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## **ABSTRACT**

In this paper, I provide a theory for the brand-protection strategies to counterfeiting under weak intellectual property rights. My theoretical framework has general implications for endogenous sunk cost investments as a means of deterring counterfeiters. My model incorporates two layers of asymmetric information that counterfeits can incur: counterfeiters fooling consumers, and buyers of counterfeits fooling other consumers. Brands have a number of different tools at their disposal to maintain a separating equilibrium in the face of counterfeits. One of the theoretical predictions of this study is that counterfeit entry would induce incumbent brand to introduce new products. This helps to explain the innovation strategies that authentic firms employ in response to entry by their counterfeiters in the real world. Authentic prices rise if and only if the counterfeit quality is lower than a threshold level. In addition, the model demonstrates how authentic producers could invest in self-enforcement to increase counterfeiters' incentives to separate themselves. Better channel management through company stores and other costly devices are forms of non-price signals and complement a company's own enforcements against counterfeits. These predictions are validated using a unique panel data collected from Chinese shoe companies covering the years 1993-2004. Data further reveal that companies with worse relationships with the government invest more in various self-enforcement strategies, which are effective in reducing counterfeit sales, and that the set of strategies are complements rather than substitutes.

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# 1 Introduction

Brand names have significant economic value and offer a guarantee of quality that generic products often do not match. The inherent value that brand names carry generate incentives for imitation and counterfeiting. As a cover story in *Business Week* declares, “the global counterfeit business is out of control” (February 7, 2005). The World Customs Organization estimates that 512 billion *Euro* of traded world merchandise in 2004 may have been counterfeits (*Business Week*, 2005). Besides the business stealing effect that industries have blamed counterfeits for, counterfeiting could also bring ethical costs (Gino et al, 2010). Therefore, it is pertinent to study and propose marketing strategies that original producers could employ to appropriately countervail counterfeits.

Demand of counterfeits has been explored to some extent in the marketing literature (Bloch et al., 1993; Cordell, et al., 1996; Wee, et al., 1995; and Tom, et al., 1998; Kwong et al. 2003; Wilcox et al 2009; Han et al. 2010), with price, attitudes toward big branded companies, and the need for status signaling being cited as main factors of driving counterfeit demand. On the supply side, a few studies have examined the piracy network effects (Conner and Rumelt, 1991), the legal responsibilities (Olsen and Granzin, 1993), and firms’ internal organizations in complementing weak IPR enforcement (Zhao, 2006). Enlightening as these studies are, the economic impacts of counterfeits and the corresponding marketing strategies are not fully understood yet. Grossman and Shapiro (1988, 1989) discuss counterfeit impacts primarily in the international trade settings and their theoretical predictions cannot fully explain the recent empirical findings. In particular, counterfeiters attempt to infringe upon brands and may generate asymmetric information complexities to fool consumers. The findings in Qian (2008) that authentic companies strive to upgrade quality and build company stores after counterfeiters enter demonstrate the value of disentangling the asymmetric information for consumers. These strategies can also broadly be considered as endogenous sunk costs (ESC), a term first introduced by Sutton (1991).

I build upon a vertical differentiation model (Gabszewicz and Thisse, 1979 and 1980) with endogenous quality and other endogenous sunk costs (ESC) to analyze brand-protection strategies to counter counterfeit entry. I introduce quality options for the authentic producer, who chooses quality according to its potential to yield higher profits. I first analyze price competition with a

given quality (one per firm) under the entry game, and then look at the *ex ante* choice of quality. This endogenization of quality setting helps to resolve the counter-intuitive observations in practice that authentic prices often times rise after entry by counterfeiters (Barnett, 2005). This study derives conditions under which quality can be used as one of the key strategic decision variables to combat counterfeits.

In addition, I model two layers of asymmetric information that counterfeits frequently generate: First, and perhaps most important, asymmetric information lies between the counterfeiter and buyers. I model this through a fraction of consumers who cannot distinguish counterfeits from authentic goods when they are sold at the same price. National surveys indicate that the majority of consumers who purchased counterfeits (98% for cigar and 70% in footwear) thought they were authentic. Second, some buyers may show off the counterfeits to signal their fake status. I model such asymmetric information among consumers by a positive probability that a consumer who wears counterfeits cannot be discerned by others and hence derive the full utility on brand premium.

I take into account asymmetric information by building on the literature of quality uncertainty. Price is the conventional signal for product quality, but Nelson (1974) points out the importance of advertisement as a form of non-price signal for quality. Milgrom and Roberts (1986) argue that prices are better signals for quality than non-price signals (notably advertisements) unless repeated purchase is assumed. Moorthy and Srinivasan (1995) propose money back guarantees as another effective signal for quality. Despite the sophistication of the previous literature, the models only considered a monopolistic market and assumed exogenous quality levels. Since counterfeiters attempt to copy authentic products and usually produce an inferior quality, the competition is more vertical in nature. Metrick and Zeckhauser (1999) use a simplified vertical differentiation framework to model competition under asymmetric information. However, their models are still confined to exogenous quality, and they derive equilibrium market shares in a price-pooling equilibrium, which is helpful for explaining certain sector equilibria but not applicable to most counterfeit markets.

In sum, my model captures the defining characteristic of counterfeits, i.e., the intent to deceive, by incorporating both layers of asymmetric information pertaining to counterfeits. The

framework enriches the analysis of a broad set of instruments that authentic producers can use to combat counterfeits: prices, quality, signaling and enforcement devices. I argue that these strategic instruments can play important roles in the context of price rivalry and asymmetric information. The analysis in this paper conceptualizes many insights of interest to marketing academics and practitioners alike.

First, I highlight the strategic nature of *quality differentiation*, and analytically reveal the two functionalities of quality upgrades in the face of counterfeiting: 1. widening quality gap to alleviate competition, and 2. reducing asymmetric information brought by counterfeiting. Such practices are observed among various companies, ranging from Microsoft's software encryptions to shoe companies' quality upgrades in China in the mid-1990s (Qian, 2008). This study provides one of the first analyses on the conditions under which entry would lead to innovation. In particular, I show that incumbent seeks to innovate only when the counterfeit quality is within a range. If the counterfeit quality is too low, then it does not pose sufficient threat to induce innovation. If the entrant quality is too high, then innovation may not be effective to alleviate competition. The predictions shed new lights on the debates in the economics literature on the relationship between competition and innovation.

Second, I analytically parse out the price increase due to entry into its two parts: that due to the actual quality increase, and that due to the *price signaling effect*. Specifically, I show that price increases are greater than would be seen if they only reflected actual quality increases. I show that price signaling can be a separating strategy for the authentic company to self-differentiate from the counterfeits. The higher price in essence results from authentic producer's constrained optimization to force counterfeiters out of the pooling equilibrium. This is a viable strategy when there is a sufficiently large fraction of expert consumers in the market who can perfectly tell counterfeits apart, and will therefore only purchase counterfeits at a sufficiently low price.

Third, the analysis here offers many new strategic insights for brand management. I show that non-price signals such as holograms could also enlarge the parameter range for a separating equilibrium to obtain. Authentic companies' investments in self-enforcements and in vertical integration of downstream retail stores could also effectively combat counterfeits. These measures can be broadly considered as ESC, and adds to the stream of literature on this topic (Sutton,

1991; Athey and Schmutzler, 2001). The results on the benefits of establishing the company stores complement efficiency arguments of downstream vertical integration in McGuire and Staelin (1983) and provide new insights on the channel-management literature (Desai, et al., 2004; Coughlan, Anderson, Stern and El-Ansary, 2006).

Last but not least, the main theoretical predictions are buttressed by empirical analysis of a new panel dataset that I collected from the Chinese footwear industry. This panel data includes detailed prices, production costs, quality dimensions, and financial statements of a representative sample of branded companies and their corresponding counterfeits. Stratified analysis on different clusters of products with counterfeit entry of different quality levels reveal that authentic price increases post-entry are observed mainly in the stratum of products that were infringed by relatively low-quality counterfeits. In addition, companies' self-enforcement investments are shown to significantly correlate with the reduction in counterfeit entry or sales. All these findings align with the theoretical predictions, and support the intuition that supply side initiatives may be best for countering counterfeits (Bian and Moutinho 2009; Penz and Stottinger 2008). This research enriches a Teecean perspective: a substantial portion of the rents from innovation arise not from technological novelty but from embedding innovation in brands and distribution systems insulated from fringe competition.

The rest of the paper is organized as follows. Section 2 develops the model used in our analysis. Section 3 analyzes the various endogenous sunk costs and their implications for brand protections. Section 4 takes theoretical predictions to data and finds empirical validations. Finally, Section 5 summarizes the managerial insights and concludes with suggestions for future research.

## 2 Model

Following the tradition of vertical differentiation models, I characterize a good with a quality index  $s_i$ , where  $i$  indexes company  $i$ . There is at first one original producer with the option of producing two qualities:  $s_L = s, s_H = Ms$ , where  $M > 1$ . The additional unit costs of producing the  $Ms$  quality versus the  $s$  quality is  $c$ . She opts into one quality level that yields most profits. Each consumer consumes one unit of a product or none, and derives utility  $U = Vs_i - P_i$  if one unit with quality  $s_i$  is consumed at price  $P_i$ , and  $U = 0$  otherwise. All consumers prefer high quality,

given the same price. However, consumer heterogeneity in taste is captured by  $V$ : the distribution of  $V$  in the economy,  $f(V)$ , is uniform on  $[0, 1]$ .

When counterfeiter enters with a product of quality  $s_c = ms$ ,  $m \leq 1^1$ , the counterfeiter and incumbent play a duopoly game. Let  $P_a, P_c$  be the prices for the incumbent and counterfeit goods, respectively. I assume counterfeit quality is exogenously given because counterfeiters have limited technology available relative to authentic producers.<sup>2</sup> I assume the marginal costs of producing the low-quality authentic and counterfeit products are zero to simplify the model. Robustness checks without this assumption is derived in Appendix 6.3. The sequence of events is:

1. Authentic producer chooses her quality and sets the corresponding optimal price;
2. Counterfeiter decides whether to enter. If he enters, he picks his price, recognizing that he relies on the resemblance to sell his product due to technology limitations in matching the authentic quality;
3. Each consumer purchases one unit from the brand or counterfeiter, or nothing.

With the intention of fooling some consumers, counterfeiters would like to wait until authentic qualities and prices are set before setting his. Therefore, this leadership-follower game setting is more reasonable than a Bertrand one. The results under simultaneous Bertrand moves are qualitatively similar, and are available upon request.

