Law, Social Responsibility, and Outsourcing

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Abstract

Previous research into enforcement of law and corporate social responsibility mostly assumes that the vertical structure of the entities causing harm is exogenous. By outsourcing, the source of harm may avoid some liability and responsibility, while losing direct control over the evasive actions that cause harm. Here, we analyze the trade off between avoidance of liability and control over evasion. (i) A brand’s preference for outsourcing increases with the extent that outsourcing reduces liability and responsibility. (ii) Evasion of law and responsibility reduces costs and increases with production scale. So, under outsourcing, the brand depresses production to induce less evasion. (iii) If the rate of expected penalty on the producer is sufficiently low and the penalty on the brand is sufficiently large, vertical integration discretely raises welfare. Integration increases production and consumer benefit, while lowering evasion, which reduces harm by more than it raises production costs.

Keywords: Law, corporate social responsibility, outsourcing, vertical integration

JEL: L2, F2, J3
1 Introduction

Unilever is one of the world’s top consumers of palm oil and palm kernel oil, using the oils to manufacture products including soaps, cleaners, margarine, and ice cream. As a corporation, it has committed to procuring all agricultural raw materials from sustainable sources by the year 2020. Unilever buys palm kernel oil derivatives from independent growers. As these products are shipped over long distances, it is difficult to trace their origin. So, Unilever has decided to vertically integrate: “[Unilever is] investing €69 million in a palm kernel oil processing plant in Indonesia and considering similar joint venture investments in processing crude palm oil derivatives elsewhere to help us achieve traceable supplies” (Unilever, 2013: 42) [emphasis added].

Major oil producers outsource drilling operations to specialized contractors. BP hired Transocean to operate the Deepwater Horizon rig and drill the Macondo well in the Gulf of Mexico. On April 20, 2010, the well blew out, causing explosions and fires, leading to the deaths of 11 workers and injuries to at least 17 others, and billions of dollars in environmental and economic losses in the region. At trial in federal court, the major issue was the allocation of liability between BP as owner and Transocean as contractor (Deepwater Horizon 2014).

Manufacturers of chocolate procure raw cocoa from Ghana and the Ivory Coast, countries where the employment of child labor in the cocoa industry is widespread (BBC 2010). In 2001, U.S. Congressman Eliot Engel proposed legislation to require that all chocolate sold in the United States be marked as being free from slave and child labor. Opposed by the chocolate industry, the bill did not pass into law. Subsequently, three former Ivory Coast child slaves sued Nestle, Archer Daniels Midland, and Cargill under the Alien Tort Statute (28 U.S.C. §1350) for aiding and abetting child slavery by Ivorian farmers. The defendant corporations denied liability (Doe v. Nestle 2014).

Apple and Hewlett-Packard outsource the production of electronic devices and computers to contract manufacturers in China such as Foxconn. Contract manufacturers have been criticized for labor practices such as excessive mandatory overtime and employing student “interns” as full-time workers, as well as unsafe working conditions (CNET 2014).

Here, motivated by the above examples, we study the distribution of legal liability and
social responsibility across vertically related organizations. Issues of enforcement and responsibility arise in any chain of production – whether within a country or transcending international borders. As reviewed by Polinsky and Shavell (2000), Kaplow and Shavell (2002), and Kitzmueller and Shimshack (2012), the enforcement of law and corporate social responsibility against businesses that choose between vertical integration and outsourcing is an open research question.

In the strategic choice between vertical integration and outsourcing, the brand faces a fundamental trade-off. Under vertical integration, the brand bears the full brunt of legal liability as well as corporate social responsibility, but the brand fully controls the harmful actions that give rise to liability and responsibility. By contrast, under outsourcing, the brand may (partly) shield itself and its brands from legal liability and social responsibility, which fall on the contract producer. However, with outsourcing, the brand cannot directly control the producer’s harmful actions.

We analyze the trade-off between control and avoidance of liability, and show the following. First, the brand’s preference for outsourcing is monotone increasing in the extent that it can avoid legal liability and social responsibility by outsourcing. The “benefit” of outsourcing is avoidance of liability and responsibility. Hence, the greater is this benefit, the higher will be the brand’s profit with outsourcing.

Second, under outsourcing, the brand depresses the quantity of production in order to induce the producer to reduce the level of the harmful action, which we call “evasion”. Under outsourcing, the producer over-evades as it chooses evasion according to its expected penalty, which is less than the total expected penalty on brand and producer. Since the producer’s choice of evasion increases with the scale of production, the brand orders less production to induce the producer to reduce evasion.

Third, if the rate of expected penalty on the producer is sufficiently low and the penalty on the brand is sufficiently large, society can discretely raise welfare by inducing the brand to switch from outsourcing to vertical integration. Conditional on the quantity of production, the outsource producer over-evades as compared with a vertically-integrated producer. A switch from outsourcing to vertical integration raises the quantity of production, while the reduction in evasion reduces social harm by more than it raises the cost of production. Accordingly, the switch yields a first-order increase in welfare.
Overall, our analysis contributes to a better understanding of managerial strategy and public policy with regard to enforcement of law and social responsibility when the vertical structure of the production chain is endogenous.

A long-standing issue in the economics of enforcement is when the law should penalize individual managers as well as the organization. Previous research has identified circumstances including limited liability, asymmetries of information, and agency problems within the organization (Sykes 1984; Chu and Qian 1995; Shavell and Polinsky 2000; Chen and Chu 2002). A related question is when should the law penalize the organization as well as individual managers. Kraakman (2013) reviews the economic efficiency of “vicarious liability”, a legal concept that distinguishes between the harmful actions of an employee (employer is liable) vis-a-vis independent contractor (employer is not liable). In the context of managed care, Arlen and Macleod (2005) show that imposing liability on the organization for the actions of physician-contractors can raise welfare. Here, we study how the assignment of liability affects welfare through the choice between vertical integration and outsourcing and the decision on compliance.

These issues are at the forefront of the Deepwater Horizon case as well as suits against U.S. corporations under the Alien Tort Statute (Sykes 2011). In the Deepwater Horizon case, the U.S. District Court for the Eastern District of Louisiana adjudicated 67 percent of the liability to BP, 30 percent to Transocean, and 3 percent to Halliburton, which cemented the Macondo well. Transocean hailed the decision as: “again ratif[y]ing the industry-standard allocation of liability between drilling contractors and the owners and operators of oil wells” (BloombergBusinessweek 2014). In the cocoa case, Senior Circuit Judge Dorothy W. Nelson wrote that, “defendants’ involvement in the cocoa market gives them economic leverage, and along with other large multinational companies, the defendants effectively control the production of Ivorian cocoa”. By a two-to-one majority, the Court decided to allow the former Ivorian child slaves to proceed with their suit (Doe v. Nestle USA 2014).

Our analysis suggests that changes in the distribution of liability will affect the extent to which brands will contract out upstream activities that possibly cause harm to others. Such outsourcing of legal liability seems to be prevalent in some industries. Between 1967-1980, changes in liability laws were associated with the disproportionate growth of small businesses in hazardous industries. Ringleb and Wiggins (1990) explained the pattern as the
outcome of systematic efforts to avoid liability. More recently, investors in nursing homes have shielded themselves from liability by disaggregating the provision of service to multiple smaller entities that are difficult for patients to sue (Kraakman 2013).

Our research also contributes to the economics of corporate social responsibility (CSR) for labor rights, sustainability, and business practices in general. CSR activists tend to assume that imposing more responsibility is always better (BBC 2010; CNET 2014). However, our analysis points to an inherent non-convexity: the social welfare maximum is the maximum of welfare under two scenarios – vertical integration and outsourcing. As in any non-convex problem, moving towards a local optimum may actually move away from the global optimum.

Most previous research on social responsibility takes organizational structure as exogenous. Indeed, Kitzmueller and Shimshack (2012) call for “future research investigating the implications of CSR for industrial organization broadly”. We contribute by analyzing how changes in the extent of responsibility influence the vertical structure of the production chain and the social harm. Unilever’s new Indonesian factory illustrates this effect. To make good on the corporate commitment to sustainable procurement, Unilever vertically integrated upward into the processing of palm kernel oil. Our analysis relates to empirical studies in political science showing that labor standards in advanced economies propagate to developing economies more strongly through foreign direct investment (vertical integration) than trade (outsourcing) (Mosley and Uno 2007).

2 Setting

A business performs two functions – branding and manufacturing. Let the brand sell a quantity, $Q$, of some item at a retail price, $p$. The product yields benefit, $B(Q)$, to consumers. The marginal benefit diminishes with consumption, $B'(Q) > 0$ and $B''(Q) < 0$. Ignoring income effects, we stipulate that the brand sets the retail price, $p = B'(Q)$.

For simplicity, we assume that the brand incurs no costs of retailing. The item is produced at a cost that depends on the degree, $x \in [0, 1]$, to which the producer evades laws and regulations or socially responsible practices. Specifically, the producer’s cost of production is $[1 - x]C(Q)$, where $C'(Q) > 0$, $C''(Q) > 0$, is exogenous. So, the cost of production
decreases in the degree of evasion. Evasion of laws and regulations or socially responsible practices causes social harm, $H(x)$, where $H'(x) > 0$.

The producer is subject to enforcement at an exogenous rate that increases with the degree of evasion, $\mu m(x)$, where $\mu \in [0, 1]$, $m(x) \in [0, 1]$, $m'(x) > 0$, and $m''(x) > 0$. In the event of enforcement, the producer suffers a penalty, $F_M$, which may be a monetary penalty or the loss of future profit. The brand also suffers a penalty, $[1 - \alpha]F_B$, which may be a loss of reputation, cost of shifting production to another location, or monetary penalty. The factor, $\alpha \in [0, 1]$, characterizes the extent to which the brand can avoid legal liability and social responsibility for the producer’s evasion.

