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BRAND MANAGEMENT AND STRATEGIES AGAINST COUNTERFEITS

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ABSTRACT

In this paper I provide a theory for brand-protection strategies to reduce 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 tools at their disposal to maintain a separating equilibriumin the face of counterfeits. One of the theoretical predictions of this study is that counterfeit entry induces incumbent brands to introduce new products. This helps to explain the innovation strategies that authentic firms employ in response to entry by counterfeiters in practice. 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 from brands. 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 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 for each other.

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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 generates incentives for imitation and counterfeiting. The World Customs Organization (WCO) estimates that 512 billion *euro*'s worth of traded world merchandise in 2004 may have been counterfeits (WCO, 2004). Besides the business stealing effect that industries have blamed counterfeits for, counterfeiting can 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 for counterfeits has been explored to some extent in the marketing literature (Bloch et al., 1993; Cordell et al., 1996; Wee et al., 1995; 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 driving counterfeit demand. On the supply side, a few studies have examined the piracy network effects (Conner and Rumelt, 1991), the legal responsibilities of firms and government (Olsen and Granzin, 1992), and the way firms' internal organizations complement weak IPR enforcement (Zhao, 2006). Enlightening as these studies are, the economic impacts of counterfeits and the corresponding marketing strategies are still not fully understood. Grossman and Shapiro (1988) discuss counterfeit impacts primarily in the international trade setting and their theoretical predictions cannot fully explain 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 asymmetric information for consumers. These strategies can also broadly be considered as endogenous sunk costs (ESC), a term introduced by Sutton (1991).

I build upon a vertical differentiation model (Gabszewicz and Thisse, 1979 and 1980) with endogenous quality and other 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 counterintuitive observations in practice that authentic prices often 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 more 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 cigars and 70% for footwear) thought they were authentic. Second, some buyers may show off 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 this consumer derives 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 advertising as a 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 purchases are assumed. Moorthy and Srinivasan (1995) propose money-back guarantees as another effective signal for quality. Despite the sophistication of the previous literature, the models considered only a monopolistic market and assumed exogenous quality levels. Since counterfeiters attempt to copy authentic products and usually produce 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 model contributes to the IO theory literature by endogenizing quality, price, and a plethora of enforcement and non-price signaling instruments in a vertical differentiation framework. 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. a widening quality gap to alleviate competition and 2. a reduction in asymmetric information brought about 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). Competition with counterfeits brings unique pressure to vertically differentiate in a market where brand enjoys monopolitic power in its own niche. This study provides one of the first analyses of the conditions under which counterfeit entry would lead to innovation. In particular, I show that brand seeks to innovate only when the counterfeit quality is within a certain range. If the counterfeit quality is too low, it does not pose sufficient threat to induce innovation. If the quality is too high, innovation may not alleviate competition. The predictions shed new light 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 reflected only 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 the authentic producer's constrained optimization to force counterfeiters out of the pooling equilibrium. This is a viable strategy when there are enough consumers in the market who can perfectly tell counterfeits apart, and will therefore purchase counterfeits only 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 can also enlarge the parameter range for a separating equilibrium to be obtained. Authentic companies' investments in self-enforcement and in vertical integration of downstream retail stores could also effectively combat counterfeits. These measures can be broadly considered as ESC, and add to the stream of literature on this topic (Sutton, 1991;

Athey and Schmutzler, 2001). The effects of establishing company stores complement efficiency arguments of downstream vertical integration in McGuire and Staelin (1983) and provide new insights for the channel-management literature (Desai et al., 2004; Coughlan, et al., 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. These panel data include detailed prices, production costs, quality dimensions, and financial statements of a representative sample of branded companies and their corresponding counterfeits. The empirical analyses address a set of questions that were not touched upon in Qian (2008). Stratified analysis on different clusters of products with counterfeit entry of different quality levels reveals that authentic price increases post-entry are observed mainly in products that were infringed by relatively low-quality counterfeits. In addition, companies' self-enforcement investments are shown to significantly discourage counterfeit entry or sales, and these strategies complement each other. 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 empirically validates theoretical predictions. 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 chooses the quality level that yields the 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 a counterfeiter enters with a product of quality $s_c = ms, m \leq 1$,[1] the counterfeiter and the brand play a duopoly game. Let P_a, P_c be the prices for the brand and counterfeit goods, respectively. I assume counterfeit quality is exogenously given because counterfeiters have limited technology available relative to the brand.[2] 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 are available upon request. The sequence of events is:

1. Authentic producer chooses quality and sets the corresponding optimal price;
2. Counterfeiter decides whether to enter, depending on potential profits and costs of punishment under the law. If he enters, he picks his price, recognizing that he relies on the resemblance to sell his product due to 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 like to wait until authentic qualities and prices are set before setting theirs. Therefore, this leader-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. If the government perfectly implements and enforces intellectual property rights, there is no counterfeiter. The brand-name 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

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

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

[2]Furthermore, in some countries 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 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 offers lower quality.

2.2 Market with Counterfeits

We next consider a market with weak trademark enforcement so that authentic and counterfeit producers coexist. The price, quality, quantity, and other marketing dynamics are more complicated. I first consider a case in which 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, 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 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 the equilibrium with this benchmark case.

2.2.1 Nondeceptive 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 products 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:

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

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

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

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 the larger profit. Proposition 1 gives the condition under which the brand chooses the lower quality in the monopoly setting, and the following proposition suggests conditions under which she chooses the higher quality when faced with competition.

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

The brand upgrades quality in the hope of alleviating competition by widening the quality gap, provided that the additional costs are not too high, as outlined in the above Lemma. 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 (e.g., 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 rise. 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 higher quality when faced with counterfeiters' 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 a larger gap between the low counterfeit quality and the high authentic quality. It therefore allows for a wider range of counterfeit quality where the brand finds it profitable to raise the price of its new product.

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

One 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.

I model this asymmetric information by recognizing a 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 ($\lambda = 1$).

Propositions 2 and 3 can be rederived with new threshold values for c and s_c, as in Appendix A.1.1. 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.

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. Based on the equilibrium conditions (Appendix 1.1.1), 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 Counterfeiters 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.[3] I assume that there is a fraction, γ, 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. Counterfeiters, on the other hand, mostly try to mimic the appearance of authentic products and misrepresent attributes to extract short-term windfalls.

Lichtenstein et al.(1993) report, "Price is unquestionably one of the most important marketplace cues". The model here allows confused consumers to infer quality information when different prices are charged. This fraction, γ, of consumers hold a prior belief in 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.[4] They update their beliefs about a 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

[3]Chinese media reported a few years ago that a lady bought a pair of Nike shoes on sale, only to have them fall apart one month later. 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 had was a counterfeit.

[4]Relaxing this assumption and drawing more heavily from low-valuation consumers would not qualitatively change the results.

purchasing. They may purchase counterfeits at a lower price, depending on their 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 (e.g., 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 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 his products are authentic and to charge the same authentic price so as to split the original monopoly profit. However, he soon realizes that expert consumers will not buy 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 set 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

$$P_a \geq \frac{2\gamma(M-m)M(m - bm + bM)s}{m^2 - bm^2 + bmM + 2M\gamma(M-m)} \equiv \underline{P} \tag{1}$$

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 generic) 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:

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

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

Lemma 3 *The brand may raise the price (above the monopoly price level associated with a given quality) after the 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 (γ) 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 a 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 degradates 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 2 *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 higher 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 price hikes 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 were gone as a result of the government's strengthened enforcement ("yan da"), Pfizer would have to lower prices because consumers would no longer be willing to pay extra for Pfizer 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.4.3). 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 explore another set of brand-protection strategies. The analyses shed light on a plethora of strategic decision variables and enrich the competition model under examination. They further complement the ESC literature. ESC are fixed costs that firms can choose to invest in and that 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, 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.

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 in the meaningful positive range.

Intuitively, the higher the authentic quality is 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 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 his 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 A.1, 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 might 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 a counterfeiter enters.

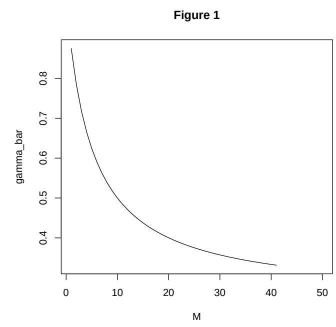

Figure 1: Comparative Statistics of $\bar{\gamma}$ and M.

2.3.2 Enforcement

Enforcement activities against counterfeiters (either publicly lobbying or privately funding spot-checks) are taken by many authentic producers. Notably, luxury house LVMH assigned approximately 60 full-time employees to 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 producers send their employees to walk around the market as consumers and track down counterfeiters. They then report their 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 effects of enforcement on counterfeit deterrences and on authentic prices are examined here. The risk of such penalties reduces incentives for counterfeiting and favors the separating equilibrium. Hence, the brand's relationship with the government and the subsequent enforcement strength are important for the entry cost of counterfeiters. I model the theoretical mechanism here and exactly exploit this mechanism in my empirical approach to identify entry effects of counterfeits in the next section.

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 a better relationship with the government have a higher w given the same investment e. Now the

IC constraint for the counterfeiter $IC(1): \ \Pi^{se}_{imitate} \geq (1-w)\gamma\frac{\Pi_{pe}}{2} + w(-\gamma\frac{\Pi_{pe}}{2})$ 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 be revealed 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 $IC(2): \ min[\Pi^{se}_a, \Pi^e_a] \geq \Pi^{pe}_a \ \ \& \ \ P_a \geq \underline{P}^e$

If we define the authentic profit with enforcement investments $\Pi^e_a = w\Pi^{se} + (1-w)\Pi^{pe} - e$, 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 the optimal separating equilibrium price is lower than $\underline{P}$), then the enforcement activities can be profitable if $\Pi^e_a \geq \Pi^{pe}_a$. *i.e.*, $e \leq w(\Pi^{se}_a - \Pi^{pe}_a)$. Together with the condition that $P^e_a \geq \underline{P}^e$, 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 3 *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 were fulfilled as in Proposition 2.*

Galloni (2006) reports another real-world example of self-enforcement. Luxury-goods companies like LVMH lobbied governments to declare 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. In my interviews and field studies in China, a few brands shared stories of how their tight connection with the government helped deter 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? Yes, these could include forms of either fixed-cost investment, such as licensed company stores in which authentic producers display exclusive licenses obtained from the Bureau of Industrial Commerce (Qian, 2008), or marginal-cost investment, such as costly holograms and packaging (Galloni, 2006).

