protection benchmark: in both regimes, D produces a novel collection, incurring fixed costs of $F_d^m$; however it is only in the no protection benchmark case that D is able to maintain a small novelty lead when M's quality is in the specified ranges.

The key here is that in our model, mass-marketers are imitators not by necessity but by choice - they free-ride on the high-end designers' spending on seasonal trends and silhouettes so as to save on collection-related overheads. Should such free-riding be prohibited, however, there is no reason to believe that such firms would be content to fall behind both on quality and on design terms. Indeed, if ownership of a design right sufficiently increases the status (and hence willingness to pay) associated with a fashion good, the mass-marketer will have an incentive to secure such a right; for *both* firms, investing in novelty and making use of the protection system would be a dominant strategy. In equilibrium, both firms produce novel collections and there is no single, status-conferring trend in the season.

Comparing across the two regimes, we have the following proposition:

**Proposition 1** *If $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$ and $\lambda > \hat{\lambda}$, the designer firm is unambiguously worse off under design protection relative to the no protection benchmark.*

The somewhat counter-intuitive outcome is that it is exactly when protection for fashion designs yields valuable advantages that designer firms are worse off if protection is available.

For mass-marketers, the model suggests that outcomes are more in line with what may be expected: firms that prefer to knockoff in the absence of protection are worse off if the design

protection system is used. However it is not because with suppressing imitation leaves them at a disadvantage in design. Rather, it is that these firms find themselves driven to invest in novelty - hiring in design teams, for example - though the increased profit associated with producing a competing trend is low compared to the increased fixed-cost spend. This is nonetheless the best available action, since trailing in both novelty and design protection ownership yields an even smaller payoff. We summarize the above in the following proposition:

**Proposition 2** *If $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$ and $\lambda > \hat{\lambda}$, the mass-market firm is worse off under design protection relative to the no protection benchmark.*

How can it be that providing the intellectual property right can leave both firms worse off? The intuition rests on the principle that, for a given quality differential, design novelty is perceived only in relation to the rival firm's offering: consumers like displaying trendsetting apparel and are therefore willing to pay more for such items, but this implies there must be other consumers lagging the trend. The design rights system may provide an incentive for mass-marketers to narrow the effective degree of product differentiation with designers, making them more dangerous competitors to the higher-cost design firms.

The model therefore provides a cautionary note for IDPPPA proponents: while imitation does reduce the profitability of novel designs - the designer indeed makes lower profit if its design is imitated than it would make if it could enjoy the full extent of a novelty lead - the designer will only be better off suppressing knockoffs if the mass-marketer *continues to trail in novelty.* If instead the mass-marketers start to offer competing designs, the effect of protection is to make the industry more competitive. Results also suggest that even if the high-end firms cannot appropriate the full extent of a design lead, they have every incentive to keep investing in novelty despite the effects of imitation, as failing to do so would leave them vulnerable to being overtaken in design.

Indeed, the overall message is that the proposed design rights system may in fact do designers more harm than good, as fashion firms may find themselves trapped in a trend arms-race: each spends to introduce new, attention-grabbing designs to outdo the rival, but the result is that the competing designs in the marketplace effectively cancel each other out and consumers judge the collections by brand/firm location, just as they would if neither firm invested in novel designs.

### 5.3.1 Welfare Effects of Design Protection

We have shown that if design protection rights carry sufficient benefits to firms beyond the ability to suppress imitation, certain mass-market firms' equilibrium strategies differ from the no protection case. What, then, is the welfare impact of the design protection system if the system is utilized (i.e., if $\lambda > \hat{\lambda}$)?

If design protection is not available or not utilized and $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$, M will imitate and D will produce a novel collection. We simply substitute for prices into (2) with $U_d = \theta - p_d + 1$

and $U_m = \theta\beta - p_m + (1-\gamma)$ to calculate total consumer surplus as:

$$CS^{np} = \frac{(-13 - \beta^4 + 44\gamma + 4\beta^3(-5+\bar{\theta}) - 28\bar{\theta} - 4(\gamma+\bar{\theta})^2 + \beta^2(30 - 4\gamma - 4(-9+\bar{\theta})\bar{\theta}) + 4\beta(1 - 3\bar{\theta} + 2(\gamma(-5+\bar{\theta}) + \bar{\theta}^2)))}{72(-1+\beta)} \tag{22}$$

Total profit to the firms is given by the sum of (6) and (7).

If instead design protection is available and $\lambda > \hat{\lambda}$, both firms will produce novel collections. Again, we substitute for prices into (2), though now with $U_d = \theta - p_d$ and $U_m = \theta\beta - p_d$. Total consumer surplus is now given by:

$$CS^{ipr} = \frac{(-59 - \beta(-9 + \beta(21+\beta)) + 28\bar{\theta} + 4\beta(10+\beta)\bar{\theta} - 4(-1+\beta)\bar{\theta}^2)}{72} \tag{23}$$

and total profit to the firms is given by the sum of (10) and (11).

The increase in welfare under the design rights system relative to the no protection benchmark may be expressed as:

$$W^{ipr} - W^{np} = \Delta W = \frac{(18 + 5\beta^2\gamma + \gamma(-19 + 5\gamma + 10\bar{\theta}) - 2\beta(9 - 7\gamma + 5\gamma\bar{\theta}))}{18(-1+\beta)} - F_m^n \tag{24}$$

and we have the following:

**Proposition 3** *If $\beta \in (0, \beta_1]$ or $\beta \in (\beta_2, \beta_3]$ and $\lambda > \hat{\lambda}$, welfare is unambiguously lower in the design protection regime relative to a no protection benchmark.*

**Proof**: See the Appendix

The intuition here is that high-end consumers prefer buying a novel design when others in the market cannot, as the firm is a trendsetter. The presence of knockoffs in the market erodes, but does not completely remove, this effect: designer customers enjoy higher utility - even after considering the higher prices paid for such goods - in the no protection benchmark. Further, as imitation allows mass-market customers to participate in the status-conferring trend, they are also better off. Consumer surplus is therefore higher without design protection.

Joint firm profit is higher in the no protection benchmark: the designer firm's trendsetting good is more attractive to consumers, allowing it to increase prices and at the same time serve a larger share of the market. The imitating mass-marketer is also better off, as it is able to partially close the designer's novelty lead while saving on season fixed costs.

### 5.3.2 Licensing

We have shown above that if the design rights system is used, firm profits and welfare may be lower than in a no protection benchmark, but we have not so far allowed for licensing of design rights. Let us now suppose that if D elects to invest in novelty and protect its design at stage 0.1, it could offer a license to M on entry at stage 0.2. This license constitutes permission to produce an official (lower quality) copy of the novel, protected design under M's brand. The firms license via Nash bargaining.