## 2.1 Branded Monopoly without Counterfeiting

I solve the game backwards to find the equilibrium level of prices, quality, and purchase decisions. In the event that there is no counterfeiter, the brandname producer is the monopoly. Given quality  $s_a$  of the authentic product, the lowest valuation among consumers who purchase is  $\underline{V}s_a - P_a = 0$ , implying that  $\underline{V} = \frac{P_a}{s_a}$ . This yields the demand

$$D(P_a) = \begin{cases} \int_{\underline{V}}^1 f(V)dV = 1 - \underline{V} = 1 - \frac{P_a}{s_a} & \text{if } P_a < s_a \\ 0 & \text{otherwise} \end{cases}$$

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<sup>1</sup>Both news articles and my own data reveal that counterfeiters offer inferior quality most times. The rare scenario of equal quality by counterfeiters and the authentic producer is captured in the case of  $m = 1$ .

<sup>2</sup>Furthermore, in some countries, the counterfeiters cannot import fancy materials and equipment because they are not legitimately-registered companies and have no permits for imports (Qian, 2008).

The authentic producer maximizes profits  $\Pi_a^M = (P_a - c_a)D(P_a)$  w.r.t.  $P_a$ , resulting in the equilibrium price  $P_a^M = \frac{s_a+c_a}{2}$ , the optimized monopoly profits  $\Pi_a^M = \frac{(c_a-s_a)^2}{4s_a}$ .

In deciding which quality level to offer, the producer substitutes in the two quality values ( $s$  or  $Ms$ ) in the optimized profit function above and chooses the one that yields a higher profit. In Appendix A, I establish the proof for

**Lemma 1** *Without counterfeits,  $s$  is offered instead of  $Ms$  iff  $\frac{c}{s} \geq M - \sqrt{M}$ .*

When higher quality would raise costs more than it would yield profits, the monopoly incumbent offers a lower quality.

## 2.2 Market with Counterfeits

In a market where authentic and counterfeit producers coexist, the price, quality, quantity, and other marketing dynamics are more complicated. I first consider the case that consumers have perfect information on quality. In some circumstances, counterfeits are sold in very different markets from the authentic products (Canal Street in New York City, U.S.A., for instance), or are made of very inferior materials that one can detect instantly. However, these are certainly not the exclusive channels for counterfeit transactions. For instance, when interviewing the branded shoe companies and shopping malls in China, 40% of consumers told me that they or their friends had purchased counterfeits unintentionally. I will relax the perfect information assumption in the next sections and compare with this benchmark case.

### 2.2.1 Non-deceptive Counterfeits: a Benchmark

For any quality level  $s_a (a = H, L)$  that the authentic producer chooses, she is the leader and sets her price first, taking into account that the counterfeiter will set his price according to hers. Note that the consumer who is completely indifferent between purchasing the authentic and counterfeit product has a valuation:  $\underline{V}s_a - P_a = \underline{V}ms - P_c$ , which implies  $\underline{V} = \frac{P_a - P_c}{s_a - ms}$ . Similarly, the consumer who is indifferent between purchasing counterfeits and purchasing nothing has the valuation of  $\frac{P_c}{ms}$ . It then follows that the players' profit functions are:

$$\begin{aligned}\Pi_a^D &= (P_a - c_a)\left(1 - \frac{P_a - P_c}{s_a - ms}\right); \\ \Pi_c^D &= P_c\left(\frac{P_a - P_c}{s_a - ms} - \frac{P_c}{ms}\right).\end{aligned}$$

It is easy to derive that, given any brand price  $P_a$ , the profit-maximizing price for the counterfeit is  $P_c = \frac{msP_a}{2s_a}$ . The brand therefore sets her price by maximizing

$$\Pi_a^D = (P_a - c_a)(1 - \frac{P_a - \frac{msP_a}{2s_a}}{s_a - ms}),$$

yielding

$$\begin{aligned} P_a^D &= \frac{s_a(s_a - ms)}{2s_a - ms} + \frac{c_a}{2} \\ P_c^D &= \frac{ms(s_a - ms)}{4s_a - 2ms} + \frac{msc_a}{4s_a} \\ D_a^D &= \frac{1}{2} - \frac{(2M - m)c_a}{4M(M - m)s}. \end{aligned}$$

To determine which quality level to pick in the first place, the brand compares the maximum profits attainable with optimized prices under each quality level (high or low), and chooses the quality that yields a larger profit among the two options. Proposition 1 gives the condition under which the brand would choose the lower quality in the monopoly setting, and the following proposition suggests conditions under which she would choose the higher quality when faced with competition.

**Lemma 2** *With counterfeiting,  $Ms$  is offered by the brand iff  $\frac{c}{s} \leq \frac{2M(M-m)}{2M-m} - \sqrt{\frac{(1-m)4M(M-m)}{(2-m)(2M-m)}}$ .*

Brand upgrades quality in the hope of alleviating competition by widening the quality gap, provided that the additional costs are not too high. It is easily verified using the derived equilibrium prices that should the authentic firm produce the same quality as without counterfeits, its price will drop with competition, similar to predictions from prior entry models with exogenously given quality (eg. Fudenberg and Tirole, 2000). However, this study more importantly pinpoints the previously unexplored interplay of quality and price dynamics when both can be endogenously chosen by the brand, as in the following proposition.

**Proposition 1** *Under the conditions specified in Lemmas 1 and 2, the brand upgrades quality in the face of counterfeiting. Her price rises if the counterfeit quality  $s_c$  is below a certain cutoff value, which is an increasing function of  $M$  and  $s$ .*

It is worth noting the conditions on the incremental cost of introducing the higher quality (including R&D costs and production costs) in order to have the innovation and price raise. The cost has to be large enough to dissuade the brand from investing in higher quality as a monopoly

(Lemma 1), yet still be surmountable (Lemma 2) so that she is willing to produce the higher quality when faced with counterfeits' competition.

The theoretical result that the threshold value for the entry quality is increasing in  $M$  and  $s$  is again very intuitive. In particular, higher  $Ms$  implies larger gap between the counterfeit quality and the high authentic quality. It therefore allows for a wider range of counterfeit product quality where the brand finds it profitable to raise price.

The key propositions hold with wider parameter ranges in the variant case where consumers signal their social status through a low-cost counterfeit purchase, as in the next subsection.

### 2.2.2 When Buyers Fool Others through Counterfeit Status Signaling

Section 2.2 analyzes a typical market where some consumers are conned into buying counterfeits. Another type of market exists in practice where consumers often knowingly purchase counterfeits to signal their status to friends at a low cost. For instance, the fact that the fake Coach bags, Chanel perfume, and Nike shoes sold for a small fraction of the cost of the legitimate products in street corners are quite evident to the consumers that they are not authentic products to begin with. Counterfeits serve to unbundle the prestige and quality attributes of branded products (Grossman and Shapiro, 1988). In this case, the asymmetric information lies between the purchaser of counterfeits and other consumers instead of between the counterfeiter and the buyer. In this section, I analyze the implications of this layer of asymmetric information.

I model this asymmetric information by recognizing the key feature of counterfeits that allows buyers to enjoy an imperfect fraction of the brand premium without having to pay for the authentic quality. So the consumer utility derived from purchasing one unit of the authentic product is  $U_a = V * s_a + r - p_a$ , and from purchasing one unit of the counterfeit is  $U_c = V * s_c + \lambda * r - p_c$ , where  $0 \leq \lambda \leq 1$ . If the buyer of the counterfeit cannot be discerned by others as wearing a counterfeit, then s/he acquire the full status signaling ( $\lambda = 1$ ).

In a market without counterfeits, the consumer who is just indifferent between purchasing the authentic product and nothing has a valuation of  $\underline{V} = \frac{P_a - r}{s_a}$ . The equilibrium price and quantities can be derived by maximizing profits  $\Pi_a^M = (P_a - c_a) * D(P_a) = (P_a - c_a) * (1 - \frac{P_a - r}{s_a})$ .

This yields:

$$\begin{aligned}
P_a^M &= \frac{s_a + c_a + r}{2} \\
\Pi_a^M &= \frac{(s_a + r - c_a)^2}{4s_a} \\
D_a^M &= 1 - \frac{s_a + c_a - r}{2s_a}.
\end{aligned} \tag{1}$$

**Proposition 2** *Without counterfeits, authentic producer with brand premium  $r$  offers product with quality  $s$  instead of  $Ms$  iff  $c \geq (\sqrt{M} - 1)(\sqrt{M}s - r)$ .*

*Proof:* Solve  $\Pi_{Ms}^M \leq \Pi_s^M$  by substituting in the equilibrium profits,  $\frac{(s+r)^2}{4s} \geq \frac{(Ms+r-c)^2}{4Ms}$ . Rearranging the terms immediately gives the condition  $c \geq (\sqrt{M} - 1)(\sqrt{M}s - r)$ . *Q.E.D.*

The intuition is similar to those explained in Section 2.1. Moreover, we could rearrange the terms in the condition to obtain  $r \geq \sqrt{M}s - \frac{c}{\sqrt{M}-1}$ . The proposition is equivalent to stating that authentic monopoly will offer a lower quality iff its brand premium is high enough. This suggests that brand premium and quality can be considered substitutes to some extent. When the brand premium is very high, then the authentic producer has less incentive to develop a high quality product without competition in the market.

With counterfeits in the market, the consumer who is just indifferent between purchasing a counterfeit and an authentic product has valuation  $\underline{V} = \frac{P_a - P_c - (1-\lambda)r}{s_a - ms}$ , and the consumer who is indifferent between counterfeit and nothing has valuation  $\frac{P_c - \lambda * r}{ms}$ . Following the same derivation as in Section 2.2.1, the equilibrium conditions in the game is:

$$\begin{aligned}
P_a &= \frac{2M(M-m)s + (M\lambda - m)r}{2(2M-m)} + \frac{c_a}{2} \\
P_c &= \frac{m(P_a - r)}{2M} + \frac{\lambda * r}{2} \\
D_a &= \frac{1}{2} - \frac{(2M-m)c_a}{4M(M-m)s} + \frac{(4M-m-3M\lambda)r}{4M(M-m)s} \\
D_c &= \frac{3M-2m}{2(2M-m)} + \frac{(3M-2m)c_a}{4M(M-m)s} - \frac{(4M^2-7Mm+2m^2+M^2\lambda)r}{4M(M-m)(2M-m)s} - \frac{\lambda r}{2ms}.
\end{aligned}$$

Again, competition from counterfeits could stimulate authentic innovation if the higher quality  $Ms$  yields a higher profit than the regular quality  $s$ . Propositions 2 and 3 can be rederived here with new threshold values for  $c$  and  $s_c$ .

