Reveal the Supplier List? A Trade-off in Capacity vs. Responsibility

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Problem definition: Under what conditions and how can a buying firm, by committing to publish a list of its suppliers and/or the identities and violations of terminated suppliers, increase its expected profit and supplier responsibility?

Academic / Practical Relevance: This paper contributes to a recent thrust in the OM literature on how various sorts of transparency influence social and environmental responsibility in a supply chain. In practice, companies are under pressure to publish their supplier lists and suppliers’ violations, and some are beginning to do so. This paper could help guide their decisions.

Methodology: Game Theory

Results: This paper shows how a buying firm can use transparency to reward a supplier for responsibility effort to eliminate social or environmental violations. By publishing its supplier list, the buying firm can signal that a supplier is responsible and generate profitable new business for the supplier. However, the resulting competition for the supplier’s scarce capacity could cause the buying firm to obtain fewer units or pay a higher price. We identify the conditions under which a buying firm should commit to publish its supplier list, and conditions under which the buying firm should also help a supplier with cost-reduction or capacity-expansion. In addition, the paper shows how a buying firm can use transparency to punish a supplier for a responsibility violation- by warning other buying firms not to source from that supplier. Commitment to do so increases the supplier’s responsibility effort and can screen out a supplier with a known responsibility violation, thereby increasing a buying firm’s expected profit. If the supplier is uncertain whether or not it has a violation (e.g., faulty electrical wiring likely to cause a fire) then the two forms of transparency can be complementary.

Managerial Implications: Buying firms should consider transparency as a potentially profitable approach to mitigating social and environmental violations in their supply chains.

1. Introduction

Companies concerned about suppliers’ social and environmental violations are turning to supply chain transparency. Specifically, some are beginning to publish the identities of their suppliers, whereas in the past they were strategically secretive (Marshall et al. 2016). Nike historically refused
to disclose its suppliers’ identities, explaining that “giving a list of all of Nike’s factory addresses would be like giving away your playbook” ... until Nike began publishing the list of its suppliers and their addresses in 2005 (Stroup 1999, Murray 2005). Currently, Nike publishes the name and address of every factory contracted to make Nike products, along with the types of products each factory makes (Nike Manufacturing Map 2017). Many other prominent apparel companies including H&M, Patagonia, Gap, Adidas, Columbia, Levis, Puma etc. have also started to publish the identities of their suppliers (Follow the Thread 2017, p. 3). Apparel companies face a threat of brand damage associated with suppliers’ social and environmental violations and face NGO pressure for supply chain transparency; according to the Fashion Transparency Index 2017, 32% percent of brands are now publishing the identities of at least their tier-1 suppliers (Fashion Revolution 2017).

That phenomenon is also occurring in the electronics, automotive, and consumer goods industries. In 2011, Apple was in the headlines due to suicides and environmental violations in its suppliers’ facilities and then, responding to calls for transparency, Apple first revealed a list of its suppliers in 2012 (Wingfield and Duhigg 2012). Apple currently publishes the names and addresses of its top 200 suppliers, which represent at least 97% of procurement expenditures (Apple 2017). Shamed during 2016-2017 by IPE1 for lack of transparency and environmental violations by “suspected” suppliers and subsidiaries in China, Toyota and Anheuser-Busch InBev began publishing lists of their suppliers located in China. According to IPE, the number of buying firms doing so has increased to 89 with leadership primarily from the electronics and apparel industries, whereas luxury brands and automakers tend to lag behind2. Though Unilever to date has resisted IPE’s pressure to publish the identities of its Chinese suppliers, in 2018 Unilever became the first company to publish the identities of its palm oil suppliers (Zweynert 2018).

While some companies are revealing their supplier lists, other companies are taking action to protect the secrecy of their supplier lists. In the US, customs authorities are required by law to collect data on each shipping container entering a US port. That data includes the shipper (which ordinarily is the supplier) and the consignee (which ordinarily is the buying firm). By invoking the US Freedom of Information Act, subscription database providers Import Genius and Panjiva are obtaining that customs data, and marketing it in a searchable format (Import Genius 2017, Panjiva 2017). In response, some buying firms are concealing their names and their suppliers’ names from customs authorities to protect the secrecy of their supplier lists (Follow the Thread 2017).

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1 The Institute for Public Economics (IPE) is an influential environmental NGO that promotes supply chain transparency in order to incentivize factories in China to mitigate air and water pollution.

2 This information is drawn from the IPE’s 2016 Annual Report and Toyota Reports, and IPE’s Corporate Information Transparency Index (CITI) scores and 2017 report, accessed from the IPE website www.en.ipe.org.cn on June 16, 2018. Under “Promote Supply Chain Transparency” IPE lists 89 firms with points for publishing a list of their suppliers in China, and 178 other firms with 0 because they declined to do so. Luxury brands and automakers that declined to publish their suppliers’ identities include Tiffany, Mercedes-Benz, BMW, Volkswagen, Nissan and Volvo.
In deciding whether or not to be transparent about who their suppliers are, buying firms face a trade-off between capacity and responsibility. On the one hand, the identity of suppliers has long been considered to be proprietary information for a buying firm. Resisting pressure to disclose its list of suppliers in 2010, Gap explained “We invest a lot of time, effort and money in identifying factories that meet our product-quality and vendor-compliance standards. We also invest a lot of time in working with factories to continually improve conditions. Any factory has limited production capacity, and we are in a very competitive business. We believe it would be unwise to provide a complete list of approved factories for our competitors to use.” (Doorey 2010)

Indeed, competition for supplier capacity is the primary reason cited by firms that decline to publish the identities of their suppliers, including Inditex (Zara) and Primark (Follow the Thread 2017, p. 13). On the other hand, using a game-theoretic model, this paper explains how publishing supplier’s identities motivates suppliers to exert effort to eliminate safety, environmental or other responsibility violations.

Under what conditions should buying firms publish suppliers’ identities? Why are some apparel and electronics companies leaders in doing so, whereas luxury brands and automakers lag behind? To address those questions, §3 of this paper identifies the conditions that favor transparency: the buying firm has a low selling price or slim margin, high cost of identifying and qualifying a candidate supplier, high risk that a candidate supplier initially has a responsibility violation, or large potential brand damage from sourcing from a supplier with a responsibility violation. Under those conditions, a buying firm’s commitment to publish a supplier’s identity yields a triple win: increased expected profit for the buying firm, its supplier, and another buying firm attracted to source from the same supplier.