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

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

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

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

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

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 4 *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 is best explained in managers' own words. During my interviews with some Chinese branded companies that 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, "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 nondeceptive 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 Figure 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 0.5.

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 knock off the authentic quality, the lower the brand's profit. In the extreme case of a perfect knockoff, both firms price at zero and earn 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 (e.g., $m = 1$, $M = 1.1$), as it can then split the market almost evenly with the brand (Fig. 2c). As counterfeit's 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 upgrades are low when the quality gap between the counterfeit and authentic products is already wide. Notably, when the counterfeit's quality is very low (e.g., $m = 0.1$ in Fig 2c), counterfeiter profit is not sensitive to the change in M. On the other hand, when the counterfeiter completely knocks off the original product quality ($m = 1$), then the brand's innovation ($M > 1$) can drastically drive down the counterfeiter's profitability, although not likely enough to drive it out of the market. This again confirms Propositions 1 and 2 that innovation can be a viable strategy.

In calculating 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

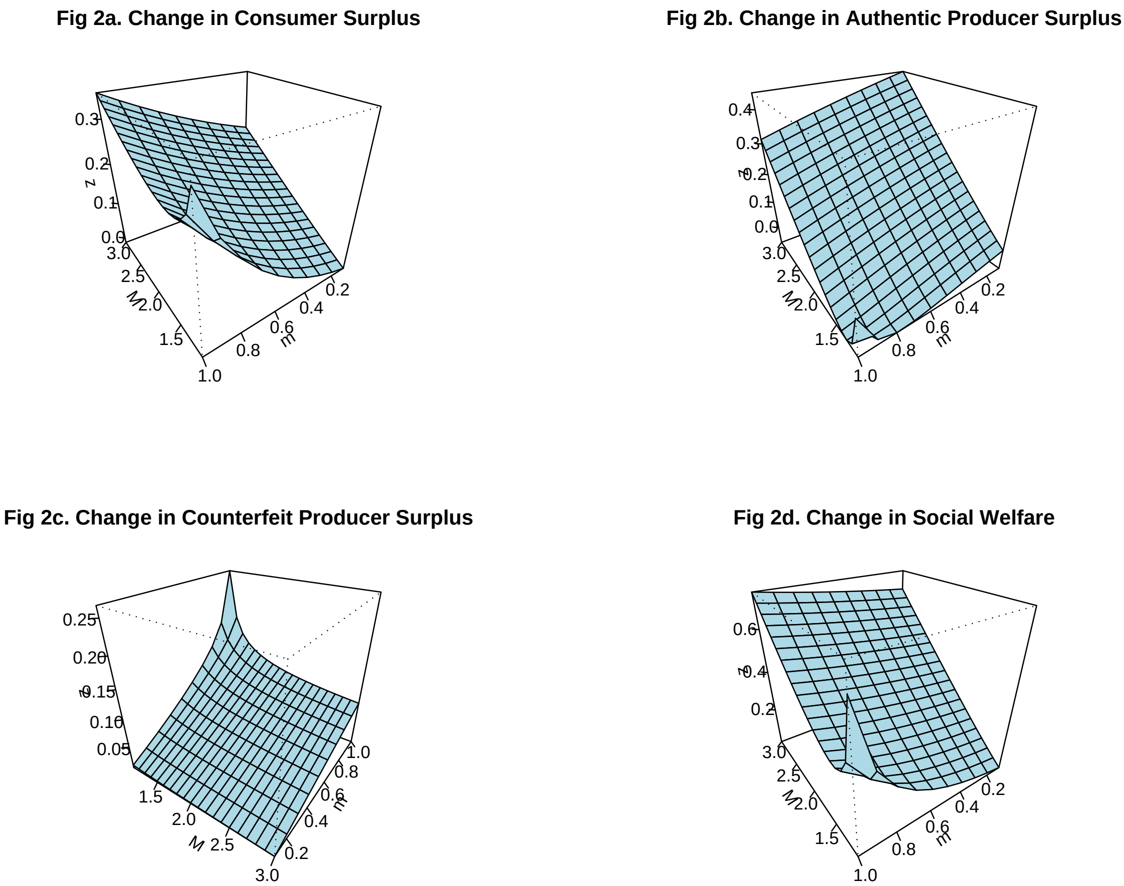

Figure 2: Welfare Simulations Under Complete Information.

brand price in the separating equilibrium.

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

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

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

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

Figures 3c and 3d graph how social welfare in the constrained separating equilibrium changes with respect to a counterfeit's quality as a fraction of original monopoly quality (m) and market asymmetric information (γ) 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 (γ close to zero). In the extreme where the counterfeiter could perfectly knock off authentic quality s ($m = 1$), 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, welfare drops as the proportion of novices increases. When nobody in the market could tell counterfeits and authentic products apart at the same price, the 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 a very similar intuition to Figure 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 with low levels of counterfeit quality.

The parameters here take on realistic values as reflected in the data I collected from the

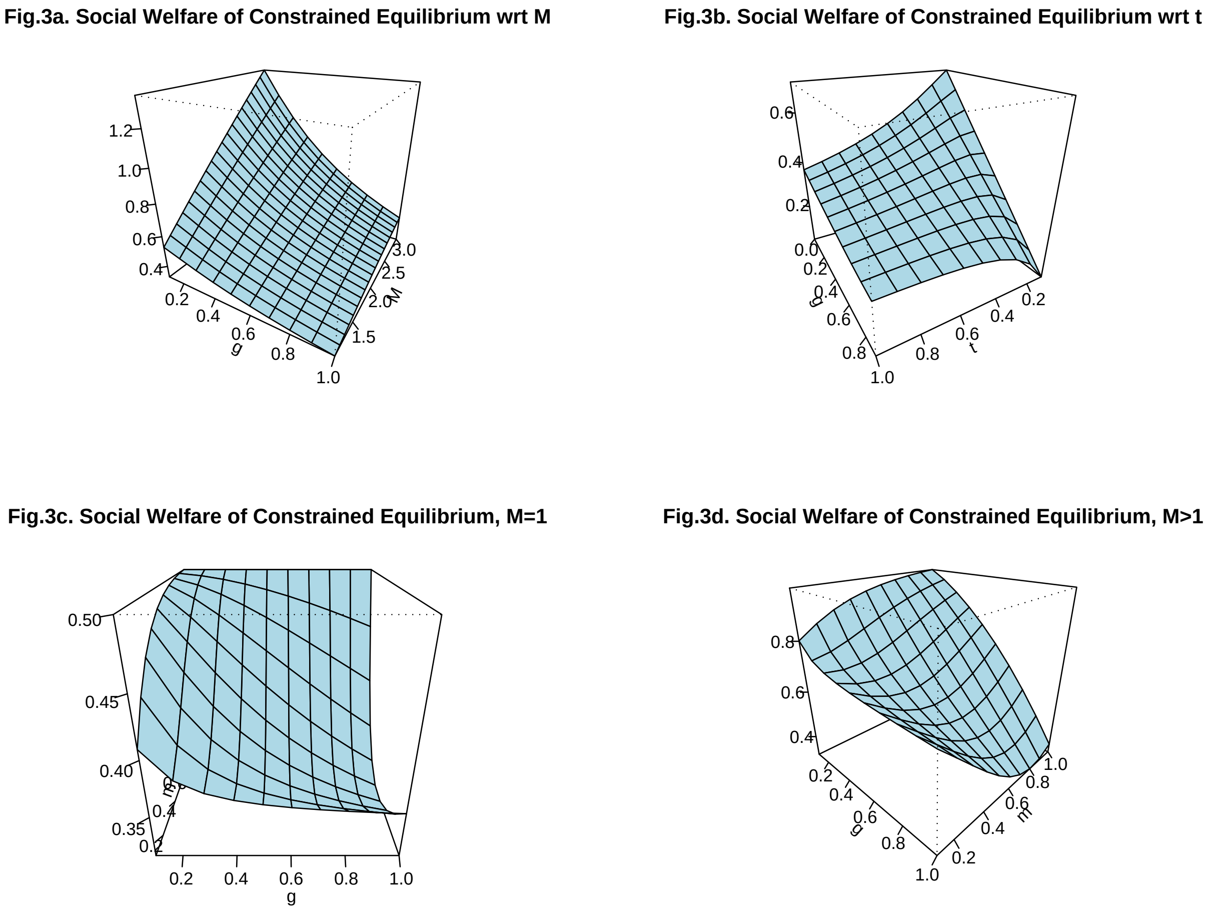

Figure 3: Welfare Simulations Under Asymmetric Information.

representative companies in China, and the simulations cover the entire range of possible values for some key parameters, such as m, γ, λ. The empirical analyses in the next section found significant quality upgrades by brands after they were infringed by the counterfeits ($M > 1$). The price increase was significant only for the authentic products whose counterfeit quality was below a threshold. Tying with the comparative statics in Figures 2 and 3, we can infer that consumer surplus and social welfare were not likely to have diminished in the Chinese shoe market in the period under examination.

While the theory here considers the endogenous pricing, quality, and other marketing decisions of a brand in the face of counterfeiting, it is worth noting that the model does not incorporate dynamic learning. It is possible that the knockoff competition could affect the legitimate brand's future incentives to invest in R&D and affect social welfare differently than the results here. This deserves future research.

3 Empirical Validation

3.1 Data and Identification Strategy

I test the theory predictions 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 nationwide, to supervise product qualities and outlaw counterfeits. The bureau has enlarged its personnel and funding since 1991 in joint efforts with legislatures 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 producers reveal that they experienced significant counterfeit entry after this loosening of governmental monitoring and enforcement: most entries 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 when authentic producers had poor relationships with a local QTSB more than it did when authentic producers had strong ties. This finding was revealed in both qualitative interviews with managers and data analyses, as detailed in Section 3.2. The importance of relationships is not confined to China. In an Imaging Supplies Coalition Anti-Counterfeiting conference in 2008, Andrew Gardner from Lexmark International presented a case study on actual "sting" operations to bust counterfeiting rings in developing countries. It showed how close collaboration between multiple vendors and local governments were crucial to successfully executing such operations. I therefore use the interaction between the policy change and the differential relationships between authentic producers and the government to identify the entry effects by counterfeiters for different brands, as detailed in the next subsection.