**Proposition 3** *When consumers of counterfeits could derive utility from the infringed brand status, authentic producer has incentive to upgrade quality iff the innovation cost is below a threshold level, and the authentic price will increase iff the counterfeit quality  $s_c < \bar{s}_c$  where the threshold value of  $\bar{s}_c$  is increasing in  $s, \lambda$ .*

*Proof:* First, solve  $\Pi_{Ms}^D > \Pi_s^D$ . Substituting in the duopoly equilibrium profits and rearrange terms, we have  $\frac{2M-m}{8M(M-m)s}c^2 - c * B + C > 0$ , where  $B = \frac{2M-m+1}{4(2M-m)} + \frac{(2M-m+1)(M\lambda-m)r}{8M(M-m)(2M-m)s}$  and  $C = \left(\frac{2M(M-m)}{2M-m} - \frac{1-m}{2-m}\right)\frac{s}{2} + \frac{m(M-1)(2-\lambda)}{2(2M-m)(2-m)}r + \frac{2M(M-m)s+(M\lambda-m)r}{2(2M-m)}\frac{(M\lambda-m)r}{4M(M-m)s} - \frac{2(1-m)s+(\lambda-m)r}{2(2-m)}\frac{(\lambda-m)r}{4(1-m)s}$ . Ruling out the negative root, the authentic profit derived from the high quality product exceeds that from the low quality one iff  $c < \frac{B + \frac{B^2 - \frac{2M-m}{2M(M-m)s}C}{2M-m}}{\frac{2M-m}{4M(M-m)s}}$ .

In addition, price of the authentic high-quality product would increase as compared to the monopoly case with a regular quality iff  $\frac{2M(M-m)s+(M\lambda-m)r}{2(2M-m)} + \frac{c_{Ms}}{2} > \frac{s+r+c_s}{2}$ . This implies  $2M * s_a - 2M * s_c + (c_{Ms} - c_s)(2M - m) > 2s_a - s_c + M(2 - \lambda)r$ , where  $s_a = Ms$ ,  $c_{Ms} - c_s = c$ . This condition is satisfied iff  $s_c < \frac{2(M-1)s_a + (2M-m)c - M(2-\lambda)r}{2M-1} \equiv \bar{s}_c$ . Note that  $\frac{\partial \bar{s}_c}{\partial s} = \frac{2M(M-1)}{2M-1} > 0$  and  $\frac{\partial \bar{s}_c}{\partial \lambda} = \frac{Mr}{2M-1} > 0$ . *Q.E.D.*

The intuitions remain similar that quality and price increases if the cost of innovation is not too high and the counterfeit quality is low as compared to the innovated quality. In addition, the more status signaling a consumer are able to fake from utilizing the counterfeit, the more urgency that authentic company has to self-differentiate through quality and price. The detailed proofs are in the Appendix.

One special case of the model is interesting to consider. Some customers may attach zero status signaling on the counterfeits, i.e.  $\lambda = 0$ . These customers can be considered the “moral experts”, as they have no intention to fool their friends and other consumers. From the equilibrium conditions derived above, the equilibrium prices will be lower and demand for authentic products will be higher when consumers are “moral experts”. The equilibrium demand for counterfeits is lower in this scenario too.

### 2.2.3 Deceptive Counterfeits: When Counterfeitors Fool Buyers

Asymmetric information is important in the context of counterfeiting, as many articles and news stories reveal how consumers are conned into buying counterfeits.<sup>3</sup> I assume that there is a fraction,  $\gamma$ , of consumers who can distinguish between authentic qualities  $s$  and  $Ms$ , but may not be able to tell counterfeits from their authentic counterparts at the same price, at least not until after the purchase. This setup is not unfounded. In particular, authentic producers tend to provide detailed information about their products in order to build reputation and brand recognition. Notably, brands list product attributes and materials in their product catalogs. They also have “customer service hot-lines” to address questions. Counterfeitors, on the other hand, mostly try to mimic the appearance of authentic products and misrepresent attributes to extract short-term windfalls.

“Price is unquestionably one of the most important marketplace cues” (Lichtenstein et al., 1993). The model here allows these confused consumers to infer quality information when different prices are charged. This fraction,  $\gamma$ , of consumers hold a prior belief on the probability a good is authentic or counterfeit:  $\mu(\theta_a) = b$  and  $\mu(\theta_c) = 1 - b$ . These consumers (henceforth called *novices*) are drawn uniformly from all the consumers in the taste  $V$  distribution.<sup>4</sup> They update their beliefs about seller’s type after observing prices. Let  $\mu(\phi_i|p) = 1$  denote consumers’ updated posterior beliefs about seller  $i$ ’s type being exactly  $\phi = \phi_i$ . The other  $1 - \gamma$  fraction of consumers are experts in the product (henceforth called *experts*) and know exactly the quality of the product they are purchasing. They may purchase counterfeits at a lower price depending on their individual willingness to trade off quality for price (similar to the case with complete information).

I handle the technical issue of out-of-equilibrium beliefs using an existing refinement (eg. Simester 1995, Feltovich et al 2001, Harbaugh and To 2008). In particular, I apply the popular Divinity Criterion (D1) (Banks and Sobel, 1987), which is a variant to the intuitive criterion (Cho and Kreps, 1987) to refine the set of perfect Bayesian equilibria. Suppose that the counterfeiter type benefits from deviations under a set of best responses associated with possible out-of-equilibrium

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<sup>3</sup>Chinese media reported a few years ago that a lady bought a pair of Nike shoes on sale, but only one month later, they fell apart. Her happiness in catching the sale turned into indignation, and she sued the NIKE branch in Shanghai. She then found out that the pair she got was a counterfeit version.

<sup>4</sup>Relaxing this assumption and drawing them more heavily from the low valuation consumers would not qualitatively change the results.

beliefs. D1 then requires that the consumer does not believe that the deviating type is an authentic producer. More generally, suppose that in deviation  $p \neq P^*$ , the counterfeiter is more likely to yield higher profit than in equilibrium under a bigger set of best responses from the consumer than an authentic product does. D1 then requires that the consumer does not believe that the product could be authentic. I detail the D1 criterion and its applications in this setting (both separating and pooling equilibria) in Appendix A.3.

The counterfeiter ideally wants to pretend that its products are authentic and to charge the same authentic price so as to split the original monopoly profit. However, he soon realizes that the expert consumers will not buy the counterfeits at the same price as the authentic price. Under such pricing strategies, the perception of the novices on the quality of any product will drop:  $s^{pe} = bs_a + (1-b)s_c < s_a$ , and they will decide whether to purchase any product based on the utility function of this expected quality. The counterfeiter reconsiders his pricing strategy accordingly, by comparing the separating and pooling equilibria profits:  $\Pi_c^{se} = P_c(\frac{P_a - P_c}{s_a - ms} - \frac{P_c}{ms})$  and  $\Pi_c^{pe} = \frac{\gamma}{2}P_a(1 - \frac{P_a}{s^{pe}})$ .

If the counterfeiter chooses to separate with a different price from the authentic price, then all consumers can tell the products apart based on the model setup, and the resulting prices and profits can be easily solved as in Section 2.1. In particular, the reaction function is  $P_c = \frac{msP_a}{2s_a} = \frac{mP_a}{2M}$ , where  $M \geq 1$  encapsulates any authentic producer's movements along the quality ladder: equal to or above  $s$ . The counterfeiter prefers a separating equilibrium iff  $\Pi_c^{se} \geq \Pi_c^{pe}$ . With the above reaction function, this inequality implies that

$$P_a \geq \frac{2\gamma(M-m)M(m-bm+bM)s}{m^2 - bm^2 + bmM + 2M\gamma(M-m)} \equiv \underline{P} \quad (2)$$

where  $\underline{P}$  is then a cutoff value of the authentic price, above which the counterfeiter prefers to separate and below which the counterfeiter prefers to pool with the authentic producer. I assume that at the cutoff value, the counterfeiter chooses to separate (reveal as generics) for fear of the potential legal consequences of cheating. I will explicitly model such legal consequences and enforcement in Section 2.3.2.

Bearing in mind the counterfeiter's strategy, the authentic producer attempts to maximize

her profits subject to condition (1), when setting her price as a leader. Mathematically, she solves:

$$\begin{aligned} \max \Pi_a^{se} &= (P - c_a)(1 - \frac{P - \frac{mP}{2M}}{(M - m)s}) \\ \text{s.t. } P &\geq \underline{P} \\ \max \Pi_a^{pe} &= (1 - \gamma)(P - c_a)(1 - \frac{P}{Ms}) + \frac{\gamma}{2}(P - c_a)(1 - \frac{P}{bMs + (1-b)ms}) \\ \text{s.t. } P &< \underline{P} \end{aligned}$$

and decides whether to set  $P_a^{se}$ ,  $\underline{P}$ , or  $P_a^{pe}$  depending on which would yield the largest profits,  $\Pi_a^{se}$ ,  $\Pi_a^{pe}$ , or  $\Pi_a^{pe}$ , respectively. In particular, I denote the constrained separating profits (profits obtained at  $\underline{P}$ ) as  $\Pi_a^{se}$ . I assume that whenever profits are equivalent, the authentic producer chooses to separate from the counterfeits. Several results follow from here, with detailed proofs in the Appendix.

**Lemma 3** *The brand may raise price (above the monopoly price level associated with a given quality) after counterfeiter's entry to distinguish herself from the counterfeiter who has no incentive to pool with such a high price level. This is the **price signaling effect**.*

Theoretically, this signaling effect occurs when the optimal authentic price is the corner solution at the constrained equilibrium. Intuitively, charging higher price is a viable separating strategy for the brand largely due to the presence of the experts, who will purchase counterfeits only at a low price. Therefore, at a sufficiently high price, a counterfeiter does not have enough incentive to pool with the brand. Given a sufficiently large proportion of novices ( $\gamma$ ) and sufficient quality gap ( $m$ ), it is worthwhile for the brand to price higher in order to signal her quality. The benefits of capturing the “novices” outweigh the costs of losing some low valuation consumers who may not purchase at the constrained high price. Such signaling effect could prevail with or without authentic quality change, in theory, as long as it is the solution for the constrained optimization.