§3 explores the complementarity between publishing supplier lists and helping suppliers become more productive, as Nike has done and which, according to (Distelhorst et al. 2017), is associated with fewer Nike suppliers failing audits due to responsibility violations.

§4 considers a different sort of transparency: to publish the identity of any terminated supplier, along with negative audit reports that reveal the responsibility violation for which the supplier was terminated. For example, the Bangladesh Accord on Fire and Building Safety and the Alliance for Bangladesh Worker Safety commit signatories (219 and 29 apparel buyers, respectively) to publish the identity and negative audit report for every supplier that is terminated for a safety violation. This is commonly called “blacklisting” because it prevents buying firms from sourcing from a supplier. §4 shows how the threat of blacklisting can increase a buying firm’s expected profit by screening out a candidate supplier with a known violation. Unfortunately, the threat of blacklisting can also cause a buying firm to lose a good candidate supplier if the supplier is uncertain whether or not he has violation. Then, commitment to publish a supplier’s identity (a reward for passing
the audit) and blacklisting (a penalty for failing the audit) are complementary. Together, they increase the buying firm’s expected profit by motivating the supplier to exert greater effort to identify and eliminate any responsibility violation and undergo the audit.

A caveat, addressed in §5, is that either of the two sorts of transparency can motivate suppliers to try to hide violations in order to pass an audit. §5 identifies conditions under which, despite potential for suppliers to try to hide violations, commitment to publish suppliers’ identities or blacklisting nevertheless motivates greater supplier effort to eliminate violations.

**Related Literature**

This paper contributes to the literature on the role of transparency in responsible supply chain management. The majority of that literature focuses on transparency about a firm’s responsibility policies or the responsibility levels of its suppliers. Xu et al. (2015), for example, consider a mandate for a buying firm to disclose its policy for auditing suppliers for child labor, which enables the firm to commit to not audit and pay lower prices. Kalkanci and Plambeck (2018) consider a mandate for a buying firm to disclose whatever it learns about a supplier’s CO2 emissions or other impacts, which affects the buying firm’s stock market price, and hence its learning and impact reduction decisions. Guo et al. (2016) consider how consumers’ ability to see whether or not a product comes from a responsible supplier affects a retailer’s pricing and supplier selection. Using human-subject experiments, Kraft et al. (2017) find value for a buying firm in giving consumers visibility regarding wages paid in its upstream supply chain. Caro et al. (2017), Fang and Cho (2015) and Plambeck and Taylor (2016) consider the sharing of audit reports among buying firms with a common supplier, which influences auditing effort and supplier responsibility effort. In contrast, this paper considers transparency about the identities of a firm’s current and/or terminated suppliers and is novel in considering how transparency influences supplier selection and screening, buying firms’ competition for a supplier’s limited capacity, and complementarities between different sorts of transparency. A complementary paper (Chen et al. 2018) examines how transparency about its supplier’s identity could influence a buying firm’s cost associated with a violation by that supplier, influence auditing efforts by NGOs and the buying firm, and thereby influence the supplier’s responsibility effort.

For excellent surveys of the broader literature on responsible supply chain management and on operational transparency we refer the reader to Chen et al. (2017), Guo et al. (2016) and Kraft et al. (2017).

This paper also contributes to the literature on managing suppliers with private information and subject to moral hazard, surveyed in (Kim and Netessine 2013, Lewis et al. 2017, Bolandifar et al. 2017). Within that literature, (Lewis et al. 2017) and (Chen and Lee 2017) are most closely related to this paper, in that they consider supplier responsibility. However, whereas in (Lewis et al. 2017) and (Chen and Lee 2017) a supplier has private information about its marginal cost to produce
in a responsible manner, this paper considers a different sort of private information: knowledge of a preexisting violation (e.g., a building safety violation). Leveraging that difference, §4 develops insights by contrasting results in (Chen and Lee 2017) with ones in this paper.

This paper is also related to the literature on observational learning in marketing and economics (Miklos-Thal and Zhang 2013, Gill and Sgroi 2012, Taylor 1999). Observational learning refers to the idea that by observing others’ actions, one obtains signals of private information. Similarly, in this paper, a buying firm can make inferences about a supplier’s social and environmental responsibility level by observing another buying firm’s sourcing decision.

Though this paper is primarily motivated by examples of buyers publishing their supplier lists to promote social and environmental responsibility, appearing on a supplier list could signal that a supplier has high quality or other desirable characteristics, so the literature on supplier qualification and quality management is relevant. Beil (2010) describes how supplier qualification works in practice, and surveys the operations management literature related to supplier qualification. As notable examples, Beil and Wan (2009) examine supplier qualification and a procurement auction for suppliers having private cost information and Aral et al. (2014) consider sustainability audits in conjunction with a procurement auction. Babich and Tang (2012) and Levi et al. (2017) examine inspection and incentive approaches to deter suppliers from product adulteration. Baiman et al. (2000) show that when a buyer can commit in advance to inspection, then the supplier’s quality effort and both firms’ expected profits increase, which provides some motivation for our base model assumption that the buying firms are committed to audit. We refer the reader to (Chen and Lee 2017, Plambeck and Taylor 2016) for additional literature on motivating quality effort from a supplier.

In model formulation, this paper is similar to (Arya et al. 2008, Chen and Guo 2014) wherein sharing a supplier causes buying firms to either suffer shortage or pay a higher procurement cost. Moreover, following (Cachon and Lariviere 2001; Ozer and Wei 2006) and references therein, we assume that a buying firm’s selling price is fixed and does not vary with the amount of capacity available from a supplier.

2. Model Formulation
A buying firm faces uncertain demand in the upcoming selling season, represented by nonnegative random variable \( X \), and must search for, qualify and contract with a supplier in advance of the selling season. The contract specifies the price per unit \( w \) that the buying firm will pay; \( w \) is strictly greater than a supplier’s outside option \( w_0 \), which incentivizes a candidate supplier to pass a responsibility audit in order to qualify and become the buying firm’s supplier. The buying firm will sell at price \( p \) per unit, where \( p > w \).
We consider two such (symmetric) buying firms, and study the potential for an asymmetric equilibrium to occur in which one of the buying firms (B1) commits to publish its supplier’s identity, to attract a second buying firm (B2) to consider sourcing from that same supplier. To focus on B1’s decision of whether or not to make that transparency commitment, we take the selling price $p$ and wholesale price $w$ as exogenous parameters.

