Misconduct and Innovation as a Response to Global Competitive Pressure*

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Abstract

This article theoretically examines the effect of an intensified global competition. Since consumers observe product quality imperfectly, inefficient firms are incentivized to supply less valuable goods deceptively, which spreads consumers’ distrust of the market. On the other hand, escaping its negative externality, efficient firms undertake innovation to build trust with consumers. Using a model that describes this market dynamism, this article shows that in some circumstances, the intense competition negatively affects average domestic product quality, social welfare, and, inequality across firms.

Key words: misconduct, innovation, import competition, competitive pressure

1 Introduction

Recently, large waves of deregulation, trade liberalization, and technological innovation have accelerated worldwide integrations of product markets, intensifying global competition among firms. Does this change help improve quality of our lives? This article examines the impact of intense global competition, created through its effect on firms’ misconduct and innovation.

Product quality and safety incidents, such as data falsification and fraud, involving food, labeling, and advertising, occur regularly. These incidents, which inevitably cause serious market malfunctions that can destroy consumers’ trust, may be caused by intense competition. For instance, in 2008, infant formula in China was found to contain harmful melamine. Gale and Hu (2009) opined that this crisis was caused by intense competition in the Chinese dairy industry, initiated by national market integration. Many academic articles also conclude that producers’ misconduct often results from intense competition (e.g., Shleifer (2004), Branco and Villas–Boas (2015), and Baumann and Frieha (2016) for theoretical analysis, Ben-
On the other hand, if the term innovation is interpreted broadly, as in Schumpeter (1942),3) various types of innovation establish trust with consumers. Firms develop new technologies to ensure product safety and quality (For example, technology in farming, processing, sterilization, packaging, and labeling ensure food safety). Firms also establish elaborate governance structures to improve corporate transparency and compliance and develop corporate brands (by creating new ideas for advertisement or marketing). These innovative activities, which help establish consumer trust by fortifying a firm’s commitment to supplying high-quality products, sometimes result from crises. If a negative action, caused by competition, triggers consumer distrust throughout a market, it also may plant the seeds for innovative efforts that recover consumer trust.4) In other words, competition generates a market dynamism in which trust is destroyed by misconduct but then recreated by innovation. This article analyzes how this dynamism affects quality of our lives. Furthermore, the seminal studies of Schumpeter (1942) and Arrow (1962) stimulate a debate over the relationship between competition and innovation. This article also aims to provide an alternative viewpoint of this traditional research theme.

We suppose an economy with a continuum of production sectors. Each sector has one domestic firm that can supply a unit of goods to the domestic market. A domestic consumer purchases one unit of either domestic good or a foreign imported good in market of each sector. The degree of competitive pressure imports put on the domestic firm is captured by the size of the surplus that domestic consumers can acquire from purchasing foreign goods.

A domestic firm undertakes one of three activities, (i) innovation, which commits itself to supplying high quality, (ii) status quo activity, which supplies standard goods, and (iii) misconduct, which supplies valueless goods, falsely labeling standard goods. But misconduct is a risky choice that is exposed to the public with positive probability. A firm’s productivity is private information, and a more productive firm generally has a cost advantage in supplying higher-quality goods over a firm with lower productivity. Using this model, this article analyzes the effect of intense import competition. The main results are summarized as follows.

First, intense competition tends to drive less productive firms to misconduct. This can also cause consumers to distrust all markets, since consumers lack information about firm’s productivity. By contrast, escaping its negative externality, relatively high productive firms undertake innovation to ensure consumer trust. Furthermore, when competitive pressure from imports exceeds a certain level, the market for the standard goods collapses, forcing less-productive firms from the market.

Second, due to the contrasting effects of misconduct and innovation, the relationship between import competition and the average quality of domestic goods is not always mono-

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2) What is behind the positive association between competition and misconduct? Criticizing the media, which often explains it as an inherent property of markets, Ohyama (2016, Chapter 11) asserted that its cause was market failure. To confirm the plausibility of this view, this article proposes an economic model in which market failure is based on asymmetric information about product quality.

3) In addition to product and process innovation, Schumpeter (1942) considered that the creation and development of new organizations and markets represent innovation.

4) Golan et al. (2004), who expatiated about food safety innovations voluntarily adopted by firms in US meat industry, provides one example that crises of food safety provided a momentum to innovation.
tonic. In some circumstances, the former effect dominates and competition causes product quality deterioration.

Third, intense import competition may have a negative effect on domestic social welfare. This occurs, in particular, when the standard terms-of-trade effect is dominated by the negative effect on producer surplus generated by the consumers’ distrust. Innovation, when motivated by the desire to escape from the negative externalities, only has a secondary effect on the welfare, even though it mitigates the welfare losses. This negative welfare effect occurs only when consumers observe product quality imperfectly.5)

Forth, when intense import competition collapses the market for standard goods, it also expands inequality between firms with low versus high level of productivity. While the former tends to be driven out of the market, the latter can survive by innovation. But in the process, since profits of all firms do not rise, inequality can expand without benefiting any type of firm.