After working out the equilibrium prices for the same quality of the brand, it is natural to consider how the conditions differ if authentic quality changes due to counterfeiting. The alternative quality strategies can be best divided into two cases, both starting from quality  $s$ : 1. “*striving for the better*”: she improves quality to  $Ms$ ; 2. “*racing to the bottom*”: she degrades quality to  $ms$ . For each case, I derive the pooling and separating equilibria in the appendices. For notational convenience, I also denote the strategy with no quality change as Strategy 3. With a few supplemental lemmas and proofs as detailed in the appendices, I arrive at the following result:

**Proposition 4** *Counterfeiting can induce the brand price to rise under a wide range of parameter values: First, the brand charges a higher price on the upgraded quality if the counterfeit quality  $s_c$  is below a certain cutoff value, which is an increasing function of  $M$  and  $s$ . Second, even if the brand retains the quality, she may charge a high price to signal superior quality and to distinguish herself from the counterfeiter.*

The finding here that asymmetric information enlarges the parameter range for price increases helps to explain why we observe authentic prices hike more often in response to counterfeit entry than to entry by other branded or generic producers. The manager of Pfizer in the Shanghai office commented that once counterfeits are gone as a result of the government's strengthened enforcement ("yan da"), they would have to lower prices because consumers would no longer be willing to pay extra for the brand authenticity.

When extending the model to monopolist competition with multiple brands, the intuition is very similar to the benchmark model here. Relevant competition occurs mainly among firms that are adjacent in the quality hierarchy, and counterfeit entry affects the infringed brands most (Appendix A.5.3). Key predictions hold when extending the model to a brand with multiple products (Qian 2011).

### 2.3 Brand Protection Strategies

The previous section suggests quality differentiation and price signaling as strategies against counterfeits. In this section, I further explore a set of brand-protection strategies. The analyses shed lights on a plethora of strategic decision variables and enrich the competition model under examination. It further complements the Endogenous Sunk Costs (ESC) literature. ESC are fixed costs that firms can choose to invest in, which affect the price-cost margin of a firm. Sutton (1991) argues that the incentive for firms to invest in ESC increases as the market expands, and thereby limiting the number of firms that can profitably remain in the market. I examine and propose the set of ESC in the context of counterfeiting.

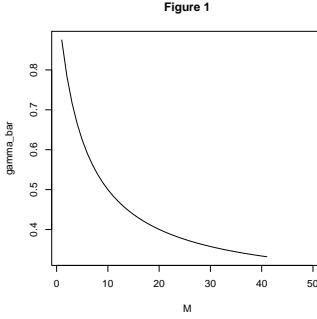


Figure 1: Comparative Statistic of  $\bar{\gamma}$  and  $M$ .

### 2.3.1 Further Implications of Quality

Besides quality differentiation, the model here illuminates another strategic function of quality upgrades in the face of counterfeiting. From the threshold value of the fraction of expert consumers to ensure separating equilibrium,  $\bar{\gamma}$ , that satisfies the binding condition in formula (1), I plot the comparative static of  $\bar{\gamma}$  as the authentic quality improvements  $M$  increases ( $\frac{\partial \bar{\gamma}}{\partial M}$ ) in Figure 1, given a set of other parameter values. Here, the set of *ceteras parabis* values are:  $c = 0.5, m = 0.5, b = 0.5, s = 1$ . The negative relationship between  $\bar{\gamma}$  and  $M$  holds under alternative specifications of parameter values as long as the  $\bar{\gamma}$  values are kept at the meaningful positive range.

Intuitively, the higher the authentic quality is as compared to the counterfeit, the lower is the upper bound for the fraction of novices to induce a separating equilibrium in prices. In other words, consumer expertise in detecting counterfeits and authentic quality improvements,  $M$ , are substitutes.  $\gamma_{\bar{M}s} < \bar{\gamma}_s$ . When the authentic producer adopts a higher quality, notably better materials (e.g. crocodile skins instead of cow skins), to produce its shoes, it naturally charges a higher price that counterfeiters would not pool with. In sum, this drop in  $\bar{\gamma}$  indicates that the authentic producer, by increasing its own quality, is less affected by counterfeits in two dimensions: first, she faces less competition from counterfeits with a more different product, and second, the widened quality gap helps to disentangle information friction so that counterfeits can fool fewer consumers.

As we see in Section 2.2.2 and the Appendix, the drop in  $\bar{\gamma}$  is also important for providing incentives for the counterfeiter to choose a separating equilibrium price, because he would enjoy a

diminished fraction of consumers in the pooling equilibrium and may be better off charging a lower price to increase market share. In this scenario, the brand is more likely to provide a higher quality product when counterfeiter enters.

### 2.3.2 Enforcement

Enforcement activities against counterfeits (either publicly lobbying or privately funding spot-checks) are taken by many authentic companies. Notably, luxury house LVMH assigned approximately 60 full-time employees on anti-counterfeiting, in collaboration with a wide network of outside investigators and a team of lawyers, and spent more than \$16 million on investigations and legal fees in 2004 alone. In the Chinese shoe market, authentic firms send their own employees to walk around the market as consumers and track down counterfeiters. They then report the discoveries to the local government, the Quality and Technology Supervision Bureau (QTSB) in particular, and have them close down these counterfeit sources and outlaw illegal companies. Intuitively, these enforcement investments increase the odds that counterfeits will be confiscated and major counterfeiters will be jailed. Most times, successful enforcement cases are announced in newspapers to caution consumers and to deter future counterfeits. The risk of such penalties reduces incentives for counterfeiting and favors the separating equilibrium. The effects of enforcement on counterfeit deterrences and on authentic prices are examined here.

To weave the above intuition into my model, suppose that with probability  $w(e)$ , which is an increasing function of  $e$ , counterfeiters are fined  $-\frac{\gamma \Pi^{pe}}{2}$ . Note that branded companies that have better relationship with the government have a higher  $w$  given the same investment  $e$ . Now the IC constraint for the counterfeiter  $IC(1) : \Pi_{imitate}^{se} \geq (1-w)\gamma \frac{\Pi_{pe}}{2} + w(-\gamma \frac{\Pi_{pe}}{2})$  implies that he would separate iff

$$P_a \geq \frac{2(M-m)M(b(M-m)+m)s\gamma}{2M\gamma(M-m)+\frac{m^2+bm(M-m)}{1-2w}} \equiv \underline{P}^e.$$

For  $w \in (0, 1]$ ,  $\underline{P}^e < \underline{P}$ , so this is a looser condition for a separating equilibrium – the counterfeiter has less incentive to pool than to reveal as a low-quality producer. In addition, as the winning probability  $w$  increases,  $\underline{P}^e$  drops, favoring the separating equilibrium.

The separating equilibrium incentive constraint also relaxes for the authentic producer, and is  $IC(2) : \min[\Pi_a^{se}, \Pi_a^e] \geq \Pi_a^{pe} \ \& \ P_a \geq \underline{P}$

Define the authentic profit with enforcement investments  $\Pi_a^e = w\Pi^{se} + (1 - w)\Pi^{pe} - e$ , then we notice that it is no higher than the optimal separating equilibrium profit, if attainable, without enforcement investments. If, however, the natural separating equilibrium is not attainable (because optimal separating equilibrium price is lower than  $\underline{P}$ ), then the enforcement activities can be profitable if  $\Pi_a^e \geq \Pi_a^{pe}$ . *i.e.*,  $e \leq w(\Pi_a^{se} - \Pi_a^{pe})$ . Together with the condition that  $P_a^e \geq \underline{P}^e$ , the authentic producer has incentives to invest in enforcement. In addition, we see in the previous section that separating equilibrium profit exceeds pooling equilibrium profit more when there are a larger fraction of novices in the market. It then follows from the inequality conditions here that the incentive to invest in self-enforcement increases as information asymmetry worsens. We therefore have

**Proposition 5** *Enforcement activities add risks and costs to counterfeiters, thereby favoring a separating equilibrium. The brand would upgrade quality iff the conditions for the R&D costs and counterfeit quality are fulfilled as in Proposition 2.*

An article in the *Wall Street Journal* reports another real-world example on self-enforcement. Luxury-goods companies like LVMH lobbied governments to announce it illegal not only to manufacture and sell counterfeits, but also to participate in leasing, shipping, and any other part of the supply chain that leads to the sale of counterfeit wares (Galloni, 2006). In my interviews and field studies in China, a few brands shared stories on how their tight connection with the government helps deterring counterfeits. For instance, the brands that get faster government responses in tracking down their counterfeits experienced less counterfeiting.

### 2.3.3 Non-price Signals

While price is a typical signal of quality and authenticity, as derived in Section 2.2.2, are there additional signaling devices besides price? These devices could be forms of either fixed-cost investment, such as licensed company stores where authentic producer display exclusive licenses obtained from the Bureau of Industrial Commerce (Qian, 2008), or marginal-cost investment, such as costly holograms and packaging (Wall Street Journal, 2006).

Intuitively, these signaling devices help to establish a separating equilibrium where the authentic products can be distinguished from the counterfeits. I denote the fixed-cost signals (eg.

company stores)  $l$ , and marginal cost signals (eg. holograms)  $T$ . I redefine the strategy space  $\sigma_i = (P_i, l_i, T_i), i = a, c$ .

The IC constraints for a separating equilibrium now become:

$$IC(c) : \Pi_c(\sigma_c, \sigma_a) \geq \max[\Pi_c(\sigma_a, \sigma_a), 0]$$

$$IC(a) : \Pi_a(\sigma_a, \sigma_c) \geq \max[\Pi_a(\sigma_c, \sigma_c), 0], \text{ subject to } IC(c)$$

$$\text{Note } IC(c) : \frac{mP}{2M} \left( \frac{P - \frac{mP}{2M}}{(M-m)s} - \frac{P}{2Ms} \right) \geq \frac{\gamma}{2}(P - T)(1 - \frac{P}{bMs + (1-b)ms})$$

$$P_a \geq \frac{2(M-m)M(b(M-m) + m)s\gamma}{2M\gamma(M-m) + \frac{m^2 + bm(M-m)}{1-T/P}} \equiv \underline{P}^T$$

As  $T$  increases,  $\underline{P}^T$  drops, and IC(c) becomes a looser condition to satisfy (it is easier for  $P_a$  to fall in the range where the counterfeiter prefers to separate).

Next check IC(a):  $(P - c_a - T)(1 - \frac{P - \frac{mP}{2M}}{(M-m)s}) - l \geq \frac{\gamma}{2}(\frac{mP}{2M} - c_a)(1 - \frac{P}{bMs + (1-b)ms})$ . If we define  $g_a = l + T(1 - \frac{(2M-m)P}{2M(M-m)s})$ , then IC(a) becomes:  $(P - c_a)(1 - \frac{(2M-m)P}{2M(M-m)s}) - g_a \geq \Pi_a^{pe}$ .