We analyze two scenarios: vertical integration and outsourcing. If the brand vertically integrates into manufacturing, it cannot avoid any liability or responsibility, $\alpha = 0$, and incurs the entire penalty on the brand for evasion, $F_B$, and also incurs the producer-level penalty, $F_M$. However, under vertical integration, the brand can directly control the degree of evasion, $x$.

By contrast, under outsourcing, the brand orders the quantity of production, $Q$, and sets a wholesale price, $w$, while the producer independently decides the degree of evasion, $x$. The brand cannot contract with the producer over the degree of evasion, because such contracts are either ethically repugnant or simply illegal (just imagine contracts over how much primary forest to burn or how many child workers to hire). Likewise, the producer cannot insure the brand against the penalty for evasion – besides such a contract being unethical or illegal, the producer might not have the financial resources. The brand can only indirectly influence the producer’s choice of evasion through the production quantity and wholesale price.\(^1\)

In the discussion below, we focus on interior solutions, $Q_{int}^* > 0$ and $x_{int}^* < 1$ and $Q_{out}^* > 0$

\(^1\)Broadly, our research builds on previous research into the choice between vertical integration and outsourcing when contracts are necessarily incomplete. Generally, outsourcing is costly because the principal cannot enter into a complete contract with the contractor, and so, the contractor under-invests in effort (Grossman and Hart 1986; Hart and Moore 1990). Our analysis is similar to that of public-private partnerships, where the government makes a discrete choice between two modes. In the unbundled mode, the party that builds some infrastructure cannot enter into a complete contract with the party that operates the facility, and so, giving rise to an externality. In the bundled mode, the externality is internalized but at some cost (Hart 2003; Iossa and Martinort 2012; Hoppe and Schmitz 2013). In our context, the brand and producer cannot enter into a complete contract, and so, the producer has excessive incentive to evade law and responsibility.
and $x_{\text{out}}^* < 1$. However, the proofs take account of possible boundary solutions, $x_{\text{int}}^* = 1$ or $x_{\text{out}}^* = 1$.

3 Vertical Integration

Under vertical integration, the brand chooses the degree of evasion, $x$, and quantity of production, $Q$, to maximize profit,

$$\Pi_{\text{int}} = p(Q)Q - [1 - x]C(Q) - \mu m(x)[F_B + F_M].$$ (1)

Clearly, the profit function reflects a complementarity between compliance, $1 - x$, and enforcement (both the rate of enforcement, $\mu$, and penalties on the brand and producer for evasion, $F_B$ and $F_M$). If the enforcement rate or penalties are higher, the marginal return to complying with law and regulations will be higher. Intuitively, the optimal degree of compliance (evasion) will increase (decrease) in the strength of enforcement. Further, an increase in evasion will lower the cost of production, thus $x$ and $Q$ are complements, and their decrease or increase should be mutually reinforcing. Formally,

**Proposition 1** Under vertical integration, the quantity of production, $Q_{\text{int}}^*$, and degree of evasion, $x_{\text{int}}^*$, decrease, while the price, $p_{\text{int}}^*$, increases in the enforcement rate, $\mu$, penalty on the brand for evasion, $F_B$, and the penalty on the producer for evasion, $F_M$.

Proof. We use the techniques of supermodularity (Vives 2000; Van Zandt 2002) to prove the result for $x$ and $Q$ with respect to $\mu$, while omitting the proofs with respect to $F_M$ and $F_B$, as they are similar. Let $\phi(\mu) = \arg\max_{x,Q}\{\Pi_{\text{int}}(x,Q,\mu) : x \in [0,1], Q \in R_+\}$ be the solution correspondence for the brand’s profit maximization. Partially differentiating (1) with respect to $x$,

$$\frac{\partial \Pi_{\text{int}}}{\partial x} = C(Q) - \mu m'(x)[F_B + F_M].$$ (2)

Further, partially differentiating (2) with respect to $Q$,

$$\frac{\partial^2 \Pi_{\text{int}}}{\partial x \partial Q} = C'(Q) > 0.$$
Accordingly, $\Pi_{int}$ has strictly increasing differences in $(x, Q)$.

With respect to the parameter, $\mu$, partially differentiating (2)

$$\frac{\partial^2 \Pi_{int}}{\partial x \partial \mu} = -m'(x)[F_B + F_M] < 0,$$

and so, $\Pi_{int}$ has strictly decreasing differences in $(x, \mu)$, Similarly, partially differentiating (1) with respect to $Q$,

$$\frac{\partial \Pi_{int}}{\partial Q} = p'(Q)Q + p(Q) - [1 - x]C'(Q),$$

and, partially differentiating with respect to $\mu$,

$$\frac{\partial^2 \Pi_{int}}{\partial Q \partial \mu} = 0,$$

and so, $\Pi_{int}$ has decreasing differences in $(Q, \mu)$.

Then, by Van Zandt (2002: Theorem 3), the maximal and minimal selections of $\phi(\mu)$ are decreasing functions. Equivalently, for $\mu' < \mu''$, the maximum solution, $\phi(\mu') \geq \phi(\mu'')$, and the minimum solution, $\phi(\mu') \geq \phi(\mu'')$. Hence, $x$ and $Q$ decrease in $\mu$. Since the price decreases in the production quantity, $p'(Q) < 0$, it follows immediately that $p$ increases in $\mu$. [Q.E.D.]

4 Outsourcing

Under outsourcing, the brand stipulates the quantity, $Q$, that it buys from the producer and the wholesale price, $w$, for each unit of production. Given the order quantity and wholesale price, the producer must first decide whether to engage in production and, if so, choose the degree of evasion, $x$, to maximize profit.

Consider the producer. Its profit is

$$\pi = wQ - [1 - x]C(Q) - \mu m(x)F_M,$$  \hspace{1cm} (3)
and it will engage in production if only if it earns non-negative profit,

$$\pi = wQ - [1 - x]C(Q) - \mu m(x)F_M \geq 0,$$

which is its participation condition.

Given non-negative profit, and conditional on $Q$, the producer chooses evasion, $x$. Differentiating (3), the first-order condition is

$$\frac{d\pi}{dx} = C(Q) - \mu \frac{dm}{dx}F_M = 0,$$

or

$$\frac{dm}{dx} = \frac{C(Q)}{\mu F_M}.$$  \hspace{1cm} (6)

Differentiating (5),

$$\frac{d^2\pi}{dx^2} = -\mu F_M m''(x) < 0,$$

so, the producer’s profit function is concave in $x$. Hence the producer’s profit-maximizing evasion is characterized by (6), which implicitly defines the equilibrium degree of evasion, $x(Q)$, as a function of the quantity of production.

Let the inverse function of $dm/dx$ be $\nu(\cdot)$, so, the first-order condition for evasion, (6), becomes

$$x = \nu\left(\frac{C(Q)}{\mu F_M}\right).$$

(7)

Now $\nu(\cdot)$ is the inverse of $dm/dx$, hence

$$m'\left(\nu\left(\frac{C(Q)}{\mu F_M}\right)\right) = \frac{C(Q)}{\mu F_M},$$

(8)

$$\nu'\left(\frac{C(Q)}{\mu F_M}\right) = \frac{1}{m''(x)} > 0,$$

(9)

since $m''(\cdot) > 0$, and

$$\nu''\left(\frac{C(Q)}{\mu F_M}\right) = -\frac{m'''(x)}{[m''(x)]^3}.$$  \hspace{1cm} (10)

Next, we analyze the brand’s choice of quantity and wholesale price given that the pro-
ducer independently chooses the degree of evasion. The brand’s profit is

$$\Pi_{out} = p(Q)Q - wQ - [1 - \alpha]\mu m(x)F_B.$$  

The brand maximizes $\Pi_{out}$ subject to the producer’s participation condition, (4), and choice of evasion, (6).

To maximize profit, the brand should set the wholesale price, $w$, such that the producer just breaks even, $\pi = 0$. Substituting in (4), this means

$$wQ = [1 - x]C(Q) + \mu m(x)F_M.$$  

Hence, the brand’s profit simplifies to

$$\Pi_{out} = p(Q)Q - [1 - x]C(Q) - \mu m(x)[1 - \alpha]F_B + F_M.$$  \hspace{1cm} (11)

Compared with the brand’s choice of production quantity under vertical integration, (1), there are two key differences. First, in the event of enforcement, the brand can avoid part of the penalty, and so, reducing its total cost. Second, the brand cannot directly choose the level of evasion, but rather, can only influence the producer’s choice of evasion through the quantity of production, $Q$. These two differences reflect the central trade-off in the outsourcing decision.

Next, we show that the producer will increase evasion with the production that the brand orders, $dx/dQ > 0$. Further, we show that increases in the degree, $\alpha$, to which the brand can avoid liability and responsibility by outsourcing will increase the equilibrium evasion and quantity of production.

**Proposition 2** Under outsourcing, the producer’s degree of evasion, $x(Q)$, increases in the quantity of production, $Q$. In equilibrium, both the quantity of production, $Q_{out}^*$, and evasion, $x_{out}^*$, increase, while the price, $p_{out}^*$, decreases in the brand’s avoidance of liability and responsibility by outsourcing, $\alpha$.

Proof. We first show that $x(Q)$ increases in the quantity of production, $Q$. Partially differ-
entiating (3) with respect to \(x\),
\[
\frac{\partial \pi}{\partial x} = C(Q) - \mu m'(x)F_M,
\]
and partially differentiating again with respect to \(Q\),
\[
\frac{\partial^2 \pi}{\partial x \partial Q} = C'(Q) > 0.
\]
Hence, the producer’s profit, \(\pi\), has strictly increasing differences in \((x,Q)\), and so, by supermodularity, \(x(Q)\) increases in \(Q\).