The sequence of events for those two buying firms is depicted in Figure 1. First, B1 chooses whether or not to commit to publish its supplier’s identity. Next, B1 searches for, qualifies and contracts with a supplier (through a process described in detail in the next paragraph). If committed to do so, B1 publishes the identity of its supplier (S) and B2 decides whether to take S as its candidate supplier or search for a different one, and proceeds to qualify and contract with a supplier. Next, the buying firms’ uncertain demands are realized and each sources from its supplier. If both buying firms source from the same supplier S and their aggregate demand exceeds S’s capacity, negotiation occurs by which that capacity is allocated between the buying firms. Finally, in the event that a buying firm sources from a supplier with a responsibility violation, that buying firm may incur costs associated with that violation. (For example, a safety violation may result in a fatal fire, causing the buying firm to incur brand damage and pay reparations.)

Now let us describe the process through which a buying firm searches for and qualifies a supplier, first in the base case with no transparency commitment. A buying firm incurs search cost $s$ to identify a candidate supplier, which includes costs to determine that the candidate has acceptable quality. The candidate supplier may have an environmental, labor, health or safety violation. The supplier knows whether or not it has a violation, whereas the buying firm assigns prior probability $v \in (0,1]$ that a supplier has a violation. If the supplier has a violation, the supplier chooses how much responsibility effort $e$ to exert to eliminate the violation. Responsibility effort is costly and may fail. A supplier chooses $e \in [0,1]$, which is the probability that the violation is eliminated, and incurs cost $r(e)$ that is twice differentiable, increasing, and strictly convex, with $r(0) = 0$. For brevity, we will refer to the responsibility effort of a supplier without reiterating that the supplier chooses responsibility effort when it has a violation. Next, the buying firm responsibility-audits the candidate supplier. The audit costs the buying firm $a > 0$ and is imperfect, in that if the supplier has a violation, the buying firm’s audit detects this violation with probability $d \in (0,1)$. A supplier without a violation passes a buying firm’s audit with probability 1. The buying firm contracts to source from a candidate supplier if and only if the candidate passes buying firm’s audit. If a candidate fails the audit, the buying firm again incurs the search cost $s$ to identify a different candidate supplier and audits the candidate supplier (repeatedly) until a candidate passes the audit.
If B1 commits to publish its supplier’s identity, the process by which each buying firm searches for a responsible supplier remains the same, except that B2 may choose to take B1’s supplier S as its own first candidate and thereby avoid the initial search cost $s$.

Candidates are drawn without replacement from a pool of statistically independent and identical suppliers. Hence the buying firms will share a supplier if and only if B1 commits to publish its supplier’s identity, B2 chooses to take B1’s supplier S as its own first candidate, and S passes B2’s audit. The random variables representing whether a candidate supplier has a responsibility violation, whether the supplier’s responsibility effort is successful, and whether a supplier with a violation passes a buying firm’s audit all are independent. Each supplier has capacity $k$ and variable production cost $c$ per unit, with $c \leq w$. The case that a supplier is demand-constrained, i.e., will sell only to B1 or B2, is captured by setting $w = c$.

During the selling season, each buying firm observes the realization of its uncertain demand and sources from its supplier. Let $x_1$ and $x_2$ denote the realized demand for B1 and B2, respectively. Regarding the joint distribution of the buying firms’ demands, we assume that with probability 1, $x_1 + x_2 > k$ and $x_i < k$ for $i \in \{1, 2\}$, i.e., sharing a supplier causes some shortage. Hence if B1 and B2 source from different suppliers, B1 obtains $x_1$ at the contractually-specified price of $w$ per unit, sells those $x_1$ units at the selling price of $p$ per unit, and has contribution $(p-w)x_1$. Meanwhile, B1’s supplier sells $x_1$ to B1 at $w$ per unit, if $w > c$ sells its remaining capacity $k-x_1$ at $w$ per unit to other buyers that do not audit for responsibility, and has contribution $(w-c)x_1 + (w-c)(k-x_1)$. Similarly, B2 has contribution $(p-w)x_2$ and its supplier has contribution $(w-c)x_2 + (w-c)(k-x_2)$.

If both B1 and B2 source from the same supplier S, negotiation occurs by which S allocates its capacity between the buying firms, B1 has contribution of $(p-w)(k-x_2)$, B2 has contribution of $(p-w)(k-x_1)$, and S has contribution of $(p-c)k-(p-w)(k-x_2)-(p-w)(k-x_1)$; in terms of the contribution for each of the 3 firms, that is the unique core outcome, as proven in the Appendix.

In the event that a buying firm sources from a supplier with a responsibility violation, the buying firm incurs expected cost $\tau > 0$ associated with that violation. The parameter $\tau$ incorporates the...
Table 1 Notation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>$\tau$</td>
<td>Buying firm’s expected cost associated with its supplier’s responsibility violation</td>
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<tr>
<td>$s$</td>
<td>Search cost to identify a candidate supplier</td>
</tr>
<tr>
<td>$v$</td>
<td>Prior probability that a candidate supplier has a violation</td>
</tr>
<tr>
<td>$d$</td>
<td>Probability that an audit detects a responsibility violation</td>
</tr>
<tr>
<td>$a$</td>
<td>Cost of an audit</td>
</tr>
<tr>
<td>$r(e)$</td>
<td>Cost of the supplier’s responsibility effort $e$</td>
</tr>
<tr>
<td>$X$</td>
<td>Uncertain customer demand faced by each buying firm</td>
</tr>
<tr>
<td>$p$</td>
<td>Per unit selling price</td>
</tr>
<tr>
<td>$w$</td>
<td>Unit price that the buying firm will pay to a qualified supplier</td>
</tr>
<tr>
<td>$w_0$</td>
<td>Unit price a candidate supplier receives if the supplier sells to other buyers that do not audit for responsibility</td>
</tr>
<tr>
<td>$c$</td>
<td>Variable per unit production cost for each candidate supplier</td>
</tr>
<tr>
<td>$k$</td>
<td>Capacity of a candidate supplier</td>
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probability that the violation will come to light (e.g., be detected and publicized by an NGO) and all associated costs to the buying firm.