The brand prefers separating equilibrium iff  $g_a \leq \Pi_a^{se}(\sigma_a, \sigma_c) - \Pi_a^{pe}$ . Such  $(T, l)$  pairs are easily attainable, and authentic prices rise in the separating equilibrium. Therefore,

**Proposition 6** *Non-price signals relax the conditions for separating equilibrium.  $\frac{\partial \Delta P}{\partial T} > 0$ . These signaling devices take on more important roles when they provide actual information about authenticity.*

The role of vertical integration of downward retail stores are best explained in managers' own words. During my interviews with some Chinese branded companies who suffered from counterfeiting, one manager said, "Starting from 1996, our company products have reduced using the wholesale market and we switched the channel to licensed retailing. We established a well-managed retail distribution system nationwide. This is one of the most effective ways to combat counterfeits, and it almost deterred counterfeiting. These guys have little incentive to mimic our strategy, because having company stores will only reveal themselves to be easily detected and tracked down." Another sales manager told me, "Counterfeits pushed us to establish our [licensed] stores. We have now discovered a new channel [of retailing] and we are now trying to build our personality into it." One brand protection officer stated that, "Once our licensed company stores were opened, we had an influx of customers come and purchase even at much higher prices than the old wholesale

prices. Why? We later learned that many customers who bought counterfeit shoes felt very uncomfortable due to the inferior shoe materials, and some [counterfeits] even fell apart in public, which caused embarrassment. These customers undoubtedly would rather pay more to secure authentic purchases. In the end, we had higher mark-ups for our shoes and more resources to develop new models of higher quality, which certainly would charge further higher prices and bring in more profits. As the gap between our products and the counterfeits widens, customers like ours more. We call this a virtuous cycle.”

## 2.4 Welfare Analyses

In the monopolistic market without counterfeits, the total demand  $D_a^M = 1 - \frac{s_a+c_a}{2s_a}$  and consumer surplus  $CS^M = \int_{\frac{P_a}{s_a}}^1 (Vs - \frac{s_a+c_a}{2})f(V)dV = \frac{(s_a-c_a)^2}{8s_a}$ . Social welfare is the sum of consumer and producer surpluses:  $SW^M = \frac{(s_a-c_a)^2}{8s_a} + \frac{(c_a-s_a)^2}{4s_a}$ . In a market with non-deceptive counterfeits,  $CS^D = \frac{Ms-c_a}{2} - \frac{M(M-m)s}{2M-m} + \frac{(2M(M-m)s+(2M-m)c_a)^2}{32M^2(M-m)s} > CS^M$ . Competition increases consumer surplus because the counterfeits capture the low-valuation consumers who could not have afforded the authentic products. In addition, consumers derive more utility from the possible quality upgrade of the brand. It is worth noting from the simulation plot Fig. 2a that consumer surplus is high when the counterfeit quality is close to the authentic quality ( $m \approx 1$  and  $M \approx 1$ ) because perfect competition drives price down to the marginal cost level, and consumers enjoy equal quality at a much lower price than in the monopoly case. When authentic quality improves marginally in the neighborhood of  $s$  ( $M$  slightly exceed 1), consumer surplus actually drops. Only when the authentic quality upgrades to a significantly higher level ( $M > 1.5$  in the figure) will the gain in consumer surplus pick back up; The higher the product qualities (larger  $M$  and  $m$ ), the more welfare gain there is in the competitive market (Fig.2a). In these simulations, I normalize quality  $s$  to be unit 1 and cost  $c$  to be a half.

The brand’s profit changes in the market with counterfeits as compared to the one without:  $\delta\Pi_a = \Pi_a^D - \Pi_a^M$ . Figure 2b shows that authentic producer surplus is a decreasing function in  $m$ . That is, the more the counterfeiter could knockoff the authentic quality, the lower the brand’s profit. In the extreme case of perfect knockoff, both firms price at zero and earns zero profit in

the equilibrium. As also shown in the figure, minor increases in quality ( $M$  slightly exceed 1) only worsen profits when counterfeit quality is very high ( $m \approx 1$ ), because it is not sufficient to alleviate competition while incurring additional cost. Outside this particular range of  $M$  and  $m$ , authentic innovation leads to more authentic profits.

The counterfeiter's surplus is highest when it can very closely replicate the authentic quality  $s$  (eg.  $m = 1$ ,  $M = 1.1$ ), as it can then split the market almost evenly with the brand (Fig. 2c). As counterfeit quality decreases, its profit decreases by stealing less share from the brand. Counterfeiter profit also declines as the brand upgrades quality ( $M$  increases), although the marginal benefits of further quality upgrade are low when the quality gap between the counterfeit and authentic products is already wide. Notably, when the counterfeit quality is very low (eg.  $m = 0.1$  in Fig 2c), counterfeit profit is not sensitive to the change in  $M$ . On the other hand, when counterfeit completely knocks off the original product quality ( $m = 1$ ), then brand's innovation ( $M > 1$ ) can drastically drive down counterfeiter's profitability, although not likely to completely drive it out of the market. This again confirms Propositions 1 and 2 that innovation can be a viable strategy.

In calculating the social welfare, I used the traditional definition of including consumer surplus and all producer surpluses. The comparative statics resemble those discussed for the consumer surplus, as Figure 2d displays. Social welfare simulations without summing the counterfeiter surplus result in similar (only more sharpened) comparative statics.

The unconstrained separating equilibrium in a market with deceptive counterfeits resembles the benchmark case. Consumers benefit from the increased product variety as well as lowered brand price in the separating equilibrium.

However, in the constrained separating equilibrium, demand and consumer surplus change to:

$$\begin{aligned} D_a^{se} &= \left(1 - \frac{P - \frac{mP}{2M}}{(M-m)s}\right); \\ CS^{se} &= \int_{\frac{P - \frac{mP}{2M}}{(M-m)s}}^1 (Vs_a - \underline{P})f(V)dV \\ &+ \int_{\frac{P - \frac{mP}{2M}}{2Ms}}^{(M-m)s} (Vms - \frac{mP}{2M})f(V)dV \end{aligned}$$

Fig 2a. Change in Consumer Surplus

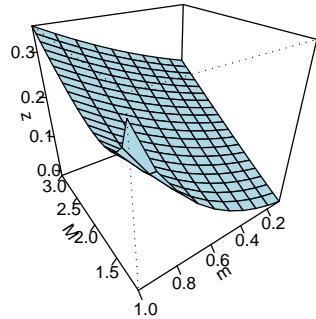


Fig 2b. Change in Authentic Producer Surplus

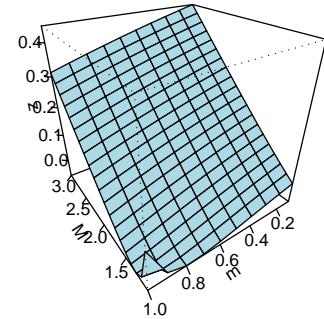


Fig 2c. Change in Counterfeit Producer Surplus

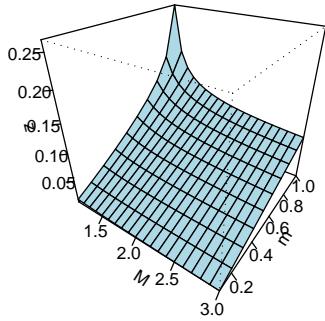


Fig 2d. Change in Social Welfare

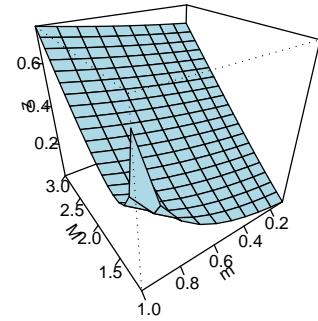


Figure 2: Welfare Simulations under Complete Information.

Suppose the authentic quality is  $s$  pre- and post-entry, and denote

$$A = \frac{(b(1-m)+m)(2-m)\gamma}{b(1-m)m+m^2+2\gamma(1-m)}; B = \frac{P}{2s}, \text{ then}$$

$$\begin{aligned} D_a^{se} &= 1 - A \\ CS^{se} &= \frac{s(M-(M-m)A^2-mB^2)}{2} - \bar{\Pi}_a^{se} - \bar{\Pi}_c^{se} \\ SW^{se} &= \frac{s(M-(M-m)A^2-mB^2)}{2} \end{aligned}$$

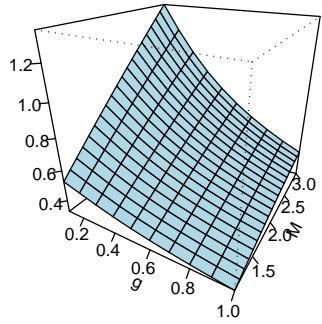
$CS^{se} > CS^M$  only for small  $m$  ( $m \leq \frac{4}{7}$ ) and  $\gamma$  mainly because counterfeits impose two opposing effects on consumer surplus in the constrained separating equilibrium. On the one hand, when the brand separates herself from the counterfeiter, similar welfare improvement could occur as in the benchmark case without deception. On the other hand, counterfeiting would lead to distortions in authentic price (high price for signaling), where price is artificially high to satisfy the IC constraints. Sufficiently low counterfeit quality and sufficiently small fraction of uninformed consumers ensure

the first effect dominates.

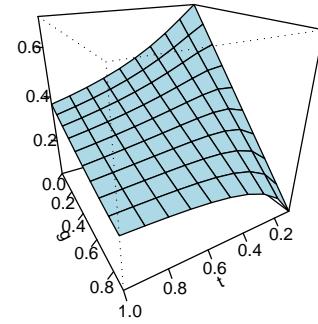
When non-price signals and enforcement investments were applied to attain a separating equilibrium, the social welfare becomes  $SW^{se} = \frac{s(M-(M-m)A^2-mB^2)}{2} - e - l - T * (1 - A)$ . Figures 3a plots the social welfare of the constrained separating equilibrium as functions of the extents of authentic innovation ( $M$ ) and asymmetric information ( $\gamma$ ). In general, social welfare increases when authentic upgrades quality more ( $M$  increases) and when the fraction of confused consumers in the market (the fraction of novice consumers in the market  $\gamma$ ) is less. Figures 3b plots the social welfare as functions of the extent of asymmetric information ( $\gamma$ ) and the non-price signal investment ( $t$ ). Social welfare is a decreasing function of  $\gamma$ . When there are a lot of novices in the market ( $\gamma$  close to 1), brand's investment in non-price signals and self-enforcement alike helps to alleviate asymmetric information and improve social welfare. When there is little asymmetric information ( $\gamma$  close to 0), these investments are wasteful and decrease social welfare, as Figure 3b demonstrates.