For the relationship between \((Q^*_{out}, x^*_{out})\) and the level of avoidance, \(\alpha\), we again show using supermodularity. Substituting from (7) in the brand’s profit function, (11),
\[
\Pi_{out} = p(Q)Q - \left[1 - \nu \left(\frac{C(Q)}{\mu F_M}\right)\right] C(Q) - \mu m \left(\nu \left(\frac{C(Q)}{\mu F_M}\right)\right) \left[1 - \alpha\right] F_B + F_M. \tag{12}
\]
Let \(\varphi(\alpha) = \operatorname{argmax}_Q \Pi_{out}(Q, \alpha : Q \in R_+)\). Partially differentiating (12) with respect to \(Q\),
\[
\frac{\partial \Pi_{out}}{\partial Q} = p'(Q)Q + p(Q) - \left[1 - \nu \left(\frac{C(Q)}{\mu F_M}\right)\right] C'(Q) + \nu \left(\frac{C(Q)}{\mu F_M}\right) C'(Q) C(Q) - \mu m' \left(\nu \left(\frac{C(Q)}{\mu F_M}\right)\right) \cdot \nu' \left(\frac{C(Q)}{\mu F_M}\right) \left[1 - \alpha\right] F_B + F_M. \tag{13}
\]
Partially differentiating again with respect to \(\alpha\),
\[
\frac{\partial^2 \Pi_{out}}{\partial Q \partial \alpha} = m' \left(\nu \left(\frac{C(Q)}{\mu F_M}\right)\right) \cdot \nu' \left(\frac{C(Q)}{\mu F_M}\right) \frac{F_B}{F_M} C'(Q) > 0,
\]
after substituting from (8) and (9). This proves that \(\Pi_{out}\) has strictly increasing differences in \((Q, \alpha)\).

Thus, for \(\alpha_1 < \alpha_2\) and for \(Q_1 \in \varphi(\alpha_1)\) and \(Q_2 \in \varphi(\alpha_2)\), we have \(Q_1 < Q_2\). Since the price decreases in the production quantity, it follows immediately that the corresponding prices, \(p_1 > p_2\). Further, by (7) and (9), the producer’s choice of evasion are
\[
x_1 = \nu \left(\frac{C(Q_1)}{\mu F_M}\right) < \nu \left(\frac{C(Q_2)}{\mu F_M}\right) = x_2.
\]

[Q.E.D.]
Proposition 2 highlights an essential economy of scale in the producer’s choice of evasion, \( x \). Referring to (3), the expected penalty is a fixed cost that does not vary with quantity. But, the return to evasion increases with the quantity of production, \( Q \). Hence, the larger is the production quantity, the more the producer chooses to evade laws and regulations and social responsibility.

Proposition 2 also shows that, under outsourcing, evasion and production are essentially complementary with the degree, \( \alpha \), to which outsourcing enables the brand to avoid liability and responsibility. Referring to (11), the higher is the degree to which the brand can avoid liability and responsibility, the greater is the marginal return from evasion. However, the brand can only indirectly influence evasion through the quantity of production, so, it raises \( Q \) to induce the producer to increase evasion, \( x \). Thus, in equilibrium, \( x \) and \( Q \) increase with \( \alpha \).

By contrast, the effect of enforcement, \( \mu \) and \( F_M \), on the equilibrium is ambiguous. Consider an increase in the rate of enforcement, \( \mu \). The effect of the increased enforcement on the brand’s choice of production, \( Q \), depends on three factors. One is whether the increased enforcement affects the expected penalty on the brand or producer relatively more. Referring to (13), another factor is the sensitivity of the producer’s choice of evasion to the increased enforcement, i.e., the shape of \( m(\cdot) \). The third factor is the cost of production, \( C(Q) \). The higher is the cost of production, the more the producer gains by evasion, and hence, the less the producer will adjust evasion in response to the increased enforcement. (The analysis of the effect of an increase in the penalty, \( F_M \), is similar.) Formally, we have

**Remark** In equilibrium, the quantity of production, \( Q_{\text{out}}^* \), and evasion, \( x_{\text{out}}^* \), decrease in the rate of enforcement, \( \mu \), if and only if

\[
C(Q) \frac{m'''(x)}{[m''(x)]^2} > \mu F_M \left[ 1 - \frac{F_M}{1 - \alpha / F_B} \right].
\]

(14)

Please refer to the Appendix for the proof of the Remark.
5 Integration vis-a-vis Outsourcing

We are interested in how differences in institutions, as characterized by the degree, $\alpha$, to which the brand can avoid liability and responsibility by outsourcing, affect the brand’s decision on vertical integration. Accordingly, we need to compare the effect of $\alpha$ on the brand’s profit maxima under vertical integration vis-a-vis outsourcing.

Under vertical integration, the brand faces an unconstrained choice of evasion, $x$, and production quantity, $Q$. By contrast, under outsourcing, the brand faces a constrained choice of production quantity, $Q$, subject to the producer’s choice of evasion, $x(Q)$, as characterized by (6).

Next, we show that the brand’s actual choice between vertical integration and outsourcing is monotone in the extent of avoidance, $\alpha$. Outsourcing enables the brand to shift part of the responsibility and liability to the producer, which suffers a smaller expected penalty from enforcement than the brand. However, under outsourcing, the producer chooses the degree of evasion. The brand cannot directly control the degree of evasion, and can only indirectly influence it through the quantity of production. Overall, if the brand can sufficiently avoid liability and responsibility, then the reduction in expected penalty outweighs the loss of control over the evasion, and the brand prefers outsourcing.

**Proposition 3** There exists some extent of avoidance, $\bar{\alpha}$, such that the brand prefers outsourcing if and only if $\alpha > \bar{\alpha}$.

Please refer to the Appendix for the proof of Proposition 3.

Referring to Figure 1, the essence of Proposition 3 is that the brand’s profit increases with $\alpha$ under outsourcing (the higher is $\alpha$, the more the brand can avoid liability and responsibility through outsourcing), but does not vary with $\alpha$ under vertical integration. Further with $\alpha = 0$, the brand obviously prefers vertical integration, while with $\alpha = 1$, it prefers outsourcing. Hence, there exists some intermediate $\bar{\alpha}$ at which the brand is indifferent between outsourcing and integration.

We have shown that the brand’s choice between vertical integration and outsourcing is monotone in the extent, $\alpha$, to which the brand can avoid liability and responsibility by
Figure 1: Brand profit: Outsourcing vis-a-vis vertical integration
outsourcing. If the brand can avoid liability and responsibility by at least \( \tilde{\alpha} \), then it will choose outsourcing. This result provides a perspective in terms of legal liability and social responsibility that complements theories of outsourcing based on costs of contracting and monitoring (Grossman and Hart 1986; Hart and Moore 1990). Although cast in the context of international outsourcing, our findings apply equally to outsourcing within national jurisdictions. The only essential ingredient is that the brand can avoid some liability and responsibility by outsourcing.

Proposition 2 above shows that, under outsourcing, both the production quantity and evasion increase in the extent, \( \alpha \), to which the brand can avoid liability and responsibility by outsourcing. By contrast, under vertical integration, the production quantity and evasion obviously do not vary with \( \alpha \).

Can we then conclude that the production quantity and evasion are monotone in \( \alpha \)? The answer is no, the reason being that the effect of changes in \( \alpha \) on the production quantity and evasion depends on both the effect of \( \alpha \) on the brand’s choice between modes of production (vertical integration vis-a-vis outsourcing) as well as the effect of \( \alpha \) on production quantity and evasion within the mode of production (vertical integration or outsourcing). Lemma 1, proved in the Appendix, formalizes this analysis.

**Lemma 1** Assuming that the brand’s profit under outsourcing, \( \Pi_{out} \), is single-peaked in quantity, \( Q_{out} \),

1. There exists \( \alpha_x \) such that \( x^*_{out} \leq x^*_{int} \) if and only if \( \alpha \leq \alpha_x \),

2. If the penalty on the brand, \( F_B \), is sufficiently large or the rate of enforcement satisfies \( m''(\cdot) \leq 0 \), there exists \( \alpha_Q \) such that \( Q^*_{out} \leq Q^*_{int} \) if and only if \( \alpha \leq \alpha_Q \),

3. \( \alpha_x \leq \alpha_Q \).

Figure 2 illustrates three critical levels of avoidance: \( \tilde{\alpha} \), above which the brand chooses outsourcing over vertical integration; \( \alpha_x \), above which the degree of evasion is higher under outsourcing, and \( \alpha_Q \), above which the quantity of production is higher under outsourcing.

\(^2\)Single-peakness is a weaker condition than concavity.
Figure 2: Evasion and production quantity: Outsourcing vis-a-vis vertical integration
To show intuitively that $\alpha_x < \alpha_Q$, suppose that $\alpha = \alpha_Q$, and so, the quantity of production is the same under outsourcing and vertical integration. Now, under outsourcing, the producer chooses evasion without considering the expected penalty on the brand. Hence the producer will choose a higher level of evasion than the vertically-integrated brand, $x_{\text{out}}^* > x_{\text{int}}^*$, which means that $\alpha > \alpha_x$. Thus, we have $\alpha_x < \alpha_Q$.