Table 1 summarizes the notation for model parameters.

**Characterization of Equilibria:** We focus on perfect Bayesian equilibria in pure strategies in which B1, B2 and each candidate supplier maximizes its expected profit, and categorize those equilibria into two types. In the first type, a candidate supplier has potential to supply B1 but not B2. An equilibrium in which B1 chooses not to commit to publish its supplier’s identity is of this first type, as is an equilibrium in which B1 publishes its supplier’s identity but B2 chooses not to source from B1’s supplier but instead to search for a different supplier. In any equilibrium of the first type, the optimal responsibility effort for each candidate supplier is uniquely determined by

$$
e \equiv \arg \max \left\{ \left( e + (1 - e)(1 - d) \right) \left( (w - c)E[X] + (w_0 - c)(k - E[X]) \right) + (1 - e)d(w_0 - c)k - r(e) \right\},$$

and hence the expected discounted profit for each buying firm is

$$\pi \equiv (p - w)E[X] - \frac{v(1 - e)(1 - d)\tau + a + s}{1 - vd(1 - e)}.$$  

(1)

In the second type of equilibrium, a candidate supplier to B1 has potential to supply both buying firms, due to *transparency*. In such an equilibrium, B1 commits to publish the identity of its supplier S, B2 audits S and B2 sources from S if S passes the audit. The optimal responsibility effort for a candidate supplier to B1 is uniquely determined by

$$
\bar{e} \equiv \arg \max \left\{ \left( e + (1 - e)(1 - d)^2 \right) \left( (p - c)(2E[X] - k) + 2(w_0 - c)(k - E[X]) \right) + (1 - e)(1 - d)d \left( (w_0 - c)E[X] + (w_0 - c)(k - E[X]) \right) + (1 - e)d(w_0 - c)k - r(e) \right\}. \quad (2)
$$

The expected profit for B1 is

$$\pi_{t1} = \frac{vd(1 - d)(1 - \bar{e})(p - w)E[X] + (1 - v(1 - (1 - d)^2))(1 - \bar{e})(p - w)(k - E[X]) - v(1 - \bar{e})(1 - d)\tau - a - s}{1 - vd(1 - \bar{e})}. \quad (3)$$
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The expected discounted profit for B2 is

\[
\pi_{t2} = \frac{p-w}{1-vd(1-\bar{e})} \left( k - E[X] - vd(1-\bar{e}) \left( (2-d)k - (3-2d)E[X] \right) \right)
\]

\[
- \frac{a \left( 1-vd \left( 1-\bar{e} + d(1-\bar{e}) (1-(1-\bar{e})v) \right) \right) + (1-d)d(1-\bar{e})vs + v(1-d)^2(1-\bar{e})\tau}{(1-vd(1-\bar{e})) (1-vd(1-\bar{e}))}. \tag{4}
\]

The reason that \( e \) appears in (4) is that in the event that S fails B2’s audit and B2 searches for a different supplier, \( e \) is the optimal responsibility effort for each of B2’s candidate suppliers.

Henceforth we refer to this type of equilibrium as a \textit{transparency equilibrium}.

The remainder of the paper focuses on the case where candidate suppliers’ effort choices \( e \) and \( \bar{e} \) are interior solutions.

We focus on the parameter region in which B1 and B2 would have negative expected profit from sourcing from a supplier with a responsibility violation

\[
\tau > (p-w)E[X],
\]

in the absence of transparency B1 and B2 each earn positive expected profit

\[
\pi > 0.
\]

For simplicity, we are also assuming that B1 and B2 responsibility-audit a candidate supplier and source from that supplier if and only if the supplier passes the audit. That could occur due to a commitment to responsibility by those buying firms. Moreover, that is ex post optimal for each of the buying firms under the following sufficient conditions, which are derived in the Appendix. In the absence of transparency, to responsibility-audit a candidate supplier and source from that supplier if and only if the supplier passes the audit is ex post optimal for B1 and for B2 if

\[
a < vd(1-\bar{e}) \left( -s + (1-(1-\bar{e})v) \tau \right). \tag{5}
\]

To do so in a transparency equilibrium is ex post optimal for B1 if

\[
a < \frac{d(1-\bar{e})v \left( 1-vd(1-\bar{e}) \right) \left( -s + (1-v(1-\bar{e}) \left( \tau - d(p-w)(2E[X] - k) \right) \right)}{1-vd(1-\bar{e})}. \tag{6}
\]

To audit and source from S if and only if S passes the audit is ex post optimal for B2 if

\[
a < \frac{(1-d)d(1-\bar{e})v \left( -s + (p-w)(2E[X] - k) \left( 1-vd(1-\bar{e}) \right) \right) + \tau \left( 1-v(1-\bar{e}) \right)}{1-vd \left( 1-\bar{e} + d(1-\bar{e}) \left( 1-v(1-\bar{e}) \right) \right)}. \tag{7}
\]

All parameter regions defined in propositions in Section 3 are non-empty under (5)-(7).

\(^3\) A reader might be concerned that in the event that B1 publishes that S is its supplier and sources from S without experiencing a shortage, B1 might infer that S failed B2’s audit and therefore choose to stop sourcing from S. At that stage, however, the time has passed within which B1 could have searched for and qualified an alternative supplier and, moreover, B1 is already sourcing from S so B1’s expected cost \( \tau \) associated with a violation by S is sunk. Hence B1 will continue to source from S in order to maximize its profit.
3. Results: Commitment to Publish a Supplier’s Identity

Proposition 1 identifies the conditions under which each buying firm gains higher expected profit and a more responsible supplier through transparency. Those conditions are that a buying firm’s expected cost from sourcing from a supplier with a responsibility violation $\tau$ is high; the prior probability $v$ that a candidate supplier has a responsibility violation is high; the search cost $s$ is high; the audit cost $a$ is high; or a buying firm’s selling price $p$ is low.