Figures 3c and 3d graph how social welfare of the constrained separating equilibrium changes with respect to counterfeiter's quality as a fraction of original monopoly quality ( $m$ ) and market asymmetric information ( $\gamma$ ) when the brand doesn't ( $M = 1$ ) or does ( $M > 1$ ) innovate in response, respectively. As shown in Figure 3c, social welfare improves as  $m$  increases when there is little asymmetric information ( $\gamma$  close to zero). In the extreme where counterfeiter could perfectly knockoff authentic quality  $s$  ( $m = 1$ ), then it does not matter how many confused consumers there are in the market, as any product would have the same quality  $s$ . When counterfeit quality is low, then welfare drops as the proportion of novices increases. When nobody in the market could tell counterfeits and authentic products apart at the same price, intermediate level of  $m$  is worst for social welfare because it forces up price to attain the constrained separating equilibrium without offering high quality to compensate for the loss in consumer surplus. Figure 3d conveys very similar intuition to Fig. 3c. A minor difference is that asymmetric information uniformly hurts social welfare here with authentic innovation, since counterfeits are always inferior to the upgraded authentic quality. Comparing Figures 3c and 3d, authentic innovation lifts up the social welfare surface to a higher level, especially at low levels of counterfeit quality.

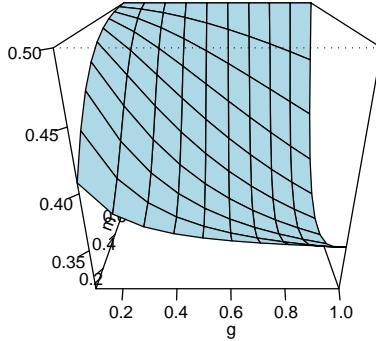
**Fig.3a. Social Welfare of Constrained Equilibrium wrt M**



**Fig.3b. Social Welfare of Constrained Equilibrium wrt t**



**Fig.3c. Social Welfare of Constrained Equilibrium, M=1**



**Fig.3d. Social Welfare of Constrained Equilibrium, M>1**

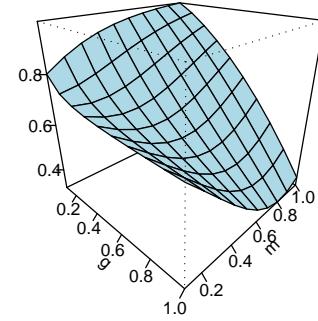


Figure 3: Welfare Simulations Under Asymmetric Information.

## 2.5 Discussion of the Model

The model proposed here provides a simple theoretical framework to analyze brand's responses to a new entrant. The framework encapsulates a few special cases as summarized in the chart below. In particular, some counterfeits involve no asymmetric information to either the user or user's friends ( $\gamma = 0, \lambda = r = 0$ , as in Section 2.2.1). A typical example is pirated movie disc that is usually sold at less than a dollar in Asian countries, where one generally does not associate any status signaling with any of these CDs. The more common counterfeits generate two layers of asymmetric information, as captured by the general model. Based on interviews with retailers in China, some counterfeiters fake themselves as promotion agents and offer stores deep discounts of branded products. The counterfeit products that are mixed into these regular channels has the

	Complete Info.	Asymmetric Info.
Counterfeits	$\gamma = 0, \lambda = r = 0$ Eg. Pirated movie disc	$\gamma > 0$ Eg. Regular store fake shoes $\gamma = 0, \lambda > 0$ Eg. Canal St. products
Imitation and Generic products	$\gamma = 0, \lambda = 0$ Legal, no lawsuit $e = 0$ Eg. CVS Cookies	$\gamma > 0, \lambda = 0, e = 0$ Eg. a new service with unknown quality

potential to deceive buyers. In other cases, counterfeits are sold in suspicious locations such as the Canal Street in NYC. All buyers know exactly what they are getting by going there, and they intend to fool others into thinking that they own branded products.

In addition, entry of some generic products can be considered as special cases of the model, where certain parameter values reduce to zero. The key difference between counterfeiting and imitation is that the former has the intent to deceive. As the second block of the chart summarizes, most imitative or generic entry incurs no law suit. Some may still generate asymmetric information to the extent that the buyers may be uncertain of its quality (high or low). The model provides detailed parameter ranges for various predictions as detailed in previous sections, and one could easily apply the derived results to these special cases with the appropriate parameter values.

While this model covers many aspects of counterfeits and imitation, it leaves out many others. For example, my model does not cover potential network effects that consumer utility may increase as the number of user base increases. Such network effects are quite unique to the software industry and are modeled by Conner and Rumelt (1991). On the status signaling side, this model also addresses only a key aspect of how counterfeits could enable consumers to disbundle quality and brand premium and how such asymmetric information could affect authentic producer's price and quality choices. Other aspects, such as the optimal demand for status goods, are out of the scope of this paper and are related to the vast fashion literature (Pesendorfer, 1995). Interestingly, a most recent study on fashion (Raustiala and Spigman, 2006) concluded that "Not only has the lack of copyright protection for fashion designs not destroyed the incentive to innovate in apparel, it may have actually promoted it" (p92), based on detailed historical and industry analyses.

### 3 Empirical Validation

#### 3.1 Data and Identification Strategy

I test the theory predication using a natural experiment in the Chinese shoe industry, arising from an exogenous shift in government enforcement efforts away from monitoring footwear trademarks. The Chinese copyright and trademark laws were restored after 1976. Since 1985, the Chinese government has established the Quality and Technology Supervision Bureau (QTSB), with a branch in each city and joint forces nation-wide, to supervise product qualities and outlaw counterfeit localities. The Bureau has enlarged its personnel and funding since 1991 in joint efforts with legislations to protect IPR and to monitor product quality. Due to a series of accidents arising from low quality or counterfeit agricultural products, gas tanks, food, drugs, and alcohol, the Chinese government issued notifications in late 1994 (Notification No.52) and early 1996 (Notification No.10) to enhance quality supervision and combat counterfeits in seven main sectors prone to hazardous materials. The majority of the Bureau workforce and funding went into these sectors, lessening enforcement in the footwear industry. In the early 1990s, approximately 12% of the Bureau's resources were devoted to the footwear sector (5% to leather shoes). This number, however, fell to 2% after 1995 (QTSB yearbooks). Data provided by the authentic companies reveal that they experienced significant counterfeit entry after this loosening of governmental monitoring and enforcement: most entry occurred in 1996. This exogenous policy shock provides a natural experiment to study the effects of counterfeit entry in the Chinese shoe industry.

Furthermore, this policy change increased the likelihood of entry by counterfeiters to authentic companies that have poor relationships with the local government than it did to authentic companies with strong ties to the government. This finding was revealed in both qualitative interviews with managers and data analyses, as detailed in Section 3.2. The importance of relationship is not confined to China. In an Imaging Supplies Coalition Anti-Counterfeiting conference in 2008, Andrew Gardner from Lexmark International gave a case study on actual “sting” operations to bust a counterfeiting ring in developing countries. It articulated how close collaboration between multiple vendors and the local government was crucial to successfully executing this operation. I

therefore use the interaction between the policy change and the differential relationships between each branded company and the government to identify the entry effects by counterfeiters for different brands, as detailed in the next subsection.

The data I gather consist of detailed information taken from companies' annual financial statements and other relevant company records on a random sample of 31 branded companies from the census of Chinese shoe firms and the brands' corresponding counterfeits for the years 1993-2004. The data here include the average prices and costs of two product-quality levels (high and low, mapping to  $M_s$  and  $s$  in the theoretical model) for each authentic brand and the corresponding counterfeits, the number of personnel and amount of expenditure used for trademark enforcement, advertisement expenditure, and the total number of licensed company stores. All these data are taken from each company's financial statements. My dataset includes both domestic brands and multinational brands operating in China, and is supplemented by the Chinese Industrial Census database, product catalog information, and interviews. Data on counterfeit entry, prices, and costs for each brand are obtained from each company's "brand-protection" offices and the government (specifically, the Quality and Technology Supervision Bureau). Qian (2008) and Appendix B provide further data details.

In addition, I code and compile a dataset of the different characteristics for each type of shoes listed in the companies' and stores' annual catalogs. These data consist of the shoe material, comfort level, decorative patterns, support and cushioning features, ventilation, etc. Recognizing the importance of validating the data from firm reports, I run hedonic regressions of the unit production costs, as provided by the sampled companies, on the corresponding material, machinery, and other characteristics of the shoes, as recorded in the catalogs. I conduct the analyses on the samples of leather shoes and sport shoes separately. These characteristics together account for 90% of the cost variation. These results lend credibility to the company data.

I also conducted mall intercepts and street interviews with retailers ( $N=30$ ) and consumers ( $N=200$ ) to learn about potential channels of counterfeits and consumer attitudes toward counterfeits. Some retailers were fooled by the counterfeiters who claimed to be sales force of branded company and who offered huge discounts to fulfill their year-end sales quota. A majority of the consumers at the mall claim that they cannot tell counterfeits apart, and they usually rely on price

or store signals to infer quality and authenticity of the product. However, in the interviews with consumers who frequent street corner merchants, the consumers unanimously told me that they like these boutiques for the cheap prices and that they don't expect real branded products.

### 3.2 IV Validity

The branded companies that were infringed upon set up their own “brand-protection” offices to make up for the lack of government monitoring of counterfeits. The company fixed-effects regression of the log of company enforcement investment on a legislation dummy is positive and significant at the 5% level (coefficient=3.2), implying an 20-fold increase in private enforcement investment to compensate for the lack of public enforcement. However, the authentic companies still had to get the government to outlaw the counterfeit sites once their own enforcement employees discovered them. This is where relationships with the government (the QTSB in particular) come into play.

Before the enforcement change, the Quality and Technology Supervision Bureau conducted regular inspections in the shoe markets and factories. They confiscated and shut down counterfeit localities right on the spot. The monitoring mechanism was therefore quite uniform across different brands. After the enforcement change, however, companies that had a good relationship with the government received more attention and faster responses when they reported counterfeit cases. All else being equal, this would reduce the incentives of counterfeiters to infringe these brands. This company-level variation is helpful in exploring the variation in the effect of enforcement change on counterfeit entry and sales for different brands and, in turn, the effect on different authentic prices. The challenge is to obtain a proxy for such a relationship.