Lemma 1 establishes sufficient conditions for $\alpha_Q > 0$, so that there exists a range of avoidance such that the production quantity is higher under vertical integration and another range such that the production quantity is higher under outsourcing. (We discuss the sufficient conditions below, following Proposition 5.) However, it is possible that $\alpha_x = 0$, which means that evasion is always higher under outsourcing than vertical integration. Essentially, if the expected penalty on the producer is sufficiently high, both evasion under vertical integration and outsourcing will be very low, and indeed, so low that evasion under outsourcing cannot be less than under vertical integration.

With Lemma 1, we can analyze how changes in the extent of avoidance affect the production quantity and evasion. Referring to Figure 2, three cases are possible, depending on the relation among $\tilde{\alpha}$, $\alpha_x$, and $\alpha_Q$.

**Proposition 4** Depending on the relative magnitudes of avoidance at which the brand is indifferent between vertical integration and outsourcing, $\tilde{\alpha}$, production under vertical integration and outsourcing is the same, $\alpha_Q$, and evasion under vertical integration and outsourcing is the same, $\alpha_x$, we have

(i) $\tilde{\alpha} > \alpha_Q$: A slight reduction in $\alpha$ around $\tilde{\alpha}$ discretely reduces both the quantity of production and degree of evasion.

(ii) $\alpha_x < \tilde{\alpha} \leq \alpha_Q$: A slight reduction in $\alpha$ around $\tilde{\alpha}$ leads to no change or a discrete increase in the quantity of production, and a discrete reduction in the degree of evasion.

(iii) $\tilde{\alpha} < \alpha_x$ and $\alpha_x > 0$: A slight reduction in $\alpha$ around $\tilde{\alpha}$ discretely raises both the quantity of production and degree of evasion.

Referring to Figure 2, consider a reduction in $\alpha$ from above to below $\tilde{\alpha}$ in case (iii). For $\alpha > \tilde{\alpha}$, the brand chooses outsourcing, so, both the production quantity and evasion
decrease in $\alpha$. As $\alpha$ crosses from above to below $\tilde{\alpha}$, the brand switches from outsourcing to vertical integration, and hence, both the production quantity and evasion increase discretely. Evidently, neither the production quantity nor evasion are monotone in $\alpha$.

Moreover, in this case, a reduction in $\alpha$ results in more evasion, which seems quite counter-intuitive. The reason is the effect of $\alpha$ on the brand’s choice between modes of production (outsourcing vis-a-vis vertical integration).

6 Welfare

Taking a utilitarian approach, social welfare is consumer benefit less the cost of production and less the harm caused by evasion,

$$W(Q, x) = B(Q) - [1 - x]C(Q) - H(x).$$ (15)

The first-best welfare optimum is characterized by the first-order conditions,

$$\frac{dW}{dQ} = B'(Q) - [1 - x]C'(Q) = 0,$$

and

$$\frac{dW}{dx} = C(Q) - H'(x) = 0.$$ (16)

Note that the first-best does not necessarily imply zero evasion. Suppose, for instance, that $x = 0$. Then, by (16),

$$\frac{dW}{dx} \bigg|_{x=0} = C(Q) - H'(0) > 0,$$

for sufficiently low $H'(0)$.

In our context, the obvious policy issue is how welfare changes with adjustment to the degree, $\alpha$, to which the brand can avoid liability and responsibility through outsourcing. Generally, it is challenging to characterize the second-best welfare optimum because of a fundamental non-convexity. Even if, under outsourcing, welfare is well-behaved in the sense
that there is some optimal $\alpha$ that maximizes welfare, there remains the challenge of comparing the welfare under outsourcing vis-a-vis vertical integration. A switch from outsourcing to vertical integration would discretely affect production and evasion, and hence, any change in $\alpha$ around $\tilde{\alpha}$ would induce a discrete change in welfare. Hence, maximization of welfare is an inherently non-convex issue.

Accordingly, we focus here on the source of the non-convexity. Under particular conditions, we can show that vertical integration provides a discrete improvement in welfare. Generally, a switch from outsourcing to vertical integration will affect production and evasion. The change in production would affect the benefit to consumers and the cost of production, while the change in evasion would affect the cost of production and social harm. By Lemma 2, the increase in benefit outweighs the increase in production cost due to increased output, while, by Lemma 3, the reduction in social harm outweighs the increase in production cost due to reduced evasion.

**Lemma 2** Under outsourcing, in equilibrium, an increase in production, $Q$, raises consumer benefit by more than it raises the cost of production.

Proof. Generally, an increase in production, $\Delta Q > 0$, will change consumer benefit by $B'(Q)\Delta Q$, and, by (3), change the cost of production by $[1 - x]C'(Q)\Delta Q$. Now, under outsourcing, the brand chooses $Q$ to maximize profit, (11). This implies the first-order condition,

$$\frac{d\Pi_{out}}{dQ} = p'(Q)Q + p(Q) - [1 - x]C'(Q) + C(Q)\frac{dx}{dQ} - \mu \left[1 - \alpha \right] F_B + F_M \frac{dm}{dx} \frac{dx}{dQ} = 0.$$

Under outsourcing, by (6), the outsource producer chooses evasion, $x$, according to $m'(x) = C(Q)/\mu F_M$, and so, $C(Q) = \mu m'(x) F_M$. Hence, the above simplifies to

$$p(Q) - [1 - x]C'(Q) = -p'(Q)Q - \mu \left[1 - \alpha \right] F_B + F_M \frac{dm}{dx} \frac{dx}{dQ} = 0.$$

Since $p(Q) = B'(Q)$, $p'(Q) = B''(Q) < 0$, $dm/dx > 0$, and, by Proposition 2, $dx/dQ > 0$, the above implies that $B'(Q) - [1 - x]C'(Q) > 0$. Hence, $B'(Q)\Delta Q > [1 - x]C'(Q)\Delta Q > 0$. 

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Lemma 3 Suppose that

$$\mu F_M < \frac{H'(x)}{m'(x)}. \quad (17)$$

Then, under outsourcing, in equilibrium, a reduction in evasion, $x$, reduces social harm by more than it raises the cost of production.

Proof. Generally, a reduction in evasion, $\Delta x < 0$, will change social harm by $H'(x)\Delta x$, and, by (3), change the cost of production by $C(Q)\Delta x$. Under outsourcing, by (6), the outsource producer chooses evasion, $x$, according to $m'(x) = C(Q)/\mu F_M$, and so, $\mu m'(x)F_M = C(Q)$. Now, by (17), $H'(x) > \mu m'(x)F_M$, and so, $H'(x) > C(Q)$ and $H'(x)\Delta x < C(Q)\Delta x < 0$.

Applying Lemmas 2 and 3, we can analyze how a reduction in the extent of avoidance around $\tilde{\alpha}$, which leads the brand to switch from outsourcing to vertical integration, will affect welfare. Referring to Proposition 4 and Figure 2, in the three cases:

(i) $\tilde{\alpha} > \alpha_Q$: A slight reduction in $\alpha$ around $\tilde{\alpha}$ leads to discrete reductions in both the quantity of production and degree of evasion. The reduction in production would reduce the net consumption benefit to society, while the reduction in evasion would reduce social harm and raise the cost of production, and so, the net effect on welfare might be ambiguous. For $\tilde{\alpha}$ sufficiently close to $\alpha_Q$, the reduction in harm outweighs the reduction in net consumption benefit and increase in production cost.

(ii) $\alpha_x < \tilde{\alpha} \leq \alpha_Q$: A slight reduction in $\alpha$ around $\tilde{\alpha}$ would lead to no change or a discrete increase in the quantity of production, and a discrete drop in the degree of evasion. The increase in production would raise the net consumption benefit to society, while the drop in evasion would reduce social harm and raise the cost of production. Lemma 3 above shows that the reduction in social harm outweighs the increase in the cost of production. Hence, the reduction in the extent of avoidance yields a discrete increase in welfare.
(iii) $\tilde{\alpha} < \alpha_x$ and $\alpha_x > 0$: A slight reduction in $\alpha$ around $\tilde{\alpha}$ would lead to discrete increases in both the quantity of production and degree of evasion. The increase in production would raise the net consumption benefit to society, while the increase in evasion would raise social harm. Hence, the net effect on welfare is ambiguous.

Proposition 5 focuses on case (ii), in which a reduction in the extent of avoidance yields a discrete increase in welfare.$^3$

**Proposition 5** Suppose that the marginal expected penalty on the producer is sufficiently low that

$$\mu F_M m'(x) < H'(x), \quad (17')$$

and the penalty on the brand is sufficiently large. Then, a reduction in $\alpha$ from above to below $\tilde{\alpha}$ will discretely raise welfare by increasing the quantity of production while reducing evasion.

The welfare result follows from two properties of the equilibria between the brand and producer. The first is that, under outsourcing, the producer chooses evasion so that its marginal expected penalty, $\mu m'(x)F_M$, just balances the total cost of production without evasion, $C(Q)$. This links the cost of production to the expected penalty and through the assumption (17) to the marginal harm. A sufficient condition for (17) is that the rate of the expected penalty on the producer, $\mu F_M$, be low enough.

The second basis of the welfare proposition is that, if the quantity of production is the same under vertical integration and outsourcing, then evasion is higher under outsourcing. Essentially, the reason is that, under outsourcing, the producer chooses evasion according to the expected penalty, $\mu m(x)F_M$, while under vertical integration, the brand chooses evasion according to the expected penalty, $\mu m(x)(F_B + F_M)$, which is larger. So, the outsource producer tends to evade excessively.