Closely related to this article, many studies tackled the relationship between competition and innovation. Traditionally, they focus on two contrasting effects: Schumpeter’s (1942) effect, that discourages innovation due to the reduction of post-innovation profit, and Arrow’s (1962) effect, that promotes innovation due to the reduction of pre-innovation profits. The latter is also often referred to as the escape–competition effect. Aghion et al. (2005) showed theoretically and empirically that these two effects produce an inverted U-shaped relationship between competition and innovation. Many recent empirical studies have attempted to check the validity of this result empirically (e.g., Hashmi (2013), Amiti and Khandelwal (2013)).6) More closely related to ours, many empirical studies examined how intense import competition affected innovation. Many (e.g., Gorodnichenko et al. (2010), Bloom et al. (2016), Bombardini et al. (2017), Lim et al. (2017), Fieler and Harrison (2018), and Hombert and Matray (2018)) confirmed its positive effect on innovation. Bloom et al. (2016) and Bombardini et al. (2017) also showed that the positive effect is larger for highly productive firms.7) These empirical results can be interpreted as evidence of the escape–competition effect. This article’s focus on innovation’s effect is a form of escape–competition because a firm’s innovations avoid competition with dishonest firms that deceptively supply low–value goods. Thus, even though our attention is restricted to more specific type of trust–building innovation, our results are consistent with many empirical findings.

Section 2 presents the basic model. Section 3 characterizes a market equilibrium and then examines the effect of intensified import competition on the firms’ incentives for misconduct and innovation. Section 4 analyzes how intense competitive pressure affects the average quality of domestic products, domestic social welfare, and domestic firms’ inequality. Concluding remarks are provided in Section 5. The proofs of some statements are provided in the Appendix.

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5) This justifies Ohyama’s view (Ohyama 2016, Chapter 11) that a product quality crisis results not from market competition but from market failure.

6) Other than Aghion et al. (2005), many studies (e.g., Boone (2000), Vives (2008), Spulber (2013), and Beneito et al. (2015)) showed theoretically and empirically that the relationship between competition and innovation depends crucially on the type of market competition and market environments.

7) Conversely, Autor et al.’s (2019) empirical results showed a negative effect between import competition and innovation. But they also showed that this negative effect is larger for less–productive firms.
2 Model

We consider an economy with a continuum of industrial sectors located uniformly on $[0, 1]$. All sectors are identical except for a firm’s productivity parameter $\theta$ explained below. In each sector, one domestic firm can supply one unit of goods to the domestic market, which is associated with one of three activities: (i) status quo activity $S$, (ii) deviant activity $D$, and (iii) innovative activity $I$. Activity $S$ generates a unit of standard-quality goods (or good $S$) with cost $\theta$. Activity $D$ produces a unit of defective goods (or good $D$), with zero costs. A firm supplies good $D$ as if it is good $S$ through false labeling, and deceives consumers successfully with probability $1 - \lambda$. In other words, low-quality goods are exposed and publicized with probability $\lambda$. A firm also has the option to take activity $I$, which supplies a unit of innovative good (or good $I$) at a higher cost $(1 + \Delta)\theta$ (where $\Delta > 0$). Because of costly investment (equal to $\Delta \theta$) to establish consumer trust regarding product quality, a consumer can observe the quality of good $I$ precisely. Hence, producers of goods $S$ and $D$ cannot camouflage a product as good $I$. $\theta$ is privately observed by each firm, but there is the common knowledge that $\theta$ is distributed uniformly on $[0, 1]$. $\theta$ is a parameter indicating a firm’s productivity. Hereafter a firm with $\theta$ is sometimes called firm $\theta$. A consumer purchases, at most, one unit of goods in each sector, and his/her willingness-to-pay for all sectors is $v$ ($> 0$) for good $S$, $v + R$ (with $R > 0$) for good $I$, and 0 for good $D$. A consumer never purchases a valueless good $D$ when its true quality is exposed. In each sector, instead of a domestic good, a consumer alternatively can purchase a unit of imported goods (good $F$), featured by willingness-to-pay $v_F$ and price $p_F$. A consumer’s surplus from purchasing good $F$ is denoted by $\phi \equiv v_F - p_F$, which is a non-negative and exogenous variable in our model. Domestic firms face more intense competitive pressure from imports as $\phi$ becomes higher (as a result of either lower import prices or the higher quality of good $F$).