Qian (2008) established that the ISO proxy is a plausibly exogenous measurement for such relationship based on a synthesis of interview evidence and empirical analyses. Since the late 1980s, all registered companies in China were *required* to meet the standards set by the International Standards Organization (ISO)<sup>5</sup>. For the shoe industry, ISO sets standards for the basic equipment a company uses and basic environment and labor treatments. The QTSB is in charge of the ISO certification. For some companies, one month was sufficient for obtaining the ISO certificate, but

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<sup>5</sup>This differs from the U.S. practice where companies adopt ISO voluntarily.

for others, the application and grant dates were over 300 days apart. Among these companies that spent a long time to fulfill the ISO requirements, some are small companies and some are medium or large ones. I use the number of work days it took each company to pass the ISO 1994 requirements as a proxy for its relationship with the local government (or how fast it dealt with the bureaucracy). There are more variations in this indicator across firms within the same local area than variations across regions. There is also no significant correlation between this relationship proxy and the company's market share, sales, product quality or production cost in my data. The largest correlation amounts to only .08.

Because the enforcement change was due to a series of accidents which took place in other industries, it is plausibly randomly assigned. The IV exclusion restrictions are also fulfilled because tightened government enforcement elsewhere is not expected to affect shoe prices directly. The relationship proxy does not correlate with counterfeit entry directly in the first step of IV regression. The first stage (Equation 2 below) regresses counterfeit dummy on the indicator variable (Loose) for the loosened attention to the footwear industry, which takes on a value 1 for years 1995 onwards and 0 otherwise, the interaction variable between the legislation change indicator and relationship proxy, the relationship proxy, and year trend. I only included these most important instruments because additional weaker instruments can reduce the effectiveness of IV.

$$\text{Counterfeit}_{a,t} = \alpha_0 + \alpha_1 * (\text{Loose} * \text{Relationship})_{a,t} + \alpha_2 * \text{Loose}_{a,t} + \alpha_3 * \text{Relationship}_{a,t} + \alpha_4 * t + e_{a,t} \quad (3)$$

This first stage of IV estimation shows clearly that the instruments are highly correlated with the endogenous variables: fake entry and fake sale quantities as a share of authentic sale quantities (Table A2). As shown in Columns 2 and 4 in Table A2, the legislation dummy and the interaction variable are highly correlated with the counterfeit entry or sales and statistically significant at the 1% level. The overall Wald Chi-square test for the instruments are highly significant. The relationship proxy itself, however, does not carry statistically significant coefficients. This means that a company's relationship with the local government correlates with its counterfeit entry only after the loosening of the governmental enforcement efforts in the footwear sector. This is exactly as we expected, giving evidence that this relationship proxy fulfills both the relevance and the exclusion restrictions.

## 4 Empirical Findings

### 4.1 Stratification Analyses for Pricing Responses

From the theoretical model in Section 2, the comparative statics are  $\frac{\partial P}{\partial s} > 0$ ;  $\frac{\partial P}{\partial c} > 0$ ;  $\frac{\partial P}{\partial m} < 0$ .

This guides my basic model:

$$\log(P_{a,t}) = \beta_0 + \beta_1 * \text{Counterfeit}_{a,t-k} + \beta_2 * \log(c_{a,t}) + \beta_3 * m_{a,t} + \beta_4^T * \text{YearD}_t + \beta_5^T * \text{BrandD}_a + \epsilon_{a,t}, \quad (4)$$

where  $k$  stands for the number of lagged years for the entry of counterfeits to take full effect on the price outcome. Based on the Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC), a model with a two-year lag ( $k = 2$ ) was selected.  $c_{a,t}$  is the unit materials cost that also serves as a quality proxy for the corresponding authentic product in the current year  $t$ .  $m_{a,t} = \frac{s_{c,t}}{s_{a,t}}$  is the quality (as proxied by unit cost) of the counterfeit product as a fraction of the authentic counterpart. To address the potential endogeneity of couterfeit entry, I simultaneously estimate Equations (3) and (4) using 2SLS.

Propositions 1 predicts that authentic price will rise post-entry if and only if the imitator's quality is below a threshold. I therefore stratify the authentic products into two subsamples according to the threshold value and analyze them separately. I try to map this threshold value  $(\frac{2M((M-1)s+c)-mc}{2M-1})$  empirically to the best approximation allowed by the data. Qualities are not observed directly but approximated by the unit production (material) costs, and the additional cost to upgrade quality is simply the unit cost difference between the high-quality and pre-entry low-quality products. I calculate  $m$  as in Equation (4) and  $M$  as the ratio between the year  $t$  product cost and the pre-entry product cost. I stratify the sampled brands according to whether their counterfeit quality is less than the threshold at the entry year. I then estimate Equations (3) and (4) on the panel data of each sample of brands.

Regression outputs for these two strata are reported in Table 1. Please note that the set of brands that were not infringed in the sampled period are included in both strata to serve as the control group. Columns 1 and 2 report results using high-end product prices as the outcome variable and Columns 3 and 4 report those using low-end product prices as outcome. Both the stan-

dard and clustered standard error regressions yield consistent empirical results with the theoretical predictions:  $\hat{\beta}_1 > 0, \hat{\beta}_2 > 0, \hat{\beta}_3 < 0$ . Results show that the log cost for authentic products are strong predictors for log prices in both samples. The improved quality (proxied by log of authentic cost) explains most of the price change. The more competitive pressure counterfeit entry exerts, the less authentic price rises. These results are highly consistent with the theoretical model predictions.

The counterfeit entry indicator bears statistically significant positive coefficient in predicting high-end authentic prices only for the subsample of products that are infringed by low-quality counterfeits (Column 2 of Table 1), as predicted by Proposition 1. Since most counterfeit quality is considerably inferior, the threshold condition is satisfied by majority of the sample. The part of the price increase that remains significant after controlling for the costs are consistent with two hypotheses: First, segmentation of customers into purchasing high-end brand and low-end entrant products could imply that the brand could reoptimize to a higher price for the high valuation consumers (Frank and Salkevers 1997, 1999); Second, the brand charges a higher price to signal quality so as to separate from the counterfeits. Both effects are modeled in Section 2. However, should segmentation of customers be the sole driver of the price increases, such increase would be manifested mostly for the higher-end authentic products as these tailor to the higher-valuation consumers. The fact that the net counterfeit effect (controlling for cost) is also positive and significant for the low-end authentic price (Column 3 of Table 1) reveals at least some price signaling effect in action, as predicted by Proposition 2, although a more complete test among competing hypotheses would require detailed consumer-level data that are not available here.

Results are qualitatively robust when splitting the sample in other ways. When I stratified the sample with looser conditions on counterfeit quality (eg. quartile values, etc.), the results for the subsamples of low-quality entrants remain qualitatively similar. The positive coefficient on the entry dummy takes on more significances (economically and statistically) in the subsamples of “high-quality” counterfeits when the definition of “high-quality entrant” becomes looser. The inclusion of observations with lower-quality entrants naturally alters the average-effect estimates.

## 4.2 Quality Differentiation

Propositions 1, 2, and 3 all predict innovations as a combating strategy with appropriate costs. To gain a deeper understanding of the authentic quality responses, I gathered data on shoe characteristics from the product catalogs. I ranked the quality in each observable or meaningful dimension according to the cost of the materials used for that dimension.<sup>6</sup> For the less quantifiable attributes, I mainly used dummy indicators. I constructed the variable for shoe appearance by summing up three dummy variables—fine, elegant, and patterns—each taking on a value of 1 if a pair of shoes is described in the catalog to possess the characteristic, and 0 otherwise. A simple sum is generated instead of a weighted sum to avoid biasing results according to prior beliefs on which attributes are the more important quality components. I then constructed a variable for functionality by summing up the following indicator variables: versatility, cushioning (whether a pair of shoes has cushioning effects), absorption (whether it can absorb sweat), countering athlete's foot, softness, comfort, sturdiness, warmth, friction (for protection on slippery ground), and additional features for sport shoes such as durability, flexibility, and support.

I exhausted all the attributes that are mentioned in the product catalogs. I also constructed a variable indicating the technology applied to make the shoes, embodied in the equipment. Before counterfeit entry, all the companies used domestic equipment. However, after entry, many of them imported Italian production lines, pattern-pressing machines, and equipment to make shoe bottoms with cow skins. I first constructed a dummy variable for each type of equipment, and then added them up to generate the “equipment” variable. I generated the variable “workmanship” to indicate whether the shoes were made with detailed and careful craftsmanship. Finally, I added up the values of these different-characteristic variables to obtain the overall quality proxy.

To examine the actual innovations after being infringed by counterfeits, I carried out regressions for the continuous variable for overall quality on counterfeit entries of brands in the leather-shoe sector (Panel A of Table 2) and sport-shoe sector (Panel B), following the same identification strategy and controlling for year- and company-fixed effects. I found statistically significant

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<sup>6</sup>For instance, the variable for surface material takes on a value of 1 if it is made of plastic leather,...,4 for regular cow skin,..., and 14 for crocodile skin, in ascending order of material costs. Similar procedures are carried out to generate the variables for measuring the quality of the shoe side and bottom materials.

coefficients on the quality measures (log deflated production costs and the overall quality rank), significant at the 1% level (Tables 2). In particular, the coefficients on counterfeit entry in the regressions for overall quality ranks indicate that the overall authentic quality shifted up by 15 percentile points after the brand experienced counterfeits (the modes of the distributions for quality ranks were approximately equal to 20). This set of empirical findings directly support the theory predictions on innovations, and could be welfare enhancing under a wide parameter ranges as in the simulation exercises.

### 4.3 Effectiveness of Other Marketing Strategies

Propositions 3 and 4 predicts self-enforcement strategies as means of deterring counterfeiting. In this setion, I explore the the stigma of counterfeits by regressing the counterfeit measure on a set of variables as detailed in the variables' column of Table 3. The results provide some evidence that the strategies companies use to fight counterfeits are quite effective. In particular, an additional licensed company store established in the previous year helps to reduce counterfeit sale quantities as a fraction of authentic quantities by 2%, on average, statistically significant at the 5% level. Each store also helps to deter entry by 0.1% on average, although significant only at the 10% level. Lagged-year enforcement costs are also shown to be negatively correlated with counterfeit entry, sale quantities, and log sales. An additional 10,000 yuan (\$1,250) invested in enforcement reduces counterfeit sales by 0.3% on average, which is significant at the 5% level. These results help to put some figures to the predictions in Propositions 3 and 4.

