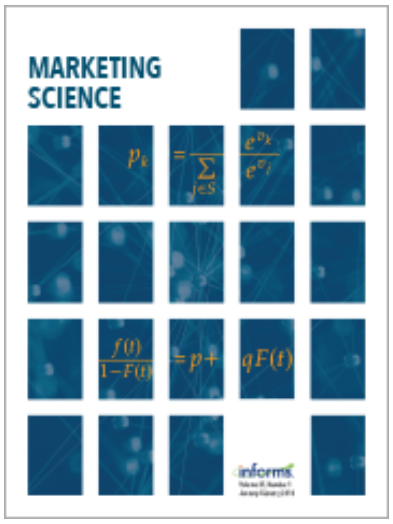

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Untangling Searchable and Experiential Quality Responses to Counterfeits

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In this paper, we untangle the searchable and experiential dimensions of quality responses to entry by counterfeiters in emerging markets with weak intellectual property rights. Our theoretical framework analyzes market equilibria under competition from counterfeiting as well as under monopoly branding. A key theoretical prediction is that emerging markets can be self-corrective with respect to counterfeiting issues in the following sense: First, counterfeiters can earn positive profits by pooling with authentic brands only when consumers have good faith in the market (i.e., they believe there is low probability that any product is a counterfeit). When the proportion of counterfeits in the market exceeds a cutoff value, brands invest in self-differentiation from the competitive-fringe counterfeiters. Second, to attain a separating equilibrium with counterfeiters, branded incumbents upgrade the searchable quality (e.g., appearance) of their products more and improve the experiential quality (e.g., functionality) less compared with monopoly equilibrium. However, in the pooling equilibrium with sporadic counterfeits, authentic firms instead may invest in experiential quality to attract more of the expert consumers who are well versed in quality. This prediction uncovers the nature of product differentiation in the searchable dimension and helps with analyzing real-world innovation strategies employed by authentic firms in response to entries by counterfeit entities. In addition, welfare analysis hints at a nonlinear relationship between social welfare and intellectual property enforcement.

Keywords: counterfeit; emerging markets; searchable quality; experiential quality; signaling; two-dimensional vertical differentiation

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1. Introduction

Along with rapid growth and industrialization, emerging markets are often characterized by underdevelopment in legal infrastructure. Emerging markets grow fast despite these limitations. Last year, Chinese luxury consumption accounted for USD 12.6 billion, and by 2015, China is expected to top luxury consumption in the world. This study sheds light on some of the self-correcting mechanics of a market in a setting where brands face competition from counterfeiters under weak intellectual property rights (IPR), as is common in many emerging markets. By providing counterfeit products with an appearance that is similar to that of a brand, counterfeiters can trick consumers into purchasing their products. Even nondeceptive counterfeits are desired by a large segment of customers in the emerging market. In a 2004 study on global counterfeiting, the World Customs Organization estimated that as much as 512 billion *euros* of traded world merchandise may have been counterfeits (*BusinessWeek* 2005). The sheer volume of counterfeit merchandise around the world underscores the importance of studying how markets function in the face of counterfeiting, a topic that no multinational corporation operating in emerging markets can ignore. In particular, how should brands design various quality dimensions in response to counterfeiting?

To some extent, the literature has explored the demand for counterfeits (Bloch et al. 1993, Wee et al. 1995, Commuri 2009, Wilcox et al. 2009, Han et al. 2010), with price, social aspiration, and attitudes toward large branded companies cited as main factors in driving counterfeit demand. On the supply side, several studies have examined piracy effects (Anand and Galetovic 2004, Conner and Rumelt 1991, Sinha et al. 2010, Vernik et al. 2011); legal responsibilities (Olsen and Granzin 1992); counterfeit impacts in the international trade setting (Grossman and Shapiro 1988a, b); and firms'

internal organizations in complementing weak IPR enforcement (Zhao 2006).

Qian (2008) focuses on documenting the general impact of counterfeiting, whereas this paper provides a deeper theoretical examination of that impact by disentangling the attributes of quality. The theoretical model in Qian (2014) provides the microfoundations of consumer deception by a counterfeiter and an authentic firm's tactics (distribution choices and self-enforcement) to mitigate it. Neither of those papers dissects the extent and nature of innovations. This paper, in contrast, is focused on the differential impact on two dimensions of quality. That counterfeiters usually mimic an authentic product's design but offer inferior functional quality has important implications for authentic producers' incentives for innovation and the nature of innovations. Our theoretical framework helps unravel these complexities with intuitive closed-form solutions. Although Grossman and Shapiro (1989) primarily define a prestige effect as a function of the total sales of the brand (and its counterfeits) and one-dimensional quality, we decompose quality to a finer level. In addition, we endogenize quality choices and analyze the model under producers' flexible cost structures. The findings provide practical guidance on brand protection strategies under different market conditions, where counterfeits may vary by their production costs and pervasiveness.

A key novelty in our theoretical model is that we extend Nelson's (1970) constructs on searchable and experiential goods to quality dimensions within a good. Although Nelson categorizes goods into those that are searchable and experiential, we observe that most products possess a combination of searchable and experiential attributes. For many products, including authentic products subjected to counterfeit imitations, some quality traits may be observable before purchase (e.g., brand logo, stitching, appearance) and others unobservable (e.g., durability, breathability) at the time of purchase. Counterfeits, by definition, share some searchable (observable) quality traits with the authentic brand, whereas the deception revolves around the experiential (unobserved) quality. Untangling these two quality dimensions yields insight into the unique impact counterfeiting can have on branded products compared with a generic entry. This study contributes to the literature on counterfeits and product quality differentiation.

We build upon a vertical differentiation model (Gabszewicz and Thisse 1979, Shaked and Sutton 1983) with two dimensions of endogenous quality to analyze the quality and pricing responses to counterfeit entry. Since counterfeiters attempt to copy authentic products and usually produce inferior quality, the competition is actually more vertical in nature. We incorporate two quality dimensions, as defined in the previous paragraph, both vertical. This novel model captures the special feature of counterfeits in unbundling searchable quality (e.g., brand name and appearance) and experiential quality (e.g., functionality) and examines the brand's strategies in these two quality dimensions in response to counterfeiting.

We analyze the market equilibrium under asymmetric information (specific to deceptive counterfeiting) and compare equilibrium solutions with the monopoly equilibrium. We take into account asymmetric information by building on the literature of quality uncertainty. Price is the conventional signal for product quality, but Nelson (1974) points out the importance of advertisement as a form of a nonprice signal for quality. Milgrom and Roberts (1986) argue that prices are better signals for quality than nonprice signals (notably advertisements) unless we assume repeated purchases. Moorthy and Srinivasan (1995) propose a money-back guarantee as another effective quality signal. Metrick and Zeckhauser (1999) use a simplified vertical differentiation framework to model competition under asymmetric information. Despite the sophistication of the previous literature, these models only consider a monopolistic market and assume exogenous quality levels. A few exceptions are Moorthy (1988), who examines product and price competition, and Purohit (1994), who models a Cournot game with endogenous quality. However, their models are confined to a single dimension of quality. There exists a small literature on nonprice signaling in nonmonopolistic markets. Hertzendorf and Overgaard (2001) and Fluet and Garella (2002) consider duopolies facing partially uninformed consumers. They show that adjustments along nonprice investments (e.g., advertising and packaging) can be used to signal underlying quality.

Unlike these traditional models that consider one predetermined and often fixed quality for each producer, we introduce two quality variables for the producers to optimize over. We incorporate asymmetric information between deceptive counterfeiters and consumers by assuming that a fraction of consumers cannot differentiate counterfeits from authentic products at the same price and searchable quality levels.[1] We then analyze the quality decisions by producers. This endogenization of qualities helps explain detailed quality dynamics in the face of competition.

The key finding among a rich set of results is that emerging markets can be self-corrective with respect to counterfeit issues in the following sense: First, counterfeiters can earn positive profits by pooling with authentic brands only when consumers have a prior belief that there is low probability that any product is a counterfeit. When the proportion of counterfeits in

[1] The asymmetric information due to status signaling is not dealt with here, but it is in Qian (2014).

the market exceeds a cutoff value, brands invest in self-differentiation and profits dissipate for the competitive-fringe counterfeiters. Second, in the pooling equilibrium with sporadic counterfeits, the authentic brand has the incentive to innovate experiential quality to attract more expert consumers. As counterfeits become more rampant, the authentic producer invests in searchable quality instead of experiential quality to differentiate its product from counterfeits in a separating equilibrium.

Although there is no consensus on how entry affects innovation in the economics literature (Purohit 1994, Aghion et al. 2005), marketers often note product differentiation as a practical consequence. Establishing such results in a closed-form solution is novel. Our findings yield additional insights into the nature and extent of quality differentiation. Our model aids in understanding the observations in practice that brands choose to upgrade different quality dimensions under different circumstances and, as a result, that they often raise prices after entry by counterfeiters (Barnett 2005). In addition, we highlight the strategic nature of searchable quality differentiation and analytically reveal the two uses of searchable quality upgrades in the face of counterfeiting: namely, widening the searchable quality gap to alleviate competition and disentangling asymmetric information due to counterfeiting. Our study provides one of the first analyses on the theoretical finding that searchable quality often provides signal value for experiential quality and on the conditions under which entry leads to innovation.

It is worth noting that such innovation responses can generate mixed welfare implications across product categories. In industries where the marginal benefits of searchable quality are high, such as fashion products, searchable quality innovations lead to welfare gains. However, in other industries where there is little marginal utility associated with searchable quality, such as pharmaceuticals, such innovation responses are rather wasteful. Our predictions shed new light on the debate in the marketing and economics literature on the relationship between competition and innovation.