The data I gathered consist of detailed information taken from annual financial statements and other relevant company records from a random sample of 31 authentic producers from the census of Chinese shoe firms and the producers' 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 Ms 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 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 QTSB). Qian (2008) and Appendix B provide further data details.

In addition, I coded and compiled a dataset of the different characteristics for each type of shoe 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 ran 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 conducted 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 interviews 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 counterfeiters who claimed to be sales representatives of a branded company and who offered huge discounts to fulfill their year-end sales quota. A majority of the consumers at the mall claimed that they could not recognize counterfeits, and they usually relied on price or store signals to infer quality and authenticity. However, consumers who frequented street corner merchants unanimously told me that they liked these boutiques for the cheap prices and didn't expect real branded products.

3.2 IV Validity

The authentic producers 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 a 20-fold increase in private enforcement investment to compensate for the lack of public enforcement. However, the authentic producers still had to get the government to outlaw the counterfeit sites detected by their enforcement employees. This is where relationships with the government (the QTSB in particular) come into play.

Before the enforcement change, the QTSB conducted regular inspections in the shoe markets and factories. It confiscated and shut down counterfeit localities 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 reduced the incentives of counterfeiters to infringe on these brands. This company-level variation is helpful in exploring variations 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 a relationship based on a synthesis of interview evidence and empirical analyses. Since the late 1980s, all registered companies in China have been *required* to meet the standards set by the International Standards Organization (ISO).[5] For the shoe industry, the 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 for others the application and grant dates were over 300 days apart. Among companies that took a long time to fulfill the ISO requirements, some were small and some medium or large. 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 that 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 the 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 included only these most important instruments because weaker instruments can reduce the effectiveness of IV.

$$\text{Counterfeit}_{a,t} = \alpha_0 + \alpha_1 * (\text{Loose*Relationship})_{a,t} + \alpha_2 * \text{Loose}_{a,t} + \alpha_3 * \text{Relationship}_{a,t} + \alpha_4 * t + e_{a,t} \quad (2)$$

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

[5]This differs from the U.S. practice, where companies adopt ISO voluntarily.

significant at the 1% level. The overall Wald Chi-square tests 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 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:

$$log(P_{a,t}) = \beta_0 + \beta_1 * \text{Counterfeit}_{a,t-k} + \beta_2 * log(c_{a,t}) + \beta_3 * m_{a,t} + \beta_4^T * \text{YearD}_t + \beta_5^T * \text{BrandD}_a + \epsilon_{a,t}, \quad (3)$$

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 counterfeit entry, I simultaneously estimate Equations (2) and (3) using 2SLS.

Proposition 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 (3) 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 (2) and (3) on the panel data for 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 the outcome. Both the standard 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 costs for authentic products are strong predictors for log prices in both samples. The improved quality (proxied by the log of authentic cost) explains most of the price change. The more competitive pressure the counterfeit entry exerts, the less the authentic price rises. These results are highly consistent with the theoretical model predictions.

The counterfeit entry indicator bears a 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 is consistent with two hypotheses: First, segmentation of customers into purchasing high-end brand and low-end counterfeits could imply that the brand could reoptimize to a higher price for the high-valuation consumers (Frank and Salkevers 1997); 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 an 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 the sample is split in other ways. When I stratified the sample with looser conditions on counterfeit quality (e.g., quartile values), the results for the subsamples of low-quality entrants remained qualitatively similar. The positive coefficient on the entry dummy takes on more significance (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.[6] 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 was described in the catalog as possessing the characteristic and 0 otherwise. A simple sum is generated instead of a weighted sum to avoid biasing results according to prior beliefs as to 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 mentioned in the product catalogs. I also constructed a variable indicating the technology applied to make the shoes. Before counterfeit entry, all the companies used domestic equipment. However, after entry, many imported Italian production lines, pattern-pressing machines, and equipment to make shoe bottoms with cowskins. 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.

[6] For instance, the variable for surface material takes on a value of 1 if a product is made of plastic,...,4 for regular cowskin,..., 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.

To examine the actual innovations after a product was infringed by counterfeits, I carried out regressions for the continuous variable for overall quality on counterfeits 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 coefficients on the quality measures (log deflated production costs and overall quality rank), significant at the 1% level (Table 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 percent after the brand experienced counterfeits (the modes of the distributions for quality ranks were approximately equal to 20). This set of empirical findings directly supports 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 predict self-enforcement strategies as means of deterring counterfeiting. In this section, 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, establishing an additional licensed company store helps to reduce counterfeit sale quantities as a fraction of authentic quantities in the following year 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?" and "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 a larger segment of consumers would like to own 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 (Columns 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 a firm's strategies are complements or substitutes for 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 the 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 counterfeiters.

The fact that the infringed brands had to coexist with counterfeiters even after investing handsomely in a plethora of self-enforcement strategies in the period of loosened public enforcement speaks to the necessity for government enforcement. In the years of strong government monitoring, counterfeiters were afraid to enter 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 counter 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 price, 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 counterfeit entry may exert downward pressure on prices by lowering expected quality in any short-run pooling equilibrum. More important, 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. It is noteworthy in the empirical setting that brands did not innovate in the long period prior to entry by counterfeiters, even though there were sufficient competition among the brands. The analytical model conceptualizes and resolves this puzzle: due to the knockoff nature of counterfeits, it presents vertical differentiation to the market. Such competition brings unique pressure for the brand to move up the quality ladder in a market where brand enjoys monopolitic power in its own niche (even when it may coexist with other brands that are horizontally differentiated).

The brand's innovations and the newly-available counterfeits that tailor to low-valuation consumers could imply some positive welfare improvement in diversifying demand and increasing consumer surplus. However, individual consumers who prefer the baseline authentic quality (s) at the monopoly price (p), if any exist, would be worse off if this quality level (s) were replaced by a higher quality (Ms) at a higher price after counterfeits entered 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 helping 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. Taking in a positive light, this implies that public-private partnership in enforcement could be effective, leveraging both the private firms' insider knowledge and the government's sanction power. In a world with asymmetric information, the social planner's optimization could often result in corner solutions. Discretizing the optimization problem by inviting collaboration with the brands who have vest interests and incentives to combat illegal activities such as counterfeits could lead to more efficiency.

Although starting from a simple model, the propositions have general implications for imitative or counterfeit entries. Honest imitative entry (e.g., generic drugs) is 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 predications also helps 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 about market entry and potential complementary effects counterfeits could have on 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$_{t-2}$ 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	High-quality	Low-quality	High-quality
	(1)	(2)	(3)	(4)
Counterfeit$_{t-2}$	.04***	.01	.06**	.01*
	(.02)	(.06)	(.03)	(.01)
logCost	.93***	.89***	.95***	.91***
	(.02)	(.03)	(.01)	(.02)
m	-.09**	-.59	-.08*	-.63
	(.04)	(.61)	(.05)	(.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$_{t-2}$	.45***	2.82***
	(.12)	(.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$_{t-2}$	.30***	2.67***
	(.09)	(.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$_{t-1}$	-.001*	-.02***	-.01
	(.000)	(.005)	(.02)
Sales$_{t-1}$	.04	.01	.52**
	(.04)	(.05)	(.25)
Enforce$_{t-1}$	-.000	-.01	-.003**
	(.000)	(.015)	(.001)
Cost$_{t-1}$	.16	.27	-.25
	(.13)	(.20)	(.93)
Log(GDPpcPPP)	3.4	2.55	18.3
	(3.1)	(4.36)	(19.5)
Growth	-.01	-.05	.02
	(.03)	(.05)	(.23)
GINI	.14**	.07	1.32***
	(.05)	(.08)	(.37)
Log(deflated HHC)	.95	1.70	8.5
	(.88)	(1.22)	(5.9)
Year Trend	.22	-.43	-.01
	(.24)	(.25)	(.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-squre values from the two alternative regression specifications are similar, and I report the first specification R-square in the last line.

Dependent variable:	$\log(\mathbf{Ads_t})$	$\log(\mathbf{Store_t})$	$\log(\mathbf{Enf_t})$	$\log(\mathbf{C_t}) - \log(\mathbf{C_{t-1}})$
	(1)	**(2)**	**(3)**	**(4)**
ISO	**.001**	**.39****	**.004**	**.0003****
	(.001)	**(.17)**	**(.003)**	**(.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**

Table A1. Summary Statistics Before and After the Loosening of Government Efforts in Monitoring Footwear Trademarks in 1995

This table presents the summary statistics of the dataset, slicing into two parts: data prior to the year 1995, when Chinese government reallocated enforcement resources away from the footwear sector to fill in the needs of the safety sectors, and data post year 1995. Each row reports the means and standard deviations (in parentheses) of a variable in the two time-lines. All company level data are gathered through original interviews and surveys. The percentage of government resources devoted to monitoring the shoe sector is obtained from the Quality and Technology Supervision Bureau. Real GDP per capita PPP, growth rates, consumption over income, and household consumption are obtained from the World Bank *World Development Indicators (WDI).* Prices and costs are deflated using the Consumer Price Index published in the WDI. Gini coefficients are extracted from the UN Human Development Reports.