If the firms fail to agree a license, the outcome is as we have already shown: if the design system is used, each produces a novel, protected collection. If firms successfully conclude a license, however, then they compete in prices with D having both a protection and a trend lead. Licensing would therefore allow the designer firm to maintain a larger effective lead. But this outcome is only possible if *both* firms would be active in the market given such a combined lead for D. This requires that the quality differential is sufficiently large, or more formally, $\beta \leq \beta_5 = -2+\bar{\theta}+\sqrt{(-3+\bar{\theta})^2-2(\gamma+\lambda)}$.[21]

The surplus available to be shared in any licensing agreement is given by the difference between joint profit if D has both a protection and a novelty lead and the joint profit firms would make in the absence of licensing. We denote this surplus $T$, where:

$$T = F_m^n - \frac{2(\gamma+\lambda)\left(-2+\beta+\beta^2+\gamma+2(1-\beta)\bar{\theta}+\lambda\right)}{9(-1+\beta)} \tag{25}$$

If the firms split the surplus equally, the payoffs to the designer and mass-marketer, respectively, under licensing are simply the outside option to each firm (what it earns if no license is agreed and both offer novel, protected designs) plus $\frac{1}{2}T$, or:

$$\Pi_d^{lic} = \frac{1}{36}\left((-1-\beta)(1+\beta-2(1+\bar{\theta}))^2 - Y\right) - F_d^n; \tag{26}$$

$$\Pi_m^{lic} = \frac{1}{36}\left((1-\beta)(5+\beta-2\bar{\theta})^2 - Y\right) - F_m^n; \tag{27}$$

$$Y = \frac{2\left(9F_m^n(-1+\beta) - 2(\gamma+\lambda)\left(-2+\beta+\beta^2+\gamma+2\bar{\theta}-2\beta\bar{\theta}+\lambda\right)\right)}{-1+\beta}$$

The designer's payoff under licensing is smaller than its payoff in the no protection regime iff $\lambda \in (0, \lambda^*]$ and $\gamma < \gamma^*$ where

$$\lambda^* = \frac{1}{2}(3-3\beta) \tag{28}$$

$$\gamma^* = \frac{9F_m^n(-1+\beta) - 2\lambda((-1+\beta)(2+\beta-2\bar{\theta})+\lambda)}{-6+6\beta+4\lambda}. \tag{29}$$

If we also define $\gamma_1$ as:

$$\gamma_1 = \frac{3}{2}(-1+\beta+\beta^2) + \frac{1}{2}\sqrt{4-4\beta+9\beta^4} \tag{30}$$

we have the following proposition:

**Proposition 4** *If $\lambda > \hat{\lambda}$, $\beta \in (0, \beta_5]$ and firms equally split any surplus associated with licensing, the designer will produce a novel collection and the mass-marketer a licensed, lower quality version of the novel design. The designer is nonetheless worse off under design protection with licensing relative to a no-protection benchmark if $\hat{\lambda} < \lambda < \lambda^*$ and $\gamma_1 < \gamma < \gamma^*$.*

[21] If $\beta \in (\beta_5, 1)$, a designer with a combined novelty and protection lead would capture the whole market.

*If $\beta \in (\beta_5, 1)$, no licensing is possible and both firms produce novel, protected designs.*

**Proof**: See the Appendix

Intuitively, licensing would allow the designer to enjoy the benefits associated with leading in both novelty and ownership of the protected design - it markets its product with a larger effective gap than it could in the no protection benchmark. However, D must transfer half of the joint benefit to the mass-marketer in order to successfully conclude the agreement. The smaller are $\gamma$ and $\lambda$, the smaller is the surplus associated with licensing and the less D is left with after its transfer to M. Thus, even allowing for licensing, the designer firm could be worse off under design protection: the size of the relevant transfer to M may outweigh the benefits of enjoying an expanded gap when selling in the market, meaning that D earns a payoff that is smaller than it would earn in the no protection regime.

Note that the agreement outlined here involves, either explicitly or implicitly, M *receiving* from D a payment on signing the license, as the surplus shared between the firms consists mainly (if not exclusively) of the benefits to D. Such an arrangement may easily be understood as the basis of the diffusion line concepts which are growing in popularity in the fashion industry: licensing with implicit payment to the mass-market firm is consistent with designer firm lending its expertise and brand power to a lower-quality rival via a collection designed by the high-end brand but sold under the lower quality firm's brand. Such undertakings have become increasingly popular in Europe and in the US, with recent examples including: Isaac Mizrahi for Target (2002-2007), Ronson for JC Penney (2009), Jimmy Choo for H&M (2009), Jean Paul Gaultier for Target (2010), Lanvin for H&M (2010), Missoni for Target (2010), Jil Sander's '+J' at Uniqlo (2009-2011) and Versace for H&M (2011).

This model therefore provides an alternative explanation for the proliferation of high-street diffusion lines crafted by designers and would predict an increase in such activity in the US in the wake for the aforementioned legislation.

# 6 Concluding Remarks

The model presented here is very stylized, focussing on a simple, sequential duopoly game with key assumptions of low fixed costs of novelty and full market coverage, and results should be read with the appropriate caution. We nevertheless feel that it succeeds in illustrating a key scenario in which design protection may actually hurt designer firms, the industry as a whole and indeed welfare.

While the claims of designers seeking design rights protection do have merit - imitation hurts innovative firms relative to the case in which they could enjoy the full extent of any novelty lead - it is by no means certain that such rights will leave them better off. Indeed, in suppressing imitation protection rights may in fact change the behavior of the mass-marketers, inducing these lower quality - and lower cost - competitors to innovate in design. Put more simply, while mass-market firms are happy to free-ride on the innovator and trail slightly, they may not be prepared to fall totally behind in novelty if free-riding is no longer permitted.

If design rights have little or no value in and of themselves, designers can avoid any suboptimal outcome by simply declining to use the system, effectively sanctioning knockoff activity. However if the ownership of design rights has a sufficiently high value to consumers (for example as certification of the originality of the design) firms may find themselves locked in a trend arms race, producing novel designs which simply cancel each other out in the market, so that in the end only quality matters, just as it would without any novelty in design. For certain parameter values licensing provides a way to stave off the arms race, though even this may not compare favorably with a no protection benchmark.

The policy may therefore have effects which run counter to the expectations of proponents, harming even the firms that seem to most support such legislation. The model also offers alternative explanations for both the lack of case law surrounding the establishment of the European Design Right System and for the uptick in designer-led diffusion lines at mass market stores.

There are several promising areas for extension of the model. These include relaxing the full market coverage assumption, incorporating a continuous novelty measure (as opposed to the binary choice here) and expanding the time horizon of the model to analyze the effect of stacked design rights on firms' future design and protection choices.