Initially, the firm in each sector decides whether or not to enter to a market. If not, it earns zero profit, and a consumer purchases good $F$. Otherwise a firm ships either one of good $I$, $S$ or $D$ to the market, selecting its price. The producer of good $I$ offers the optimal price $p_I = \max \{v + R - \phi, 0\}$, since a consumer purchases it only when $v + R - p_I \geq \phi$. The producers of goods $S$ and $D$ offer the same price $p^S$, since the producer of good $D$ mimics the behavior of the good $S$’s manufacturer, and the latter does not have an instrument to signal its quality correctly. Let $q$ be a consumer’s belief that the good is truly $S$, conditioned that he/she sees no evidence that it is good $D$. Then, a firm sets $p^S = \max \{qv - \phi, 0\}$ optimally, counting on a consumer’s expected willingness-to-pay $qv$. If a firm’s supply of good $D$ is disclosed, a consumer purchases import good $F$. Assuming the a firm is risk neutral, firm $\theta$ chooses the activity that achieves a maximum profit equal to $\max \{p_I(1 + \Delta)\theta, p^S - \theta, (1 - \lambda)p^S, 0\}$. To restrict our attention to the more interesting cases, we impose the following assumptions regarding parameters.

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8) A model with a continuum of sectors helps nullify the effect of uncertainty at the aggregate level and greatly simplifies our analysis.

9) Zero production cost of good $D$ is assumed only for the analytical simplicity.

10) We can extend the model to a general distribution case without changing the qualitative results.

11) Since a consumer can dispel the aggregate risk completely by purchasing a continuum of goods, his/her attitude for risk does not affect our analysis.
Assumption 1

\[ 0 < \frac{R}{\Delta} < 1 < \lambda v. \]

\[ R/\Delta < 1 \] is equivalent to \( v - 1 > v + R - (1 + \Delta) \). If this inequality does not hold, a firm never produces good \( S \), regardless of \( \theta \). \( 1 < \lambda v \) is equivalent to \( v - 1 > (1 - \lambda)v \). If a domestic firm does not face any competitive pressure from imports (\( \phi = 0 \)), it never selects \( D \), given that a consumer expects \( q = 1 \). These assumptions guarantee that the market of good \( S \) works normally, given weak import competition.

The next lemma shows that a firm’s choice has the threshold property for a given \( q \in [0, 1] \).

**Lemma 1**

(i) If \( qv - \phi \geq 0 \), there exist \( \theta' \) and \( \theta^S \) with \( 0 \leq \theta' \leq \theta^S \leq 1 \) such that a firm selects \( I \) for \( \theta \in [0, \theta'] \), \( S \) for \( \theta \in (\theta', \theta^S] \) and \( D \) for \( \theta \in (\theta^S, 1] \).

(ii) If \( qv - \phi < 0 \), a firm selects \( I \) for \( \theta \in [0, \theta_0] \) and does not enter to a market for \( \theta \in (\theta_0, 1] \) where

\[ \theta_0' = \max \left\{ 0, \min \left\{ \frac{v + R - \phi}{1 + \Delta}, 1 \right\} \right\}. \]

The proof is provided in the Appendix. If \( qv - \phi \geq 0 \), the supply of good \( D \) generates non-negative expected profits \( (1 - \lambda)(qv - \phi) \) for any type of firm. Because of its guaranteed non-negative minimum profit, all types of firms decide to enter to the market. By our assumptions about production cost, more efficient firms with lower \( \theta \) have a relative advantage in supplying more valuable but more costly goods, which generates the threshold property about the firm’s choice. On the other hand, if \( qv - \phi < 0 \), a firm earns a negative payoff by taking activities \( S \) and \( D \) for any \( \theta \). The firm takes \( I \) unless it has negative profits, or equivalently, if \( \theta \leq \theta_0' \).

3 Market Equilibrium

We focus on an equilibrium, in which a consumer’s belief \( q \) is formed based on Bayes rule, if the firm selects either \( S \) or \( D \) with a positive probability. Otherwise, \( q \) is arbitrary. There always exists an equilibrium where the firm selects neither \( S \) nor \( D \) for any \( \theta \). Since we cannot apply Bayes rule in this equilibrium, \( q \) is allowed to be arbitrary. This equilibrium is achieved by choosing \( q \) that satisfies \( qv - \phi < 0 \). Here, the market for a domestic good \( S \) collapses. A firm selects \( I \) for \( \theta \in (0, \theta_0') \) and does not enter to the market for \( \theta \in (\theta_0', 1] \).