Variable:	**Pre-1995**	**Post-1995**
Percentage of Government Resources	.11	.02
Devoted to Monitoring the Shoe Sector	(.004)	(.001)
Fake Sale Quantity	Median 0	85.71
(in 10,000 pairs)	When exist, range from 1.2 to 1.87	(75.85)
Fake Shoe Price	Median 0	58.55
(Deflated, in Yuan)	When exist, range from 75 to 94	(33.61)
Fake Shoe Costs	Median 0	21.29
(Deflated, in Yuan)	When exist, range from 20 to 32	(12.51)
Authentic High-level Shoe Price	389.71	491.86
(Deflated, in Yuan)	(184.13)	(324.64)
Authentic High-level Shoe	301.79	376.10
Production Costs (Deflated, in Yuan)	(143.55)	(240.25)
Authentic Low-level Shoe Price	152.46	150.51
(Deflated, in Yuan)	(65.48)	(83.83)
Authentic Low-level Shoe	118.40	115.35
Production Costs (Deflated, in Yuan)	(52.25)	(61.32)
Incorporation Year	1985	1985
of Authentic Brands	(11)	(11)
Sale Quantity (in 10,000 pairs)	309.38	558.28
of Authentic Brands	(725.76)	(995.82)
Total Sales of an Authentic Brand	378.52	626.33
(Deflated, in million Chinese Yuan)	(674.83)	(839.97)
Domestic Sale of Authentics	348.05	393.41
(Deflated, in million Chinese Yuan)	(675.24)	(575.26)
Self-enforcement Costs of Authentic Brands	.39	65.10
(Deflated,in 10,000 Chinese Yuan)	(1.16)	(66.51)
Authentic Brand-Protection Office Personnel	.17	4.0
(Head-count)	(.46)	(2.23)
Advertising Expenditure	1122.53	1905.18
(Deflated, in 10,000 Yuan)	(2043.18)	(2663.43)
Number of Company Stores	0	684
(Retail Stores Established by an Authentic Brand)	(0)	(533.5)
Employment of an Authentic Company	609	2499
(Head-count)	(355)	(2708)
Wage in an Authentic Company	208.41	2103.60
(Deflated, in Yuan)	(119.43)	(3468.87)
Workdays Authentic Company Took to Pass ISO	124	122
(Relationship Proxy)	(116.5)	(112.6)
Real GDP per capita PPP	2326.86	3905.05
(in Yuan)	(41.79)	(22.63)
Economic Growth	12.99	8.43
(X 100%)	(.15)	(.03)
GINI	37.13	43.82
(X 100%)	(.34)	(.08)
Consumption as Share of National Income	57.76	57.40
(X 100%)	(.32)	(.02)
Household Consumption	23.6	38.4
(Deflated, in billion Yuan)	(.17)	(.21)
No. of Obs.	62	310

Table A2. The IVs' Relevances

This table reports the first stage of IV estimations. All models use company fixed effects. Counterfeit entry dummy (equals one if counterfeits are discovered for a brand) is regressed on the set of I.V., with year trend and company fixed effects, in four separate regressions. Each column reports one regression specification. Heteroskedasticity-consistent standard errors that correct for clustering at the company level appear in parentheses.Statistical significance levels: *-10%; **-5%; ***-1%.

IV1: Enforcement legislation change – Loose, a dummy which equals 1 in 1995 onwards, and year trend.

IV2: Interaction between legislation change and a company's relationship with its local government – Relation (Proxied by the number of work days between the application and grant dates of ISO certificate for an authentic company), Loose*relation, Loose, and year trend.

IV3: Interaction between legislation change and a company's relationship with its local government (Loose*relation), year and company dummies.

Dependent Variable:	Fake Entry		
	(1) IV1	(2) IV2	(3) IV3
Loose	.72***	.27***	
	(.04)	(.05)	
Relation		.001	.001
		(.001)	(.001)
Loose*relation		.14***	.002***
		(.02)	(.000)
year trend	-.000	.04**	
	(.000)	(.01)	
Year Fixed Effects	N	N	Y
No. of Obs.	372	372	372
Wald Chi2 (or F-stat)	135	179	49.3

Online Appendices

A Theory Appendix

A.1 Derivation of Status Signaling

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:

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

Proposition 5 *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 the previous Section. 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.

Proposition 6 *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, λ.*

Proof: First, solve $\Pi^D_{Ms} > \Pi^D_s$. 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 $C = (\frac{2M(M-m)}{2M-m} - \frac{1-m}{2-m})\frac{s}{2} + \frac{m(M-1)(2-\lambda)}{2(2M-m)(2-m)}r + \frac{2M(M-m)s+(M\lambda-m)r}{2(2M-m)}\frac{(M\lambda-m)r}{4M(M-m)s} - \frac{2(1-m)s+(\lambda-m)r}{2(2-m)}\frac{(\lambda-m)r}{4(1-m)s}$. Ruling out the negative root, the authentic profit derived from the high quality product exceeds that from the low quality one iff $c < \frac{B+\sqrt{B^2 - \frac{2M-m}{2M(M-m)s}C}}{\frac{2M-m}{4M(M-m)s}}$.

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 satisified 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.*

This is clearly a stepstone in modeling the status-signaling aspect of counterfeiting due to the space constraint.

A.2 Proofs

Proof for Lemma 1:

When the incumbent is a monopoly in the market, she would choose s over Ms iff $\Pi_L > \Pi_H$. That is, $\frac{(s)^2}{4s} > \frac{(Ms-c)^2}{4Ms}$.

This implies: $M + \sqrt{M} \geq \frac{c}{s} \geq M - \sqrt{M}$

However, we already know that $c < P < Ms$ to ensure positive producer markup and consumer utility. Thus, the upper bound (first inequality) is trivially satisfied. *Q.E.D.*

Proof for Lemma 2:

With new entry, if the incumbent still produces s, I derive the equilibrium solutions. If s is offered, then equilibrium

$P_a^{DS}(s) = \frac{(1-m)s}{2-m}$ and $\Pi_a^{DS}(s) = \frac{(1-m)s}{4-2m)}$;

whereas the equilibrium with Ms is

$P_a^{DS}(Ms) = \frac{c}{2} + \frac{M(M-m)s}{2M-m}$ and $\Pi_a^{DS}(Ms) = \frac{(2M(M-m)s-(2M-m)c)^2}{8M(2M-m)(M-m)s}$.

$\Pi_a^{DS}(Ms) \geq \Pi_a^{DS}(s)$ leads to $2M(M-m)s - (2M-m)c \geq s\sqrt{\frac{4M(2M-m)(M-m)(1-m)}{2-m}}$

$\frac{c}{s} \leq \frac{2M(M-m)}{2M-m} - \sqrt{\frac{(1-m)4M(M-m)}{(2-m)(2M-m)}} \equiv \text{cutoff}_1^{DS}$

Equivalently, $s_c \geq \frac{c}{\frac{2M(M-m)}{(2M-m)m}+m\sqrt{\frac{(1-m)4M(M-m)}{(2-m)(2M-m)}}} | s_c \geq \frac{c}{\frac{2M(M-m)}{(2M-m)m}-m\sqrt{\frac{(1-m)4M(M-m)}{(2-m)(2M-m)}}}$ *Q.E.D.*.

Proof for Proposition 1:

Lemmas 1 and 2 outline the case where the incumbent produces a low-quality product without counterfeit entry but is induced to produce a high-quality product after entry. Under this scenario, the producer initially enjoys a monopoly price $P_L = \frac{s}{2}$ and later charges $P^D = \frac{c}{2} + \frac{M(M-m)s}{2M-m}$ in a leader-follower game. The original prices rise after entry if

$P^D \geq \frac{s}{2} \Leftrightarrow s_c = ms \leq \frac{2M((M-1)s+c)-mc}{2M-1} = \text{cutoff}_3^{DS}$

$(\Leftrightarrow s \leq \frac{(2M-m)c}{2M(1+m-M)-m})$

$$\begin{aligned}
\frac{\partial cutoff_2^D}{\partial M} &= \frac{2Ms+2((M-1)s+c}{2M-1} - \frac{4M((M-1)s+c)-2mc}{(2M-1)^2} \geq 0; \\
\frac{\partial cutoff_2^D}{\partial s} &= \frac{2M(M-1)}{2M-1} > 0;
\end{aligned}$$

It is almost identical to the comparative statics for Bertrand games. The threshold values for s_c increase as M or s rises. *Q.E.D.*

Proof for Proposition 2:

Under the unconstrained separating equilibrium, the game reduces to one with complete information. Demand is segmented according to the vertically differentiated product qualities. Given any incumbent price P_a, the profit-maximizing price for the entrant is $P_c = \frac{msP_a}{2s_a}$, because $\Pi_c = P_c(\frac{P_a - P_c}{s_a - ms} - \frac{P_c}{ms})$. The incumbent therefore sets her price by maximizing

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

yielding

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

Hence, $P_a^{se} = \frac{M(M-m)s}{2M-m} + \frac{c_a}{2}$, using $M \geq 1$ to generalize s_a. Note that if quality is s, then $c_a = 0, M = 1$. Substituting into condition (1), we can solve out the cutoff value of γ for the constraint $P_a^{se} = \frac{M(M-m)s}{2M-m} + \frac{c_a}{2} \geq \underline{P}$ to bind. Hence,

$$\gamma \leq \frac{cm((1-b)(m+bM)(2M-m)) + 2mMs(m(M-m)(1-b+bM))}{2(M-m)M(2ms(1-b)(3M-m) - c(2M-m) - 2M^2s(1-2b))} \equiv \bar{\gamma} \tag{5}$$

We are left to solve for P_a^{pe}. Maximizing Π_a^{pe} $w.r.t.$ P yields:

$$P_a^{pe} = \frac{\gamma(c(2m-2bm-M+2bM)+mMs(1-b)+bM^2s)-2(m+2bm-2bM)c-2mMs(1-b)-2bM^2s}{2(-2m+2bm-2bM+\gamma(2m-2bm-M+2bM))}$$

$$\Pi_a^{pe} = \frac{(M(m-bm+bM)s(2-\gamma)-c(2(1-b)m(1-\gamma)+M(2b+\gamma-2b\gamma)))^2}{8M(m-bm+bM)s(M(2b(1-\gamma)+\gamma)+2m(1-b)(1-\gamma))}$$

Lemma 4 *The authentic price of the same-quality product drops if a pooling equilibrium is reached between the authentic and the counterfeit producers.*

Proof: Suppose the contrary, $P_a^{pe} \geq P_a^M = \frac{Ms+c_a}{2}$. Then this would imply that $m \geq M$. However, by assumption, $m < 1, M \geq 1$, a contradiction. *Q.E.D.*