# A Appendix

## A.1 Proof of Lemmata 1 & 2

If we define $\theta^*$ as the location of the consumer indifferent between buying from the designer and the mass marketer given that the designer maintains novelty and/or protection leads, we can solve for $\theta^*$ as the solution to $U_d = U_m$ (designer and mass-marketer qualities are fixed at 1 and $\beta < 1$, respectively):

$$\theta^* = -\frac{-p_d + p_m + \gamma + \lambda}{1 - \beta}. \tag{A.1}$$

$\theta^*$ is internal to the support $[(\bar{\theta}-1), \bar{\theta}]$ iff $(p_d - p_m) \in [((1-\beta)(-1+\bar{\theta})+\gamma+\lambda), ((1-\beta)\bar{\theta}+\gamma+\lambda)]$. Profits to the designer and mass-marketer, respectively, are given by:

$$\pi_d = (p_d - \frac{1}{2})(\bar{\theta} - \theta^*); \tag{A.2}$$

$$\pi_m = (p_m - \frac{\beta^2}{2})(\theta^* - (\bar{\theta} - 1)). \tag{A.3}$$

Substituting for $\theta^*$ in the profit functions, the first order conditions w.r.t prices, respectively,

are:

$$\frac{\delta\pi_d}{\delta p_d} = \frac{-4p_d + 2p_m + 1^2 + 2\bar{\theta} - 2\beta\bar{\theta} + 2(-1+\gamma+\lambda)}{2(1-\beta)} = 0; \tag{A.4}$$

$$\frac{\delta\pi_m}{\delta p_m} = \frac{2p_d - 4p_m - 2(-1+\bar{\theta}) + \beta(-2+\beta+2\bar{\theta}) - 2(-1+\gamma+\lambda)}{2(1-\beta)} = 0. \tag{A.5}$$

In the no protection benchmark, $\lambda = 0$. If there is imitation by M, $\gamma > 0$, so that the simultaneous solution yields the candidate equilibrium prices given in (3) and (4). If there is novelty by both firms, $\gamma = 0$ and the simultaneous solution yields the candidate prices given in (7) and (8). These prices satisfy the second order conditions.

These candidate prices are substituted into the profit functions to generate the profit equations shown in (5) and (6), and (9) and (10), respectively.

Full market coverage with both firms active in the market requires that: (i) the price differential is such that $\theta^*$ is internal to the support of consumer tastes; (ii) the customer with the lowest marginal utility of quality, $(\bar{\theta} - 1)$, finds it preferable to purchase the product; and (iii) prices are non-negative.

For given trendsetting and protection leads, the marginal $\theta$ customer is internal to the support of tastes iff the quality differential is sufficiently large, or if:

$$\beta < \breve{\beta} = -2 + \bar{\theta} + \sqrt{(-3+\bar{\theta})^2 - 2(\gamma+\lambda)}. \tag{A.6}$$

which corresponds to $\beta_3$ at (14) for $\lambda = 0$. The closer are firms in the quality dimension the closer is the market to horizontal competition and the stronger is the benefit associated with a lead. A leading designer captures the whole market ($\theta^* = (\bar{\theta} - 1)$) if $\beta = \beta_3$ and therefore any M with higher quality will always close any novelty or protection leads.

The utility of the lowest $\theta$ customer given the candidate prices is:

$$U_m(\bar{\theta} - 1) = (\bar{\theta} - 1)\beta - p_m + (1-\gamma) \tag{A.7}$$

$$= \frac{1}{6}\left(-5 + 2(1+2\beta)\bar{\theta} - 2(-2+\beta+\beta^2+2\gamma)\right). \tag{A.8}$$

Solving $U_m(\bar{\theta} - 1) = 0$ for $\bar{\theta}$, we obtain:

$$\bar{\theta}_0 = \frac{-1 + 2\beta(1+\beta) + 4\gamma - 2\lambda}{2(1+2\beta)} \tag{A.9}$$

with positive surplus requiring $\bar{\theta} > \bar{\theta}_0$.

Setting the candidate $p_m$ to zero and solving for $\bar{\theta}$ yields:

$$\bar{\theta}_1 = \frac{5 + 2(2-\beta)\beta - 2\gamma - 2\lambda}{2(1-\beta)} \tag{A.10}$$

with non-negative price requiring $\bar{\theta} < \bar{\theta}_1$. This particular restriction arises because in this setup

we abstract from optimizing behaviour in respect of quality. For any higher value of $\bar{\theta}$, the very lowest quality firms would have to reduce prices to zero and market participation by both firms is not satisfied.

This critical value $\bar{\theta}_1$ is equivalent to $\hat{\theta}$ in (14) for $\lambda = 0$. Comparing (A.9) and (A.10), $\bar{\theta}_1 > \bar{\theta}_0 \; \forall \; \gamma < \hat{\gamma} = \frac{1}{2}\left(2 + \beta - 2\beta^2 + 2\beta^3 - 2\beta\lambda\right)$.

Full market coverage and participation by both firms, given exogenous qualities, thus requires that the market is not too rich and that knockoffs are perceived sufficiently well.

To determine whether M prefers imitation or novelty, we set (6)=(10) and solve for $\beta$. This yields two solutions:

$$\beta_1 = -\frac{-9F_m^n + \sqrt{81F_m^n - 4\gamma^2(\gamma - (-3+\bar{\theta})^2) + 36F_m^n\gamma(-3+\bar{\theta})} - 2\gamma(-2+\bar{\theta})}{2\gamma}$$

$$\beta_2 = \frac{9F_m^n + \sqrt{81F_m^n - 4\gamma^2(\gamma - (-3+\bar{\theta})^2) + 36F_m^n\gamma(-3+\bar{\theta})} + 2\gamma(-2+\bar{\theta})}{2\gamma}$$

Straightforward comparison illustrates that $(6) > (10) \, \forall \, \beta < \beta_1$ and $\beta > \beta_2$ and $(6) < (10) \, \forall \, \beta \in (\beta_1, \beta_2)$.

## A.2 M choice if D does not protect and $\lambda > 0$

If M opens up a protection lead over D, $U_d = \theta - p_d + 1$ and $U_m = \theta\beta - p_m + 1 + \lambda$. We find the consumer indifferent to buying from the designer and the mass-marketer by setting $U_d = U_m$ and solving for $\theta^*_{M_l}$ and proceed with the profit-maximization in a manner analogous to that followed in Appendix A.1. Optimal prices and profits in (17) through (20).

If facing a novel, unprotected design by D, M has four (4) choices: it may produce a mainstream collection and trail the designer firm; it may imitate the designer firm; it may produce a novel design and choose not to protect it; or it may produce a novel design and protect it.

We can rule out the first and third strategies: the first because producing a mainstream collection would mean trailing the designer in novelty and generating a lower total payoff then investing in novelty; and the third because investing in novelty but not protecting would mean foregoing the costless option of taking a protection lead over the designer. Any investment in novelty is therefore accompanied by utilization of the design right system.

We are left to compare the second and fourth strategies. If the mass market firm imitates, it earns a payoff equal to (6). If the mass-market firm is novel and seeks design protection, both firms operate iff $\beta < \beta_4 = 1 + \bar{\theta} - \sqrt{\bar{\theta}^2 + 2\lambda}$. Note also that $\beta_4 > \breve{\beta}$.

Comparing the payoffs, (20) exceeds (6) iff $\gamma > -\lambda$ and $\bar{\theta} < \bar{\theta}_2$ where

$$\bar{\theta}_2 = \frac{9F_m^n(1-\beta) - 5\gamma + 4\beta\gamma + \beta^2\gamma + \gamma^2 - 5\lambda + 4\beta\lambda + \beta^2\lambda - \lambda^2}{2(-1+\beta)(\gamma+\lambda)}. \tag{A.11}$$

We compare this critical value to $\hat{\theta}$ to establish which is larger; if $\bar{\theta}_2 > \hat{\theta}$, then for all relevant

model parameters (20) exceeds (6). Given $\gamma$ and $\beta$, $\bar{\theta}_2 > \hat{\theta}$ if:

$$\lambda > \frac{1}{2}\left(3\beta^2 + 3\sqrt{-4F_m^n(-1+\beta)+\beta^4} - 2\gamma\right). \tag{A.12}$$

This critical value is renamed $\hat{\lambda}$ in the text.