We buttress our main theoretical predictions by business cases across industries and empirical settings in Qian (2014). Using a panel data set on the Chinese footwear industry that includes detailed quality dimensions of a representative sample of brands and their corresponding counterfeits, we reveal through analyses that authentic branded firms invest handsomely in various searchable quality dimensions (shoe style, surface, and side materials, etc.), but not in shoe bottoms and functional quality, where differences, if any, are minor. Such practices are starting to be adopted by various companies, ranging from Microsoft's software encryptions to the most recent conspicuous CD packaging and from unique imprints on pharmaceutical pills to holograms on Fendi scarfs (Passariello 2006). All these findings align with our theoretical predictions. The weakened regulation of counterfeit shoe manufacturers in China is a nice setting for the theory's empirical test. Therefore, this research can provide insights into marketing in emerging markets.

We organize the rest of the paper as follows. We first develop the theoretical model that incorporates two dimensions of quality under competition with asymmetric information. We then proceed to validate the key theoretical predictions. Finally, we conclude by summarizing the managerial insights and contributions.

2. Theoretical Framework

In this section, we first set up the game. We then solve the benchmark case with a monopoly brand before probing into the competitive market equilibria. In particular, we derive the pooling and separating equilibria properties in cases where counterfeiters have either a cost disadvantage or advantage over the authentic producer. We refine the equilibria with the intuitive and divinity (D1) criteria (Cho and Kreps 1987, Banks and Sobel 1987). Finally, we end this section with welfare analyses and discussions.

2.1. Model Setup

Extending the traditional vertical differentiation framework to incorporate two dimensions of quality, we characterize a good with an experiential quality (e.g., functionality) as index h_i and a searchable quality (e.g., appearance) as index s_i, where i indexes good i and each company produces only one good. Experiential quality includes dimensions of quality that are unobserved and can only be inferred. In the data for shoe companies, h includes cushioning effects, friction, and other shoe functionalities. Searchable quality, on the other hand, includes dimensions of quality that are searchable or observable at the time of purchase. For instance, s includes the brand name, shoe surface materials, and other appearance characteristics. Each dimension of quality could take on either a high or low value, and we normalize the low value to be 1 without loss of generality: $\{1, H\}$.[2]

Experiential quality can be inferred based on past experiences and signals such as product price and searchable quality. An authentic firm has been in the market for a long time, so there are lots of reviews, advertisements, expert magazines, etc. There may be many other ways to convey signals that we may not capture in the model because we focus on the interaction with counterfeits. In our theoretical framework, consumers expect experiential quality h_a based on prior experience and beliefs. As a preview of later sections,

[2] The key results are robust in the setting with continuous quality; please see Qian et al. (2013). This discrete quality setting makes predictions more salient and reveals additional insights.

in a separating equilibrium, the expected experiential quality for the authentic product is the authentic h_a. In a pooling equilibrium, the expert consumers can still correctly infer the true h_a. However, the confused consumers form the expectation around the authentic h_a equaling the weighted average of the authentic and counterfeit experiential qualities.

There is a continuum of consumers. Each consumer derives a utility from consuming a unit of the authentic product $U = V(h_a, s_a, \theta) - P_a = \theta \cdot (h_a + s_a) - P_a$ if one unit with quality (h_a, s_a) is consumed by a consumer with taste $\theta \sim \text{unif}[0, 1]$ at price P_i, and $U = 0$ if the consumer does not buy any unit. All consumers prefer high quality, given the same price. We therefore capture consumer heterogeneity in taste by θ: a higher θ indicates more willingness to purchase a given quality. The cumulative distribution function $F(\theta)$ is therefore the fraction of consumers with a taste parameter less than θ. We start with the assumption that the tastes for the two dimensions of quality are collinear because high-income consumers are more able to afford both dimensions of quality or because true lovers of the product are more able to appreciate its finer attributes.[3] This assumption is similar to the one commonly made in the price discrimination literature: that individuals' demand curves do not cross. Relaxing this assumption does not change the predictions qualitatively but only complicates calculations.[4]

At first, one branded producer leads in the market, and a set of counterfeiters could potentially seek opportunities to enter. To offer a product of quality $q_i = (h_i, s_i)$, the producer i faces a combination of marginal and fixed costs. The sunk cost for innovating high quality H on either dimension of quality is I. We assume that the production cost is linear and separable: $C_a(s, h) = cs + ch$. The counterfeiters free-ride on the authentic producer's research and development and hence incur no sunk costs. They are limited by technology and have no capacity to innovate. They can only produce the low quality by themselves. However, they can imitate the high quality by the authentic producer as followers. That is, whenever the brand sets either dimension of quality to the baseline level 1, the counterfeiters' quality in that dimension will be 1 as well. Whenever the brand innovates either quality to H, counterfeiters have the liberty to choose between 1 and H for that quality dimension. As they imitate the authentic quality $q_a = (h_a, s_a)$, their quality is $q_c = (h_c, s_c)$, which brings the consumers' utility level to $U_c = \theta \cdot (\delta \cdot h_c + s_c) - P_c$, where $0 < \delta \leq 1$. They usually cannot perfectly reproduce the authentic experiential quality or bring about the same associated utility to consumers ($\delta < 1$). We do incorporate the best-case scenario of $\delta = 1$, whereby the counterfeiters bring about the same experiential quality utility as the authentic firm. The counterfeiters face perfect competition among themselves. Without loss of generality, we assume that these counterfeiters are symmetric in their marginal costs: $C_c(s, h) = (c + \Delta c)s + (c + \Delta c)h$, where $\Delta c > 0$ implies that counterfeiters have higher production costs than does the authentic firm, and $\Delta c \leq 0$ implies the opposite.[5]

We assume based on the practical intuition that the cost differential is moderate and the sunk investment costs are larger than the marginal cost differential.[6] The general solution without this simplifying assumption is outlined in Online Appendix A.16 (available as supplemental material at http://dx.doi.org/10.1287/mksc.2014.0867). The assumption helps to streamline calculations without sacrificing intuitions and predictions.

We model a game with a dominant authentic branded firm and a set of competitive-fringe imitators or counterfeiters that is closest to the actual interactions among consumers, authentic producers, and counterfeiters. The sequence of events is the following:

1. An authentic producer chooses her quality, both experiential and searchable (h_a, s_a), with the corresponding costs as specified before. She also sets the optimal price P_a to correspond to this quality level.

2. Based on the brand's price and quality decisions, counterfeiters decide whether to enter the market and, if so, whether to enter without deception (i.e., reveal the true product source and quality), with deception (i.e., fool consumers into thinking they are real), or both.

3. Counterfeiters pick their searchable quality s_c and the corresponding price P_c for a product with experiential quality h_c.

4. Each consumer purchases at most one unit of a product. They can observe searchable quality at the time of purchase but can infer experiential quality only based on past experiences, word of mouth, and signals such as price and searchable quality.

[3] Analogously, Grossman and Shapiro (1988) model the utility of a status good as being derived from its quality and prestige, which positively correlates with quality and negatively relates to total sales. Our model differs from theirs in three important ways: (1) We disentangle quality into two dimensions. (2) We endogenize quality and price choices. (3) We incorporate potential asymmetry in information about quality due to counterfeiting. It is a common phenomenon in emerging markets that consumers are fooled into purchasing counterfeits.

[4] Results are available upon request.

[5] Generally speaking, a product has multiple aspects for both searchable and experiential qualities. Hence, the cost for the authentic firm can be expressed in general as $C_a(s_i, h_j) = c(\sum_{i=1}^{N} s_i + \sum_{i=1}^{M} h_j)$, and the cost for the counterfeits is $C_c(s_i, h_j) = \sum_{i=1}^{N}(c + \Delta c_i^s)s_i + \sum_{i=1}^{M}(c + \Delta c_j^h)h_j$.

[6] The production-cost difference between authentic and counterfeit products Δc and the innovation cost of each quality I $(\Delta c, I)$ have to satisfy certain simplifying conditions for closed-form solutions.

To solve this game, we first solve for benchmark prices and profits when the authentic firm is a monopoly. We then introduce asymmetric information between counterfeiters and consumers, a unique feature associated with counterfeiters compared to general entrants. We examine the pooling equilibrium under the constraint that the brand's quality and price choices need to be such that counterfeiters have incentives to pool. We solve for separating equilibrium prices, qualities, and profits when some consumers can be fooled, under the constraint that counterfeiters have no incentive to match price and quality with the authentic firm, which is necessary to guarantee separation. Since the authentic firm moves first, its actions will determine whether we are in a pooling or separating equilibrium. We derive the perfect Bayesian equilibria solutions under both pooling and separating conditions.

2.2. Monopoly Benchmark

Let us start with the benchmark scenario where the market has just a monopoly branded producer. Consumers will purchase the authentic product of quality (h_a, s_a) and price P_a if they derive positive utility from it. That is, $\theta(h_a + s_a) - P_a \geq 0$, implying that $\theta \geq P_a/(h_a + s_a)$. The market demand for the authentic product is then $1 - P_a/(h_a + s_a)$. The authentic producer maximizes profit:

$$\max_{h,\, s_a,\, P_a} \{P_a D_a(s_a, h_a, P_a) - (c \cdot s_a + c \cdot h_a) D_a(s_a, h_a, P_a) - I \cdot [m(s_a) + m(h_a)]\}, \quad (1)$$

where $m(1) = 0$, $m(H) = 1$.

Proposition 1. *The optimal quality choices for the branded monopoly are either $q_a = (1, 1)$ or (H, H). There is a threshold $\bar{I}^m = ((H-1)(1-c)^2)/2$ such that it is profitable for the authentic producer to innovate to $q_a = (H, H)$ when $I < \bar{I}^m$ and adopt $q_a = (1, 1)$ otherwise.*

Proof. Please see Online Appendix A.1.

The authentic firm has the same innovation cost for improving each dimension of quality here. When there exists no counterfeit, consumers can observe the searchable quality and they can infer the authentic experiential quality; that is, consumers can get the true information on both dimensions of quality. Thus, the authentic firm is indifferent about improving either dimension of quality.