Given the above, referring to (15), a reduction in $\alpha$ from above to below $\tilde{\alpha}$ would change welfare by

$$\Delta W(Q, x) = B'(Q)\Delta Q - [1 - x]C'(Q)\Delta Q + C(Q)\Delta x - H'(x)\Delta x,$$

$^3$Please refer to the Appendix for the proof of Proposition 5.
with $\Delta Q > 0$ and $\Delta x < 0$. By Lemma 2, since $\Delta Q > 0$, the first two terms on the right-hand side of (18), \( \{B'(Q) - [1 - x]C'(Q)\} \Delta Q > 0 \). By Lemma 3, since $\Delta x < 0$, the second two terms on the right-hand side of (18), \( \{C(Q) - H'(x)\} \Delta x > 0 \).

To characterize the second-best welfare maximum, we need to compare the maximum welfare under outsourcing with the welfare under vertical integration. Under outsourcing, the equilibrium production and evasion vary with $\alpha$. Under vertical integration, the equilibrium production and evasion are constant. Hence, identifying the welfare maximum involves two steps: finding the maximum under outsourcing, and then comparing it with vertical integration.

We should emphasize that Proposition 5 shows that, under particular conditions, vertical integration raises welfare. This does not mean that vertical integration maximizes welfare. There may be some $\alpha > \bar{\alpha}$ that, with outsourcing, yields an even higher level of welfare.

What vertical integration does achieve is to ensure that the brand “fully internalizes” the penalties for evasion. Of course, if the expected penalties on brand and producer are set equal to the social harm, \( \mu m(x)[F_B + F_M] = H(x) \), then vertical integration will ensure maximization of social welfare. Here, we assume that, for reasons such as differences in jurisdiction, whether within a country or across countries, the expected penalties differ from the social harm.

7 Extensions

With a fairly simple model, we have shown that the brand’s preference for outsourcing increases in the extent that it can avoid liability and responsibility by outsourcing, that under outsourcing, the brand reduces the production quantity to induce less evasion, and that vertical integration can yield a discrete increase in welfare. Here, we investigate whether these results are robust to

- Stronger brands – those with larger sales – being held to higher responsibility,
- Penalties for evasion on stronger brands being larger, and
Product demand decreasing in the degree of evasion.

Avoidance and size. The degree, \( \alpha \), to which a brand can avoid liability and responsibility through outsourcing depends on law, regulation, and norms of corporate social responsibility. What if stronger brands – those with larger sales – are held to higher responsibility? Larger companies have a higher profile and attract more media attention. They are more concerned to protect their reputation with shareholders, the general public, and government. In terms of our model, this means that \( \alpha \) is endogenous and decreases with production quantity, \( Q \).

Under vertical integration, the profit of the brand would be (1), and Proposition 1 applies. Under outsourcing, let the expected penalty on the brand for evasion be \( \mu m(x) \left[ [1 - \frac{\alpha}{Q}] F_B + F_M \right] \). Then, the profit of the producer would be (3) while the profit of the brand, after substituting for the wholesale price, would be

\[
\Pi_{out} = p(Q)Q - [1 - x]C(Q) - \mu m(x) \left[ [1 - \frac{\alpha}{Q}] F_B + F_M \right].
\]

Partially differentiating (3),

\[
\frac{\partial^2 \pi}{\partial x \partial Q} = C'(Q),
\]

so, the profit of the producer has increasing differences in \((x, Q)\). Hence, under outsourcing, the brand reduces the production quantity to induce less evasion.

When the extent to which the brand can avoid liability and responsibility increases in the production quantity, there still exists a cutoff, \( \tilde{\alpha} \), such that the brand is indifferent between vertical integration and outsourcing. The proof is essentially the same as in the basic setting where the extent of avoidance is independent of the production quantity, and so, for brevity, we do not present the proof here.

The key to our welfare result is that, if the production quantity is the same under vertical integration as outsourcing, then the evasion is lower under vertical integration than outsourcing. To check, consider the first-order conditions. Under outsourcing, the producer would choose evasion according to (6):

\[
\frac{dm}{dx} = \frac{C(Q)}{\mu F_M}.
\]
while, under vertical integration, the brand would choose evasion according to (2), which simplifies to

\[
\frac{dm}{dx} = \frac{C(Q)}{\mu[F_B + F_M]}.
\]

Since \(m''(\cdot) > 0\), the evasion under outsourcing would exceed that under vertical integration.

To summarize, all three major results are robust to allowing the degree, \(\alpha\), to which a brand can avoid liability and responsibility through outsourcing to decrease with production quantity.

Penalty and size. Related to the above discussion, what if brands with larger sales are subject to higher penalties for evasion? For instance, South Korean law specifies penalties as a percentage of sales for violations of car safety (Korea Times 2014). To consider this possibility, we interpret the penalties, \(F_M\) and \(F_B\) as per-unit rates of penalties.

Then, under vertical integration, the profit of the brand would be

\[
\Pi_{int} = p(Q)Q - [1 - x]C(Q) - \mu m(x)[F_B + F_M]Q.
\]

(19)

Partially differentiating,

\[
\frac{\partial^2 \Pi_{int}}{\partial x \partial Q} = C'(Q) - \mu m'(x)[F_B + F_M].
\]

Hence, the profit of the brand has increasing differences in \((x, Q)\), and evasion would increase in the production quantity if and only if

\[
C'(Q) > \mu m'(x)[F_B + F_M].
\]

Under outsourcing, the profit of the producer would be

\[
\pi = wQ - [1 - x]C(Q) - \mu m(x)F_M Q,
\]

(20)

while the profit of the brand, after substituting for the wholesale price, would be

\[
\Pi_{out} = p(Q)Q - [1 - x]C(Q) - \mu m(x)[1 - \alpha]F_B + F_M]Q.
\]
Partially differentiating (20),
\[
\frac{\partial^2 \pi}{\partial x \partial Q} = C'(Q) - \mu m'(x) F_M,
\]
and, so, the producer’s profit has increasing differences in \((x,Q)\), and, under outsourcing, the brand reduces the production quantity to induce less evasion if and only if
\[
C'(Q) > \mu m'(x) F_M.
\]

When the penalty increases with production quantity, there still exists a cutoff \(\tilde{\alpha}\), such that the brand is indifferent between vertical integration and outsourcing. We do not present the proof here, as it is essentially the same as in the basic setting.

To check the welfare result, consider the first-order conditions. Under outsourcing, by (20), the producer would choose evasion according to
\[
\frac{dm}{dx} = \frac{C(Q)}{\mu Q F_M}.
\]
Under vertical integration, by (19), the brand would choose evasion according to
\[
\frac{dm}{dx} = \frac{C(Q)}{\mu Q [F_B + F_M]}.
\]
Since \(m'' > 0\), if the production quantity \(Q\) is the same under vertical integration as outsourcing, then the evasion under outsourcing would exceed that under vertical integration.

To summarize, the three main results are robust to allowing the penalties, \(F_B, F_M\), to increase with the production quantity.

Consumer sensitivity to evasion. So far, we assumed that the evasion of law and responsibility in manufacturing reduces the cost of manufacturing but has no effect on demand for the final product. But consumers may care about the method of production – whether the item was manufactured using child labor or under unsafe or unsustainable conditions. Consumers may value ethical sourcing (Hainmueller et al. 2014; Dragusanu et al. 2014).
The effect on our analysis depends on whether consumers can readily observe the producer’s evasion. If they can readily observe evasion, then we model the demand as \( Q[1 - x] \). If consumers are like the government and cannot readily observe evasion, then their impact fits into our basic model above with the consumers contributing to the ex-post penalties, \( F_B \) and \( F_M \).

Suppose that consumers can readily observe evasion. Then, under vertical integration, the brand’s profit becomes

\[
\Pi_{int} = p(Q)Q[1 - x] - [1 - x]C(Q) - \mu m(x)[F_B + F_M].
\]

(21)

Partially differentiating,

\[
\frac{\partial^2 \Pi_{int}}{\partial x \partial Q} = C'(Q) - p'(Q)Q - p(Q).
\]

Hence, the profit of the brand has increasing differences in \((x, Q)\), and evasion would increase in the production quantity if and only if

\[
C'(Q) - p'(Q)Q - p(Q) > 0.
\]

which suggests that without any evasion \((x = 0)\), the marginal cost less the marginal revenue must be positive. In other words, the brand will shut down with zero evasion.

Under outsourcing, the profit of the producer would be

\[
\pi = wQ[1 - x] - [1 - x]C(Q) - \mu m(x)F_M,
\]

(22)

while the profit of the brand, after substituting for the wholesale price, would be

\[
\Pi_{out} = p(Q)Q[1 - x] - [1 - x]C(Q) - \mu m(x)[1 - \alpha][F_B + F_M].
\]

Partially differentiating (22),

\[
\frac{\partial^2 \pi}{\partial x \partial Q} = -w + C'(Q),
\]
and hence, the profit of the producer has increasing differences in \((x, Q)\), and the brand reduces the production quantity to induce less evasion if and only if

\[ C'(Q) > w. \]

which means that without any evasion \((x = 0)\), the producer’s marginal cost of production exceeds the wholesale prices offered by the brand, i.e., the producer should not accept the order. Taken together, a sufficient condition to have the brand reduce the production quantity to induce less evasion is that, without evasion, neither the brand nor the producer will find it profitable to produce.

The existence of \(\bar{\alpha}\), and thus Proposition 3 holds when demand decreases with evasion. The proofs are the same as in the the basic setting and hence we omit them here.

To check the welfare result, consider the first-order conditions. Under vertical integration, by (21), the brand would choose evasion according to

\[
\frac{dm}{dx} = \frac{C(Q) - p(Q)Q}{\mu Q[F_B + F_M]}.
\]

Under outsourcing, by (22), the producer would choose evasion according to

\[
\frac{dm}{dx} = \frac{C(Q) - wQ}{\mu Q F_M} > \frac{C'(Q) - p(Q)Q}{\mu Q[F_B + F_M]},
\]

as \(w \leq p(Q)\). Since \(m''(\cdot) > 0\), if the production quantity \(Q\) is the same under vertical integration as outsourcing, the evasion under outsourcing would exceed that under vertical integration.