Next we examine an equilibrium where the \( S \)'s market works actively with \( \theta' < \theta^S \). We define \( \theta'(q) \) and \( \theta^S(q, \phi) \) as

\[ \theta'(q) = \frac{R + (1 - q)v}{\Delta} \]

and

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12) We presume that when choices bring the same profits, a firm gives priority in the order of \( I, S, D \) and no entry.
\[
\theta^S(q, \phi) \equiv \min\{1, \lambda(qv - \phi)\}
\]
respectively. Since \(v + R - \phi - (1 + \Delta)\theta'(q) = qv - \phi - \theta'(q), \theta'(q)\) indicates a critical firm’s type at which \(I\) and \(S\) generate the same profits. \(\theta^S(q, \phi)\) satisfies \(v - \phi - \theta'(q, \phi) = (1 - \lambda)(v - \phi)\) if \(\theta'(q, \phi) < 1\). This is a critical type which makes an alternation of the optimal choice between \(S\) and \(D\). Here, the equilibrium, as far as it exists, is characterized by the thresholds \(\theta' = \theta'(q)\) and \(\theta^S = \theta^S(q, \phi)\). Bayes rule also requires \(q\) to satisfy
\[
q = \Phi(q: \phi) \equiv \frac{\theta^S(q, \phi) - \theta'(q)}{\theta^S(q, \phi) - \theta'(q) + (1 - \theta^S(q, \phi))(1 - \lambda)} \tag{1}
\]
and
\[
\theta^S(q, \phi) > \theta'(q). \tag{2}
\]
Thus, if and only if there exists \(q \in (0, 1]\) which satisfies (1) and (2), there also exists an equilibrium with a positive supply of good \(S\). We assume that this equilibrium occurs whenever it exists. Furthermore, when there exist multiple \(q \in (0, 1]\) that satisfy the conditions, we focus on the one with the largest \(q\). In other words, we presume that the good \(S\)’s market collapses only when this type of equilibrium does not exist. Hereafter an equilibrium is denoted by variables with asterisks, such as \(q^*, \theta^*\) and \(\theta^{S*}\).

We now analyze some properties of the equilibrium. First, suppose that \(\phi \leq \phi^* \equiv v - 1/\lambda\) and a firm faces relatively weak import competition.\(^{13}\) \(\phi \leq \phi^*\) implies
\[
(1 - \lambda)(v - \phi) \leq v - \phi - \theta
\]
for any \(\theta \in [0, 1]\). No firm has an incentive to take \(D\) if the consumer expects \(q = 1\). Then, \(q^* = 1, \theta^* = \theta'(1) = R/\Delta < 1\) and \(\theta^{S*} = \theta^S(1, \phi) = 1\) satisfy the equilibrium conditions (1) and (2). For \(\phi \leq \phi^*\), competitive pressure from imports does not affect all types of domestic firms.

Next, suppose a \(\phi > \phi^*\) case where a firm faces more intense import competition. Since \((1 - \lambda)(v - \phi) > v - \phi - \theta\) for \(\theta\) sufficiently close to 1, the firms with high \(\theta\) would take deviant actions if a consumer expected \(q = 1\). Thus, \(q^* = 1\) cannot be an equilibrium belief. Since (2) is rewritten as \(q > q(\phi)\) where
\[
q(\phi) = \frac{v + R}{\lambda} + \frac{\lambda \phi}{\Delta},
\]
an equilibrium belief is also characterized by \(q^* \in (q(\phi), 1]\), such that \(q^* = \Phi(q^* : \phi)\).

Since \(q(\phi) < 1\) is equivalent to \(\phi < \phi^* \equiv v - (R/\Delta)(1/\lambda)\), if this type of equilibrium exists, \(\phi\) must be less than \(\phi^*\). It is easy to check that, for each \(\phi \in (\phi, \phi^*)\), \(\Phi(q: \phi)\) is continuous, increasing and strictly concave for \(q\) on \([q(\phi), 1]\), and it also satisfies \(\Phi(q(\phi): \phi) = 0.\)\(^{14}\) \(\Phi(q: \phi)\)

13) Assumption 1 \((1 < \lambda v)\) guarantees the existence of such a \(\phi\).
14) It is shown that
\[
\Phi(q: \phi) = \frac{\left(\frac{\lambda v + v}{\Delta} - \Phi(q: \phi)\left(\frac{\lambda v + v - \lambda v(1 - \lambda)}{\lambda(qv - \phi) - \frac{R(1-q)v}{\Delta} + (1-\lambda(qv - \phi))(1-\lambda)}\right)\right)}{\lambda(qv - \phi) - \frac{R(1-q)v}{\Delta} + (1-\lambda(qv - \phi))(1-\lambda)} > 0
\]
is decreasing in $\phi$ with $\Phi(1: \phi) = 1$ and converges uniformly to zero as $\phi$ approaches $\bar{\phi}$.