2.3. Entry by Counterfeiters

There are two types of counterfeits: nondeceptive and deceptive. Nondeceptive counterfeiters reveal their products as different from the authentic ones by offering a lower price and searchable quality than the authentic product's. The deceptive counterfeiters intend to fool consumers by fully imitating authentic price and searchable quality. Asymmetric information is important in the context of counterfeiting because many articles and news stories reveal how consumers are conned into buying counterfeits. In a Chinese national survey with 30 retailers and 200 consumers (Qian 2014), some retailers were fooled by the counterfeiters who claimed to be the sales force of a branded company and who offered huge discounts to fulfill their year-end sales quotas. The majority of consumers at the mall intercepts claim that they cannot tell counterfeits apart, and they usually rely on price or store signals to infer the quality and authenticity of the product.

2.3.1. Modeling Deception. Although the optimized quality and prices are public information $(h_a, s_a, P_a, h_c, s_c, P_c)$, we assume that a fraction, γ, of consumers may not be able to tell counterfeits apart from their authentic counterparts at the same price and searchable quality (henceforth appearance), at least not until after the purchase. This setup is intuitive because authentic producers tend to provide detailed information about their products in order to build reputation and brand recognition. Counterfeits, on the other hand, mostly try to mimic the appearance of authentic products and misrepresent attributes to extract short-term windfalls (Qian 2014).

The other $1 - \gamma$ fraction of consumers are experts in the product (e.g., based on the source or channel of the product) and know the exact quality of the product they are purchasing, even if they, too, do not directly observe the experiential quality. They have accurate expectations on the authentic experiential quality based on past experiences, word of mouth, and rational inferences. They may purchase counterfeits at a lower price depending on their individual willingness to trade off quality for price (similar to the case with complete information). Let $\mu(\phi_i)$ denote uninformed consumers' prior beliefs on the probability of any product being each type (counterfeit or authentic) $\phi = \phi_i$ $(i = a, c)$, where subscripts a and c denote authentic and counterfeit products, respectively. We denote $\mu(\phi_c) = \tau$ and $\mu(\phi_a) = 1 - \tau$. They are drawn uniformly from all consumers in the valuation distribution.[7] They can calculate P_a^s, s_a^s, s_a^p, and P_a^p, where superscripts s and p denote separating and pooling equilibria, respectively. However, they cannot recognize the experiential quality in practice. After observing the seller's price and searchable quality, consumers update their beliefs about the seller's type. Let $\mu(\phi_i \mid p, s) = 1$ denote uninformed consumers' updated beliefs about seller i's type being exactly $\phi = \phi_i$.

We handle the technical issue of specifying the out-of-equilibrium beliefs following the prior literature. There are two main methods. One of them is to assume

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

a particular set of beliefs following a deviation (e.g., McAfee and Schwartz 1994). This approach is sometimes criticized for considering the specific set of chosen beliefs to be arbitrary. The second method is to start with an unconstrained set of out-of-equilibrium beliefs and then narrow it down using existing refinement. This approach imposes some structure on the out-of-equilibrium beliefs by suggesting that the more reasonable belief would be the one that is consistent with the refinement. The intuitive criterion (Cho and Kreps 1987) and the divinity criterion (Banks and Sobel 1987) are the two existing refinements most commonly used in signaling models (e.g., Simester 1995, Desai and Srinivasan 1995, Zhao 2000, Feltovich et al. 2002, Harbaugh and To 2005, Mayzlin and Shin 2011).

We apply these popular criteria to refine the set of perfect Bayesian equilibria. The intuition is briefly described here and proved in detail in Online Appendix A.14. Consider the set of best responses associated with a particular out-of-equilibrium belief. Suppose that the counterfeit type benefits from the deviation under a set of best responses bigger than the authentic type's. Furthermore, this is the case for all possible beliefs. The refinement criteria then require that the consumer not believe the deviating type is an authentic producer. More generally, suppose that in deviation $(p, s) \neq (P^*, s^*)$, type ϕ' producer is more likely to yield higher profits in equilibrium under a bigger set of best responses from the consumer than is type ϕ producer. D1 then requires that the consumer not believe the product could be from type ϕ.

The D1 criterion is stronger than the intuitive criterion in that it does not require that the authentic type not benefit from the deviation under any possible belief. Instead, it requires that the set of consumers' best responses, which are based on the consumer's beliefs, be strictly smaller than that of the counterfeit type. We require that a potential equilibrium be supported by out-of-equilibrium beliefs that survive the refinement. We detail the intuitive criterion and D1 criterion with their applications in our setting (both separating and pooling equilibria) in Online Appendix A.14.

The authentic producer maximizes profit as in Equation (1). The counterfeiters can choose searchable or experiential quality of either 1 or H. We denote the counterfeiters' searchable and experiential qualities as (s_c, h_c). Since the nondeceptive counterfeiters are under perfect competition with each other, they set the price at the marginal cost level: $P_c = (c + \Delta c)s_c + (c + \Delta c)h_c = (c + \Delta c)(s_c + 1)$.

Lemma 1. *The counterfeiters will always keep the experiential quality low at* $h_c = 1$.

Proof. Please see Online Appendix A.2.

The intuition is simple: since there is only one dealing between consumers and the counterfeit products, counterfeiters have no incentive to invest in experiential quality that consumers do not observe.

We find that the authentic firm can adopt different strategies depending on the production costs to counterfeiters. We consider the following two scenarios: (1) when counterfeiters have higher production costs than does the authentic brand, i.e., $\Delta c > 0$, and (2) when counterfeiters enjoy lower production costs, i.e., $\Delta c \leq 0$. In the following sections, we analyze the two types of equilibria under each of these two scenarios: the pooling equilibrium and the separating equilibrium.

2.3.2. Counterfeiters Have a Higher Marginal Cost. Sometimes counterfeiters' marginal costs can be higher than the brand's. For instance, the elegant appearance of authentic branded shoes requires superior materials, fine labor, and pattern-press technology during the production process. Without economies of scale and legitimate accesses to technology and knowhow, it is often more costly for counterfeiters to achieve the exact appearance of the authentic product. Notably, as illegal entities, counterfeiters do not have an import license to acquire fancy materials (Qian 2008), and branded companies abide by strict allocation of raw materials to their subcontracted manufacturers to prevent them from counterfeiting (Zhao 2006). Counterfeiters usually use inferior materials to mimic the authentic appearance, and it naturally becomes harder to do so when the appearance becomes more sophisticated. Because the authentic producer enjoys economies of scale and designs an appearance level that is hard to imitate, we also consider the case where $\Delta c > 0$.

The results derived in this section hold in the general setting of $C_c(s_i, h_j) = \sum_{i=1}^{N}(c + \Delta c_i^s)s_i + \sum_{i=1}^{M}(c + \Delta c_j^h)h_j$, whenever $\max_{i=1}^{N} \Delta c_j^h > 0$, that is, whenever there exists one aspect of either dimension of quality that requires a higher marginal cost from the counterfeiters.

Pooling equilibrium. Our theoretical framework yields insights into the pooling equilibrium where counterfeiters opt into the same price and searchable quality levels as authentic producers. In this section, we analyze the model to draw out these implications.

Because only $1 - \gamma$ fraction of consumers is expert in differentiating authentic products from counterfeits, the other γ fraction of consumers will have probability τ of being conned into purchasing counterfeits.[8] There are now three types of products: authentic branded products; nondeceptive counterfeits, which self-differentiate from the authentic products with a lower quality and price; and counterfeits that are indistinguishable from

[8] Here, τ is the availability of counterfeits and is a function of government law enforcement. Bearing in mind that counterfeiting carries the risk of being caught and punished, we assume that there can be at most N counterfeiters in the market, covering τ proportion of the market.

the authentic product in price and appearance (searchable quality). The latter two types of products are both produced by the set of competitive-fringe counterfeiters. Their production capacity is not satiated in either the perfectly competitive low-end market with residual demand or the pooling market with fixed probability τ of being purchased by the uninformed consumers. These counterfeiters thus produce both types of products in a pooling equilibrium. They set (s_a, P_a) for their counterfeit products in a pooling equilibrium and (s_c, P_c) for the nondeceptive counterfeits.

If the authentic firm does not improve searchable quality ($s_a = 1$), the nondeceptive counterfeiters can only choose $s_c = 1$ because that is the only available level they can imitate. If the authentic firm improves the searchable quality to H, the counterfeiters can choose either $s_c = 1$ or $s_c = H$. Given the technical assumption that Δc is not too big,[9] since the counterfeiters compete perfectly and set the price equal to its marginal cost, consumers will strictly prefer the counterfeiters with $s_c = H$. We therefore have $s_c = s_a$ in equilibrium.

Expert consumers will always choose authentic products over counterfeits in this pooling equilibrium. The expert consumers who purchase the authentic product must derive nonnegative utility from it, $V(h_a, s_a, \theta) - P_a \geq 0$, and that utility must exceed their utility derived from a unit of the lower quality product, $V(h_a, s_a, \theta) - P_a \geq V(1, s_c, \theta) - P_c$. These two conditions imply that the indifferent customer who is equally happy with an authentic or counterfeit product must have taste $\bar{\theta} = (P_a - P_c)/(h_a - \delta)$ for the nondeceptive counterfeits market to persist. The demand of informed consumers for the authentic product is

$$D_i(P_a) = 1 - \bar{\theta} = 1 - \frac{P_a - P_c}{h_a - \delta}.$$

The novices who purchase any product with appearance s_a at price P_a must have a positive expected utility, satisfying $(1-\tau)V(h_a, s_a, \theta) + \tau V(1, s_a, \theta) - P_a \geq 0$ and $(1-\tau)V(h_a, s_a, \theta) + \tau V(1, s_a, \theta) - P_a \geq V(h_c, s_c, \theta) - P_c$. This implies that the customer who is indifferent between purchasing the authentic and counterfeit products has taste $\tilde{\theta}$

$$(1-\tau)(\tilde{\theta}h_a + \tilde{\theta}s_a) + \tau(\tilde{\theta}\sigma h_c + \tilde{\theta}s_c) - P_a = \tilde{\theta}\delta h_c + \tilde{\theta}s_c - P_c$$
$$\Rightarrow \quad \tilde{\theta} = \frac{2(P_a - 2c - 2\Delta c)}{(1-\tau)(H-\delta)}.$$

It follows that the demand of uninformed consumers for the pooled authentic and deceptive counterfeits is

$$D_u(P_a) = 1 - \tilde{\theta} = 1 - \frac{P_a - P_c}{(1-\tau)(h_a - h_c)}.$$

[9] In particular, when $\Delta c \leq (c(1-\delta))/(s_c - 1)$, $s_c = s_a$.