## A.3 Proof of Proposition 3

Total welfare in the no protection benchmark is given by:

$$W^{np} = \frac{1}{72(-1+\beta)}(-65 - 72F_d^n(-1+\beta) - 5\beta^4 + 76\gamma + 4\bar{\theta} - 20(\gamma+\bar{\theta})^2 + 4\beta^3(-7+5\bar{\theta}) + \\ \beta^2(6 - 20\gamma + 4(9-5\bar{\theta})\bar{\theta}) + \beta(92 + 20\bar{\theta}(-3+2\bar{\theta}) + 8\gamma(-7+5\bar{\theta})) \tag{A.13}$$

while if design protection is available and $\lambda > \hat{\lambda}$, welfare is given by:

$$W^{ipr} = \frac{1}{72}\left(-7 - 72F_d^n - 72F_m^n - \beta(27+\beta(33+5\beta)) - 4\bar{\theta} + 4\beta(14+5\beta)\bar{\theta} - 20(-1+\beta)\bar{\theta}^2\right) \tag{A.14}$$

The welfare effect of design protection is therefore given by (A.14) minus (A.13), denoted $\Delta W$ at (24) in the text. The overall sign of the welfare effect of design protection depends on the sign of the numerator of the first term in the $\Delta W$ expression as the denominator of the first term is negative. The numerator of the first term is positive, rendering the entire expression negative, iff $\gamma > 0$, $\beta < 1$ and $\bar{\theta} > \theta'$ where

$$\theta' = \frac{(18 - 18\beta - 19\gamma + 14\beta\gamma + 5\beta^2\gamma + 5\gamma^2)}{(-10\gamma + 10\beta\gamma)}. \tag{A.15}$$

This term is increasing in gamma and so will be highest if $\gamma$ is at its maximum, $\hat{\gamma}$. Evaluating this term at the maximum value of $\gamma$, we have:

$$\theta' = \frac{1}{20}\left(43 + \frac{15}{(-1+\beta)} + 10\beta(1+\beta) - \frac{7}{2+\beta(1+2(-1+\beta)\beta)}\right) < 0. \tag{A.16}$$

As such, even at its highest possible value, this critical value for $\theta$ is negative. The numerator of the first term of the expression is therefore positive, and the entire expression for $\Delta W$ negative, for all relevant values of $\bar{\theta}$. Welfare is lower under design protection.

## A.4 Proof of Proposition 4

The benefit to the designer from agreeing a license with M is given by the difference between what the firm would earn if M imitated its protected, novel design under the contract and what it would earn absent licensing (if M also produced a novel, protected design), with the latter given by (10).

If M imitates with $\lambda > 0$, D earns:

$$\pi_d^{im-p} = \frac{((1-\beta)(4+1+\beta-2\bar{\theta})) - 2(\gamma+\lambda)^2}{36(1-\beta)}. \tag{A.17}$$

The designer's benefit is therefore the increase in profit it earns if M chooses to trail in both novelty and design right ownership in the market (which it agrees to do if licensing) versus investing in novelty and removing D's lead. We denote this benefit by $H$, where:

$$H = -\frac{(\gamma+\lambda)(1+\beta^2+\gamma+2\bar{\theta}-2\beta(1+\bar{\theta})+\lambda)}{9(-1+\beta)} \tag{A.18}$$

The benefit to the mass-marketer from entering the license agreement is similarly given by the difference between what it would be able to earn if it produces a licensed copy of the design but incurs a reduced fixed cost spend and what it would earn absent licensing (that is, if it produces a novel, protected collection).

If it produces a novel collection, it earns a payoff equal to (10) and if it imitates D's protected design it earns:

$$\pi_m^{im-p} = \frac{((1-\beta)(1+\beta+2(2-\bar{\theta})) - 2(\gamma+\lambda)^2}{36(1-\beta)} \tag{A.19}$$

the benefit to M is therefore the cost saving associated with imitation net of any reduction in profit it experiences from trailing in both novelty and design rights ownership. Let the overall benefit to M be denoted by $G$, where:

$$G = \frac{9F_m^n(-1+\beta) + (\gamma+\lambda)(-5+\beta^2+\gamma-2\beta(-2+\bar{\theta})+2\bar{\theta}+\lambda)}{9(-1+\beta)} \tag{A.20}$$

The surplus available under bargaining is therefore $T = G + H$, defined at (25) in the text.

We assume that the firms split the surplus equally; as such, firm payoffs under licensing are simply the firm's outside option (what it earns absent licensing) plus $\frac{1}{2}T$ and are defined in (26) and (27), respectively, for the designer and the mass-marketer.

In order to establish whether firms are better off under licensing relative to the no protection case, we compare payoffs under licensing to the payoffs under no protection, given at (5) and (6), respectively.

The designer is worse off under licensing - (5) exceeds (26) - iff $\beta < 1$, $F > 0$, $\lambda < \frac{1}{2}(3-3\beta)$ and:

$$\gamma < \frac{9F_m^n(-1+\beta) + 4\lambda - 2\beta\lambda - 2\beta^2\lambda - 4\bar{\theta}\lambda + 4\beta\bar{\theta} - 2\lambda^2}{-6+6\beta+4\lambda} \tag{A.21}$$

and these critical values for $\lambda$ and $\gamma$ are renamed $\lambda^*$ and $\gamma^*$, respectively, in the text.

It remains to show that such values are possible for the range of parameters in which design protection is utilized. Recall that design protection is used as long as $\lambda > \hat{\lambda}$ and that the maximum novelty lead possible under imitation is given by $\hat{\gamma}$.

This requirement on $\gamma$ is not restrictive as whether this restriction is larger or smaller than $\hat{\gamma}$, there is a non empty set of values which satisfy it. We then must compare $\lambda^*$ and $\hat{\lambda}$. $\lambda^* > \hat{\lambda}$ - so that there is a non-empty set of values for which D will choose to use the design right system but would be worse off under licensing - iff $\beta < -\frac{1}{2} + \frac{\sqrt{15+8\gamma}}{2\sqrt{3}}$, $\gamma \leq \frac{3}{2}$ and $F < F^*$ where

$$F^* = \frac{(-9 + 18\beta + 9\beta^2 - 18\beta^3 - 12\gamma + 12\beta\gamma + 12\beta^2\gamma - 4\gamma^2)}{36(-1+\beta)}. \tag{A.22}$$

Note that the condition on $\beta$ is always satisfied (this critical value exceeds $\beta_5$), and the condition on F is satisfied iff $\gamma > \gamma_1 = \frac{3}{2}(-1 + \beta + \beta^2) + \frac{1}{2}\sqrt{4 - 4\beta + 9\beta^4}$. We next compare this value to $\hat{\gamma}$. $\hat{\gamma} > \gamma_1$ - so there is a non-empty set of values satisfying all requirement - for moderate to low values of $\beta$.