**Proposition 1.** (a.) Responsibility effort by a candidate supplier to B1 is higher in a transparency equilibrium

$$\bar{c} > c.$$  

(b.) A transparency equilibrium exists if and only if $\tau \geq \tau$. (c) If $\tau > 0$ then $\tau$ strictly decreases with $s$, $a$, and $v$. Furthermore, $\tau = 0$ if $s \geq \bar{s}$, $a \geq \bar{a}$, or $p \leq \bar{p}$.

Closed-form expressions for the thresholds $\tau$, $s$, $a$, and $p$ are in (27), (34), (35) and (33), respectively, in the Appendix. Proofs of all propositions also are in the Appendix.

Proposition 1a is consistent with the claim by H&M, on the website where H&M publishes its suppliers’ identities, that “Our experience shows that [disclosing the names and locations of our suppliers’ factories] incentivizes our suppliers for increasingly taking ownership over their sustainability and it recognizes the progress that they make.” (H&M Group 2017). The rationale for Proposition 1a is that a candidate supplier is willing to bear more cost to pass B1’s responsibility-audit when doing so yields higher expected contribution. A supplier’s expected contribution from selling to both B1 and B2, $(p - c)(2E[X] - k) + 2(w - c)(k - E[X])$ in (2) is strictly greater than a supplier’s expected contribution from selling to B1 and other buyers that do not audit, $(w - c)E[X] + (w - c)(k - E[X])$ in (1).

A transparency equilibrium exists when B2 achieves greater expected profit by taking B1’s supplier as its own first candidate supplier and B1 achieves greater profit by committing to publish its supplier’s identity to enable B2 to do so. Therefore, to understand the rationale for Proposition 1b-c, let us first consider the trade-offs faced by B2 in deciding whether to freeride by taking B1’s supplier S as its own first candidate supplier. Freeriding offers three benefits to B2. First, B2 need not incur the search cost $s$ to identify its first candidate supplier. Second, S is less likely than an alternative candidate supplier to fail B2’s audit, due to the positive signal that S has already passed B1’s audit and the elevated responsibility effort by S in a transparency equilibrium. That lower probability of a failed audit becomes more valuable to B2 to the extent that the ongoing cost in the event of a failed audit, particularly the search cost $s$ or audit cost $a$ for an alternative supplier, is high. Third, B2 faces a lower risk of a responsibility violation (lower risk of incurring the expected cost $\tau$) with S than an alternative supplier, again due to the positive signal that S has
already passed B1’s audit and elevated responsibility effort by S. Hence B2 earns greater expected profit by taking S as its first candidate supplier when either $s$, $a$, or $\tau$ is large. The countervailing drawback for B2 in taking B1’s supplier S as a candidate supplier is that sharing S causes supply shortage. B2’s contribution is subsequently lower if B2 sources from S than an alternative supplier $((p - w)(k - x_1))$ with S vs. $(p - w)x_2$ with an alternative supplier). That reduction in contribution is less harmful for B2 when the selling price $p$ is low, so that B2 has a slim margin. Hence, when $p$ is small, the first three benefits outweigh the drawback of reduced contribution, which motivates B2 to choose S as its first candidate supplier.

Now let us consider the trade-offs faced by B1 in deciding whether to commit to publish its supplier’s identity. Recall that if B2 will freeride, commitment by B1 to publish its supplier’s identity increases the responsibility effort by each candidate supplier to B1. That lowers the probability that a candidate supplier will fail B1’s audit, causing B1 to again incur the search cost $s$ and audit cost $a$ for another candidate supplier. Moreover, the increase in responsibility effort by each candidate supplier reduces the probability that B1’s chosen supplier S has a responsibility violation and B1 incurs the associated expected cost $\tau$. The countervailing drawback for B1 from publishing its supplier’s identity, shortage of supply when B2 shares the supplier, is less harmful to B1 when the selling price $p$ is low, so that B1 has a slim margin. Hence commitment by B1 to publish its supplier’s identity increases B1’s expected profit when either $s$, $a$, or $\tau$ is large. All the benefits for B1 from transparency arise only if a candidate supplier initially has a violation, which occurs with probability $v$. Moreover, as $v$ increases, S becomes less likely to pass B2’s audit, so B1 is correspondingly less likely to experience the supply shortage from sharing S with B2. Hence an increase in $v$ favors transparency. Finally, note that B1 must commit to publish its supplier’s identity before a candidate supplier exerts responsibility effort because, afterwards, B1 will want to hide its supplier’s identity to avoid attracting B2 to source from that supplier.

In reality, buying firms in the apparel and electronics industries are under increasing pressure from NGOs and other actors that expose and publicize suppliers’ harms to workers and the environment (Plambeck and Taylor 2016), which translates to increase in the parameter $\tau$ in our model. Prominent brands presumably face the greatest scrutiny and potential for brand damage, and correspondingly high $\tau$. Hence Proposition 1b helps to explain the phenomenon documented in §1 that buying firms in the apparel and electronics industries, led initially by Nike and Apple, are beginning to publish the identities of their suppliers.

Unilever faces tremendous scrutiny and potential brand damage associated with illegal deforestation in Indonesia by palm oil suppliers, and relatively less scrutiny and potential brand damage associated with environmental violations by suppliers in China. Hence Proposition 1b also helps
to explain the observation in §1 that Unilever has committed to publish the identities of its palm oil suppliers, while refusing to publish the identities of its suppliers in China.

Proposition 1c helps to explain the observation by (Spellings 2017) and in footnote 2 in §1 that that luxury brands and automakers (i.e., firms with a high selling price \( p \)) lag behind others in transparency about their suppliers.

Perhaps the most surprising insight from Proposition 1c is that a high cost of finding, qualifying and auditing a supplier \( (s + a) \) can cause a buying firm to promote that supplier to another buying firm. The rationale is that a buying firm’s cost \( s + a \) is wasted unless a candidate supplier chooses to incur enough cost to pass the audit, and potential to sell to additional buying firms motivates the supplier to incur more cost to pass the audit. Similarly, when FedEx partnered with suppliers to develop energy-efficient, hybrid-electric delivery trucks for FedEx, which required substantial effort and investment from both FedEx and the suppliers. Environmental Defense and FedEx committed to promote the innovative trucks to other buyers to boost future profits for the suppliers, though ex post that would be disadvantageous for FedEx (Hoyt and Plambeck 2006).