The total demand is $D_a(P_a) = (1-\gamma)D_i(P_a) + (1-\tau) \cdot \gamma D_u(P_a)$, and the authentic firm will maximize its profit as follows:

$$\pi_a^p = \max_{P_a, s_a, h_a} \{(P_a - cs_a - ch_a)D_a(P_a) - I \cdot [m(s_a) + m(h_a)]\}.$$

Proposition 2. *In a pooling equilibrium, the authentic firm will not increase searchable quality. In addition, there exists a threshold $\bar{I}_h^p$ as follows*:

$$\bar{I}_h^p = \frac{[(1-\tau\gamma)(H-\delta) + 2\Delta c - c(H-1)]^2}{4(H-\delta)} - \frac{[(1-\tau\gamma)(1-\delta) + 2\Delta c]^2}{4(1-\delta)}.$$

When $I \leq \bar{I}_h^p$, the authentic producer will only improve the experiential quality, and when $I > \bar{I}_h^p$, the authentic producer will improve neither quality.

Proof. Please see Online Appendix A.3.

This proposition illustrates that when counterfeiters are able to pool with the authentic firm on price and searchable quality, the authentic producer will not have the incentive to improve its searchable quality since counterfeiters are capable of completely replicating. However, when innovation costs are low, the authentic firm will improve experiential quality to capture more of the expert consumers who know all quality levels.

Corollary 1. (1) *When informed consumers increase, that is, γ decreases, the authentic firm will have a stronger incentive to improve experiential quality.* (2) *When counterfeits become more rampant in the market, that is, τ increases, the authentic firm will have less of an incentive to improve experiential quality.*

Proof. Please see Online Appendix A.4.

The intuition of part (1) directly follows the discussion underlying the above proposition since the higher experiential quality is especially tailored to the informed consumers. Part (2) hints at the fact that in a pooling equilibrium, some of the authentic innovations also benefit counterfeiters because of the pooling nature of the uninformed consumers. Therefore, as counterfeits become more rampant in the market, the authentic firm has less incentive to innovate.

Separating equilibrium. If the authentic producer and counterfeiters choose different prices and searchable qualities from each other, then all consumers can tell the products apart based on the model setup. To differentiate their products from counterfeits, authentic producers should set the price at $P_a \leq (c + \Delta c)(s_c + h_c) = (c + \Delta c)(s_a + h_c)$—the incentive compatibility (IC) constraint—to preempt the deceptive counterfeiters. The brand competes with nondeceptive counterfeits with quality $(1, 1)$ and price $P_c = 2(c + \Delta c)$.

We again denote $\bar{\theta}$ as the threshold level of consumer taste for qualities, at which a consumer is indifferent between consuming a branded product or a counterfeit,

and consumers with utility level θ will buy a brand product if and only if $\theta \geq \bar{\theta}$. We have

$$\bar{\theta}h_a + \bar{\theta}s_a - P_a = \bar{\theta}\delta h_c + \bar{\theta}s_c - P_c \quad \Rightarrow \quad \bar{\theta} = \frac{P_a - 2(c+\Delta c)}{h_a + s_a - \delta - 1}.$$

The demand for the authentic products is

$$D(P_a) = 1 - \bar{\theta} = 1 - \frac{P_a - 2(c+\Delta c)}{h_a + s_a - \delta - 1}.$$

The authentic firm will maximize its profit as follows:

$$\max_{P_a, h_a, s_a} \pi_a(s_a, h_a, P_a) = \max_{P_a, h_a, s_a} \{(P_a - C_a)D_a - I \cdot [m(s_a) + m(h_a)]\}$$
$$\text{s.t.} \quad P_a \leq (c+\Delta c)(s_a + 1). \quad \text{(IC constraint)}$$

We then arrive at the following proposition.

Proposition 3. *When $\Delta c > 0$, the authentic producer can separate its product from counterfeits by improving searchable quality. Because it is unprofitable for counterfeiters to mimic the high searchable quality when the authentic producer sets a low price, the market forms a separating equilibrium. The authentic firm will not improve its experiential quality. In addition, there exists a threshold $\bar{I}_s^s$ as follows*:

$$\bar{I}_s^s = \Delta c\left[(H-1) - (c+\Delta c)\left(\frac{H^2-1}{H-\delta} - 2\right)\right].$$

The authentic producer will improve searchable quality iff $I < \bar{I}_s^s$.

Proof. Please see Online Appendix A.5.

In the case where counterfeiting involves a higher marginal cost than the authentic cost and the IC constraint favors the separating equilibrium, the brand will choose a higher searchable quality to differentiate itself from counterfeits. The brand is more likely to offer the baseline level of experiential quality since a higher level would not help the brand to differentiate itself from counterfeits in the eyes of all consumers. The counterfeiter will choose the lowest quality level in both dimensions. This proposition highlights one of the key findings: counterfeiting can stimulate the brand to offer a higher searchable quality but a stagnant experiential quality.

Because of its nature, the innovation induced by counterfeits may be more valuable in certain industries, where searchable quality brings utility in its own right (e.g., fashion), than in others where consumer utility is primarily derived from experiential quality (e.g., pharma). We provide empirical support for this prediction based on various cases and a unique panel data set on the Chinese footwear industry in the next section.

2.3.3. Counterfeiters with Lower Production Costs. We next consider the case where counterfeiters can imitate the branded product at a lower cost than that incurred by the authentic producer ($\Delta c \leq 0$). Counterfeiters will always keep the same searchable quality for their product as that of the branded product, which means $s_a = s_c$. However, when it comes to experiential quality, Lemma 1 shows that counterfeiters will always keep it at $h_c = 1$. There will always be some incentive for the authentic producer to improve the experiential quality of the product if the innovation cost is low enough.

Proposition 4. (1) *When $\Delta c \leq 0$, the authentic firm will never improve its searchable quality.* (2) *When $0 < \delta < 1$, there exists a threshold $\bar{I}_h^p$ as follows*:

$$\bar{I}_h^p = \frac{[(1-\tau\gamma)(H-\delta) + 2\Delta c - c(H-1)]^2}{4(H-\delta)} - \frac{[(1-\tau\gamma)(1-\delta) + 2\Delta c]^2}{4(1-\delta)}.$$

When $I < \bar{I}_h^p$, it is profitable for the authentic producer to upgrade experiential quality. When $I > \bar{I}_h^p$, the authentic producer will improve neither experiential quality nor searchable quality.

Proof. Please see Online Appendix A.6.

When counterfeiters have a marginal cost advantage in producing the searchable quality compared with the authentic producer, the authentic producer will not have the incentive to improve its searchable quality just to be copied by the counterfeiters.

Corollary 2. (1) *When the proportion of informed consumers increases, that is, γ decreases, the authentic firm will have a stronger incentive to improve experiential quality.* (2) *When counterfeits become more rampant in the market, that is, τ increases, the authentic firm will have less incentive to improve experiential quality. That is, $\partial[\pi_a(1,H) - \pi_a(1,1)]/\partial\gamma < 0$, $\partial[\pi_a(1,H) - \pi_a(1,1)]/\partial\tau < 0$, $\partial\bar{I}_h^p/\partial\gamma < 0$, $\partial\bar{I}_h^p/\partial\tau < 0$. In addition, $\partial[P_a(1,H) - P_a(1,1)]/\partial\gamma < 0$, $\partial[P_a(1,H) - P_a(1,1)]/\partial\tau < 0$.*

Proof. Please see Online Appendix A.7.

The comparative statics reveal that when the proportion of informed consumers increases, i.e., γ decreases, the profits of the authentic firm will increase, as depicted in Figures 1 and 2. However, the increase in $\pi_a(1,1)$ is faster than that in $\pi_a(1,H)$ with respect to γ. The price of the authentic product will increase, whereas $P_a(1,H)$ increases faster than $P_a(1,1)$. When counterfeits become more rampant in the market, that is, τ increases, the price of the authentic product will decrease. Authentic price $P_a(1,1)$ decreases faster than $P_a(1,H)$. This is very intuitive since experiential quality is known by the informed consumers only. The more informed consumers there are in the market, the larger the demand for the authentic product. The more pervasive counterfeits are, the more free-riding

Figure 1 **Authentic Profits Under Pooling and Separating Equilibria as Functions of τ ($s = 1$)**