# B The Model with Endogenous Quality

## B.1 The no-protection benchmark

Suppose now that firms are free to select quality as well as novelty when deciding on the season's apparel collection. The designer moves first, acting as a Stackelberg leader in quality selection.

Firm prices and profits at stage 1.1 are given by

$$p_d^e = \frac{1}{6}\left(2s_d^2 + s_m^2 + 2\gamma + 2(s_d - s_m)(1 + \bar{\theta})\right) \tag{B.1}$$

$$p_m^e = \frac{1}{6}\left(s_d^2 + 2s_m^2 - 2\gamma - 2(s_d - s_m)(-2 + \underline{\theta})\right) \tag{B.2}$$

$$\pi_d^e = \frac{((s_d - s_m)(s_d + s_m - 2(1+\bar{\theta})) - 2\gamma)^2}{36(s_d - s_m)} - F_d^n \tag{B.3}$$

$$\pi_m^e = \frac{((s_d - s_m)(s_d + s_m + 2(2-\bar{\theta})) - 2\gamma)^2}{36(s_d - s_m)} \tag{B.4}$$

which correspond to expressions (3) through (6) for $s_d = 1$ and $s_m = \beta$.

The first order conditions w.r.t prices, utilizing the most general form of the model are:

$$\frac{\delta \pi_d}{\delta p_d} = \frac{-4p_d + 2p_m + s_d^2 + 2s_d\bar{\theta} - 2s_m\bar{\theta} + 2(\gamma + \lambda)}{2(s_d - s_m)} = 0; \tag{B.5}$$

$$\frac{\delta \pi_m}{\delta p_m} = \frac{2p_d - 4p_m - 2s_d(-1 + \bar{\theta}) + s_m(-2 + s_m + 2\bar{\theta}) - 2(\gamma + \lambda)}{2(s_d - s_m)} = 0 \tag{B.6}$$

whose simultaneous solution yields the candidate prices:

$$p_d = \frac{1}{6}(2s_d^2 + 2s_d(1+\bar{\theta}) + s_m(s_m - 2(1+\bar{\theta})) + 2(\gamma + \lambda)); \tag{B.7}$$

$$p_m = \frac{1}{6}(s_d^2 - 2s_d(-2+\bar{\theta}) + 2s_m(-2 + s_m + \bar{\theta}) - 2(\gamma + \lambda)). \tag{B.8}$$

These prices satisfy the second order conditions.

Plugging these expressions into the profit functions, we obtain the profits at stage 1.1:

$$\pi_d^e = \frac{((s_d - s_m)(s_d + s_m - 2(1+\bar{\theta})) - 2(\gamma+\lambda))^2}{36(s_d - s_m)} - F_d^n \tag{B.9}$$

$$\pi_m^e = \frac{((s_d - s_m)(s_d + s_m + 2(2-\bar{\theta})) - 2(\gamma+\lambda))^2}{36(s_d - s_m)}. \tag{B.10}$$

The designer is a Stackelberg leader, so that its quality is known at stage 0.2. Thus to find the optimal quality choice of the mass-marketer given $s_d$, we differentiate (B.10) and w.r.t $s_m$ and obtain the first order condition:

$$\frac{\delta \pi_m}{\delta s_m} = \frac{((s_d - s_m)(4 + s_d + s_m - 2\bar{\theta}) - 2(\gamma+\lambda))((s_d - s_m)(-4 + s_d - 3s_m + 2\bar{\theta}) - 2(\gamma+\lambda))}{36(s_d - s_m)^2} = 0 \tag{B.11}$$

This expression yields four (4) candidate qualities:

$$s_m^1 = -2 + \bar{\theta} - \sqrt{(2 + s_d - \bar{\theta})^2 - 2(\gamma+\lambda)}; \qquad s_m^2 = -2 + \bar{\theta} + \sqrt{(2 + s_d - \bar{\theta})^2 - 2(\gamma+\lambda)}$$

$$s_m^3 = \frac{1}{3}(-2 + 2s_d + \bar{\theta} - \sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}); \qquad s_m^4 = \frac{1}{3}(-2 + 2s_d + \bar{\theta} + \sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)})$$

We select the quality which results in highest profit and satisfies the second order condition: $s_m^3$.

At stage 0.1, the designer can predict the mass-marketer's quality choice and substitutes for $s_m$ in its profit function, which then becomes:

$$\pi_d^e = \frac{(s_d^2 - 2s_d(1+\bar{\theta}) - 2(\gamma+\lambda) + \frac{2}{3}(1+\bar{\theta})X - \frac{1}{9}(-X)^2)^2}{12(2 + s_d - \bar{\theta} + \sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)})}$$

$$X = (-2 + 2s_d + \bar{\theta} - \sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}).$$

To find the optimal designer quality, we differentiate w.r.t. $s_d$ and obtain the following first order condition:

$$\frac{\delta \pi_d^e}{\delta s_d} = \frac{1}{81}(19 + 4s_d^2 - 24\gamma + 8\bar{\theta} + 4\bar{\theta}^2 - 8s_d(1+\bar{\theta}) - 24\lambda - \frac{18}{\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}} + \frac{27s_d}{\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}} +$$

$$\frac{72\gamma}{\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}} - \frac{27\bar{\theta}}{\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}} + \frac{72\lambda}{\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}} -$$

$$16\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)} + 4s_d\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)} - 4\bar{\theta}\sqrt{(2 + s_d - \bar{\theta})^2 + 6(\gamma+\lambda)}) = 0.$$

This expression yields four (4) candidate qualities:

$$s_d^1 = -2 + \bar{\theta} - \frac{1}{2}\sqrt{3}\sqrt{3 - 8(\gamma+\lambda)}; \qquad s_d^2 = -2 + \bar{\theta} + \frac{1}{2}\sqrt{3}\sqrt{3 - 8(\gamma+\lambda)}$$

$$s_d^3 = 1 + \bar{\theta} - \frac{1}{2}\sqrt{9 + 8(\gamma+\lambda)}; \qquad s_d^4 = 1 + \bar{\theta} + \frac{1}{2}\sqrt{9 + 8(\gamma+\lambda)}.$$

The solution which provides highest profits and satisfies the second order condition is $s_d^3$. We

substitute for $s_d^3$ into $s_m^3$ to obtain:

$$s_m^* = \bar{\theta} - \frac{1}{3}\sqrt{9+8(\gamma+\lambda)} - \frac{1}{6}\sqrt{45+32(\gamma+\lambda)-12\sqrt{9+8(\gamma+\lambda)}}.$$

We substitute for $s_d$ and $s_m$ in candidate prices to yield:

$$p_d = \frac{1}{216}(387+280\gamma+280\lambda-96\sqrt{9+8\gamma+8\lambda}+12S^e+4(27\bar{\theta}(2+\bar{\theta})-27\bar{\theta}\sqrt{9+8\gamma+8\lambda}+\sqrt{9+8\gamma+8\lambda}S^e)); \tag{B.12}$$

$$p_m = \frac{1}{216}(423+128\gamma+108\bar{\theta}^2+128\lambda-84\sqrt{9+8\gamma+8\lambda}+24S^e+8\sqrt{9+8\gamma+8\lambda}S^e-36\bar{\theta}(2\sqrt{9+8\gamma+8\lambda}+S^e)) \tag{B.13}$$

$$S^e = \sqrt{45+32\gamma+32\lambda-12\sqrt{9+8\gamma+8\lambda}}.$$

Full market coverage with both firms active in the market requires that (i) the price differential is such that $\theta^*$ is internal to the support of consumer tastes; (ii) the customer with the lowest marginal utility of quality, $(\bar{\theta}-1)$, finds it preferable to purchase the product; and (ii) prices are non-negative.