Proof for Lemma 3: We first compare the optimal authentic price in a separating duopoly equilibrium with non-corner solution and the monopolistic price, $P_a^D - P_a^M = \frac{s_a(s_a-ms)}{2s_a-ms} + \frac{c_a}{2} - \frac{s_a+c_a}{2} = \frac{-ms*s_a}{4s_a-2ms}$. It is obvious that this is negative. It implies that $P_a^{DS} \leq P_a^M$. The only possibility in separating equilibrium where the authentic price increases even with the same quality is that the constraint binds, that is, $P_a = \underline{P}$. This binding price can be higher than the monopoly price iff $\frac{2\gamma(M-m)M(m-bm+bM)s}{m^2-bm^2+bmM+2M\gamma(M-m)} > \frac{s}{2}$, yielding:

$$\gamma > \frac{m^2 - bm^2 + bmM}{2(M-m)M(2b(M-m) - 1 + 2m)} \tag{6}$$

We need to check whether the authentic producer would ever decide to stick with this constrained optimization instead of deviating to the pooling equilibrium. This requires $\bar{\Pi}_a^{se} \geq \Pi_a^{pe}$:

$(\underline{P} - c_a)(1 - \frac{\underline{P} - \frac{m\underline{P}}{2M}}{(M-m)s}) \geq (1-\gamma)(P_a^{pe} - c_a)(1 - \frac{P_a^{pe}}{Ms}) + \frac{\gamma}{2}(P_a^{pe} - c_a)(1 - \frac{P_a^{pe}}{bMs+(1-b)ms})$

With all the parameters, analytically solving this inequality is very cumbersome and the result is not presentable with lengthy expressions. However, computational plots show that there is a lower bound of m that ensures the inequality holds, where $\underline{m}$ is a complex function of γ, b, M, c.

$$m \leq \underline{m} \tag{7}$$

In the special case that the market is evenly divided into experts and novices who expect each product is equally likely be an authentic or counterfeit ($\gamma = b = .5$) and the authentic quality remains s pre- and post-entry ($M = 1, c = 0$), then $\underline{m} = .45$.

(5) and (6) outline the conditions for the price-signaling effects of the authentic products. The intuition of the conditions is that, given a sufficiently large proportion of confused consumers (γ), it is worth the pain for the authentic producer to price higher in order to signal her quality relative to the counterfeiter's. The sufficiently low counterfeit quality as a fraction of authentic quality (m) guarantees the authentic producer that enough consumers will purchase her products even at a higher price. The benefits of capturing the "novices" outweigh the costs of losing some low-valuation consumers who may not purchase at the high price in the separating equilibrium.

Q.E.D.

I next consider $P^{se} > P^M$. Since unconstrained optimization always yields larger profits than constrained optimization, we are assured that $\Pi_a^{se} \geq \bar{\Pi}_a^{se}$ whenever the separating equilibrium is attainable, that is, whenever $P_a^{se} \geq \underline{P}$. I leave it to the interested readers to show that the authentic producer's incentive constraint for separating equilibrium is: $\Pi_a^{se} > \Pi_a^{pe}$. The point here is that it will enlarge the parameter ranges to support the increase in authentic price post-entry. (Note that the conditions in Lemma 2 are sufficient but not necessary for $P_a^{se} \geq P_a^M$.)

Lemma 5 *If the authentic producer improves quality to Ms post-entry, for a sufficiently big quality gap $\frac{M}{m}$ and a corresponding range of γ, even the pooling price could exceed the monopoly price for the old quality s.*

Proof: For $P_a^{pe}(Ms) \geq P_a^M(s) = \frac{s}{2}$, we solve the inequality and obtain:

$$\frac{M}{m} \geq \frac{(1-b)(s\gamma_{Ms}(M-2) - 2s(M-1) - 2c(1-\gamma_{Ms}))}{c(2b(1-\gamma_{Ms}) + \gamma_{Ms}) + 2bs(M-1) + s\gamma_{Ms}(b(2-M)-1)} \tag{8}$$

Together with γ_{Ms} fulfilling the pooling equilibrium condition (2), this range of quality gap leads to a price increase. *Q.E.D.*

If the authentic producer adopts quality strategy 1, the quality gap between authentic and counterfeit products widens, and consumers are willing to pay more to get the higher-quality authentic products. In addition, the widened quality gap reduces the fraction of confused consumers. (Note also, analytically, that $\frac{\partial P}{\partial M} > 0$.) These factors support the higher price even in the pooling equilibrium, intuitively explaining Lemma 3. I have shown earlier that in any separating equilibrium authentic prices, optimal or constrained, are bounded below by the pooling price. It follows that Lemma 3 outlines the sufficient, but not necessary, conditions that the separating authentic prices, whenever attainable, are higher than the monopoly price for the obsolete quality s.

If the authentic producer chooses quality strategy 2, then she can never set a positive price (P) that is profitable to her in this setting. To see this, consider first the case that the authentic producer truthfully reveals her updated quality to the public. Then, all consumers know that there is in fact only one quality available in the market, and they will purchase from the producer who charges a lower price. Knowing this, the counterfeiter, as the price follower, has the incentive to charge $P - \epsilon$ where ϵ is an infinitely small number, and seize the entire market. This will happen unless $P - \epsilon$ is less than the counterfeiting cost, which is assumed to be zero in the model. Consider next the case that the authentic producer also decides to "fool" consumers by announcing publicly that she produces a high-quality Ms. Then the counterfeiter may have an incentive to charge a high price to mislead non-expert consumers into thinking his products are of high quality, as long as this will yield more profits for him:

$\gamma P_c(1 - \frac{P_c - P}{Ms - ms}) > \frac{\gamma}{2} P(1 - \frac{P}{bMs + (1-b)ms})$

If we denote $P_c = \lambda P$, with $\lambda > 1$, then this incentive constraint for the counterfeiter, IC_c, reduces to $2\lambda - 1 > \frac{P}{s}(\frac{2\lambda(\lambda-1)}{M-m} - \frac{1}{b(M-m)+m})$

If $2\lambda(\lambda - 1) < \frac{M-m}{b(M-m)+m}$, then the inequality always holds. This happens when there is a sufficiently large deceived quality gap $M - m$ (I say deceived because there is no gap in reality if the authentic producer adopts ms). Otherwise, the IC_c becomes:

$$\frac{P}{s} < \frac{2\lambda - 1}{\frac{2\lambda(\lambda-1)}{M-m} - \frac{1}{b(M-m)+m}} \tag{9}$$

The authentic producer calculates and compares the pooling and separating equilibria in this circumstance. Mathematically, she solves:

$$\begin{aligned} max\ \Pi_a^{se} &= (1-\gamma)P(\frac{\lambda P - P}{(M-m)s} - \frac{P}{ms}) \\ s.t.\ \frac{P}{s} &< \frac{2\lambda-1}{\frac{2\lambda(\lambda-1)}{M-m} - \frac{1}{b(M-m)+m}} \\ max\ \Pi_a^{pe} &= \frac{1}{2}[(1-\gamma)P(1-\frac{P}{ms}) + \gamma P(1 - \frac{P}{bMs+(1-b)ms})] \\ s.t.\ \frac{P}{s} &\geq \frac{2\lambda-1}{\frac{2\lambda(\lambda-1)}{M-m} - \frac{1}{b(M-m)+m}} \\ \text{yielding} P^{pe} &= \frac{ms(b(M-m)+m)}{2(b(M-m)+m-b\gamma(M-m))} \\ P^{se} &= 0 \end{aligned}$$

Lemma 6 *If the authentic producer decides to degrade quality, then she has only an incentive to truthfully reveal the updated quality in public. Knowing this, quality strategy 2 is strictly dominated by strategies 1 and 3.*

Proof: Suppose to the contrary that $M > m$, then the pooling equilibrium is attainable iff: $\frac{P^{pe}}{s} \geq \frac{2\lambda-1}{\frac{2\lambda(\lambda-1)}{M-m} - \frac{1}{b(M-m)+m}}$ This requires that:

$$\gamma > \frac{-m(m+b(M-m))\lambda^2 + (m+b(M-m))(2M-m)\lambda - M(1-b)(M-m)}{b(M-m)^2(2\lambda-1)} \tag{10}$$

Since $0 \leq \gamma \leq 1$, for (7) to make sense, it is also needed that:

$$\begin{aligned} \lambda &\geq \frac{2M - m + b(M-m) + \sqrt{(2M + bM - m - bm)^2 - 2(M-m)(m - bm + bM)}}{2(m - bm + bM)}; \\ b &> \frac{M(m-M) + \sqrt{3(-m^4 + 4m^3M - 6m^2M^2 + 4mM^3 - M^4)}}{(M-m)^2} \end{aligned} \tag{11}$$

It happens, however, that the expression under the square root is always non-positive, and equaling 0 when $m = M$. This leads to a contradiction with the supposition that $M > m$. Coupled with the previous analyses that the authentic producer would earn zero profit with zero price if she chose to produce ms and truthfully report to the public, I have proved that strategy 2 is strictly dominated by strategy 1. That is, the authentic producer will not imitate the counterfeiter. *Q.E.D.*

Lemma 7 *If the authentic producer decides to upgrade quality after the entry by counterfeiters, then the authentic price will rise in the unconstrained separating equilibrium if the entrant's quality* $s_c <$ *cutoff. This cutoff value is increasing in* M *or* s.

Proof: In an unconstrained separating equilibrium with the higher-quality Ms, the optimal authentic price is the same as the one derived for the game with symmetric information: $P^D = \frac{c}{2} + \frac{M(M-m)s}{2M-m}$. The original prices rise after entry if

$P^D \geq \frac{s}{2} \Leftrightarrow s_c = ms \leq \frac{2M((M-1)s+c)-mc}{2M-1} = \text{cutoff}$

$(\Leftrightarrow s \leq \frac{(2M-m)c}{2M(1+m-M)-m})$

$$\frac{\partial cutoff}{\partial M} = \frac{2(2M-1)s+2c}{2M-1} - \frac{4M(M-1)s+4Mc}{(2M-1)^2} \geq 0;$$
$$\frac{\partial cutoff}{\partial s} = \frac{2M(M-1)}{2M-1} > 0;$$

The threshold values for s_c increase as M or s rises. *Q.E.D.*

It is worth noting that the existence of the unconstrained separating equilibrium relies on two Incentive Constraints:

$\Pi_c^{se} \geq \Pi_c^{pe}$ (IC1)

and $\Pi_a^{se} \geq \Pi_a^{pe}$ (IC2)

IC1 implies that $\frac{c}{s} > -2(\frac{M(M-m)}{2M-m} + \frac{2(M-m)M(m-bm+bM)\gamma}{m(m-bm+bM)+2M\gamma(M-m)})$, which always holds because the right-hand side is negative under the defined parameter values. IC2 for the authentic producer says that:

$$\frac{(2M(M-m)s-(2M-m)c)^2}{8M(2M-m)(M-m)s} \geq \frac{(M(m-bm+bM)s(2-\gamma)-c(2(1-b)m(1-\gamma)+M(2b+\gamma-2b\gamma)))^2}{8M(m-bm+bM)s(M(2b(1-\gamma)+\gamma)+2m(1-b)(1-\gamma))}$$

The calculation is messy, but it turns out that $\frac{c}{s} \leq \frac{2M(M-m)}{2M-m}$, providing a sufficient condition for the inequality to hold.