Together, Proposition 1 and 2 show that transparency provides a triple win (greater expected profit for both buying firms and for B1’s supplier S) under the conditions identified in Proposition 1b-c.

**Proposition 2.** *S earns strictly higher expected profit in a transparency equilibrium.*

The rationale for Proposition 2 is that S benefits from the opportunity to sell to B2. Winning the business of B1 and B2 increases S1’s sales quantity or selling price, which more than compensates for S’s increased responsibility effort to win that business.

Propositions 1 and 2 suggest that transparency may increase social welfare, through the improvements in expected profit for the buying firms and supplier and the increase in the supplier’s responsibility effort. The caveat, however, is that transparency decreases product availability for end consumers, because the quantity sold by the two buying firms is reduced by their sourcing from a common supplier with limited capacity. The other losers from transparency are the alternative candidate suppliers to B2.

Suppliers in developing countries often complain that buying firms demand social and environmental responsibility, but are unwilling to make long term sourcing commitments or pay higher prices to compensate suppliers for the costs of those responsible practices (Ruwanpura and Wrigley 2011). Together, Propositions 1 and 2 show that transparency can address that complaint, by enabling suppliers in developing countries to become both more responsible and more profitable. The conditions under which the transparency equilibrium exists, characterized by Proposition 1b-c, tend to hold for candidate suppliers located in developing countries. Therein, regulatory institutions and law enforcement are weak so, prior to engagement with a responsible buyer, a supplier
located in a developing country is likely to have responsibility violations (Locke 2013) which translates to high \( v \) in our model. Moreover, for multinational buying firms to find, qualify and audit suppliers in developing countries can be difficult and costly, in part due to a shortage of people capable of doing that work (Konrad et al. 2017), which translates to high \( s \) and \( a \). According to Proposition 1c, high \( v, s \) and \( a \) translate to a low threshold \( \tau \) in the necessary and sufficient condition \( \tau \geq \tau \) for existence of a transparency equilibrium.

Proposition 3 examines how supplier responsibility effort and the threshold \( \tau \) for existence of a transparency equilibrium vary with supplier capacity \( k \) and unit production cost \( c \).

**Proposition 3.** (a.) Increasing supplier capacity \( k \)
- strictly increases supplier responsibility effort \( \bar{e} \) in a transparency equilibrium if and only if
  \[
  (w - w) > (p - w)/2; \tag{8}
  \]
- has no effect on supplier responsibility effort \( e \) without transparency;
- strictly decreases the threshold \( \tau \) for existence of a transparency equilibrium if \( \tau > 0 \) and (8).

(b.) If suppliers are demand-constrained, decreasing supplier production cost \( c \)
- strictly increases supplier responsibility effort \( \bar{e} \) in a transparency equilibrium;
- strictly increases supplier responsibility effort \( e \) without transparency;
- strictly increases \( \bar{e} - e \) if and only if
  \[
  \frac{r''(\bar{e})}{r''(e)} < \frac{(2 - d)k - (1 - d)E[X]}{E[X]}; \tag{9}
  \]
- strictly decreases the threshold \( \tau \) for existence of a transparency equilibrium if and only if
  \[
  \tau > 0 \text{ and } \frac{r''(\bar{e})}{r''(e)} < \frac{(1 - vd(1 - e))(1 - (1 - (1 - d)^2)(1 - e))w((2 - d)k - (1 - d)E[X])}{(1 - vd(1 - \bar{e}))(1 - (1 - (1 - d)^2)(1 - \bar{e}))wE[X]}. \tag{10}
  \]

If suppliers are not demand-constrained, then \( \bar{e}, e \) and \( \tau \) are invariant with respect to \( c \).

Proposition 3a shows that supplier capacity \( k \) and transparency are complementary in increasing supplier responsibility effort under condition (8). That condition means that at the nominal wholesale price \( w \), B1’s chosen supplier S captures more than half of the value to B1 and S of having S sell to B1, rather than to the outside option. Why does supplier responsibility effort \( \bar{e} \) in a transparency equilibrium strictly increase with capacity \( k \) if and only if (8)? Selling to B2 enables S to utilize all its capacity to supply buyers that are willing to pay that nominal wholesale price \( w \) for responsibility (which becomes more valuable to S as S’s capacity \( k \) increases) but also induces price negotiation between B1 and B2 for S’s limited capacity (which increases S’s per unit contribution as S’s capacity \( k \) decreases). The former effect is dominant if and only if the nominal wholesale price \( w \) is sufficiently high, according to (8). Hence as \( k \) increases, a candidate supplier
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Condition (8) is sufficient, but not necessary, for B1’s incentive for transparency to increase with supplier capacity $k$. If both B1 and B2 source from S, B1 and B2 benefit directly from an increase in S’s capacity $k$ (acquiring more units at lower prices). Under condition (8) they benefit indirectly from the increase in S’s responsibility effort $\bar{e}$. In contrast, without transparency, B1’s expected profit is invariant with respect to supplier capacity $k$. Hence under condition (8), an increase in supplier capacity $k$ favors transparency.

Proposition 3b shows that for demand-constrained suppliers, production cost reduction increases responsibility effort. Moreover, production cost reduction and transparency are complementary in increasing responsibility effort (assuming $r''(\bar{e})$ is not too much larger than $r''(\bar{e})$ as specified in (9) which holds, for example, if $r(\cdot)$ is quadratic). The rationale for Proposition 3b is that, for a demand-constrained supplier, winning the business of B1 increases the production quantity and winning the business of B2 also does so. Reduction in a supplier’s unit production cost $c$ increases the supplier’s margin on each unit sold. Hence, for a demand-constrained supplier, reduction in $c$ makes the the opportunity to sell to B1 and the opportunity to sell to B2 more valuable. That increases the supplier’s responsibility effort $\bar{e}$ to win the business of B1 alone and, even more greatly, increases the supplier’s responsibility effort $\bar{e}$ to win the business of B1 and B2 (assuming $r''(\bar{e})$ is not too much larger than $r''(\bar{e})$ as specified in (9)). Thus, reduction in $c$ magnifies the gain in responsibility effort due to transparency, i.e., increases the incentive for B1 to commit to transparency. However, B1’s expected cost of transparency increases with supplier responsibility effort, as B1 is more likely to incur the shortage costs of sharing its supplier with B2. Hence the condition (10) for reduction in $c$ to motivate B1 to commit to transparency is stronger than (9).