As shown clearly from the lines corresponding to $\Phi = \Phi(q: \phi)$ in Figure 1, a necessary and sufficient condition for the existence of an equilibrium with $q^* \in (0, 1)$ for some $\phi$ is $\Phi_q(1: \phi) < 1$, or equivalently $R/\Delta < 1 - \lambda v(1 - \lambda)$.\(^\text{15}\)

Suppose that $R/\Delta < 1 - \lambda v(1 - \lambda)$. As illustrated in the left-hand graph of Figure 1, the properties of $\Phi(q: \phi)$ guarantee the existence of $\hat{\phi} \in (\phi, \bar{\phi})$, such that $q^* \in (0, 1)$ for any $\phi \in (\hat{\phi}, \bar{\phi})$. Since our focus is provided to the largest $\hat{\phi}$, $S$’s market collapses. Since the market for good $I$ serves as a place of refuge for relatively efficient firms (that lose the chance to supply good $S$), a collapse of $S$’s market induces a discontinuous rise of $\theta^{Ir}$.\(^\text{16}\) Once $S$’s market collapses, a further rise of $\phi$ causes a gradual decrease in $\theta^{Ir} = \theta^I_0$ by promoting the exit of $I$’s producers.

On the other hand, when $1 > R/\Delta > 1 - \lambda v(1 - \lambda)$ (corresponding to the right-hand graph in Figure 1), an equilibrium with $q^* \in (0, 1)$ does not exist. $S$’s market collapses immediately after $\phi$ exceeds $\hat{\phi}$. This is also interpreted as the case of $\phi = \hat{\phi}$, using $\hat{\phi}$ defined above. The following proposition summarizes these arguments.

\[ \Phi_{\phi\phi}(q: \phi) = \frac{-2\Phi_q(q: \phi)\left(\frac{v}{\Delta} + \lambda^2 v\right)}{\lambda(qv - \phi) - \frac{R + (1 - q)v}{\Delta} + (1 - \lambda(qv - \phi))(1 - \lambda)} < 0. \]

\(^\text{15}\) This condition is explained as follows. Taking $\phi = \phi$ as given, a small decrease in $q$ from 1 generates a positive supply of good $D$ with a marginal rate equal to $-d((1 - \lambda)(1 - \theta^D(q, \phi)))/dq|_{q=1} = \lambda v(1 - \lambda)$. On the other hand, the initial total supply of $S$ is equal to $\theta^S(1, \phi) - \theta^S(1) = 1 - R/\Delta$. Here, the ratio between them determines whether or not $\Phi_q(1: \phi)$ is greater than 1.

\(^\text{16}\) More formally, it is shown that firm $\theta^{Ir}$ earns positive profit at $\phi = \hat{\phi}$, since

\[ v + R - \hat{\phi} - (1 + \Delta)\theta^{Ir} = v - \hat{\phi} - \theta^{Ir} > v - \hat{\phi} - \theta^{Ir} \geq 0. \]
Proposition 1 There exists $\hat{\phi}(\geq v - 1/\lambda)$ such that the equilibrium has the following properties:

(i) For $\phi \in (0, \hat{\phi})$, a firm never takes $D$, and $(q^*, \theta', \theta^S) = (1, R/\Delta, 1)$.

(ii) For $\phi \in (\hat{\phi}, 1)$, there exists an equilibrium with $q^* \in (0, 1)$, $\theta'^* = \theta'(q^*, \phi)$, $q$ and $\theta^S$ are decreasing in $\phi$ and $\theta'^*$ is increasing in $\phi$. $\hat{\phi} < \phi$, if and only if $R/\Delta < 1 - \lambda v(1 - \lambda)$.

(iii) For $\phi > \hat{\phi}$, the S’s market collapses.

For comparison, let us examine a case where a firm’s supply of good $D$ is disclosed with probability one ($\lambda = 1$). The equilibrium is also characterized by two thresholds, $\theta'$ and $\theta^S$, where a firm selects $I$ for $\theta \in [0, \theta']$, $S$ for $\theta \in (\theta', \theta^S]$, and does not enter to the market for $\theta \in (\theta^S, 1]$. When this firm supplies a positive amount of good $S$, $\theta'$ is determined by a condition of the indifference between $I$ and $S$:

$$v - \phi - \theta' = v + R - \phi - (1 + \Delta)\theta'$$

or equivalently, $\theta' = R/\Delta$. This threshold does not depend on $\phi$. On the other hand, the condition of S’s non-negative profit determines $\theta^S = \min\{1, v - \phi\}$. A rise in $\phi$ gradually excludes S’s suppliers from the market, with no impact on I’s suppliers. This rise pushes out I’s suppliers only after the complete exclusion of S’s suppliers. More formally, the relationship between $\phi$ and a market structure at the equilibrium is as follows:

- If $0 < \phi < v - R/\Delta$, $\theta'^* = (R/\Delta, \min\{v - \phi, 1\})$
- If $v - R/\Delta < \phi$, $\theta'^* = \theta^S = \max\{0, \frac{v + R - \phi}{(1 + \Delta)}\}$.