The previous Lemmas trace out the wide set of necessary parameter ranges for a price increase under asymmetric information. This finally completes the proof for Proposition 2. *Q.E.D.*

Proof for Proposition 3: To see this, I derive a functional form for the counterfeit entry:

FakeEntry=$1(\Pi^{se}_{imitate} \leq (1-2w)\frac{\gamma\Pi_{pe}}{2}) = 1(P_a \leq \underline{P}^e)$

- $\frac{\partial FakeEntry}{\partial M} < 0$
- $\frac{\partial FakeEntry}{\partial e} = \frac{\partial FakeEntry}{\partial w} * \frac{\partial w}{\partial e} < 0;$

  Q.E.D.

Proof for Proposition 4: The change in prices of the authentic producer is calculated to be:

$$\begin{aligned}\Delta P &= \frac{M(M-m)s}{2M-m} + \frac{c_a+T}{2} - \frac{Ms+c_a+T}{2} \\ &= \frac{1}{2}(T - \frac{Mms}{2M-m}) \end{aligned} \tag{12}$$

We can easily derive the comparative statistics: $\frac{\partial \Delta P}{\partial M} > 0$; $\frac{\partial \Delta P}{\partial m} < 0$; $\frac{\partial \Delta P}{\partial T} > 0$.
Further, $\frac{\partial \Delta P}{\partial l} = \frac{\partial \Delta P}{\partial FakeEntry} * \frac{\partial FakeEntry}{\partial l} > 0$. *Q.E.D.*

A.3 Off-equilibrium Path and Game Refinement

Let $B(\phi, \hat{\Phi}, p) = \bigcup_{\mu:\mu(\hat{\Phi}|p)=1}\{a \in MBR(\mu, p) | \mu^*_i(\phi) < u_i(p, a, \phi)\}$. That is, B is the set of mixed best responses (MBR). ϕ-type of producer is better off by sending message p than the equilibrium message P^*. Note that $\mu(\hat{\Phi}|p) = 1$ represents that the consumer believes that message p comes only from types in the subset $\hat{\Phi} \in \Phi$.

I specify the off-the-equilibrium beliefs as follows: if a non-expert consumer observes a uniform price over the market, then he forms the belief that a product is authentic with probability b and counterfeit with probability $1-b$. He watches TV and knows what the authentic quality should be, although he cannot tell it in practice. He also can calculate the P^{se}_a, $\underline{P}$, and P^{pe}_a. If he observes two prices on the market, the higher of which is equal to either P^{se}_a or $\underline{P}$, he believes that the higher-priced one is authentic and the other counterfeit. If, however, he observes any other two prices on the market, he assumes both are counterfeits. This belief system helps to rule out the unrealistic case that the counterfeiter may want to charge a price higher than the authentic price in order to fool non-expert consumers into mismatching types.

We start by considering the separating equilibrium. If the authentic producer deviates to $p' \neq P_a^*$, consumers believe that the product is a counterfeit with quality ms. The resulting profit for the authentic producer would then be $(p' - ca)[1 - \frac{p'-P_c}{(M-m)*s}]$. This is less than the optimized $\Pi_a^*(s_a^*, P_a^*)$. Therefore, $B(\phi_a, \hat{\Phi}, p') \subset B(\phi_c, \hat{\Phi}, p')$, where $B(\phi_a, \hat{\Phi}, p')$ is the empty set, and hence $\Phi(p') = \{\phi_c\}$. Repeating this process for any off-the-equilibrium message, consumers' beliefs are restricted to $\Phi(p') = \{\phi_c\}$; the counterfeiter is the seller, if any, who is most likely to deviate.

Let us first consider the case that the counterfeiter deviates. Given $\Phi(p') = \{\phi_c\}$, the minimal profit level that the counterfeiter could achieve by sending the off-the-equilibrium message p' over the set of possible consumers demand response is:

$$\begin{aligned} MIN_{d \in D^*(\Phi(p^*,p^*)} \quad \pi_c(p^*, d, \phi_c) &= (p' - ca)[\frac{P_a - p'}{(s_a - ms)} - \frac{p'}{s_a}] \\ &< \pi_c^*(P_c^*) \end{aligned}$$

This follows because $P_c^* = argmax_{P_c} \underbrace{P_c[\frac{P_a - P_c}{s_a - s_c} - \frac{P_c}{s_c}]}_{\pi_c(P_c)}.$

Therefore, the counterfeiter does not have an incentive to deviate under the off-the-equilibrium beliefs.

Given this, the off-the-equilibrium belief as specified is stable under the D1 criterion. The consistent out-of-equlibrium belief is as follows: If the consumer observes two prices on the market, the higher of which is equal to P_a^{se}, he then believes that the higher-priced one is authentic ($\phi_i = \phi_a$) and the other counterfeit ($\phi_i = \phi_c$). If, however, he observes any other two prices on the market, he assumes both are counterfeits.

Next, we consider the pooling equilibrium analogously. Suppose the authentic producer deviates to $p'' \neq P^*$, then consumers believe that the product is a counterfeit. The resulting profit for the authentic producer would then be $(p'' - ca)[1 - \frac{D_{pool}}{2}]$. This is less than the counterfeiter's new profit $p''[1 - \frac{D_{pool}}{2}]$, and less than the optimized pooling equilibrium profit. Therefore, $B(\phi_a, \hat{\Phi}, p'') \subset B(\phi_c, \hat{\Phi}, p'')$, where $B(\phi_a, \hat{\Phi}, p'') = \{\}$, and hence $\Phi(p'') = \{\phi_c\}$. Repeating this process for any off-the-equilibrium message, consumers' beliefs are restricted to $\Phi(p'') = \{\phi_c\}$; the counterfeiter is the seller, if any, who is most likely to deviate.

Given $\Phi(p'') = \{\phi_c\}$, the consumer utility $U(p'') = (1-b)(V * m * s - p'') + b * (V * M * s - p'')$.

Thus, the minimal profit level that the counterfeiter could achieve by sending the off-the-equilibrium message p'' is:

$$\begin{aligned} MIN_{d \in D^*(\Phi(p^*,p^*)} \quad \pi_c(p^*, d, \phi_c) &= p''[1 - \frac{D_{pool}}{2}] \\ &< \pi_c^{pool*}(P^*) \end{aligned}$$

This follows because $P^* = argmax_P \pi_c^{pool*}(P^*)$.

Therefore, the counterfeiter does not have an incentive to deviate under the off-the-equilibrium beliefs. Given this, the off-the-equilibrium belief as specified is stable under the D1 criterion.

A.4 Consumer Surplus in the Pooling Equilibrium

In the pooling equilibrium, the demand for authentic products and the consumer surplus are:

$$\begin{aligned} D_a^{pe} &= \tfrac{\gamma}{2}(1 - \tfrac{P^{pe}}{bs_a+(1-b)ms}) + (1-\gamma)(1 - \tfrac{P^{pe}}{s_a}); \\ CS^{pe} &= \tfrac{\gamma}{2}\int_{\frac{P^{pe}}{bs_a+(1-b)ms}}^{1} (Vs_a - P^{pe})f(V)dV \\ &+ \tfrac{\gamma}{2}\int_{\frac{P^{pe}}{bs_a+(1-b)ms}}^{1} (Vms - P^{pe})f(V)dV \\ &+ (1-\gamma)\int_{\frac{P^{pe}}{s_a}}^{1} (Vs_a - P^{pe})f(V)dV \end{aligned}$$

If authentic qualities are always s pre- and post-entry, then

$$\begin{aligned} D_a^{pe} &= \tfrac{2-4b(1-m)(1-\gamma)-4m(1-\gamma)-3\gamma}{2(2b(1-m)(1-\gamma)+2m(1-\gamma)+\gamma)} \\ CS^{pe} &= \tfrac{ms\gamma(12-16\gamma+\gamma^2)-2\gamma(4-2(2+s)\gamma+\gamma^2)-(b^2(1-2m)s+(1-b)^2m^2s)(-4+16\gamma-13\gamma^2+\gamma^3)}{(8(2b(1-m)(1-\gamma)+2m(1-\gamma)+\gamma)^2} \\ &+ \tfrac{2bs(2(2-3\gamma)\gamma-m(-4+20\gamma-19\gamma^2+\gamma^3)}{(8(2b(1-m)(1-\gamma)+2m(1-\gamma)+\gamma)^2} \\ &< CS^M \end{aligned}$$

The math confirms the intuition that authentic demand and consumer surplus decline in the pooling equilibrium if a low-quality product enters.

A.5 Robustness to Alternative Specifications

A.5.1 Alternative Specification of Cost

Instead of assuming away the production costs of the low-quality authentic product and the counterfeit, let the corresponding costs be C_a, and C_c, respectively, where $a = s, Ms$ and $C_{Ms} -$

$C_s = c$. Then the monopoly price and profit of the authentic product of quality s become: $P = \frac{s+r-C_s}{2}$, $\Pi = \frac{(s+r-C_s)^2}{4s}$. The authentic producer will not offer the high-quality product in the monopoly condition iff $\frac{(s+r-C_s)^2}{4s} > \frac{(Ms+r-C_{Ms})^2}{4Ms}$. Discarding the negative root, this solves out to be $C_{Ms} - \sqrt{M}C_s \geq (M-\sqrt{M})s + (1-\sqrt{M})r$. This result is qualitatively similar to **Proposition 1**, with the intuition that the authentic monopoly will offer the low-quality product as long as the additional cost for a high-quality product is higher than a threshold level to justify the gain from the higher quality.