For given trendsetting and protection leads, the marginal $\theta$ customer is internal to the support of consumer tastes iff the combined effective lead of the designer is not too large, specifically if $\lambda \geq 0$ and $\gamma \in (0, \frac{81}{128}-\lambda]$.

The utility of this lowest $\theta$ customer given the candidate prices is:

$$U_m(\bar{\theta}-1) = (\bar{\theta}-1)s_m - p_m + (1-\gamma) =$$
$$\frac{1}{216}(-207+344\gamma+108(-2+\bar{\theta})\bar{\theta}-128\lambda+156\sqrt{9+8(\gamma+\lambda)}+12S^e-8\sqrt{9+8(\gamma+\lambda)}S^e)$$
$$S^e = \sqrt{45+32\gamma+32\lambda-12\sqrt{9+8(\gamma+\lambda)}}.$$

Solving $U_m(\bar{\theta}-1)=0$ for $\bar{\theta}$, we obtain two possible solutions for $\bar{\theta}$:

$$\bar{\theta}_0^e = 1 \pm \frac{1}{6\sqrt{3}}\left(\sqrt{315+344\gamma+128\lambda-156\sqrt{9+8\gamma+8\lambda}-12S^e+8\sqrt{9+8\gamma+8\lambda}S^e}\right) \tag{B.14}$$

Only the larger root is acceptable, and positive surplus requires $\bar{\theta} > \bar{\theta}_0^e$.

Setting the candidate price $p_m$ to zero and solving for $\bar{\theta}$ yields two possible solutions for $\bar{\theta}$:

$$\bar{\theta}_1^e = \frac{1}{18}(6\sqrt{9+8\gamma+8\lambda}+3S^e \pm 2\sqrt{3}\sqrt{-45+16\gamma+16\lambda+12\sqrt{9+8\gamma+8\lambda}-6S^e+\sqrt{9+8\gamma+8\lambda}S^e}) \tag{B.15}$$

Only the larger root is acceptable. Strictly non-negative price (and profit) requires $\bar{\theta} > \bar{\theta}_1^e$.

Satisfaction of the requirements for full market coverage and participation by both firms therefore restricts $\bar{\theta} > \max\{\bar{\theta}_0^e, \bar{\theta}_1^e\}$ and $\gamma \in (0, \frac{81}{128}-\lambda]$.

If full market coverage obtains, the optimal prices and qualities in the absence of design protection

simplify to ($\lambda = 0$):

$$p_d = \frac{1}{216}(387 + 280\gamma - 96\sqrt{9+8\gamma} + 12S_1^e + 4(27\bar{\theta}(2+\bar{\theta}) - 27\bar{\theta}\sqrt{9+8\gamma} + \sqrt{9+8\gamma}S_1^e));$$
$$p_m = \frac{1}{216}(423 + 128\gamma + 108\bar{\theta}^2 - 84\sqrt{9+8\gamma} + 24S_1^e + 8\sqrt{9+8\gamma}S_1^e - 36\bar{\theta}(2\sqrt{9+8\gamma} + S_1^e))$$
$$s_d^{np} = \bar{\theta} + 1 - \frac{1}{2}\sqrt{9+8\gamma},$$
$$s_m^{np} = \bar{\theta} - \frac{1}{3}\sqrt{9+8\gamma} - \frac{1}{6}S;$$
$$S_1^e = \sqrt{45 + 32\gamma - 12\sqrt{9+8\gamma}}.$$

The price charged by a leading designer (imitating mass-marketer) is increasing (decreasing) in $\gamma$, the size of the novelty lead in the presence of knockoffs.

However optimal qualities are *decreasing* in $\gamma$: if it can maintain a novelty lead, as it does if the mass-marketer imitates, the designer will optimally select a lower quality. This is for two reasons: firstly, because novelty and quality independently enter the consumer's utility function, the firm can view these as substitutes - increasing either will make its product more appealing. Secondly, both aspects are costly, but only quality increases the marginal costs of production; a rational firm therefore finds it profitable to invest in novelty and reduce quality, as this would allow it to take share from the rival and spread the fixed costs over a larger scale.

The mass-marketer optimally responds by locating some distance from the designer in order to minimize price competition; as such, the lower is the optimal quality selected by D, the lower will M's choice be. Indeed, the quality differential between the firms, $s_d^{np} - s_m^{np} = \frac{1}{6}\left(6 - \sqrt{9+8\gamma} + S\right)$, is increasing in $\gamma$: the greater is the designer's novelty lead, the farther away from the designer the mass-marketer will be forced to locate.

On the basis of the foregoing we may observe that in the absence of design protection, quality and a novelty lead are substitutes for the designer firm - in possession of a design novelty lead, it reduces the quality offered. The larger is its novelty lead, (the more imperfect the knockoff, or the larger is $\gamma$), the larger is the quality differential.

The designer has a clear incentive to invest in novelty; the mass-marketer faces the choice of partially closing the novelty gap and paying lower season fixed costs, or fully closing the novelty gap by itself producing a novel collection. If we define $\hat{F_m^n}$ as:

$$\hat{F_m^n} = -\frac{1}{486}\sqrt{\frac{729 + 21384\gamma + 165888\gamma^2 + 131072\gamma^3}{(-1)^2}} + \frac{-3 - 64\gamma}{-54} \tag{B.16}$$

The mass-marketer will knockoff the designer if the costs of novelty are sufficiently high, iff $F_m^n > \hat{F_m^n}$, and will produce its own, novel collection otherwise.

If $F_m^n > \hat{F_m^n}$, equilibrium quantities and profits are given by:

$$q_d^{np} = \frac{1}{9}\left(-3 + 2\sqrt{9+8\gamma} + S_1^e\right); \tag{B.17}$$

$$q_m^{np} = \frac{1}{9}\left(12 - 2\sqrt{9+8\gamma} - S_1^e\right); \tag{B.18}$$

$$\pi_d^{np} = -\frac{(16\gamma + (3+\sqrt{9+8\gamma})(3+S_1^e))^2}{(486(-6+\sqrt{9+8\gamma} - S_1^e))} - F_d^n; \tag{B.19}$$

$$\pi_m^{np} = -\frac{(-45+16\gamma+12\sqrt{9+8\gamma} - 6S_1^e + \sqrt{9+8\gamma}S_1^e)^2}{(486(-6+\sqrt{9+8\gamma} - S_1^e))}. \tag{B.20}$$

Market share and profit of the designer (mass-marketer) are increasing (decreasing) in $\gamma$, confirming that the payoff to the designer firm is higher the larger is its effective novelty lead. As in the previous section, we see that the designer is harmed by imitation relative to what it would earn if M trailed fully in novelty, but it nevertheless benefits from the reduced novelty lead.