Our model also has a complete closed-form solution. With the selection of $R = 1/5$, $v = 1$

The second inequality comes from $\theta'^* = \theta^S$ at $\phi = \hat{\phi}$, as a result of $0 < q(\hat{\phi}) < q'(\hat{\phi})$. Thus $\theta'^* < \theta^S$ at $\hat{\phi}$.

17) Let us define $X$ and $Y$ as

$$X = v\lambda - \left(1 - \frac{R}{\Delta}\right) + \frac{v}{\lambda}$$

and

$$Y = v\lambda^2 + \frac{v}{\lambda}$$

respectively. Then $\hat{\phi}$ and $q$ are given respectively by

$$\hat{\phi} = v - \frac{1}{\lambda} + \frac{Z}{\lambda}$$

where

$$Z = \frac{(2 - \lambda)Y - \lambda X - [((2 - \lambda)Y - \lambda X)^2 - \lambda^2 (Y - X)^2]^{1/2}}{\lambda^2}$$

and

$$q = \frac{Y + X + \lambda(1 - \lambda(v - \phi)) + D^{1/2}}{2Y}$$

where

$$D = (Y + X + \lambda(1 - \lambda(v - \phi)))^2 - 4Y (X + (1 - \lambda(v - \phi))).$$
5/4 and $\Delta = 1$, Figures 2 and 3 illustrate the relationship between $\phi$ and a firm’s choice at the equilibrium for $\lambda = 1$ and $\lambda = 0.9$ respectively. For comparison purposes, the lines in Figure 2 are also reproduced in Figure 3 as red dotted lines. Figure 3 clearly describes the effect of intense import competition in the case of $\lambda < 1$. When exposed to additional intense competitive pressure, less productive firms are tempted to undertake misconduct. Anticipating this possibility, consumers lose trust for all suppliers of good $S$, because they lack information about these firm’s productivity. Escaping its negative externality, high productive firms engage in innovation ($I$) to retrieve consumers’ trust, which also amplifies consumers’ distrust for firms staying in $S$’s market. Ultimately, $S$’s market collapses, forcing all producers of good $S$ either to take innovative activities for survival or to exit the market.

Further implications are derived from a comparison between Figures 2 and 3. First, the innovation-promoting effect of intense competition appears only when an information problem exists regarding product quality (i.e. $\lambda < 1$). Second, a firm’s option of $D$ may cause an excessive retention of less productive firms on $(\phi, \hat{\phi})_{18}$, while it oppositely excludes less productive

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18) This occurs when $\hat{\phi} < v - 1$. 

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firms excessively from the market for $\phi > \hat{\phi}$. This result also suggests that information problems cause drastic market adjustments.

4 Product Quality, Welfare, and Inequality

First, we examine how an intense import competition affects the average quality of domestic goods. The quality of each good is measured by a consumer’s willingness-to-pay for it, such as $v + R$ for good $I$, $v$ for good $S$, and $0$ for good $D$. On $[0, \hat{\phi})$ where $S$’s market works actively, the average quality of a domestic product (denoted by $AQ$) is represented by

$$AQ = \alpha^* (v + R) + (1 - \alpha^*) q^* v$$

where

$$\alpha^* = \frac{\theta^*}{1 - \lambda (1 - \theta^*)}.$$  

Since $\lambda (1 - \theta^*)$ is the amount of good $D$ driven out from the market by exposure of its true quality, $1 - \lambda (1 - \theta^*)$ represents the actual total supply of domestic goods. Hence, $\alpha^*$ is the market share of good $I$, while $(1 - \alpha^*) q^*$ is the market share of good $S$. On the other hand, for $\phi > \hat{\phi}$ where $S$’s market collapses, $AQ = v + R$, to the extent that a positive supply of good $I$ exists (i.e. $\theta^* > 0$).

Since $\theta^* > \theta^*$ and $\alpha^* < 1$ at $\phi = \hat{\phi}$, $AQ$ rises discontinuously at $\phi = \hat{\phi}$. From Proposition 1, $\alpha^*$ is increasing in $\phi$ on $(\phi, \hat{\phi})$, generating the effect of rising $AQ$. On the other hand, $q^*$ is decreasing in $\phi$ on the same interval, lowering expected quality in $S$’s market. The net effect of $\phi$ on $AQ$ is determined by the relative size of these two contrasting effects. Since the size of the former effect is proportional to $R$, it is easy to derive the following statement.

Proposition 2 Suppose that $\lambda (1 - \lambda) v < 1$. If $R$ is sufficiently close to zero, there exists $\hat{\phi} \in (\phi, \hat{\phi})$ such that $AQ$ is decreasing in $\phi$ on $(\hat{\phi}, \hat{\phi})$.