When faced with counterfeit entry, the duopoly profits are as follows:

$$\Pi_a = (P_a - C_a)(1 - \frac{P_a - P_c)}{s_a - s_c})$$
$$\Pi_c = (P_c - C_c)(\frac{P_a - P_c)}{s_a - s_c} - \frac{P_c}{s_c})$$

The reaction function of the counterfeiter is solved similar to the benchmark model $P_c = \frac{msP_a}{2s_a} + \frac{C_c}{2}$. The equilibrium prices and demand are:

$$P_a = \frac{M(M-m)s}{2M-m} + \frac{C_a}{2} - \frac{MC_c}{4M-2m}$$
$$P_c = \frac{m(M-m)s}{2(2M-m)} + \frac{mC_a}{4M} - \frac{mC_c}{4(2M-m)}$$
$$D_a = \frac{1}{2} - \frac{(2M-m)C_a}{4M(M-m)s} + \frac{C_c}{4(M-m)s} \tag{13}$$

where $M \geq 1$ generalizes the two quality options of an authentic product.

In this duopoly competition case, the authentic producer will opt to offer the higher quality if $\Pi_{Ms} > \Pi_s$, which is satisfied iff $c + \frac{C_{Ms}^2}{4s}\frac{2M-m}{M(M-m)} - \frac{C_s^2}{4s}\frac{2-m}{1-m} < (\frac{M^2}{2M-m} - \frac{1}{2-m})s + \frac{(M-1)mC_c}{2(2M-m)(2-m)} + \frac{C_c^2}{4s}(\frac{1}{(2-m)(1-m)} - \frac{M}{(M-m)(2M-m)})$. The intuition is similar to **Proposition 2** that the authentic producer is stimulated to upgrade quality to differentiate from counterfeits if and only if the additional cost of doing so is not too high.

Finally, the price increases in the duopoly case with a higher quality as compared to the monopoly price for the regular quality iff $\frac{M(M-m)s}{2M-m} + \frac{C_{Ms}}{2} - \frac{MC_c}{4M-2m} > \frac{(1-m)s}{2-m} + \frac{C_s}{2} - \frac{C_c}{4-2m}$. Rearranging terms gives $s_c = ms < \frac{2M((M-1)s+c)-mc}{2M-1} + \frac{C_c}{2}$. This echoes the intuition conveyed in **Proposition 3** that authentic price rises if and only if the counterfeit entrant's quality is below a threshold value.

A.5.2 Alternative Specification of Quality

Instead of assuming that the quality of the counterfeit is a fraction of the quality of the authentic product, I allow the counterfeit to choose a quality that is a constant less than the authentic quality. That is, the brand can choose between quality s and $s + A$, and the counterfeiter produces $s - a$. Similar to Section 2, we can derive the demand and profits for authentic and counterfeit products accordingly.

Without counterfeits in the market, the demand for authentic product is $1 - \frac{P_a}{s}$ if the quality is s and $1 - \frac{P_a}{s+A}$ if the quality is $s + A$. The optimal price for each quality can be obtained from maximizing the authentic profit with respect to its price. The resulting optimized profits are equal to $\frac{s^2}{4s}$ if quality s is produced and $\frac{(s+A-c)^2}{4(s+A)}$ if quality $s + A$ is produced. The authentic company decides which quality to provide depending on which would yield a larger profit. Therefore, a lower quality s is offered iff $\frac{s^2}{4s} \geq \frac{(s+A-c)^2}{4(s+A)}$, implying $c \geq (A + s) + \sqrt{s^2 + As}$. The prediction is similar to **Proposition 1** in that when higher quality would raise costs more than it would yield profits, the monopoly incumbent offers a lower quality.

With counterfeit infringements, we again have duopoly competition. Section 2.2.1 derives out the equilibrium conditions for the general form of authentic quality s_a. It is then straightforward to prove that the authentic company will upgrade quality from s to $s+A$ iff the higher quality yields larger profit in the duopoly condition. That is,

$$\frac{s*a}{s+a}\left(1 - \frac{\frac{sa}{s+a} - \frac{(s-a)a}{2s+2a}}{a}\right) \leq \left(\frac{(s+A)(A+a)}{s+A+a} - \frac{c}{2}\right)\left(1 - \frac{\frac{(s+A)(A+a)}{s+A+a} + \frac{c}{2} - \frac{(s-a)(A+a)}{2s+4A+2a} - \frac{(s-a)c}{4(s+A)}}{A+a}\right)$$

This inequality holds iff $c \leq \frac{2(s+A)(A+a)}{(s+A)+(A+a)} - 2\sqrt{\frac{a(s+A)(A+a)}{s(s+a)(s+2A+a)}}$. This is again consistent with **Proposition 2** that fake entry pushes the incumbent to upgrade quality in the hope of alleviating competition by widening the quality gap, provided that the additional costs are not too high.

Finally, under conditions outlined in the previous two paragraphs, the authentic price increases with counterfeit infringements iff $\frac{(s+A)(A+a)}{s+2A+a} + \frac{c}{2} > \frac{s}{2}$, which is equivalent to $s_c = s - a < s - \frac{(s-c)(s+2A)-2A(s+A)}{s+2A+c}$. This echos **Proposition 3** that authentic price increases only when the entrant quality is below a threshold level.

A.5.3 Baseline Results with Oligopolist Brands

Consider a market with N brands, with product quality s_a and brand premium N. Without loss of generality, I denote that the ordering of qualities is in descending order as $s_1, s_2, ..., s_N$ and that the ordering is strict. I keep the same set-up for consumers' preferences. Analogous to the leadership-follower logic, I consider that firms set prices sequentially in order of quality, with the highest-quality firm's moves first. The consumer who is just indifferent between buying a brand n and not buying has utility $V*s_a+r_n-P_n \geq 0$, and the consumer decides which brand to buy depending on which yields a higher utility: $V*s_a+r_n-P_n \geq V*s_a+r_o-P_o \forall o = 1, ..., n-1 and n+1, ..., N$. Firm 1 then has a demand $D_1 = 1 - \frac{(P_1-P_2)-(r_1-r_2)}{s_1-s_2}$; Firm N faces demand $D_N = \frac{(P_{N-1}-P_N}{s_{N-1}-s_N} - \frac{P_N}{s_N}$; and each firm in between has a demand interval of $D_n = (\frac{P_{n-1}-P_n}{s_{n-1}-s_n} - \frac{P_n-P_{n+1}}{s_n-s_{n+1}})$. As long as firm n does not set a zero price, firm $n+1$ could also have positive market share and profits. As a result, no firm would ever set a degenerate price in equilibrium, and all firms would have positive market shares.

The profit function for firm N is $\Pi_N = P_N * (\frac{P_{N-1}-P_N}{s_{N-1}-s_N} - \frac{P_N}{s_N})$. Maximizing these profits with respect to P_N, I derive the reaction function $P_N = \frac{s_N*P_{N-1}}{2s_{N-1}}$. Substitute this reaction function into the profit function of firm $N-1$, which is then solved and can be substituted into the profit function of firms $N-2, ...$ The general formula of the profit function for firm $n, n = 2, ..., N-1$ is $\Pi_n = P_n * (\frac{P_{n-1}-P_n}{s_{n-1}-s_n} - \frac{P_n-P_{n+1}}{s_n-s_{n+1}})$. The profit function for firm 1 is $\Pi_1 = P_1 * (1 - \frac{P_1-P_2}{s_1-s_2})$, and the profit function of firm N is $\Pi_N = P_N(\frac{P_{N-1}-P_N}{s_{N-1}-s_N} - \frac{P_N}{s_N})$. Any innovation by a firm n above its baseline quality level s_n would incurr it extra marginal cost of c_n.

Computing the equilibrium involves little intellectual but tedious work. The results yield similar intuition to the benchmark case in the maintext. In particular, the entry of a low-quality counterfeiter would stimulate quality upgrades sequentially for brands of quality above the counterfeiter's under regularity conditions underlying the innovation cost. To give a simple example with two branded producers with qualities s and $M_1 * s$ ($M_1 > 1$), respectively, the market without a counterfeiter is a duopoly market with profits:

$$
\begin{aligned}
\Pi_1 &= P_1 * (1 - \frac{P_1 - P_2}{M_1 * s - s}) \\
\Pi_2 &= P_2 * (\frac{P_1 - P_2}{M_1 * s - s} - \frac{P_2}{s})
\end{aligned}
$$

After a counterfeiter of quality $m*s(m \leq 1)$ enters the market, the oligopolist market under perfect information would be segmented into three segments of consumers who purchase from Brand 1, Brand 2, and the counterfeiter, respectively. Their profit functions are:

$$\begin{aligned}
\Pi_1 &= P_1 * (1 - \frac{P_1 - P_2}{M_1 * s - s_2}) \\
\Pi_2 &= P_2 * (\frac{P_1 - P_2}{M_1 * s - s_2} - \frac{P_2 - P_c}{s_2 - m * s}) \\
\Pi_3 &= P_c * (\frac{P_2 - P_c}{s_2 - m * s} - fracP_c m * s)
\end{aligned}$$

It is not surprising that the counterfeiter now steals part of Brand 2's market share, and Brand 2 would have an incentive to upgrade quality from s to $M * s$ iff $\Pi_2(M * s) > \Pi_2(s)(M > 1)$. Once Brand 2 moves up the quality ladder, Brand 1 is also influenced as some of the original market shares are now shifted to Brand 2. Brand 1 will also innovate if $\Pi_2(M_2 * s) > \Pi_2(M_1 * s)$ $(M_2 > M_1)$. Therefore, both brands will innovate in the face of nondeceptive counterfeits iff

$$\begin{aligned}
(P_2 - c) * (\frac{P_1 - P_2}{M_2 * s - M * s} - \frac{P_2 - P_c}{M * s - m * s}) &> P_2^D(\frac{P_1^D - P_2^D}{M_1 * s - s} - \frac{P_2^D}{s}) \\
(P_1 - c) * (1 - \frac{P_1 - P_2}{M_2 * s - M * s}) &> P_1^D(1 - \frac{P_1^D - P_2^D}{M_1 * s - s})
\end{aligned}$$

These yield the cost conditions:

$$\frac{c}{s} \leq \frac{2M_2(M - m)}{2M - m} - \sqrt{\frac{(1 - m)4M_2(M - m)}{(2 - m)(2M - m)}}$$

$$(\frac{M_3 * s(M_3 * s - Ms)}{2M_3 s - Ms} - \frac{c}{2})(\frac{1}{2} - \frac{c(2M_3 - M)}{4M_3 s(M_3 - M)}) > \frac{M_2 s(M_2 - 1)}{4M_2 - 2}$$

The intuition is similar to the benchmark case that the cost of innovations has to be large enough to discourage the brands from investing in the higher qualities without counterfeiting, but surmountable so that the brands are willing to innovate and differentiate from the counterfeiter.