### B.2 The effect of Design Protection when $\lambda = 0$

If design protection is available and is utilized, the mass market firm no longer finds it profitable to knockoff: at stage 0.2 it now must decide whether to trail and produce a very low quality or to invest and produce a novel collection of somewhat higher quality. If it chooses to produce a mainstream collection, M will be forced to locate very far away from D in the quality spectrum to relax price competition, as D maintains both a novelty and a quality lead. The low quality attracts low prices and low share. If instead it chooses to produce a novel collection, M can fully close the novelty gap and return the competitive landscape to the standard vertical differentiation setup. It is not forced as far away from the designer in quality terms and is able to charge higher prices while serving more of the market. M will therefore always choose to produce a novel collection if design protection is utilized.

The designer, aware that its novelty lead will be fully eroded if it protects its design, will invest in novelty but will not protect its design. The equilibrium - D produces a novel collection but does not protect, and M imitates once fixed costs are sufficiently low - mirrors the outcome in the parallel case with endogenous quality.

### B.3 The effect of Design Protection when $\lambda > 0$

If design protection is utilized and novelty carries benefits for the firm over and above the ability to suppress imitation, here as in the parallel case with exogenous costs, M faces slightly different choices. If D declines to protect a novel design, M considers if to trail, imitate, produce a novel design without protecting, or produce a novel design and take the protection lead. We again rule out the first and third strategies and consider only the second and fourth. If it opts for the second, M's payoff is given in (B.20). If it chooses the fourth, we solve for optimal prices and payoffs in a manner analogous to that in the previous section given instead a novelty lead by M. Optimal payoffs

become:

$$\pi_d^{np} = \frac{(2(3 - 8\lambda + \sqrt{9 + 24\lambda})^2)}{27(3 + \sqrt{9 + 24\lambda})} - F_d^n; \tag{B.21}$$

$$\pi_m^{np} = \frac{(3 + 16\lambda + \sqrt{9 + 24\lambda})^2}{54(3 + \sqrt{9 + 24\lambda})} - F_m^n. \tag{B.22}$$

Note that the marginal consumer is internal to the support of tastes iff $\lambda < \frac{9}{8}$. M does better to take a protection lead rather than imitating D iff $\lambda$ exceeds:

$$\begin{aligned}\hat{\lambda}' = (&-9 + (729(1405 + 72F_m^n(13 + 9F_m^n)) + 3888(127 - 144F_m^n)\gamma + 497664\gamma^2 + 131072\gamma^3 - 341172\sqrt{9 + 8\gamma} - 227448F_m^n\sqrt{9 + 8\gamma} \\ &- 10368\gamma\sqrt{9 + 8\gamma} + 124416F_m^n\gamma\sqrt{9 + 8\gamma} - 147456\gamma^2\sqrt{9 + 8\gamma} + 113724S_1^e + 87480F_m^nS_1^e + 10368\gamma S_1^e + 62208F_m^n\gamma S_1^e \\ &- 61440\gamma^2 S_1^e - 37908\sqrt{9 + 8\gamma}S_1^e - 23328F_m^n\sqrt{9 + 8\gamma}S_1^e + 10368\gamma\sqrt{9 + 8\gamma}S_1^e + 8192\gamma^2\sqrt{9 + 8\gamma}S_1^e + Z)^{\frac{1}{3}})^2 / \\ &(96(729(1405 + 72F_m^n(13 + 9F_m^n)) + 3888(127 - 144F_m^n)\gamma + 497664\gamma^2 + 131072\gamma^3 - 341172\sqrt{9 + 8\gamma} - 227448F_m^n\sqrt{9 + 8\gamma} \\ &- 10368\gamma\sqrt{9 + 8\gamma} + 124416F_m^n\gamma\sqrt{9 + 8\gamma} - 147456\gamma^2\sqrt{9 + 8\gamma} + 113724S_1^e + 87480F_m^nS_1^e + 10368\gamma S_1^e + 62208F_m^n\gamma S_1^e \\ &- 61440\gamma^2 S_1^e - 37908\sqrt{9 + 8\gamma}S_1^e - 23328F_m^n\sqrt{9 + 8\gamma}S_1^e + 10368\gamma\sqrt{9 + 8\gamma}S_1^e + 8192\gamma^2\sqrt{9 + 8\gamma}S_1^e + Z)^{\frac{1}{3}})\end{aligned} \tag{B.23}$$

where

$$\begin{aligned}Z = (&-531441 + (472392(F_m^n)^2 + 131072\gamma^3 + 2048\gamma^2(243 - 72\sqrt{9 + 8\gamma} - 30S_1^e + 4\sqrt{9 + 8\gamma}S_1^e) + 1296\gamma(381 - 8\sqrt{9 + 8\gamma} \\ &+ 8S_1^e + 8\sqrt{9 + 8\gamma}S_1^e) - 729(-1405 + 468\sqrt{9 + 8\gamma} - 156S_1^e + 52\sqrt{9 + 8\gamma}S_1^e) + 1944F_m^n(351 - 117\sqrt{9 + 8\gamma} \\ &+ 45S_1^e - 12\sqrt{9 + 8\gamma}S_1^e + 32\gamma(-9 + 2\sqrt{9 + 8\gamma} + S_1^e)))^2)^{\frac{1}{2}}\end{aligned} \tag{B.24}$$

Producing a novel collection and protecting is a dominant strategy for the mass-marketer if $\lambda > \hat{\lambda}'$: it can take a novelty lead and attract customers even while it relaxes the quality offered.

Aware of this, the designer will therefore always itself produce a novel collection and protect the design.

Imposition of design protection therefore results in both firms producing novel designs and using the design protection system. Neither firm maintains a protection lead or a novelty lead. Equilibrium prices and qualities are given by:

$$p_d^{np} = \frac{1}{24}(19 + 12(-1 + \bar{\theta})\bar{\theta}); \qquad p_m^{np} = \frac{1}{24}(35 + 12(-3 + \bar{\theta})\bar{\theta}); \tag{B.25}$$

$$s_d^{np} = \bar{\theta} - 1/2; \qquad s_m^{np} = \bar{\theta} - 3/2. \tag{B.26}$$

and equilibrium quantities and profits are given by:

$$q_d^{np} = \frac{2}{3}; \qquad q_m^{np} = \frac{1}{3}; \tag{B.27}$$

$$\pi_d^{np} = \frac{4}{9} - F_d^n; \qquad \pi_m^{np} = \frac{1}{9} - F_m^n. \tag{B.28}$$