To summarize, two major results—that the brand’s preference for outsourcing increases in the extent that it can avoid liability and responsibility by outsourcing, and that vertical integration can yield a discrete improvement in welfare—are robust to allowing evasion of law and responsibility to reduce demand. The result that under outsourcing, the brand reduces the production quantity to induce less evasion holds under specific conditions: the cost of production must be sufficiently high that positive evasion is necessary to remain profitable. The conditions reflect the additional effect of evasion on the brand’s revenue. In the basic setting, the expected penalty is a fixed cost that does not vary with quantity, while the
reduction in the cost of production due to evasion increases with the quantity of production. However, if the return to evasion is partly eroded by the decrease in demand, there is an economy of scale in the producer’s choice of evasion, $x$, only if the return from the decreasing cost of production is sufficiently high.

8 Concluding Remarks

Our analysis provides insight into the effects of laws on environmental sustainability, intellectual property, and against bribery. In 2008, the United States amended the Lacey Act to prohibit the trade, transport, or acquisition of illegally harvested plants. The amended Lacey Act aims to safeguard endangered forests from illegal harvesting. In the wake of the amended law, U.S. guitar manufacturer, Taylor Guitars, acquired an ebony mill in Cameroon, Africa. By vertically integrating upstream, Taylor Guitars ensures that its wood complies with the law. By contrast, Gibson Guitars has been subject to multiple federal raids on suspicion of violating the Lacey Act (Lariviere 2012).

However, if a law is limited to national jurisdiction, the law might inadvertently encourage outsourcing to foreign jurisdictions. For instance, by offshoring, a manufacturer may be able to circumvent patent protection of manufacturing processes, and so, reduce the cost of production. In the late nineteenth century, Swiss chemical manufacturers famously copied German processes to produce dyestuffs that undercut German products (Murmann 2003: 184-185). To close a similar loophole, in 1988, the United States enacted the Process Patent Amendments Act. This law prohibits the import of products that infringe U.S. process patents.

The U.S. Foreign Corrupt Practices Act of 1977 and the U.K. Bribery Act of 2010 prohibit bribery of foreign government officials. But these laws necessarily apply only to businesses within their jurisdiction. One possible outcome is that the laws will tilt businesses toward outsourcing. Payments to foreign officials might reduce production costs by expediting customs clearance and regulatory inspections. So, by outsourcing production (and the concomitant bribery), a multinational business can still achieve lower production costs while avoiding criminal liability.
Our results (Proposition 2) that evasion increases with the scale of production and that, under outsourcing, the brand depresses production to induce less evasion do not strictly require that the expected penalty be fixed. It is sufficient that the expected penalty increase with the scale of production more slowly than the cost of production. This condition is consistent with most legal penalties being stipulated on an absolute basis rather than as a function of scale of production.\(^4\)

Under outsourcing, we model the brand as choosing the quantity of production and influencing the producer’s choice of evasion through the quantity. The same model applies to the brand choosing speed of production or product quality. In the Deepwater Horizon case and outsourcing of electronics manufacturing, the brand stipulates the speed of production. BP was behind schedule on the Macondo well and in a hurry to complete the drilling job (Deepwater Horizon 2014: paragraph 72). Electronics manufacturing contractors use student workers to cope with surges in demand (New York Times 2013). In the market for guitars, consumers prefer instruments made of finer looking wood. Accordingly, guitar manufacturers stipulate the quality of wood to upstream suppliers. In terms of our model, by increasing evasion, the contractor can raise the speed of production or product quality at lower cost. However, the increased evasion will increase the expected penalty for the brand. So, under outsourcing, the brand will depress speed/quality to induce less evasion.

We view our work as the first step in an agenda of research into the trade-off between vertical organization and legal liability and social responsibility. One direction for future research is to account for consumer preferences over producer’s evasion. Above, we extended the basic model to allow consumer demand to decrease with evasion, which is consistent with empirical evidence that consumers are willing to pay for ethical production (Hainmueller et al. 2014; Dragusanu et al. 2014). Future research could investigate the impact of asymmetric information between consumers and the brand over sourcing. By upstream vertical integration, the brand not only ensures better control over the supply chain but also provides a credible signal to consumers of its commitment to organic production, green practices, and fair trade.\(^5\)

\(^4\)Outside the context of competition law, one of the few instances of legal penalties graduated by offender’s sales that we could find is a South Korean law which stipulates a fine equal to 1/1,000 of sales on car manufacturers for safety violations (Korea Times 2014).

\(^5\)A considerable literature in international economics and the economics of the environment focuses on the race to the bottom. Legal jurisdictions – whether states within a federal system like the United States or countries – compete for investors through lower tax and labor and environmental standards (Kahn 2003;
To the extent that consumers care about how things are produced and not just the finished product, this presents another dimension of competition between brands. Besides the well-known dimensions of price and product quality, future research could study competition among brands on the “quality of production”.

Our analysis has focused on how the upstream choice between vertical integration and outsourcing depends on the apportionment of legal liability and social responsibility. A similar issue arises in the downstream direction. In July 2014, the General Counsel of the U.S. National Labor Relations Board ruled that McDonald’s, as franchisor, is “jointly liable” for the employment practices of its franchisees. Labor activists hailed this decision, which breaks new ground in employment law, while industry decried it as “ripping apart a proven and time-tested business model”. Commentators disagree on whether franchisors would take a bigger role in managing their franchisees or step back even further to avoid joint liability (New York Times 2014). Clearly, these are issues worth researching.

Chau and Kanbur 2006; Mosley and Uno 2007). By choosing among these states or countries, the brand can effectively commit to minimum levels of compliance.
References


Cases


In re: Oil Spill by the Oil Rig “Deepwater Horizon” in the Gulf of Mexico, on April 20, 2010: Findings of Fact and Conclusions of Law: Phase One Trial, U.S. District Court for the Eastern District of Louisiana, September 9, 2014.
Appendix

Proof of Remark. Partially differentiating (13) with respect to $\mu$,

$$
\frac{\partial^2 \Pi_{\text{out}}}{\partial Q \partial \mu} = -\nu'(\frac{C(Q)}{\mu F_M}) \left[ \frac{C(Q)}{\mu^2 F_M} \right] C'(Q)
$$

$$
-\nu''(\frac{C(Q)}{\mu F_M}) \left[ \frac{C'(Q)C(Q)}{\mu^2 F_M} \right] - \nu'(\frac{C(Q)}{\mu F_M}) \frac{C''(Q)C(Q)}{\mu^2 F_M}
$$

$$
- m'(\frac{C(Q)}{\mu F_M}) \nu'(\frac{C(Q)}{\mu F_M}) \frac{C'(Q)[1 - \alpha F_B + F_M]}{\mu F_M}
$$

$$
+ m''(\frac{C(Q)}{\mu F_M}) \nu'(\frac{C(Q)}{\mu F_M}) \frac{C'(Q)[1 - \alpha F_B + F_M]}{\mu^2 F_M}
$$

$$
+ m'(\frac{C(Q)}{\mu F_M}) \nu'(\frac{C(Q)}{\mu F_M}) C'(Q)[1 - \alpha F_B + F_M]
$$

Substituting from (8), (9), and (10), the above simplifies to

$$
\frac{\partial^2 \Pi_{\text{out}}}{\partial Q \partial \mu} = -\frac{C(Q)C'(Q)}{\mu^2 F_M} \left[ \frac{[1 - \alpha F_B \cdot C(Q)m''(x) + \mu F_M \cdot [m''(x)]^2 F_M - [1 - \alpha F_B]}{\mu^2 F_M [m''(x)]^3} \right].
$$

Now,

$$\frac{C(Q)C'(Q)}{\mu^2 F_M} > 0,$$

and $\mu F_M^2 [m''(x)]^3 > 0$, since, by assumption, $m''(\cdot) > 0$. Hence, $\partial^2 \Pi_{\text{out}}/\partial Q \partial \mu < 0$, i.e., $\Pi_{\text{out}}$ has decreasing differences in $(Q, \mu)$ if and only if

$$[1 - \alpha F_B \cdot C(Q)m''(x) + \mu F_M \cdot [m''(x)]^2 F_M - [1 - \alpha F_B] > 0,$$

which simplifies to (14).

Proof of Proposition 3. Referring to Figure 1, the proof comprises four steps: (i) The brand’s profit under vertical integration, $\Pi_{\text{int}}(Q_{\text{int}}^*, x_{\text{int}}^*)$, does not vary with $\alpha$; (ii) The brand’s profit under outsourcing, $\Pi_{\text{out}}(Q_{\text{out}}^*, x_{\text{out}}^*)$, increases in $\alpha$; (iii) If $\alpha = 0$, the brand earns less with outsourcing, and (iv) If $\alpha = 1$, the brand earns more with outsourcing. Then,
by continuity, there exists some $\tilde{\alpha}$ such that

$$\Pi_{out}(Q^*_\text{out}, x^*_\text{out} | \tilde{\alpha}) = \Pi_{int}(Q^*_\text{int}, x^*_\text{int} | \tilde{\alpha}),$$

and such that $\Pi_{out}(Q^*_\text{out}, x^*_\text{out} | \alpha) \geq \Pi_{int}(Q^*_\text{int}, x^*_\text{int} | \alpha)$ if and only if $\alpha > \tilde{\alpha}$.

(i) This result is obvious from (1).