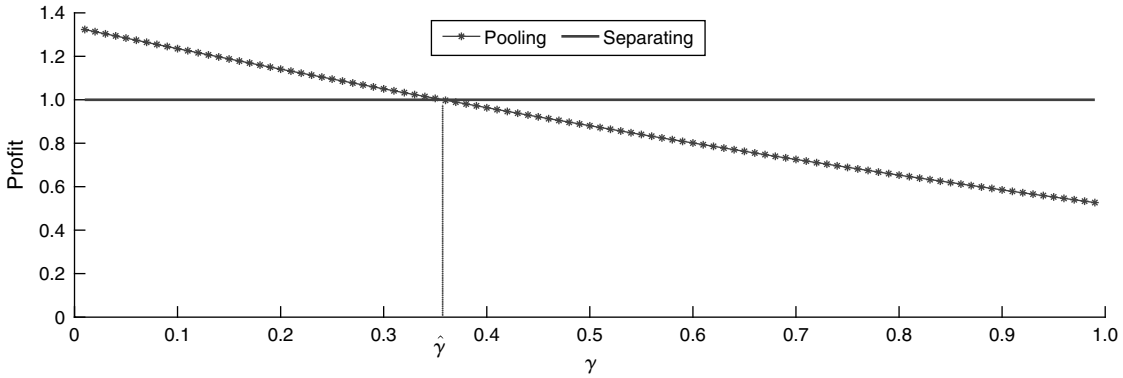
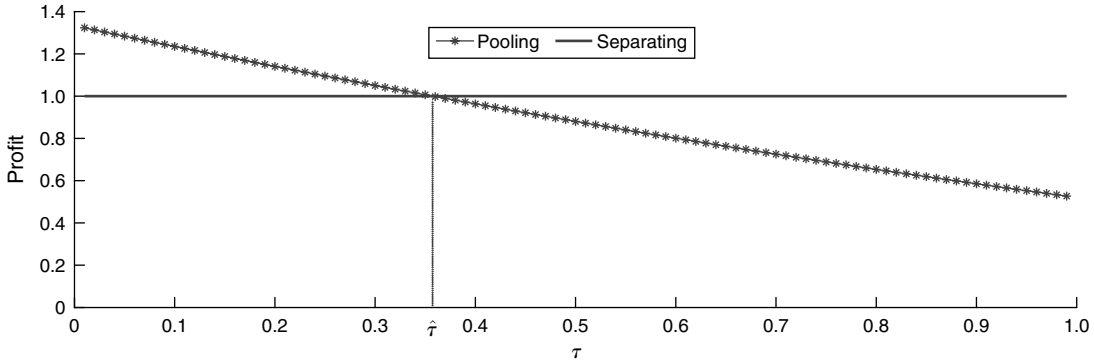


Figure 2 **Authentic Profits Under Pooling and Separating Equilibria as Functions of γ ($s = 1$)**



of the authentic innovations by counterfeiters (especially in confusing the uninformed consumers), the less incentive the authentic producer would have for innovation.

Finally, we explore the extreme case when $\delta = 1$, which implies that counterfeiters can imitate the authentic producer completely at a lower marginal cost.

Corollary 3. *When $\Delta c \le 0$ and $\delta = 1$, there exists a threshold $\bar{I}_h^p$:*

$$\bar{I}_h^p = \frac{[(1-\tau\gamma-c)(H-1)+2\Delta c]^2}{4(H-1)},$$

such that when $I > \bar{I}_h^p$, the authentic producer will improve neither its experiential nor searchable quality. Since $q_i^a = (1, 1)$ does not break even, the authentic producer will exit the market.

Proof. Please see Online Appendix A.8.

This corollary illustrates the lemon problem per Akerlof (1970). When deceptive counterfeiters enjoy a cost advantage over the authentic brand, the low-quality counterfeits can drive higher-quality authentic products out of the market. The only way for the authentic producer to survive in the market is by improving its experiential quality in order to capture the informed consumers who value higher experiential quality, provided that such innovations will not incur too high of a sunk cost.

In general, when the authentic producer adopts the pooling strategy, the experiential quality is always improved to capture the high-valuation informed consumers, in order for the authentic brand to survive in the market. In addition, the authentic firm cannot use the separating strategy with $\Delta c \le 0$.[10] That is,

Corollary 4. *When $\Delta c \le 0$, the authentic producer cannot be separated from counterfeiters by improving its searchable quality. Hence, no separating equilibrium is achieved.*

Proof. Please see Online Appendix A.9.

2.4. Self-Correcting Mechanism

In analyzing and comparing an authentic firm's incentives for the pooling and separating strategies, we discover a self-correction mechanism in the emerging market: when counterfeits become too rampant in the market, the authentic brand self-differentiates from counterfeits, switching from a pooling strategy to a separating strategy.

When the marginal cost advantage of the authentic brand over counterfeits is not big enough, a pooling strategy is adopted and the experiential quality is

[10] The corresponding condition in a more general form is $\max_{i=1}^{N} \Delta c_j^h \le 0$.

improved first. The maximized profit and the optimal price can be written as

$$\pi_a^{p*}(1,H) = \frac{[(1-\tau\gamma)(H-\delta)+2\Delta c - c(H-1)]^2}{4(H-\delta)} - I,$$

$$P_a^{p*} = \frac{(1-\tau\gamma)(H-\delta)+c(H+3)+2\Delta c}{2}.$$

As the searchable cost advantage of the authentic firm increases, it becomes profitable for the authentic firm to strive for a separating equilibrium whereby it signals authentic quality against counterfeits. The brand would improve its searchable quality rather than its experiential quality. The maximized profit of the separating equilibrium and its optimal price are

$$\pi_a^{s*}(H,1) = \Delta c(H+1)\left[1 - \frac{(c+\Delta c)(H-1)}{H-\delta}\right] - I,$$

$$P_a^{s*} = (c+\Delta c)(H+1).$$

We contrast the maximized profits under different conditions and obtain the following: When $\pi_a^{p*}(1,H) \geq \pi_a^{s*}(H,1)$, the authentic producer will adopt a pooling strategy. When $\pi_a^{p*}(1,H) < \pi_a^{s*}(H,1)$, the authentic producer will adopt a separating strategy by improving searchable quality.

Proposition 5. *There exist thresholds $\tilde{\gamma}$ and $\tilde{\tau}$, such that when either $\gamma \leq \tilde{\gamma}$ or $\tau \leq \tilde{\tau}$, the authentic producer chooses the pooling strategy.*

$$\tilde{\gamma} = 1 - \left(\sqrt{4\Delta c(H+1)(H-\delta)\left[1 - \frac{(c+\Delta c)(H-1)}{H-\delta}\right]} - 2\Delta c + c(H-1)\right) \cdot \frac{1}{H-\delta}$$

and

$$\tilde{\tau} = 1 - \left(\sqrt{4\Delta c(H+1)(H-\delta)\left[1 - \frac{(c+\Delta c)(H-1)}{H-\delta}\right]} - 2\Delta c + c(H-1)\right) \cdot \frac{1}{H-\delta}.$$

Proof. Please see Online Appendix A.10.

The set of predictions here weaves into a story of the self-corrective mechanism of emerging markets. We detail the predictions and the corresponding intuitions. Proposition 5 demonstrates that the authentic producer has more incentive to improve experiential quality in a pooling equilibrium to capture the high-valuation expert consumers. When there are lots of uninformed consumers in the market, the authentic producer prefers the signaling strategy, thus improving the brand's searchable quality in order to inform the consumers of its authenticity and superior quality. In emerging markets, where infrastructures are highly imperfect, signaling becomes even more crucial. Consistent with our empirical findings, the authentic producer prefers to improve searchable quality instead of experiential quality.

Proposition 6 below shows that asymmetric information aggravates competition and promotes the need to differentiate. In the pooling equilibrium, if attainable given the incentive compatibility constraints of the brand and counterfeiters, the counterfeiters split the market with the brand and earn a positive profit. This is more desirable for counterfeiters than the separating equilibrium, where counterfeiters as competitive fringes compete away the economic rents from the residual demand.

Proposition 6. (1) *When the fraction of uninformed consumers (γ) increases, the authentic firm will have stronger incentives to adopt the signaling strategy.* (2) *When the proportion of counterfeits in the market (τ) increases, the authentic firm will have stronger incentives to adopt the signaling strategy and to separate from the counterfeits. Formally, $\partial[\pi_a^{pe}(1,H) - \pi_a^{se}(H,1)]/\partial\gamma < 0$, $\partial[\pi_a^{pe}(1,H) - \pi_a^{se}(H,1)]/\partial\tau < 0$, $\partial(\bar{I}_h^{pe} - \bar{I}^{se})/\partial\gamma < 0$, $\partial(\bar{I}_h^{pe} - \bar{I}^{se})/\partial\tau < 0$. In addition, $\partial[P_a^{pe}(1,H) - P_a^{se}(H,1)]/\partial\gamma < 0$, $\partial[P_a^{pe}(1,H) - P_a^{se}(H,1)]/\partial\tau < 0$.*

Proof. Please see Online Appendix A.11.

When there are more uninformed consumers and more counterfeits in the market, the probability that uninformed consumers will purchase counterfeits increases. When asymmetric information becomes too severe, the brand has incentives to self-differentiate from the counterfeiters to alleviate the erosion in profits. In addition, under more severe asymmetric information, the authentic producer can charge a higher price when improving searchable quality than experiential quality.

Private incentives to compensate for public enforcement surge when counterfeits become very pervasive and when too many consumers cannot tell counterfeits from authentic products. The following corollary establishes that the authentic producer will upgrade searchable quality to differentiate its product from counterfeits when the proportion of uninformed consumers is above a threshold level, given any relatively large proportion of counterfeits in the market.

Corollary 5. *For any given $\tau > \tilde{\tau}$, there exists $\hat{\gamma} > \tilde{\gamma}$ such that when $\gamma \in [0, \hat{\gamma})$, the authentic producer prefers a pooling strategy and improves experiential quality. When $\gamma \in [\hat{\gamma}, 1]$, the authentic producer chooses a signaling strategy through innovations in searchable quality, as depicted in Figure 2.*

$$\hat{\gamma} = \frac{1}{\tau} - \left(\sqrt{4\Delta c(H+1)(H-\delta)\left[1 - \frac{(c+\Delta c)(H-1)}{H-\delta}\right]} - 2\Delta c + c(H-1)\right) \cdot \frac{1}{(H-\delta)\tau}.$$

Proof. Please see Online Appendix A.12.

Analogous to the previous corollary, the following result illustrates that the authentic producer will choose separating strategies to differentiate its product from counterfeits when the probability of randomly picking a counterfeit from all of the products is above a threshold level, given the existence of any relatively large fraction of uninformed consumers in the market.