While publishing its supplier list, Nike has helped suppliers to adopt lean manufacturing practices, which, as shown empirically by (Distelhorst et al. 2017), reduced the frequency of failed audits due to “Serious” or “Critical” violations of labor, health, or environmental standards. Lean practices reduce a supplier’s variable cost of production and increase a supplier’s productive capacity with existing resources, so Proposition 3 helps to explain how transparency and lean practices could promote supplier responsibility.

Robustness: We assumed $x_1 + x_2 > k$ for $i \in \{1, 2\}$ with probability 1 for brevity of expressions and exposition. All the results in §3 hold without that assumption. The Appendix provides the generalized expressions for the firms’ expected profit functions and the thresholds $\tau$, $\delta$, $\underline{a}$, and $\overline{p}$, allowing for the event $x_1 + x_2 \leq k$ to occur with positive probability.

All the results in §3 hold under the assumption that a candidate supplier knows whether or not he has a violation and also hold under the opposite informational assumption that each supplier
possesses the same prior probability $v$ as the buying firm regarding an existing violation and chooses responsibility effort $e$ under uncertainty to detect and eliminate a violation (if one exists). Similar symmetric prior information assumptions have been used by Plambeck and Taylor (2016) and Levi et al. (2017). The sole exception in results is that, in Proposition 1c, the threshold $\tau$ decreases with $v$ under the former assumption but may increase with $v$ under the latter. In contrast, §4 and §5 show how those two opposite informational assumptions lead to qualitatively different results.

4. Results: Commitment to Publish a Terminated Supplier’s Identity

Should B1 publish the identity and responsibility violations of a terminated supplier, i.e, “blacklist” a supplier that fails the audit? For the remainder of the paper, we focus on the case that $w > c$, meaning that a candidate supplier initially has a viable outside option to sell to another buyer, and assume that blacklisting eliminates that outside option.

The propositions in this section are complex because of the interaction between the two sorts of transparency that a buying firm may choose to employ. Therefore we will preview some high-level insights before we present the propositions and the deeper and more detailed insights therein.

**Preview of Results:** A fire safety violation (like a lack of smoke alarms and evacuation routes) would presumably be known to a supplier (ILO and IFC 2016). A buying firm gains greater expected profit by committing to blacklist any candidate supplier that fails an audit for such a “known” type of violation. That threat of blacklisting motivates a candidate supplier to exert greater effort to eliminate a known violation before undergoing the buying firm’s audit. Moreover, the threat of blacklisting can screen out a candidate supplier with a persistent known violation (assuming the buyer’s audit is likely to detect the violation). Screening occurs when the candidate supplier declines to undergo the buying firm’s audit, and instead sell all $k$ units at price $w$ to a buyer that does not audit. The first sort of transparency considered in this paper (commitment to publish a supplier’s identity) can harm the responsible buying firm by preventing screening, i.e., by attracting a supplier with a known violation to try to pass the responsible buying firm’s audit.

In contrast, a bonded labor or a building structural violation likely would not be known to a supplier, even if the supplier exerted effort to uncover and eliminate such an “unknown” violation (Verite 2016, ILO and IFC 2016). A buying firm should not commit to blacklist a candidate supplier that fails an audit for such an “unknown” type of violation, when that would cause the supplier to refuse to undergo the buying firm’s audit and instead sell to a buyer that does not audit. The two sorts of transparency (commitment to blacklisting and to publish suppliers’ identities) are complementary when, together, they attract a candidate supplier to exert greater effort to uncover and eliminate unknown violations and undergo the buying firm’s audit.

We will first consider the case that a violation is known to the supplier, then turn to the opposite case that a violation is unknown.
**Known violation:** Suppose that a candidate supplier to B1 initially knows whether or not it has a responsibility violation. If the candidate supplier initially has a responsibility violation, the supplier chooses how much responsibility effort to exert, observes whether or not that effort eliminated the violation, then decides whether to undergo B1’s audit or decline to do business with B1.

For brevity of exposition, in the case in which a candidate supplier to B1 is indifferent between declining B1’s business versus undergoing B1’s audit, we focus on the equilibrium in which the candidate supplier declines B1’s business. We focus on the parameter region in which the threshold $\tau$ is strictly positive, meaning that a transparency equilibrium arises only if B1 and B2 have responsibility concerns.

Proposition 4a-d shows that B1 should commit to publish its blacklist, which spurs responsibility effort and can screen out a candidate supplier when that supplier has a persistent violation. Proposition 4e characterizes the conditions under which B1 should also commit to publish its supplier’s identity. In the proposition below, $\eta$ and $\gamma$ are thresholds on $\tau$ that define the parameter region in which B2 is attracted to take S as its candidate supplier, and $\theta$ captures the $\tau$ threshold for B1 to commit to publish its supplier’s identity.

**Proposition 4.** Suppose that each candidate supplier to B1 knows whether or not it has a responsibility violation. (a.) In equilibrium, B1 commits to publish its blacklist. (b.) B1’s commitment to publish its blacklist strictly increases the responsibility effort by a candidate supplier to B1 to eliminate a violation, whether or not B1 also commits to publish its supplier’s identity. (c.) Suppose B1 commits to publish only its blacklist, not its supplier’s identity. In equilibrium, in the event that a candidate supplier to B1 has a violation and fails to eliminate it, the candidate supplier declines B1’s business if and only if

$$w \geq \alpha \equiv c + \frac{(w-c)(1-d)E[X]}{(1-d)E[X] + dk}.$$  

(11)

(d.) Suppose B1 commits to publish its blacklist and its supplier’s identity. In equilibrium, in the event that a candidate supplier to B1 has a violation and fails to eliminate it, the candidate supplier declines B1’s business if

$$w \geq \beta \equiv c + \frac{(1-d)^2((p-c)(2E[X]-k)+2(w-c)(k-E[X])) + d(1-d)(w-c)E[X]}{k-d(1-d)(k-E[X])} \quad \text{(where } \beta > \alpha);$$  

(12)

whereas for $w \in [\alpha, \beta)$ the candidate supplier declines B1’s business with probability

$$\begin{cases} 0 & \text{if } \tau \geq \gamma, \\ \frac{\tau-\gamma}{\eta-\gamma} & \text{if } \tau \in (\eta, \gamma) \quad \text{(where } \eta < \gamma < \tau); \\ 1 & \text{if } \tau \leq \eta, \end{cases}$$  

(13)
and for $w < \alpha$ the candidate supplier does not decline B1’s business.