(ii) Next, we prove that $\Pi_{out}(Q^*_\text{out}, x^*_\text{out})$ is increasing in $\alpha$. For any $\alpha_i$, let $(Q^*_i, x(Q^*_i))$ maximize $\Pi_{out}(Q, x(Q) | \alpha_i)$. Suppose otherwise, that $\alpha_1 < \alpha_2$, and

$$\Pi_{out}(Q^*_1, x(Q^*_1) | \alpha_1) \geq \Pi_{out}(Q^*_2, x(Q^*_2) | \alpha_2). \tag{A2}$$

By construction, $(Q^*_2, x(Q^*_2))$ maximizes $\Pi_{out}(Q, x(Q) | \alpha_2)$, hence

$$\Pi_{out}(Q^*_2, x(Q^*_2) | \alpha_2) \geq \Pi_{out}(Q^*_1, x(Q^*_1) | \alpha_2).$$

Substituting in (A2),

$$\Pi_{out}(Q^*_1, x(Q^*_1) | \alpha_1) \geq \Pi_{out}(Q^*_1, x(Q^*_1) | \alpha_2).$$

Substituting from (11), and simplifying, we have

$$-\mu m(x(Q^*_1)) \left[ (1 - \alpha_1)F_B + F_M \right] \geq \mu m(x(Q^*_1)) \left[ (1 - \alpha_2)F_B + F_M \right],$$

which implies that $\alpha_1 \geq \alpha_2$, which is a contradiction. Thus, we infer that $\Pi_{out}(Q^*_\text{out}, x^*_\text{out})$ must be increasing in $\alpha$.

(iii) Suppose that $\alpha = 0$. Then, by (11), under outsourcing, the brand’s profit simplifies to

$$\Pi_{out} = p(Q)Q - [1 - x]C(Q) - \mu m(x)[F_B + F_M] = \Pi_{int},$$

using (1). However, under outsourcing, the brand is subject to the constraint that the producer chooses evasion, while under vertical integration, the brand can freely choose evasion. So, the brand’s profit under outsourcing cannot exceed the profit under vertical integration,

$$\Pi_{out}(Q^*_\text{out}, x^*_\text{out}) \leq \Pi_{int}(Q^*_\text{int}, x^*_\text{int}).$$
(iv) Suppose that $\alpha = 1$. Then, by (11), under outsourcing, the brand’s profit simplifies to $\Pi_{out} = p(Q)Q - [1 - x]C(Q) - \mu m(x)F_M$. Comparing with (1), we infer that, for any $(Q, x)$, the profit, $\Pi_{out}(Q, x) \geq \Pi_{int}(Q, x)$. Hence, in particular,

$$\Pi_{out}(Q_{int}^*, x_{int}^*) \geq \Pi_{int}(Q_{int}^*, x_{int}^*).$$

(A3)

Under outsourcing, suppose that the brand chooses production, $Q_{int}^*$, and, by (5), the producer chooses evasion, $x_{out}(Q_{int}^*)$. Then, by (11), the brand will earn profit, $\Pi_{out}(Q_{int}^*, x_{out}(Q_{int}^*)) = p(Q_{int}^*)Q_{int}^* - [1 - x_{out}(Q_{int}^*)]C(Q_{int}^*) - \mu m(x_{out}(Q_{int}^*))F_M$.

By the definition, (3), given production, $Q_{int}^*$, the producer maximizes profit with evasion, $x_{out}(Q_{int}^*)$, and so,

$$[1 - x_{out}(Q_{int}^*)]C(Q_{int}^*) + \mu m(x_{out}(Q_{int}^*))F_M \leq [1 - x_{int}^*]C(Q_{int}^*) + \mu m(x_{int}^*)F_M.$$

Substituting above, we have

$$\Pi_{out}(Q_{int}^*, x_{out}(Q_{int}^*)) \geq \Pi_{out}(Q_{int}^*, x_{int}^*).$$

Now, by definition, $(Q_{out}^*, x_{out}^*)$ maximizes the brand’s profit under outsourcing, so,

$$\Pi_{out}(Q_{out}^*, x_{out}^*) \geq \Pi_{out}(Q_{int}^*, x_{out}(Q_{int}^*)) \geq \Pi_{out}(Q_{int}^*, x_{int}^*).$$

Combining the above with (A3), we have

$$\Pi_{out}(Q_{out}^*, x_{out}^*) \geq \Pi_{int}(Q_{int}^*, x_{int}^*),$$

which completes the proof. [Q.E.D.]

**Proof of Lemma 1.** Using (7), by (2),

$$x_{int}^* = \min \left\{ \nu \left( \frac{C(Q_{int}^*)}{\mu F_M + F_B} \right), 1 \right\}.$$

(A4)

and by (5),

$$x_{out}^* = \min \left\{ \nu \left( \frac{C(Q_{out}^*)}{\mu F_M} \right), 1 \right\}.$$

(A5)
We first prove part (ii), then (i) and (iii).

**Part (ii)**

Consider two cases – where \( x_{\text{int}}^* < 1 \) and \( x_{\text{int}}^* = 1 \).

**Case 1:** \( x_{\text{int}}^* = \nu \left( \frac{C(Q_{\text{int}}^*)}{\mu F_M} \right) < 1 \).

The proof comprises four steps, (a)-(d).

(a) Under vertical integration, the production quantity, \( Q^*_{\text{int}} \), does not vary with \( \alpha \). This is immediate from (1).

(b) Under outsourcing, the production quantity, \( Q^*_{\text{out}} \), increases in \( \alpha \). This is proved in Proposition 2.

(c) If \( \alpha = 0 \), then \( Q^*_{\text{int}} > Q^*_{\text{out}} \). Suppose that \( \alpha = 0 \). By (1),

\[
\frac{\partial \Pi_{\text{int}}}{\partial Q} = p'(Q)Q + p(Q) - [1 - x]C'(Q),
\]

while, by (11),

\[
\frac{\partial \Pi_{\text{out}}}{\partial Q} = p'(Q)Q + p(Q) - [1 - x]C'(Q) - \frac{F_B}{F_M} C(Q) \frac{dx}{dQ}.
\]

Hence, using (7)

\[
\left. \frac{\partial \Pi_{\text{out}}}{\partial Q} \right|_{Q=Q_{\text{int}}^*} - \left. \frac{\partial \Pi_{\text{int}}}{\partial Q} \right|_{Q=Q_{\text{int}}^*} = \left[ \nu \left( \frac{C(Q_{\text{int}}^*)}{\mu F_M} \right) - \nu \left( \frac{C(Q_{\text{int}}^*)}{\mu (F_M + F_B)} \right) \right] C_{\text{int}}^* - \frac{F_B}{F_M} C(Q_{\text{int}}^*) \frac{dx}{dQ}.
\]

By definition, \( Q_{\text{int}}^* \) maximizes (1), and so,

\[
\left. \frac{\partial \Pi_{\text{int}}}{\partial Q} \right|_{Q=Q_{\text{int}}^*} = 0.
\]

Further, by (7),

\[
\left. \frac{dx}{dQ} \right|_{Q=Q_{\text{int}}^*} = \nu \left( \frac{C(Q_{\text{int}}^*)}{\mu F_M} \right) = \nu' \left( \frac{C(Q_{\text{int}}^*)}{\mu F_M} \right) \cdot \frac{C(Q_{\text{int}}^*)}{\mu F_M}.
\]
Substituting above,
\[
\frac{1}{C'(Q_{int}^*)} \frac{\partial \Pi_{out}}{\partial Q} \bigg|_{Q=Q_{int}^*} = \nu \left( \frac{C(Q_{int}^*)}{\mu F_M} \right) - \nu \left( \frac{C(Q_{int}^*)}{\mu[F_M + F_B]} \right) - \frac{F_B}{\mu F_M^2} C(Q_{int}^*) \cdot \nu' \left( \frac{C(Q_{int}^*)}{\mu F_M} \right).
\] (A7)

If
\[
\frac{F_B}{\mu F_M^2} C(Q_{int}^*) \cdot \nu' \left( \frac{C(Q_{int}^*)}{\mu F_M} \right) > \nu \left( \frac{C(Q_{int}^*)}{\mu F_M} \right) - \nu \left( \frac{C(Q_{int}^*)}{\mu[F_M + F_B]} \right),
\] (A9)
then, by (A7),
\[
\frac{\partial \Pi_{out}}{\partial Q} \bigg|_{Q=Q_{int}^*} < 0,
\]
which implies that, at \( Q = Q_{int}^* \), the profit under outsourcing, \( \Pi_{out} \), decreases in \( Q \). Since the profit function \( \Pi_{out} \) is single-peaked in \( Q_{out} \), the maximum of \( \Pi_{out} \) must be at a lower level of \( Q \), i.e., \( Q_{out}^* < Q_{int}^* \).

Referring to Figure 3, a sufficient condition for (A9) is that the function, \( \nu(\cdot) \), be weakly convex. Formally, if \( \nu(\cdot) \) is weakly convex, then
\[
\frac{F_B}{\mu F_M^2} C(Q_{int}^*) \cdot \nu' \left( \frac{C(Q_{int}^*)}{\mu F_M} \right) > \nu \left( \frac{C(Q_{int}^*)}{\mu F_M} \right) - \nu \left( \frac{C(Q_{int}^*)}{\mu[F_M + F_B]} \right),
\] which proves (A9). By (9) and (10), if \( m''(\cdot) \leq 0 \), then \( \nu''(\cdot) \geq 0 \), i.e., \( \nu(\cdot) \) is weakly convex.

Referring to Figure 3, another sufficient condition for (A9) is that \( F_B \) be sufficiently large. The left-hand side of (A9) increases in \( F_B \), while the right-hand side is bounded above by \( \nu(C(Q_{int}^*)/\mu F_M) \), which decreases in \( F_B \), since, by Proposition 1, \( Q_{int}^* \) decreases in \( F_B \).