Corollary 6. *For any given $\gamma > \tilde{\gamma}$, there exists $\hat{\tau} > \tilde{\tau}$ such that when $\tau \in [0, \hat{\tau})$, the authentic producer prefers the pooling strategy with innovation in experiential quality. When $\tau \in [\hat{\tau}, 1]$, the authentic producer chooses a signaling strategy with innovation in searchable quality, as depicted in Figure* 1.

$$\hat{\tau} = \frac{1}{\gamma} - \left(\sqrt{4\Delta c(H+1)(H-\delta)\left[1 - \frac{(c+\Delta c)(H-1)}{H-\delta}\right]} - 2\Delta c + c(H-1)\right) \cdot \frac{1}{(H-\delta)\gamma}.$$

Proof. Please see Online Appendix A.13.

When there are few uninformed consumers or there is a small probability of purchasing counterfeits unknowingly, the authentic producer will opt for the pooling equilibrium because the small loss of demand to the counterfeits does not justify the cost for upgrading searchable quality in order to separate from counterfeits.

Those counterfeiters who imitate the brand with the same searchable quality and price in the pooling equilibrium gain a total profit as follows:

$$\begin{aligned}\pi^c &= \gamma\tau[P_a - (c+\Delta c)(s_a + h_c)]\left[1 - \frac{P_a - P_c}{(1-\tau)(h_a - h_c)}\right] \\ &= (\gamma\tau[(1-\gamma\tau)(H-\delta) + c(H-1) - 2\Delta c][(1+\gamma\tau-2\tau) \\ &\quad \cdot (H-\delta) - c(H-1) + 2\Delta c]) \cdot \frac{1}{4(1-\tau)(H-\delta)}.\end{aligned}$$

When $\gamma = 1$, $\pi^c = \tau(1-\tau)(H-\delta)/4 - \tau[c(H-1) - 2\Delta c]^2/(4(1-\tau)(H-\delta))$, there is a $\tau^* \in (0,1)$ such that the counterfeiter will choose τ^* to maximize profits. It is clear that this part of the counterfeiters' profits comes from cheating uninformed consumers. When the fraction of uninformed consumers or the proportion of counterfeits in the market increases, the profit to counterfeiters increases. As the positive rents attract more and more counterfeit entries, the authentic producer will eventually find it more profitable to strive for a separating equilibrium. The fringe market is competitive, so the profit to counterfeiters dissipates to zero.

In sum, this section uncovers the self-correction property of the emerging market: when counterfeiting becomes too pervasive and confuses too many consumers in the market, the authentic producer is motivated to upgrade searchable quality and force counterfeiters into a separating equilibrium.

In refining the perfect Bayesian equilibria (PBE) of this game, we have the following:

Proposition 7. *The derived pooling and separating equilibria survive the intuitive criterion and D*1*. There is a unique PBE for any parameter values under the intuitive and D*1 *criteria. In addition, $\mu_c = 1\ \forall (p = P_a^s, s = s_a^s)$ is consistent with the intuitive criterion and D*1*.*

Proof. Please see Online Appendix A.14.

2.5. Welfare Implications

In this section, we calculate the welfare impacts of counterfeiting. Notably, we are interested in deriving the welfare implications of the different market structures. While the detailed derivations of social welfare in Online Appendix A.15 do not lend themselves to simple solutions for comparisons, we conduct simulation exercises to show the important comparative statics. Social welfare declines if the asymmetric information becomes more severe in the market; i.e., γ and τ are bigger.

In the monopoly case, given $q_a = (1,1)$, we have $P_a^M = c + 1$. Given $q_a = (H, H)$, we have $P_a^M = H(1+c)$. The consumer surplus and social welfare is as follows:

$$CS^M(s_a, h_a) = \int_{\bar{\theta}}^{1} [\theta(s_a + h_a) - P_a^M]\, d\theta,$$

$$SW^M(s_a, h_a) = CS + \pi_a(s_a, h_a).$$

We show in the next proposition that innovation increases consumer surplus and social welfare.

Proposition 8. (1) *When $I < \bar{I}^m = (H-1)(1-c)^2/4$, the authentic producer will innovate and choose quality $q_a = (H, H)$, $CS^M(H,H) = H(1-c)^2/4$, and $SW^M(H,H) = 3H(1-c)^2/4 - 2I$. When $I \geq \bar{I}^m = (H-1)(1-c)^2/4$, the authentic producer will not implement any improvement; i.e., $q_a = (1,1)$. We get $CS^M(1,1) = (1-c)^2/4$ and $SW^M(1,1) = 3(1-c)^2/4$.* (2) *In addition, we have $CS^M(H,H) > CS^M(1,1)$ and $SW^M(H,H) > SW^M(1,1)$.*

Proof. Please see Online Appendix A.15.

We next turn to analyzing welfare when counterfeiters enter the market. We separately discuss two scenarios, depending on the extent of asymmetric information in the market (the values of γ and τ).

(a) When γ and τ are not too big, the authentic firm will choose the pooling strategy. In equilibrium, social welfare is the sum of consumer surplus, authentic profits, and counterfeit profits. The consumer surplus for the informed consumers is $CS_i^p(s_a, h_a) = \int_{\bar{\theta}}^{1} [\theta(s_a + h_a) - P_a]\, d\theta + \int_{\underline{\theta}}^{\bar{\theta}} [\theta(s_c + h_c) - P_c]\, d\theta$, and the consumer surplus for the uninformed consumers is $CS_u^p(s_a, h_a) = (1-\tau) \int_{\bar{\theta}}^{1} [\theta(s_a + h_a) - P_a]\, d\theta + \tau \int_{\bar{\theta}}^{1} [\theta(s_a + h_c) - P_a]\, d\theta + \int_{\underline{\theta}}^{\bar{\theta}} [\theta(s_c + h_c) - P_c]\, d\theta]$. Total social welfare

is $SW^p(s_a, h_a) = (1-\gamma)CS_i^p + \gamma CS_u^p(s_a, h_a) + \pi_a^p(s_a, h_a) + \pi_c^p(s_a, h_c)$.

Since the solution in the general situation is complicated, we first consider some possible results when the production cost is the same and the number of uninformed consumers or the proportion of counterfeits is small enough; i.e., $\gamma \to 0$ or $\tau \to 0$.

When $I < \bar{I}_h^p = (H-1)(1-2c)/4 + c^2(H-1)^2/(4(H-\delta))$, the authentic firm has the incentive to improve its experiential quality

$$CS^p(1, H) = \frac{2c^2}{1+\delta} + \frac{(H-\delta+c(H-1))^2}{8(H-\delta)} + \frac{1+\delta}{2} - \frac{c(H+3)}{2}$$

$$SW^p(1, H) = \frac{2c^2}{1+\delta} + \frac{3(H-\delta)}{8} + \frac{3[c(H-1)]^2}{8(H-\delta)} - \frac{c(2H+5)}{4} + \frac{1+\delta}{2} - I_h.$$

However, when $\bar{I} > \bar{I}_h^p = (H-1)(1-2c)/4 + c^2(H-1)^2/(4(H-\delta))$, the authentic firm has no incentive to improve its quality

$$CS^p(1, 1) = \frac{2c^2}{1+\delta} + \frac{(1-\delta)^2}{8(1-\delta)} + \frac{1+\delta}{2} - 2c,$$

$$SW^p(1, 1) = \frac{2c^2}{1+\delta} + \frac{7+\delta}{8} - 2c.$$

It is easy to check $CS^p(1, H) > CS^p(1, 1)$ and $SW^p(1, H) > SW^p(1, 1)$. This implies that quality improvement will increase both consumer surplus and social welfare. We discuss some special cases below.

We can show that $\bar{I}_h^p < \bar{I}^m$ (see Online Appendix A.15). Hence, if counterfeits enter the market and $I < \bar{I}_h^p$, the entry encourages market competition but not innovation. Social welfare increases.

When $I \in (\bar{I}_h^p, \bar{I}^m)$, the authentic firm will not improve searchable quality. That is, the entry of counterfeiters depresses social welfare. Because $I > \bar{I}^m$, there is no quality improvement in both cases, but the entry of counterfeiters adds to the market competitiveness and increases social welfare. It is easy to check that when $\Delta c \to 0$, we have $\bar{I}_b^p \to 0$. The above results hint at the uncertainty associated with the impacts of counterfeiting on authentic quality and social welfare.

(b) As γ and τ increase, the profits of the authentic firm decrease. The authentic firm prefers the signaling strategy. Social welfare is the sum of consumer surplus and the profits of the authentic firm. That is, $CS^s(s_a, h_a) = \int_{\bar{\theta}}^1 [\theta(s_a + h_a) - P_a]\, d\theta + \int_{\underline{\theta}}^{\bar{\theta}} [\theta(s_c + h_c) - P_c]\, d\theta$, and $SW^s(s_a, h_a) = CS^s + \pi_a(s_a, h_a)$. Figures 3 and 4 show these comparative statics.

Synthesizing all of the results, welfare is likely to be nonlinear in government enforcement. Notably, when government enforcement is so strong that there are no counterfeits, the monopoly producer surplus is the largest. When public enforcement is of medium strength, the brand will pool with a moderate number of counterfeits, with consumer surplus compromised for the novices. When public enforcement is so weak that counterfeits become rampant in the market, brands will innovate to separate from counterfeits, resulting in higher social welfare. Consumers enjoy more product variety (innovated authentic products and low-quality counterfeits).

3. Empirical Validations

3.1. Summary of Cases

The main theoretical predictions are buttressed by various business cases. As cited in the introduction, many producers have responded to counterfeit infringements by upgrading searchable quality while limiting experiential quality improvements. To note a few examples, musicians and recording companies conspicuously package their CDs in the face of rampant piracy. Prominent pharmaceutical companies like Abbott and Pfizer adopt unique color, shape, and RFID imprints on each pill to differentiate their products from counterfeit drugs even though the active ingredients remain the same. Many fashion brands, such as Fendi, adopt a visible hologram on their products (Passariello 2006).