The coefficients on the other controls (Rows 5-8 in Table 3) give additional insights to the questions “what attracts counterfeit entry? What suppresses counterfeit sales?” The positive coefficients on Gini, a traditional proxy for income inequality, are significant at the 5% level for predicting counterfeit entry and sales. This implies that higher income inequality may give rise to more demand for counterfeits, possibly because there is a larger segment of consumers who would like to own the luxury products but cannot afford the authentic ones, and/or because status goods play a more important role in a more unequal society. The lagged-year authentic sales are positively correlated with counterfeit sales (Column 1 and 3 in Table 4). Although not statistically significant, the lagged-year authentic product cost is negatively associated with counterfeit sales (Column 3),

indicating that products of higher quality may be less targeted by counterfeiters, possibly because they are more costly to imitate and there is less asymmetric information available to deceive consumers.

While the authentic companies try all measures to fight counterfeits, are there variations in the aggressiveness among companies? I test whether these firm strategies are complements or substitutes of its relationship with the government. As reported in Table 4, I regress the mean levels of advertisement and enforcement expenditures, number of licensed stores, and quality upgrading costs (difference in the log unit production cost as compared to the previous year), respectively, on the relationship proxy (ISO approval days, as explained in 3.2), controlling for year- and company-fixed effects. All relevant nominal terms are deflated with CPI and transformed to log terms. Companies with a worse relationship with the government are shown to have established more licensed retail stores and spent more on quality improvements, statistically significant at the 5% levels. The coefficient on the ISO variable in the private enforcement expenditure regression is not significant, although positive. This may not be surprising if we recall that even the companies with good relationships with government had to invest in monitoring markets after the government reallocated enforcement resources in 1995. The difference is that they may work better with the government to outlaw their discovered counterfeiting localities.

The fact that the infringed brands had to co-live with counterfeiters even after investing handsomely in a plethora of self-enforcement strategies in the period of loosened public enforcement speak to the necessity of government enforcement. In the years of strong government monitoring, counterfeiters were afraid of entering the footwear market. Whereas after the natural policy change, brands had to compensate for the lack of public enforcement. Their strategies were not sufficient to fully deter counterfeit entry but only to the effect of countering the infringement effects, as in the theoretical predictions of the constrained separating equilibrium. In this sense, private enforcement seem less effective than public enforcement and can be suboptimal from the social welfare perspective.

## 5 Conclusion

Economic impacts of counterfeits are urgent concerns for business managers and policy makers. The main contribution of this paper is to uncover such impacts and to propose marketing strategies against counterfeits. I develop a vertical differentiation model for imitative and counterfeit entry to predict and explain the pricing and marketing responses of authentic incumbents to new entry. By examining the equilibrium conditions and allowing the authentic producer to endogenously determine quality and a set of other strategies besides prices, I am able to provide a more complete picture of the (dis)incentive structures for counterfeiting and brand protection. This study attempts to provide a tractable theoretical framework to unveil the entry effects of counterfeits on the various marketing norms.

My analyses show that the counterfeit entry may exert downward pressure on prices by lowering expected quality in any short-run pooling equilibrium. More importantly, however, counterfeit entry with low quality also induces the original producer to offer a higher quality product at a higher price. This suggests a successful business strategy to mitigate copycat competition: innovation. The brand's innovations and the newly-available counterfeits that tailor to the low-valuation consumers could imply some positive welfare vibe in diversifying demand and increasing consumer surplus. However, individual consumers who most prefer the baseline authentic quality ( $s$ ) at the monopoly price ( $p$ ), if any of them exists, would be worse off if this quality level ( $s$ ) is replaced by a higher quality ( $M_s$ ) at a higher price after counterfeits enter the market. In that sense, counterfeiting may not be Pareto improving even if the overall social welfare increases. There is no lack of market frictions generated by the asymmetric information between counterfeiters and non-expert consumers. The analysis reveals that authentic producers may use a high price to signal authenticity and deter counterfeits from pooling. In addition, an authentic company's non-price signaling devices push up costs or reinforce its local monopoly position, thereby help its products to sustain a high price. Company-level enforcement activities and licensed stores are shown to deter counterfeit entry or reduce counterfeit sales. Finally, for companies conducting business in developing countries, it is worth noting that relationships with local governments play important roles in brand management.

Although starting from a simple model, the propositions has general implications for imitative or counterfeit entries. Honest imitative entry (e.g. generic drugs) is apparently analyzed in the benchmark model. Imitations that are not honest about their quality generate asymmetric information and their effects are analyzed in the framework with asymmetric information. The key model predictions are validated with a unique panel dataset on shoe counterfeits. The set of analytical predication also help to explain a rich set of the empirical findings and many real-world cases as explained in the main text.

This paper is a first step in exploring the complex impacts of counterfeits and the effective combating strategies. While the current analyses shed light on a diverse set of business strategies against counterfeits, there can be other strategies and other dimensions of asymmetric information and implications associated with counterfeiting. I am making further attempts to better understand counterfeiters' decisions on market entry and any potential complementary effects counterfeits could have for authentic products.

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**Table 1. Stratified Estimations for  $\log(P_t)$  on Lagged Entry**

This table reports the IV estimates on the counterfeit entry effect on the log of deflated authentic prices. All models use company- and year-fixed effects. Each column represents a regression in a different stratum classified by the counterfeit quality of the brand, as specified in the column header. Columns 1 and 3 refer to the stratum of brands infringed by low-quality counterfeits. Production cost is used to proxy quality. Columns 2 and 4 refer to the stratum consisting of companies whose counterfeit quality is above the threshold level. Counterfeit<sub>t-2</sub> dummy equals 1 if counterfeit of a brand entered in year t-2; logCost is the authentic materials costs of products; m is the counterfeit production cost divided by the authentic one; Heteroskedasticity-consistent standard errors that correct for clustering at the company level appear in parentheses. Statistical significance levels: \*-10%; \*\*-5%; \*\*\*-1%.

Dependent variable:	Log deflated high-end authentic prices		Log deflated low-end authentic prices	
Sample by Counterfeit Type	Low-quality (1)	High-quality (2)	Low-quality (3)	High-quality (4)
Counterfeit <sub>t-2</sub>	.04*** (.02)	.01 (.06)	.06** (.03)	.01* (.01)
logCost	.93*** (.02)	.89*** (.03)	.95*** (.01)	.91*** (.02)
m	-.09** (.04)	-.59 (.61)	-.08* (.05)	-.63 (.47)
Year Fixed Effects	Yes	Yes	Yes	Yes
Company Fixed Effects	Yes	Yes	Yes	Yes
No. of Obs.	324	120	324	120

**Table 2. IV Estimation on Shoe Quality**

**Panel A. Leather Shoes**

Dependent variable:	log Cost	Overall Quality
Counterfeit <sub>t-2</sub>	.45*** (.12)	2.82*** (.51)
Company and Year Fixed Effects	Y	Y
No. Obs.	3336	3336
R-square	.95	.96

**Panel B. Sports Shoes**

Dependent variable:	log Cost	Overall Quality
Counterfeit <sub>t-2</sub>	.30*** (.09)	2.67*** (.25)
Company and Year Fixed Effects	Y	Y
No. Obs.	3335	3335
R-square	.92	.93

IV estimation on the counterfeit entry effect on authentic quality, estimated by log deflated costs and the sum of various shoe characteristics, with the interaction of government enforcement change and relationship proxy as the main IV. Panel A reports results for the leather shoe sector, and Panel B reports those for the sport shoe sector.

**Table 3. Predicting Counterfeit Entry, Quantities, and Sales**

The counterfeit entry dummy (equalling one if counterfeits are discovered for a brand), counterfeit sale quantity as a fraction of the authentic sale quantity, and counterfeit sales are regressed on the set of covariates in Column 1, with company fixed effects, in three separate regressions. Each column reports one regression specification. lag licensed store, lag sales, lag enforce, and lag cost are the lagged-year number of licensed stores, sales, enforcement investments, and production costs for an authentic company; Real GDP per capita PPP, growth rates, and household consumption (HHC) are obtained from the World Bank *World Development Indicators*. Gini coefficients are extracted from the UN Human Development Reports. Due to space limitations, this table does not include a few other control variables in the regression model: Loose is a dummy for government enforcement change, which equals one from 1995 on; Relation between a company and local government is proxied by the number of workdays between the application and grant dates of the ISO certificate for an authentic company. These are not related to the message of this paper and can be found in Qian (2006). Heteroskedasticity-consistent standard errors that correct for clustering at the company level appear in parentheses. Statistical significance levels: \*-10%; \*\*-5%; \*\*\*-1%.

Dependent Variable:	Fake Entry (1)	Fake Q/Auth. Q (2)	log Fake Sales (3)
Licensed stores <sub>t-1</sub>	-.001* (.000)	-.02*** (.005)	-.01 (.02)
Sales <sub>t-1</sub>	.04 (.04)	.01 (.05)	.52** (.25)
Enforce <sub>t-1</sub>	-.000 (.000)	-.01 (.015)	-.003** (.001)
Cost <sub>t-1</sub>	.16 (.13)	.27 (.20)	-.25 (.93)
Log(GDPpcPPP)	3.4 (3.1)	2.55 (4.36)	18.3 (19.5)
Growth	-.01 (.03)	-.05 (.05)	.02 (.23)
GINI	.14** (.05)	.07 (.08)	1.32*** (.37)
Log(deflated HHC)	.95 (.88)	1.70 (1.22)	8.5 (5.9)
Year Trend	.22 (.24)	-.43 (.25)	-.01 (.08)
No. of Obs.	372	372	372

**Table 4: Fixed Effects Reg for Authentic Firms' Business Strategies on their Ties with the Government**

This table reports the OLS estimations. Post-1995 (loosened government enforcement) data are used. All models use year and company fixed effects. *ISO* is the number of workdays an authentic company took to obtain the ISO certificate and proxies for the relationship between the company and the government. Various authentic outcome variables are regressed on this proxy, in separate regressions. Each column reports one regression specification. Column 1 reports entry effects on log advertisement costs, 2 for log number of licensed stores, 3 for log enforcement investments, and 4 for the log of unit production cost of the high-end shoe, reflecting authentic quality. All nominal terms are deflated with CPI. Heteroskedasticity-consistent standard errors that correct for clustering at the company level appear in parentheses. Statistical significance levels: \*-10%; \*\*-5%; \*\*\*-1%. R-square values from the two alternative regression specifications are similar, and I report the first specification R-square in the last line.

Dependent variable:	log(Adst)	log(Store <sub>t</sub> )	log(Enf <sub>t</sub> )	log(C <sub>t</sub> ) - log(C <sub>t-1</sub> )
	(1)	(2)	(3)	(4)
ISO	.001 (.001)	.39** (.17)	.004 (.003)	.0003** (.00015)
Year and Company Fixed Effects	Y	Y	Y	Y
No. of Obs.	372	372	372	372
R-square	0.97	0.83	0.93	0.97