(d) If \( \alpha = 1 \), then \( Q_{int}^* < Q_{out}^* \). Suppose that \( \alpha = 1 \). By (11),
\[
\frac{\partial \Pi_{out}}{\partial Q} = p'(Q)Q + p(Q) - [1 - x]C'(Q).
\]
Using (A6) and (7),
\[
\frac{\partial \Pi_{out}}{\partial Q} \bigg|_{Q=Q_{int}^*} - \frac{\partial \Pi_{int}}{\partial Q} \bigg|_{Q=Q_{int}^*} = \left[ \nu \left( \frac{C(Q_{int}^*)}{\mu F_M} \right) - \nu \left( \frac{C(Q_{int}^*)}{\mu[F_M + F_B]} \right) \right] C'(Q_{int}^*) > 0.
\]
Figure 3: Evasion function
Now, by definition, $Q_{\text{int}}^*$ maximizes (1), and so,
\[
\frac{\partial \Pi_{\text{int}}}{\partial Q} \bigg|_{Q=Q_{\text{int}}^*} = 0.
\]
Substituting above,
\[
\frac{\partial \Pi_{\text{out}}}{\partial Q} \bigg|_{Q=Q_{\text{int}}^*} > 0,
\]
which implies that, at $Q = Q_{\text{int}}^*$, the profit under outsourcing, $\Pi_{\text{out}}$, increases in $Q$. Assuming $\Pi_{\text{out}}$ is single-peaked in $Q_{\text{int}}$, the maximum of $\Pi_{\text{out}}$ must be at a higher level of $Q$, i.e., $Q_{\text{out}}^* > Q_{\text{int}}^*$.

**Case 2: $x_{\text{int}}^* = 1$.**
In this case, we claim that for $Q_{\text{out}}^* \leq Q_{\text{int}}^*$, for all $\alpha \in [0, 1]$. Define $\hat{Q}_{\text{out}}$ as the quantity of production such that
\[
\nu \left( \frac{C(\hat{Q}_{\text{out}})}{\mu F_M} \right) = 1.
\]
(A8)

Suppose that $Q_{\text{int}}^* \geq \hat{Q}_{\text{out}}$. By (9), $\nu(\cdot)$ is increasing, and so,
\[
\nu \left( \frac{C(Q_{\text{int}}^*)}{\mu F_M} \right) \geq 1.
\]
Hence, by (7), the profit-maximizing evasion, $x_{\text{out}}(Q_{\text{int}}^*) = 1$. Then, $m'(x_{\text{out}}(Q_{\text{int}}^*)) = m''(x_{\text{out}}(Q_{\text{int}}^*)) = 0$, and $\nu'(Q_{\text{int}}^*) = 0$. Substituting in (13), the first-order condition simplifies to
\[
\frac{\partial \Pi_{\text{out}}}{\partial Q} \bigg|_{Q=Q_{\text{int}}^*} = p'(Q_{\text{int}}^*)Q_{\text{int}}^* + p(Q_{\text{int}}^*) = 0,
\]
which implies that $Q_{\text{out}}^* = Q_{\text{int}}^*$.

Next, suppose that $Q_{\text{int}}^* < \hat{Q}_{\text{out}}$. By (A8), since $\nu(\cdot)$ is increasing,
\[
\nu \left( \frac{C(Q_{\text{int}}^*)}{\mu F_M} \right) < 1.
\]
Hence, by (13), the first derivative,

\[
\left. \frac{\partial \Pi_{\text{out}}}{\partial Q} \right|_{Q=Q_{\text{int}}} = p'(Q_{\text{int}})Q'_{\text{int}} + p(Q_{\text{int}}) - [1 - x_{\text{out}}(Q_{\text{int}})]C'(Q_{\text{int}}) \\
- [1 - \alpha]C(Q_{\text{int}})\nu\left(\frac{C(Q_{\text{int}})}{\mu F_M}C'(Q_{\text{int}})F_B}{\mu F_M^2} < 0,
\]

which, by the assumption that \( \Pi_{\text{out}} \) is single-peaked in \( Q_{\text{out}} \), implies that \( Q^*_{\text{out}} < Q^*_{\text{int}} \).

Thus, we conclude that \( Q^*_{\text{out}} \leq Q^*_{\text{int}} \), for all \( \alpha \). Then setting \( \alpha_Q = 1 \) completes the proof of part (ii).

**Part (i)**

The proof is similar to the proof of (ii). If \( x^*_{\text{int}} = 1 \), then setting \( \alpha_x = 1 \), the result is trivial. We now consider the case of \( x^*_{\text{int}} < 1 \).

(a) Under vertical integration, the evasion, \( x^*_{\text{int}} \), does not vary with \( \alpha \), which is immediate from (1).

(b) Under outsourcing, the evasion, \( x^*_{\text{out}} \), increases in \( \alpha \), as proved in Proposition 2.

(c) If \( \alpha = 1 \), then \( x^*_{\text{out}} < x^*_{\text{int}} \). Suppose that \( \alpha = 1 \). By (ii)(d) above, \( Q^*_{\text{out}} > Q^*_{\text{int}} \). Substituting in (A4) and (A5),

\[
x^*_{\text{out}} = \nu\left(\frac{C(Q_{\text{out}})}{\mu F_M}\right) > \nu\left(\frac{C(Q_{\text{out}})}{\mu[F_M + F_B]}\right) > \nu\left(\frac{C(Q_{\text{int}})}{\mu[F_M + F_B]}\right) = x^*_{\text{int}},
\]

since \( \nu(\cdot) \) is increasing.

(d) If \( \alpha = 0 \), then two cases are possible. One is where \( x^*_{\text{out}} \geq x^*_{\text{int}} \) for all \( \alpha \), in which case, set \( \alpha_x = 0 \), and the result is trivial. The other case is where \( x^*_{\text{out}} < x^*_{\text{int}} \). By (b) and (c) above, since \( x^*_{\text{out}} \) is continuous in \( \alpha \), there exists \( \alpha_x > 0 \) such that \( x^*_{\text{out}} \leq x^*_{\text{int}} \) if and only if \( \alpha \leq \alpha_x \).

**Part (iii)**

If \( x^*_{\text{int}} = 1 \), then set \( \alpha_x = \alpha_Q = 1 \), and the result is trivial. We now consider the case of \( x^*_{\text{int}} < 1 \). By definition, at \( \alpha = \alpha_Q \), \( Q^*_{\text{int}} = Q^*_{\text{out}} = Q \) say. Under vertical integration, by (1),

\[
\frac{dm}{dx} = \frac{C(Q)}{\mu[F_B + F_M]}.
\]
Using (6), we have
\[
\frac{dm}{dx}\bigg|_{x=x^*_{\text{int}}} = \frac{C(Q)}{\mu[F_M+F_B]} < \frac{C(Q)}{\mu F_M} = \frac{dm}{dx}\bigg|_{x=x^*_{\text{out}}}.
\]
Given that \(m'(x) > 0\), and \(m''(x) > 0\), we can conclude that \(x^*_{\text{int}} < x^*_{\text{out}}\).

By definition, at \(\alpha = \alpha_x\), the evasion, \(x^*_{\text{int}} = x^*_{\text{out}}\). Suppose otherwise that \(\alpha_x > \alpha_Q\). At \(\alpha = \alpha_x\), \(Q^*_{\text{int}} < Q^*_{\text{out}}\). Then, the proof of (i)(d) above shows that \(x^*_{\text{out}} > x^*_{\text{int}}\), which is a contradiction. Thus, we conclude that \(\alpha_Q > \alpha_x\). [Q.E.D.]

**Proof of Proposition 5.** For this proposition, we need \(\alpha_Q > 0\), so that there exists \(\tilde{\alpha}\) such that \(\alpha_x < \tilde{\alpha} \leq \alpha_Q\). Referring to Figure 2, and the proof of Lemma 1 (in the Appendix), a sufficient condition for \(\alpha_Q > 0\) is that
\[
\frac{F_B}{\mu F_M^2} C(Q^*_{\text{int}}) \cdot \nu \left( \frac{C(Q^*_{\text{int}})}{\mu F_M} \right) > \nu \left( \frac{C(Q^*_{\text{int}})}{\mu F_M} \right) - \nu \left( \frac{C(Q^*_{\text{int}})}{\mu F_M + F_B} \right).
\] (A9)

In turn, referring to Figure 3, a sufficient condition for (A9) is that the penalty on the brand for evasion, \(F_B\), be sufficiently large. Note that the left-hand side of (A9) increases in \(F_B\). By contrast, the right-hand side is bounded above by \(\nu(C(Q^*_{\text{int}})/\mu F_M)\), which decreases in \(F_B\), since, by Proposition 1, \(Q^*_{\text{int}}\) decreases in \(F_B\).

Referring to (15), a reduction in \(\alpha\) from above to below \(\tilde{\alpha}\) would change welfare by
\[
\Delta W(Q,x) = B'(Q)\Delta Q - [1-x]C'(Q)\Delta Q + C(Q)\Delta x - H'(x)\Delta x,
\] (A10)

with \(\Delta Q > 0\) and \(\Delta x < 0\). By Lemma 2, since \(\Delta Q > 0\), the first two terms on the right-hand side of (A10), \(\{B'(Q) - [1-x]C'(Q)\}\) \(\Delta Q > 0\). By Lemma 3, since \(\Delta x < 0\), the second two terms on the right-hand side of (18), \(\{C(Q) - H'(x)\}\) \(\Delta x > 0\) [Q.E.D.]

A9