Using panel data on branded leather and sport shoes in China, one of the largest emerging markets, we provide additional empirical support for the key proposition that authentic producers have incentives to improve experiential quality upgrades while overinvesting in searchable quality in the face of entry by counterfeiters, compared to a monopoly equilibrium. Furthermore, the easier it is for counterfeiters to imitate authentic quality, the less an authentic producer will upgrade experiential quality.

3.2. Data and Identification Strategy

The data used to validate our theoretical predictions consist of detailed information taken from companies' annual financial statements and other relevant company records. In total, we tracked 31 branded companies (including multinational and national brands) and their corresponding counterfeits from 1993–2004. Our data set includes the average prices and costs for each authentic brand and each corresponding counterfeit at each product quality level (e.g., high, medium, low). In addition, the data collected include the brands' total domestic sales. All of the data were taken from each company's financial statements. The data set includes both domestic brands and multinational brands operating in China and is supplemented by the Chinese Industrial Census database, the eBay in China data set, product catalog information, and interviews. Data on counterfeit entry, prices, and costs for each brand were obtained by contacting each company's brand-protection offices. Also, government agencies

Figure 3 **Social Welfare Under Pooling and Separating Equilibria as Functions of τ ($s = 1$)**

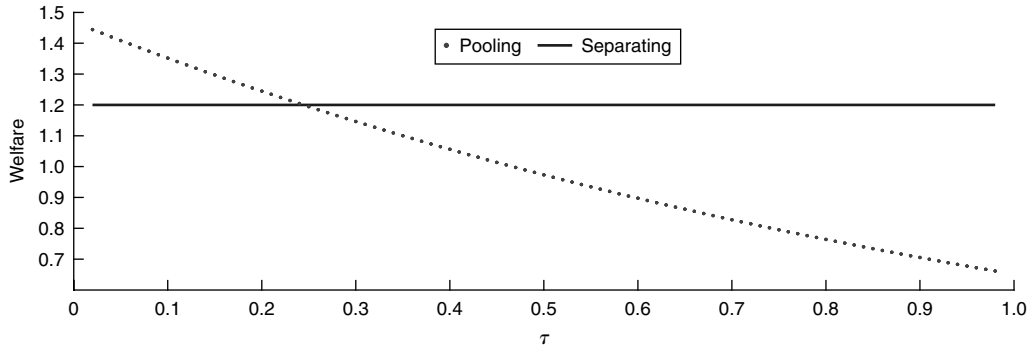
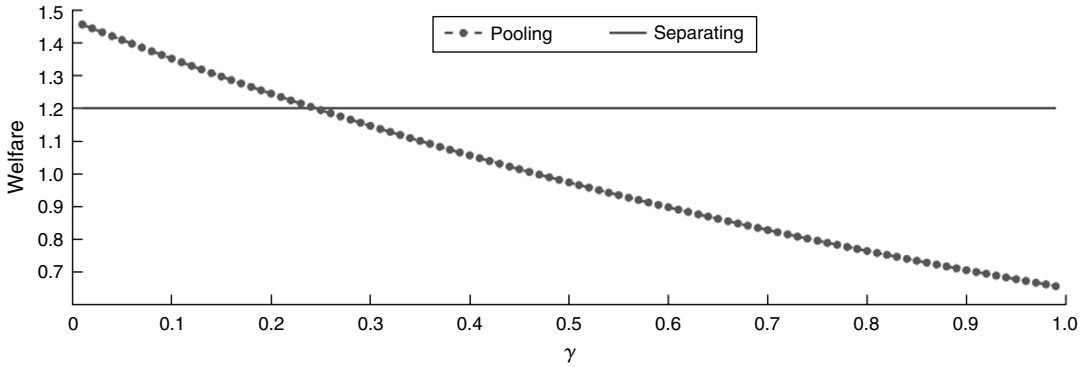


Figure 4 **Social Welfare Under Pooling and Separating Equilibria as Functions of γ ($s = 1$)**



(specifically, the Quality and Technology Supervision Bureau) were used as alternative sources of data on authentic and counterfeit firms. The Data Appendices, available online, provide further data checks as well as sampling and survey methods.

An important part of our research was locating and analyzing product-level data. The product-level data used in our study were coded and compiled based on information found in the companies' and stores' annual catalogs. These product catalogs assisted in better controlling for product quality and costs. We compiled a data set of the different characteristics for each type of shoe listed in the catalogs, consisting of material structures, comfort levels, decorative patterns, support and cushioning features, ventilation, etc. Recognizing the importance of validating the data from firm reports, we 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. We conducted the analyses on the samples of leather shoes and sport shoes separately. Those characteristics together accounted for 90% of the products' cost variation. These results lend credibility to the company data. We detail the regression model and results in §3.4.

A key difficulty in empirically measuring entry effects on prices and quality is that entry is often endogenous to these outcomes. Following Qian (2008), we exploit a natural experiment resulting from the unexpected loosening of government enforcement in China for footwear trademarks in 1995. The government reallocated enforcement resources away from footwear due to a series of accidents in several other sectors, notably gas explosions and food poisonings, leaving loopholes for massive counterfeit entry into the shoe markets soon after. In addition, this policy change made it more likely for counterfeiters to enter a market where authentic companies had a poor relationship with the local government than where authentic companies had strong ties to the government.[11] For that reason, monitoring differential relationships between each branded company and its respective government was vital in order to identify the entry effects of counterfeiters on different brands. We therefore used the interaction between the policy change and the differential relationships between each branded company and the government to identify the entry effects by counterfeiters for different brands, as in Qian (2008). For brevity, we relegate discussions of

[11] This finding was revealed in both qualitative interviews with managers and data analyses, as detailed in §3.4. The importance of relationship is not confined to China. At an Imaging Supplies Coalition Anti-Counterfeiting conference in 2008, Andrew Gardner from Lexmark International gave a case study on an actual sting operation to bust a counterfeiting ring in developing countries. He articulated how close collaboration between multiple vendors and the local government was crucial to successfully executing this operation.

the institutional and identification details to Online Appendix B. Results are qualitatively similar when using this instrumental variable (IV) approach and when simply exploiting the regression discontinuity in the natural policy experiment.

3.3. Shoe Quality Characteristics

Based on interviews and analyses of authentic prices and costs, Qian (2008) notes that "authentic firms did not engage in innovation when there was already significant competition from all the other authentic producers. Innovation occurred and prices jumped only after these authentic brands were infringed upon by counterfeits" (p. 1604). Using the data on shoe characteristics that were gathered from product catalogs, we rank the quality in each observable or meaningful dimension according to the cost of the materials used for that dimension. For instance, the variable for surface materials takes on a value of 1 for plastic leather, ..., 4 for regular cow skin, ..., and 14 for crocodile skin, in ascending order of material costs. Similar procedures are carried out to generate the variables for measuring the quality of the shoe side and bottom materials.

For the less-quantifiable attributes, we mainly use dummy indicators. We construct the variable for shoe appearance (searchable quality) by summing up three dummy variables—fine, elegant, and patterns—each taking on a value of 1 if a pair of shoes is described in the catalog as possessing the characteristics and 0 otherwise. A simple sum is generated instead of a weighted sum to avoid biasing results according to prior beliefs on which attributes constitute the more important quality components. We then construct 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.

We exhaust all of the attributes that are mentioned in the product catalogs. We also construct a variable indicating the technology applied to make the shoes, embodied in the equipment. Before counterfeit entry, all of the companies used domestic equipment. However, after entry, many of them imported Italian[12] production lines, pattern-pressing machines, and equipment to make shoe bottoms using cow skin. Some companies even adopted nanotechnologies.[13] We first construct a dummy variable for each type of equipment and then add them up to generate the "equipment" variable. We generate the variable "workmanship" to indicate whether the shoes were made with detailed and careful craftsmanship. Finally, we add up the values of these different characteristic variables to obtain the overall quality proxy.

[12] Italy has a famous cluster of shoe manufacturers.

[13] It is claimed that nanotechnology can be applied to making shoes that absorb foot sweat and increase comfort.

3.4. Analyses and Results

We study shoe characteristics before and after the brands were infringed by counterfeiters because of the unexpected loosening of government enforcement. Wilcoxon ranksum tests on the set of product-characteristics variables pre and post entry by

Table 1 Wilcoxon Ranksum Tests and Regression on Leather Shoe Quality

Panel A

Dependent variable	Functionality	Appearance	Appearance
Entry_{t-2}	−1.35	9.37***	8.50***
	(1.59)	(2.38)	(1.51)
Δc			2.05**
			(1.01)
Company and year FE	Y	Y	Y
No. obs.	3,336	3,336	3,336

Panel B

	Medium value		Ranksum test
	(1)	(2)	(3)
	Pre-entry	Post-entry	*p*-value
Surface material	Regular cow	Precious cow	0.000***
Side material	Regular cow	Sheep	0.000***
Bottom material	Regular	Regular (5% cow skin)	0.72
Appearance	Fine	Elegant, patterns	0.000***
Functionality	6.06	6.08	0.83
Workmanship	0.93	0.95	0.26
Versatility	0.096	0.10	0.77
Cushioning	0.096	0.1	0.88
Quality	18.6	22.6	0.000***

Notes. Panel A reports the IV estimate 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 B is an abridged excerpt of summary statistics from Table A.6 of the online appendix of Qian (2008). It tabulates the ranksum test statistics for the leather shoe characteristics pre and post counterfeit entry. All of the characteristics variables are categorical. Surface material includes 14 varieties, ranging from plastic leather to crocodile skin; side material includes seven varieties, ranging from plastic leather to baby cow skin; bottom material includes five varieties, ranging from inferior polysynthetic leather to cow skin. The Appearance variable is the sum of the dummies indicating whether a pair of shoes is fine, elegant, and with decorative patterns. Functionality is an aggregate variable for various functional attributes, including adroit (a dummy equals 1 if a pair of shoes is adroit), absorption (a dummy equals 1 if a pair of shoes absorbs sweat), athletic feet (a dummy equals 1 if a pair of shoes helps treat athletic feet), soft, cushion (a dummy equals 1 if a pair of shoes has cushion effects), comfort, sturdy, warm, and friction (a dummy equals 1 if a pair of shoes protects from slippery grounds). Workmanship is a dummy that equals 1 if a pair of shoes is carefully and finely manufactured. Quality is the sum of all dimensions of shoe characteristics.