The proof is provided in the Appendix. Figure 4 illustrates the relationship between $\phi$ and $AQ$ for $\lambda = 0.9$, $R = 1/5$, $v = 5/4$, and $\Delta = 1$. For comparison purpose, the dotted line describes $AQ$ when there is no information problem (i.e. $\lambda = 1$). When $\lambda = 1$, intense competition from imports never leads a deterioration in the average quality of domestic goods. In other words, an information problem generates some interval of $\phi$ on which average quality deteriorates.

We next examine how intense competition affects domestic welfare. A consumer always has the option of purchasing foreign good $F$ and can, at least, maintain a consumer surplus of

19) By Proposition 1, this is a necessary condition for the existence of an equilibrium with $q^* \in (0, 1)$.
20) In the absence of information problem,

$$AQ = \frac{R / \Delta}{\min\{v - \phi, 1\}} R + v$$

for $\phi < v - R/\Delta$, and

$$AQ = v + R$$

for $\phi > v - R/\Delta$. 
φ. On the other hand, a domestic firm always sets a maximum price which exploits all surpluses exceeding φ. Thus, a consumer always receives a surplus equal to φ, irrespective of λ. For instance, for φ < φ̂, the consumer surplus is equal to

\[ \theta^* (v + R - p^* + (\theta^* - \theta^*) (v - p^*) + (1 - \lambda)(1 - \theta^*) (0 - p^*) + \lambda (1 - \theta^*) \phi. \]

We can check that this is equal to φ.

![Figure 4: Effect of Intense Competition on Product Quality](image)
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\( \theta^S \), which is the probability that a consumer purchases good \( F \) as a result of exposure of good \( D \) in each sector. The second term captures the negative effect caused by a domestic product’s lower quality. Evaluated at \( \phi = \hat{\phi} \), \( dW/d\phi = v(1 - R/\Delta)d\theta^* /d\phi < 0 \), since the former terms-of-trade effect vanishes. This implies that there exists an interval of \( \phi \) such that more intense competitive pressure worsens domestic welfare. This is a unique property in a model with \( \lambda < 1 \). Without an information problem (i.e. \( \lambda = 1 \)), it is easy to show that \( W \) is always non-decreasing for \( \phi \). These arguments are summarized in the following proposition.

Proposition 3 Suppose \( \lambda < 1 \). If \( \hat{\phi} < \phi \), there exists an interval of \( \phi \), which is a subset of \([\hat{\phi}, \phi] \), such that the domestic welfare decreases with \( \phi \). It also induces a discontinuous drop in domestic welfare at \( \phi = \hat{\phi} \) when the \( S \) market collapses, and then the domestic welfare increases with \( \phi \) for \( \phi > \hat{\phi} \). On the other hand, if \( \lambda = 1 \), domestic welfare does not decrease with \( \phi \).

Figure 5 illustrates \( \phi \)’s effect on \( W \) for each of \( \lambda = 0.85, 0.9 \) and \( 1 \) under \((R, v, \Delta) = (1/4, 5/4, 1) \). It shows that a rise of \( \phi \) induces the welfare loss on a broader range of \( \phi \), when \( \lambda \) becomes lower. In response to intense import competition, less-productive firms tend to act dishonestly in an attempt to survive. A consumer’s distrust in \( S \)'s market also grows, negatively involving all the other suppliers of good \( S \). It may trigger a collapse of \( S \)'s market, forcing out all suppliers out of this market. The resulting reduction of firms’ profits leads to a welfare loss. Even

\[ W = \hat{\phi} + \int_{\phi}^{\hat{\phi}} \left[ v + R - \phi - (1 + \Delta) \theta \right] d\theta + \int_{\phi}^{\hat{\phi}} \left[ v - \phi - \theta \right] d\theta \]

and \( dW/d\phi = 1 - \theta^S \geq 0 \).
though this situation also provides momentum for innovation by some highly productive firms, its positive welfare effect is secondary.

Finally we argue that firms’ status becomes polarized. Figure 6 illustrates changes in a firm’s profit for each $\theta \in [0, 1]$ at the neighborhood of $\phi = \hat{\phi}$, under $\lambda = 0.9$, $R = 1/5$, $v = 5/4$, and $\Delta = 1$. The red line shows the profit of firm $\theta \in [0, 1]$ at $\phi = \hat{\phi}$. Here all types of firms earn a positive profit. But when $\phi$ exceeds $\hat{\phi}$, a firm’s profit for $\theta > \theta^{**}$ shifts downward from the red line to the blue line, preserving the red line for $\theta < \theta^{**}$. Firms between $\theta^{**}$ and $\theta^*_0$ survive by taking innovative actions, while firms with $\theta$ greater than $\theta^*_0$ are forced out of the market. Since no firm earns a higher profit, this figure describes an expansion of firms’ inequality, with no winner.