### B.3.1 Welfare Effects of Design Protection

If design protection is not available or not utilized (as is the case if $\lambda < \hat{\lambda}'$) and $F_m^n > \hat{F}_m^n$, M will imitate and D will produce a novel collection. We simply substitute for prices and qualities into (2) to give total consumer surplus as:

$$CS_e^{np} = \frac{1}{1944}\left(8\gamma(-387+16\sqrt{9+8\gamma}+8S_1^e) - 3(585-372\sqrt{9+8\gamma}+6S_1^e+20\sqrt{9+8\gamma}S_1^e - 324(-1+\bar{\theta})\bar{\theta})\right). \tag{B.29}$$

and total profit to the firms is given by the sum of (B.19) and (B.20). Total welfare in the no protection benchmark is given by:

$$W^{np-e} = \frac{1}{1944}(-1944F_d^n - 84\sqrt{9+8\gamma}\sqrt{45+32\gamma-12\sqrt{9+8\gamma}} + 8\gamma(-531+80\sqrt{9+8\gamma}+ 40\sqrt{45+32\gamma-12\sqrt{9+8\gamma}}) + 9(-3+80\sqrt{9+8\gamma}+26\sqrt{45+32\gamma-12\sqrt{9+8\gamma}}+108(-1+\bar{\theta})\bar{\theta}-216F_m^n\kappa)) \tag{B.30}$$

If instead design protection is available and $\lambda > \hat{\lambda}'$, both firms will produce novel collections. Again, we substitute for prices ad qualities into (2), and total consumer surplus is now given by:

$$CS_e^p = \frac{1}{72}(-35+36\bar{\theta}(-1+\bar{\theta})) \tag{B.31}$$

and total profit to the firms is given by the terms in (B.21) and (B.22). Total welfare is given by:

$$W^{ipr-e} = \frac{1}{72}(-11-72F_d^n-72F_m^n-12\bar{\theta}+36\bar{\theta}^2) \tag{B.32}$$

If design protection provides sufficient additional benefits to firms, then the increment in welfare if moving from the no protection benchmark to a design rights regime may be expressed as:

$$W_e^{ipr} - W_e^{np} =$$
$$\Delta W_e = \frac{1}{972}\left(729-630\sqrt{9+8\gamma}S_1^e-63S_1^e+6\sqrt{9+8\gamma}S_1^e-4\gamma(-387+80\sqrt{9+8\gamma}+40S_1^e)\right) - F_m^n. \tag{B.33}$$

This expression is negative (that is, welfare is lower with design protection relative to a no protection benchmark) if $\gamma \geq -\frac{9}{8}$; welfare is therefore unambiguously lower in the design protection regime.

So far, then, all results mirror those in the exogenous quality case. Welfare is lower with design protection, even though such protection forces both firms to provide higher quality goods to the market, as this increase in quality does not increase consumer surplus sufficiently to compensate for the loss of the profit associated with the status-related aspect of design.

### B.3.2 Licensing

Now allow for licensing of the design right. Recall that in the no protection benchmark, M will knockoff iff novelty is sufficiently costly. Given that this condition is satisfied, both firms are worse off under design protection.

The benefit to the designer from licensing is the difference between what it would earn if M produces a sanctioned imitation of its protected, novel design and what it would earn absent licensing (if M also produced a novel, protected design). The latter is given in (B.28). If M imitates, D earns:

$$\pi_d^{im-p} = -\frac{(16(\gamma+\lambda)+(3+\sqrt{9+8\gamma+8\lambda})(3+\sqrt{45+32\gamma+32\lambda-12\sqrt{9+8\gamma+8\lambda}}))^2}{486(-6+\sqrt{9+8\gamma+8\lambda}-\sqrt{45+32\gamma+32\lambda-12\sqrt{9+8\gamma+8\lambda}})} \tag{B.34}$$

The benefit to the mass-marketer from entering the license agreement is the difference between what it earns if it produces a licensed copy of the protected design and what it would earn absent licensing (that is, if it also produces a novel, protected collection). If it produces a novel collection, it earns the payoff given in (B.28) and if it imitates D's protected design it earns:

$$\pi_m^{im-p} = -\frac{(-45+16(\gamma+\lambda)+12\sqrt{9+8\gamma+8\lambda}-6S^e+\sqrt{9+8\gamma+8\lambda}S^e)^2}{(486(-6+\sqrt{9+8\gamma+8\lambda}-S^e))}, \tag{B.35}$$
$$S^e = \sqrt{45+32\gamma+32\lambda-12\sqrt{9+8\gamma+8\lambda}}.$$

The bargaining surplus is therefore:

$$T^e = \frac{1}{486}\left(162+486F_m^n-99\sqrt{9+8\gamma+8\lambda}+63S^e-6\sqrt{9+8\gamma+8\lambda}S^e+32(\gamma+\lambda)\left(-9+4\sqrt{9+8\gamma+8\lambda}+2S^e\right)\right) \tag{B.36}$$
$$S^e = \sqrt{45+32\gamma+32\lambda-12\sqrt{9+8\gamma+8\lambda}}.$$

If firms split the bargaining surplus equally, it is again the case that the designer may still be worse off with design protection relative to the no protection benchmark. Firm payoffs under licensing are simply the firm's outside option (what it earns absent licensing) plus $\frac{1}{2}T$ and are defined as:

$$\begin{aligned}\pi_d^{lic} = \frac{1}{972}(594+486F_m^n-99\sqrt{9+8\gamma+8\lambda}+63S^e-6\sqrt{9+8\gamma+8\lambda}S^e+\\ 32\gamma(-9+4\sqrt{9+8\gamma+8\lambda}+2S^e)+32\lambda(-9+4\sqrt{9+8\gamma+8\lambda}+2S^e))-F_d^n;\end{aligned} \tag{B.37}$$

$$\begin{aligned}\pi_m^{lic} = \frac{1}{972}(594+486F_m^n 99\sqrt{9+8\gamma+8\lambda}+63S^e-6\sqrt{9+8\gamma+8\lambda}S^e+\\ 32\gamma(-9+4\sqrt{9+8\gamma+8\lambda}+2S^e)+32\lambda(-9+4\sqrt{9+8\gamma+8\lambda}+2S^e)+\\ \frac{2(16\gamma+(3+\sqrt{9+8\gamma})(3+\sqrt{45+32\gamma-12\sqrt{9+8\gamma}}))^2}{(-6+\sqrt{9+8\gamma}-\sqrt{45+32\gamma-12\sqrt{9+8\gamma}})}.\end{aligned} \tag{B.38}$$

In order to establish whether firms are better off under licensing relative to the no protection case, we compare payoffs under licensing to the payoffs under no protection, given at (B.19) and

(B.20), respectively.

It is again the case that the designer firm is worse off under licensing relative to the no protection case if $\lambda$ and $\gamma$ are sufficiently low. Solutions for the critical values do not admit a convenient analytical expression. We therefore rely on a numerical example:

**Example** Suppose that $\lambda = 0.1$, $\gamma = 0.1$ and $F_m^n = 0.05$. Designer payoff under licensing minus payoff under the no protection framework simplifies to -0.0022961; the designer firm is (just) worse off under design protection, even with licensing, relative to a no protection case.

If instead we suppose that $\lambda = 0.15$, this difference becomes 0.0198941; the designer firm is (just) better off with the design protection in place and a licensing agreement signed than it would be if no protection applies. The model with endogenous quality therefore yields conclusions which are consistent with the ones which may be derived from an examination of the exogenous quality case.

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