**Statistically significant at 5% level; ***statistically significant at 1% level.

Table 2 Wilcoxon Ranksum Tests and Regression on Sport Shoe Quality

Panel A

Dependent variable	Functionality	Appearance	Appearance
Entry_{t-2}	−1.43	7.55***	6.35***
	(1.55)	(1.48)	(2.29)
Δc			1.15***
			(0.40)
Company and year FE	Y	Y	Y
No. obs.	3,335	3,335	3,335

Panel B

	Medium value		Ranksum test
	(1)	(2)	(3)
Quality dimensions	Pre-entry	Post-entry	*p*-value
Surface material	PU; net	Syn. leather; light net	0.000***
Bottom material	MD	TPR	0.229
Air pumps	None/middle	Top/middle/back	0.02**
Appearance	Fine	Fine/elegant	0.09*
Functionality	12	12	
Workmanship	1	1	
Versatility	1	1	
Supportiveness	1	1	
Quality	21.3	24.1	0.000***

Notes. Panel A reports the IV estimates of 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 B is an abridged excerpt of summary statistics from Table A.7 of the online appendix of Qian (2008). It tabulates the ranksum test statistics for the authentic sport shoe characteristics pre and post counterfeit entry. All of the characteristics variables are categorical. Surface and side material includes six varieties, ranging from inferior polysynthetic leather to real leather with materials for nets; bottom material includes four varieties, ranging from thermoplastic polyurethane to special rubber. The Appearance variable is the sum of the dummies indicating whether a pair of shoes is fine, and elegant. Functionality is an aggregate variable for various functional attributes, including adroit (a dummy equals 1 if a pair of shoes is adroit), absorption (a dummy equals 1 if a pair of shoes absorbs sweat), athletic feet (a dummy equals 1 if a pair of shoes helps treat athletic feet), soft, cushion (a dummy equals 1 if a pair of shoes has cushion effects), comfort, sturdy, warm, friction (a dummy equals 1 if a pair of shoes protects from slippery grounds), lasting (a dummy equals 1 if a pair of shoes lasts a long time), support (a dummy equals 1 if a pair of shoes supports the ankle well), and flexibility. Workmanship is a dummy that equals 1 if a pair of shoes is carefully and finely manufactured. Quality is the sum of all dimensions of shoe characteristics.

*Statistically significant at 10% level; **statistically significant at 5% level; ***statistically significant at 1% level.

counterfeiters provide summary statistics of the innovation patterns. Results (Panel B in Tables 1 and 2) clearly show that the authentic producers used fancier surface and side materials and improved the shoe appearance tremendously (especially for leather shoes) after counterfeit entry. The improvements in these searchable quality dimensions were not matched along the experiential quality dimensions. There was no significant improvement in the functionality (both at the aggregate level and the detailed-characteristics level): mobility, versatility, cushioning effects, etc. The overall quality is shown to have improved after entry, with an extremely low *p*-value in the Wilcoxon ranksum test. These findings directly support the predictions on searchable quality innovations in Propositions 3 and 6.

For a more formal test, we generate continuous measures of searchable and experiential qualities by summing the shoe characteristics along relevant dimensions of qualities, respectively. We carry out regressions for the continuous variable for searchable and experiential quality in the leather and sport shoe sectors, controlling for year and brand fixed effects.

$$\text{Quality}_{a,t} = \beta_0 + \beta_1 \text{Counterfeit}_{a,t-k} + \beta_2 (c_{c,t} - c_{a,t}) + \beta_3' \text{YearD}_t + \beta_4' \text{BrandD}_a + \epsilon_{a,t}, \quad (2)$$

$$\text{Counterfeit}_{a,t-k} = \alpha_0 + \alpha_1 \text{ISO} \cdot \text{Enforce}_{a,t-k} + \alpha_2 \text{ISO}_{a,t-k} + \alpha_3 \text{Enforce}_{a,t-k} + \alpha_4 t + \omega_{a,t}, \quad (3)$$

where $\text{Quality}_{a,t}$ refers to quality measures of brand a in year t and takes on two alternative measurements as detailed in the previous subsection: searchable quality (appearance) and experiential quality (functionality). Subscript k stands for the number of lagged years it takes for the entry of counterfeits to take full effect on the price outcome. Based on Akaike's information criterion (AIC) and Bayesian information criterion (BIC), we select a model with a two-year lag ($k = 2$). $c_{a,t}$ is the unit materials cost of the authentic product in the current year, t. $c_{c,t}$ is the unit cost of the counterfeit product in the current year. The variable $(c_{c,t} - c_{a,t})$ is then the empirical measurement of $\Delta\beta$ in the theoretical model. To address the potential endogeneity of counterfeit entry, we simultaneously estimate Equations (1) and (2) using two-stage least squares.

We find statistically significant coefficients on the searchable quality, significant at the 1% level (Panel A in Tables 1 and 2). Although experiential (functional) quality did not experience any significant changes, the searchable quality (appearance dimensions) of shoes improved by 20% (the median of the appearance distribution was 12). This provides rigorous empirical support for the key predictions in Proposition 3.

4. Conclusion

Counterfeiting is an unavoidable issue for policy makers and business managers operating in emerging markets. Although counterfeit entry is a form of competitive entry, it differs from other regular competition in three key ways. First, counterfeiters attempt to imitate authentic products and free ride on the investments in trademarks and quality by branded companies. Second, counterfeiting unbundles the searchable quality (e.g., appearance) and experiential quality (e.g., functionality) of a product. Third, counterfeiting has the defining trait of bearing the intent to deceive. Its deceptive nature

often gives rise to asymmetric information between the counterfeiters and consumers in transactions. Such asymmetric information can aggravate competition and influence market incentives in nonconventional ways. The media frequently report stories where confused consumers are conned into buying counterfeits. Our model is adept to addressing these scenarios.

The main contribution of this paper is to develop a theoretical model that incorporates all of these unique features of counterfeiting competition and to uncover the direction and nature of authentic product innovation in response to counterfeiting. Although Nelson (1970) introduces the concepts of searchable and experiential goods in economics, we argue that searchable and experiential dimensions of quality can coexist within the same good. We propose a novel model that includes both of these quality dimensions to analyze the competitive effects of imitators and counterfeiters. In the theoretical literature, this study contributes by offering a tractable theoretical framework to cover two distinct quality dimensions in a vertical differentiation setting and unveiling the entry effects of counterfeits. By examining the equilibrium conditions and allowing the authentic producer to endogenously determine experiential quality and searchable quality as well as prices, we are able to shed new light on the nature of innovations along different quality dimensions as brand protection strategies. The results therefore have immediate managerial implications.

In the case of deceptive counterfeiting, our theory predicts a noteworthy phenomenon that the market can serve as the invisible hand even for regulating counterfeits. We first discuss the results for scenarios when the brand has a production cost advantage over counterfeits. When there is a moderate amount of counterfeits in the market that confuses a small fraction of consumers, the authentic firm has an incentive to split profits with the counterfeiters in a pooling equilibrium. The brand will improve experiential quality to capture the high-valuation expert consumers if the innovation cost is not too high. When counterfeiting grows too rampant and fools too many consumers, the market incentives turn from favoring a pooling equilibrium to favoring a separating equilibrium. The authentic brand will invest to innovate and differentiate itself from counterfeiters in terms of searchable quality. In this type of separating equilibrium, counterfeiting induces the authentic producer to invest more in the product's searchable quality (e.g., appearance) and less in experiential quality (e.g., the functionality of the shoes, not apparent to consumers at the time of purchase). This could be socially wasteful if searchable quality does not contribute to consumer utility as much as experiential quality. We next turn to the scenario when counterfeiters enjoy a cost advantage over the authentic producer. No searchable quality upgrade is possible here because counterfeiters would readily copy it at a lower cost. The only hope for the brand to survive in the market is to innovate its experiential quality for the expert consumers. Otherwise, the lemon problem occurs, with counterfeits driving the authentic products out of the market.

These predictions are empirically validated by our findings based on a sample of authentic and counterfeit shoes for 31 brands operating in China at a time when counterfeit entry surged because of a sudden change in government enforcement policy. In particular, the branded companies that survived counterfeit infringements all significantly improved their shoes' surface, side materials, and appearance, whereas functional quality such as sturdiness and flexibility did not witness any significant changes. These innovations pushed up marginal production costs and hence raised authentic prices after counterfeit entry.

The findings bring to light the nature and extent of product differentiation in the face of counterfeiting, in contrast to the generally low-quality competition with perfect information, and provide managerial guidance as to which product attributes to differentiate on. 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 other searchable quality dimensions) insulated from fringe competition.

This paper is a stepping stone for exploring the complex impacts of counterfeits compared to generic competition. Although the current analyses shed light on the key quality and pricing strategies against counterfeits, other strategies (e.g., product-line proliferation) and dimensions of asymmetric information and implications can also be associated with counterfeiting. It would be a natural next step to extend the model to a dynamic multiperiod model, where one can study the reputation effects of brands and explore whether brands would invest in experiential quality in anticipation of future benefits. We are making further attempts to better understand counterfeiters' decisions to enter markets and any potential complementary effects counterfeits may have on authentic products, in line with the analytical framework in Chen and Xie (2007).

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mksc.2014.0867.

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