The green lines in Figure 6 describes a firm’s profit for each $\theta$ at $\phi = \hat{\phi}$ and $\lambda = 1$. Information problem regarding product quality tends to increase inequality among firms, even though some dishonest firms (which takes $D$) may benefit from it.

5 Concluding Remarks

Incidents regarding product quality and safety abound all over the world. Facing intense competitive pressure, inefficient firms may conduct themselves inappropriately to survive. Because they have limited information about these firm’s efficiency, consumers begin to distrust entire markets. At the same time, efficient firms are encouraged to innovate, which builds consumer trust. Our model describes this market dynamism created through destruction and creation of consumers’ trust. The analysis highlights a dismal side of market competition, which may negatively affect average product quality, social welfare, and inequality. We also conclude that limited information about product quality is a driving force for these problems.
One limitation of this study is in that our model is oversimplified. For example, it rules out the positive spillover effect of innovation, whose gains are diffused globally. More importantly this article does not take into account the government’s role in establishing consumers’ trust. Hopefully, these issues will be addressed in future work.

Appendix

Proof of Lemma 1

(i) Consider the case of \( qv - \phi \geq 0 \). Then all types of firms enter to the market. Suppose that firm \( \theta \) takes \( I \), firm \( \theta' \) does \( S \) and firm \( \theta'' \) does \( D \). Then

\[
v + R - \phi - (1 + \Delta)\theta \geq qv - \phi - \theta,
\]

and

\[
qv - \phi - \theta' \geq \max \{ v + R - \phi - (1 + \Delta)\theta', (1 - \lambda)(qv - \phi) \},
\]

and

\[
(1 - \lambda)(qv - \phi) \geq qv - \phi - \theta''.
\]

These inequalities imply \( \theta \leq \theta' \leq \theta'' \). It guarantees the existence of thresholds \((\theta', \theta'')\) satisfying \( 0 \leq \theta' \leq \theta'' \leq 1 \).

(ii) Consider the case of \( qv - \phi < 0 \). Then \( qv - \phi - \theta < 0 \) for any \( \theta \in [0, 1] \) and \( (1 - \lambda)(qv - \phi) < 0 \). Therefore the firm takes neither \( S \) nor \( I \) for any \( \theta \). But \( I \) is selected by firm \( \theta \) which satisfies \( v + R - \phi - (1 + \Delta)\theta \geq 0 \). It implies that the firm selects \( I \) for \( \theta \in [0, \theta_0^I) \) and does not enter to the market for \( \theta \in (\theta_0^I, 1) \).

Proof of Proposition 2

Suppose that \( R \) is so small that \( R/\Delta < 1 - \lambda(1 - \lambda)v \) or \( \theta < \theta \). Since (1) can be rewritten to

\[
1 - \theta''(q^*, \phi) = \frac{1 - q^*}{(1 - \lambda q^*)} \frac{1 - \theta'(q^*)}{1 - \theta'(q^*)},
\]

\( \alpha^* \) is expressed as a function of \( q^* \) such as

\[
\alpha^*(q^*) = \frac{\theta'(q^*)}{1 - \lambda \frac{1 - q^*}{(1 - \lambda q^*)} \frac{[1 - \theta'(q^*)]}{[1 - \theta'(q^*)]}},
\]

Since \( q^* = 1 \) and \( \alpha^* = R/\Delta \) at \( \phi = \hat{\phi} \),

\[
\frac{dAQ}{dq} \bigg|_{\phi = \hat{\phi}} = \left(1 - \frac{R}{\Delta} \right)v + R \frac{d\alpha^*}{dq} \bigg|_{\phi = \hat{\phi}} = \left(1 - \frac{R}{\Delta} \right)v - R \left[ \left( \frac{v}{\Delta} \right) + \left( \frac{R}{\Delta} \right) \left( \frac{\lambda}{1 - \lambda} \right) \left(1 - \frac{R}{\Delta} \right) \right]
\]

23) A companion paper (Tsumagari (2019)) analyzes government ability to improve the quality of market institutions. Ohyama (2016, Chapter 11) also suggests that some problems are caused by the failure of the government.
As R goes to zero, the right hand side converges to \( v \), implying that 
\[
\frac{dAQ}{dq} \bigg|_{\phi=\hat{\phi}} > 0
\]
for sufficiently small R. Since \( q^{*} \) is decreasing in \( \phi \) on \( (\hat{\phi}_1, \hat{\phi}_2) \), \( AQ \) is decreasing in \( \phi \), if \( \phi \) is sufficiently close to \( \hat{\phi} \).

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