B Data Appendix

B.1 Data Checks

To check the survey data quality, especially firms' cost estimates from their balance sheets, I conducted a set of hedonic regressions, as mentioned in Section 3. The set of shoe characteristics gathered from the printed product catalogs explains over 90% of the variation in reported costs and over 80% of the price variation. Production costs are also highly correlated with features that require high material and labor costs, such as using imported crocodile skin and Italian machinery, as one would expect. In addition, a cross-validation of a random sample of these price and cost data based on my calculations from the annual catalogs and companies' responses from their databases was performed to make sure that the cost estimates were in the right ballpark. For instance, knowing that a particular level of shoes is made of top-tier cow-skin implies that the material costs would be around 448 yuan (approximately 56 USD). If the shoe bottom is also made of fine cow-skin, that would cost an additional 17.4 USD.

For the data on counterfeits, I cross-referenced the data from the companies with the available records from the Industrial and Commercial Bureau of China (ICBC) and the QTSB. In addition, the QTSB kindly shared with me the shoe characteristics from its testing reports for a set of counterfeits, together with their product materials, costs, and prices as recorded in the confiscated financial records. Most counterfeit shoes are made of inferior materials, ranging from second-tier leather to imitative leather to plastic cement. The cost differentials reflect the use of different materials, as evidenced by the statistically significant coefficients associated with imitative-leather and plastic-cement variables. It is stunning to note that many materials are invariant across the sample of counterfeits. For instance, the shoe bottoms are all made of TPU. The counterfeit sport shoes are surfaced with PU and net-like materials, and are equipped with no inner-air cushions or non-standard foam cushions to imitate the look of branded shoes. Interestingly still, the quality level of the branded shoe whose appearance the counterfeit product is mimicking does not correlate with the counterfeit costs but correlates highly with the counterfeit product price. This again indicates that counterfeiters use very similar inputs to produce shoes of all imitative levels, and determine their prices largely based on the brand that they are imitating.

Among the responsive companies, 80% were infringed upon at different levels. These companies ranged from top-tier household names to low-end producers of small brands. While interviewing the companies, I learned that those infringed upon by counterfeits invest in enforcement activities by sending their employees to monitor counterfeits, lobbying at the local government level to outlaw counterfeit localities, and organizing anti-counterfeit conferences. The companies also uniformly tell me that establishing company stores for their brands is a very good strategy to signal their quality and to ward off counterfeits. One company's manager said during the interview: "*Starting from 1996, our company products have exited 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.*" In order to set up a licensed retail store, a company has to get approval from the ICBC. The application requires legal documents about the brands. The formal approval certificate has to be displayed in each licensed store. Therefore, the counterfeiters are not able to mimic this business strategy. In fact, establishing a fake licensed store will only help the authentic company and the local government track down the counterfeits and no counterfeiter has an incentive to do that. I therefore obtained data on enforcement expenditures, personnel, and number of licensed stores to test empirically the effectiveness of these strategies in deterring entry.

I further gathered data on whether the sampled companies and their regional subsidiaries were awarded import licenses to serve as an alternative measure of the relationship, or political connectedness, of these brands. This was a difficult process and I was able to obtain the data for only one year (I chose the first ISO year as my priority year in data requests). I identified which of the sampled companies were approved with import licenses as of 1995, as those were likely to be the companies with a better relationship with the government [Mobarak and Purbasari, 2006]. The ISO data correlate with this alternative connectedness measure (correlation coefficient = -0.64). I still used the ISO measure to interact with policy changes as the main instrument because the ISO measures the relationship with the QTSB, which is the government agency that directly deals with counterfeits. The Foreign Trade and Economic Cooperation Bureau (which used to be called the Foreign Trade and Economics Delegation Committee) is in charge of awarding import licenses. Companies that are not granted import and export rights have to go through intermediate agents, such as the Import and Export Companies, to carry out import and export. These intermediate agents are professional service companies analogous to law or accounting firms.

B.2 Sample Representativeness

I acquired access to the Chinese Industrial Census database for the years 1995 and 1998-2001. The data for 1995 and the dataset for 1998-2001 contain slightly different lists of variables and do not match up fully. The database contains firm-level sales, profits, year of establishment, ownership, and other financial information for all the registered companies in China. I compared the common variables in my sample to those in the Industrial Census database. The mean and standard deviations of sales, profits, and most other common variables are very similar across the two data sources (Table A.2 in Qian 2008). The alignment in sales costs across data sources again confirms the data reliability. However, my sample of small enterprises has a higher mean value for exports, profits, and size (460 employees) than that of the census database (230 employees), which is to be expected as branded companies are usually larger. There are many very small companies in the census database that produce only generic shoes. Any draws of such companies were screened out of the final sample for my research question. There are no shortage of small-scale family businesses in the countryside. The census data also provide ample evidence that, while no shoe company qualifies as large, there is a long tail of small companies. In the census data across 1998-2001, there are only 23 medium-size companies (including first-class medium-size and second-class medium-size). My sample covers 22 of the medium-size companies. It additionally includes some smaller-size branded companies resulting from the random sampling method. Summing up the market share data provided to me, the total market share of the companies in my sample approaches 90%. A large number of the small companies can be considered competitive fringe firms. Thus, even though my sample size is limited, the sample of companies highly represents the brand-active part of the market, where the main interests of this paper lie.

In addition, for the common variables of the companies that are found in both my sample and the Industrial Census database, such as sales costs, sales, exports, and incorporation year (used to calculate company age), I was able to directly see the one-to-one correspondence between the values provided by the sampled companies and the values recorded in the Industrial Census database. This provides evidence that the sampled companies provided me with data out of their financial records, as I requested specifically in my surveys. While I acknowledge potential limitations in the paper, I am confident about the general quality of the data and responses.

The industrial census does not contain price data, so I gathered price data for shoes of the sampled brands from the eBay China Website, with help from researchers at the University of Chicago. The mean price for the high-end shoes in the Ebay data is 460 yuan (57.5 USD), which is very similar to the mean of 491.86 yuan (61.5 USD) in my dataset. The prices for medium- and low-end shoes exhibit a very dispersed pattern in the eBay dataset, possibly due to the mixing in of counterfeits. When I drop the extremely low prices (e.g., those under 10 USD), the mean prices for medium- and low-end shoes are also similar to those in my sampled data. When taking the mean price of all the non-high-end shoes from the Ebay data, the results are quite comparable to the mean prices of medium-end, low-end, and counterfeit shoes in my dataset. All these corroborations speak to the representativeness and reliability of my sample and data.

B.3 Additional Data Diagnostics to Preclude Confounding Explanations

China entered an incredible boom in the late 1980s, which continued through the 1990s. Easy credit conditions prevailed in China primarily in the 1980s.[7] An unsustainable credit expansion drove demand well beyond supply, and prices began to rise rapidly. At the peak, the CPI was growing at around 25% per year, and China was taking in a massive quantity of imports, and running a substantial current-account deficit. China had to tighten credit conditions in the early 1990s in the hope of slowing the acceleration of nonperforming loans.[8] Zhu Rongji took strong steps to slow the growth. Investments and growth dropped sharply, as did the rate of price increases. By the late 1990s, there was deflation in China. Given the negative macro trends in the mid- to late-1990s, the positive coefficients on the instrumented counterfeit entry lagged by two to three years (controlling for year and company dummies), providing rather convincing evidence that the higher authentic prices and sales were due to strategies against counterfeits rather than macro factors.

According to exchange rate data from the IMF International Financial Statistics and the UPenn World Tables, China's foreign exchange regime was reformed in 1993, and a multiple exchange rate system was eliminated and the real exchange rate substantially devalued. The major devaluation occurred in 1994 (from 576.2 yuan equaling 100 USD in 1993 to 861.87 yuan equaling 100 USD in 1994). Those firms purchasing foreign inputs or materials saw the RMB(yuan) costs of

[7] Barry Naughton, "China's Economic Think Tanks: Their Changing Role in the 1990s," The China Quarterly, V.171, Cambridge University Press, Sep., 2002.

[8] Gabriel, Satya J. (1998), "Is Banking Reform in China Still on Track?" Satya Gabriel's Online Papers: China Essay Series http://www.satya.us

those purchases go up. These companies would then require a lot of incentive to import expensive foreign machinery and materials, as seen in the data. This in fact reinforces my argument that the effects of entry by counterfeiters are quite significant.

I additionally gathered economic data at the regional level on income per capita, growth, prices, and inequality. The data exhibit a drastic widening of inequality in the late 1980s and early 1990s, instead of in the late 1990s, when the authentic quality upgrades and price hikes were most pronounced. In addition, the shoe industry size stabilized after the late 1980s, and national statistics show that the number of employees in the footwear and garment industry was around 1,750,000 throughout the 1990s (Tables 12-2 and 13-2 in each yearbook, Chinese National Bureau of Statistics). According to the Basic Unit Census of China [The National Bureau of Statistics, 1996], the massive entry of legal shoe companies took place in the late 1980s. The number of companies increased from 348 in 1984 to 1,058 in 1985, with some further increases in the following years. The 1990s witnessed some declines in the number of shoe companies, but the industry size stabilized at around 1,000 registered firms. Therefore, this study examines a period where the registered companies coexisted relatively peacefully, and the effects of counterfeit entry can be teased out relatively easily.

To take into account potential ramifications arising from industry differentials in price levels, I also gathered data on CPI specifically for the shoe and garment sector from the yearbooks, and found this price index to follow the overall CPI quite closely (correlation coefficient = 0.89). All these supplemental data diagnostics and research into macro or regional market conditions in the sampled years yield additional support for the findings and conclusions in this study.