B2 takes B1’s supplier S as its first candidate supplier with probability

$$P(S) = \begin{cases} 
1 & \text{if } \tau \geq \gamma, \\
\in (0,1) & \text{if } \tau \in (\eta, \gamma) \text{ and } \alpha < w < \beta, \\
0 & \text{otherwise.}
\end{cases}$$

(e.) An equilibrium exists in which B1 also commits to publish its supplier’s identity if and only if one of the following four sets of conditions holds

$$\begin{cases}
(12), \tau \geq \gamma \text{ and } k \geq 2E[X] + v(a + s)(1 - e_s - \bar{e}_s)/(p - w)(1 - v e_s)(1 - v(1 - \bar{e}_s)) \\
\end{cases}$$

$$w \in (\alpha, \beta), \eta < \tau \leq \theta$$

$$w = \alpha, \gamma \leq \tau \leq \theta$$

$$w < \alpha, \tau \geq \theta.$$

Proposition 4 shows that some transparency is always beneficial to B1; at the very least, B1 should commit to publish its blacklist. Commitment to publish its blacklist increases B1’s expected profit (Proposition 4a) in two ways. First, it spurs greater responsibility effort by each candidate supplier to B1 to eliminate a violation (Proposition 4b). Second, it screens out a candidate supplier in the event that that supplier has a persistent violation (Proposition 4c and d). Screening occurs when $w$ (the price at which a supplier can sell without passing an audit) is high. That outside option would be destroyed by blacklisting. Hence a candidate supplier to B1, having a persistent violation, takes the outside option rather than risk failing B1’s audit when $w$ is high. If B1 commits to publish its supplier’s identity and can thereby attract B2 to potentially source from the same supplier, then a candidate supplier to B1 is more attracted to undergo B1’s audit even when it has a violation, which raises the threshold on $w$ for screening to occur from $\alpha$ to $\beta$. Screening also tends to occur when each candidate supplier to B1 has large capacity $k$ or B1’s audit is effective; both thresholds $\alpha$ and $\beta$ strictly decrease with $k$ and $d$.

To understand when B1 should also commit to publish its supplier’s identity (Proposition 4e), we consider three different regions depending on the outside option $w$; i.e., $w \geq \beta$, $w \in (\alpha, \beta)$ or $w < \alpha$. First consider (15). Under condition (12) perfect screening occurs whether or not B1 commits to publish its supplier’s identity, meaning that with probability 1, B1’s selected supplier S does not have a violation. B2 is willing to take S as its first candidate supplier if and only if $\tau \geq \gamma$. B1 commits to publish its supplier’s identity if and only if that will attract B2 to source from S ($\tau \geq \gamma$) and the resulting increase in the responsibility effort by each candidate supplier to B1, from $e_s$ to $\bar{e}_s$, reduces B1’s supplier search and auditing costs in expectation, despite the need to share S’s
capacity with B2 (reflected by the lower bound on capacity $k$ in (15)). $\bar{e}_s$ and $e_s$ in (15) represent the responsibility effort levels by a candidate supplier to B1 when B1 does and does not commit to publish its supplier’s identity, respectively, and are the unique solutions to

$$
(p - c)(2E[X] - k) + 2(w - c)(k - E[X]) - (w - c)k = r'(\bar{e}_s),
$$

(19)

$$
w - w = r'(e_s).
$$

(20)

The rationale for (16) and (17) is that for $w \in [\alpha, \beta]$, perfect screening occurs if and only if B1 does not publish its supplier’s identity. Perfect screening is more valuable to B1 than lower supplier search and auditing costs in expectation to the extent that B1’s cost associated with a responsibility violation $\tau$ is high. Hence under the conditions in (16) and (17), B1 commits to publish its supplier’s identity if and only if $\tau \leq \theta$ and B2 is attracted to take S as its first candidate supplier ($\tau > \eta$ in for $w \in (\alpha, \beta)$ and $\tau \geq \gamma$ for $w = \alpha$).

For $w < \alpha$, B1 cannot accomplish screening with transparency. Hence, in deciding whether or not to commit to publish its supplier’s identity, B1 trades off the benefits of increasing S’s responsibility effort versus the cost of sharing S’s capacity with B2, as in the base model. In (18), the condition for B1 to commit to publish its supplier’s identity is analogous to that in Proposition 1 (with $\theta$ substituted for $\tau$).

Comparison of Proposition 1 and Proposition 4e shows how commitment to publish a blacklist changes B1’s optimal policy regarding whether or not to commit to publish its supplier’s identity. In favor of full transparency, B2 is more inclined to source from B1’s supplier due to the screening and increased responsibility effort benefits with blacklisting. In other words, blacklisting expands the parameter region in which B1 can increase S’s responsibility effort through commitment to publish its supplier’s identity. However, with screening, B1 may be less inclined to commit to publish its supplier’s identity because S’s responsibility effort no longer reduces B1’s risk of being associated with a violation. Instead, B1 considers only the trade-off between increasing the responsibility effort by each candidate supplier to B1 in order to reduce the supplier qualification costs in expectation, versus the cost of sharing S’s capacity with B2. Hence with screening, B1 commits to publish its supplier’s identity when S’s capacity $k$ or the resulting improvement in the responsibility effort $\bar{e}_s - e_s$ is sufficiently large. Analogously, in the parameter region (18) in which screening does not occur, the threshold $\theta$ may be either higher or lower than $\tau$, depending on the improvement in the responsibility effort by a candidate supplier to B1 resulting from B1’s commitment to publish its supplier’s identity. That improvement may be higher or lower than $\bar{e} - e$ in the base model, depending on $r''(\cdot)$, the curvature of S’s responsibility effort cost function.

4 We establish in the Appendix that the threshold for B2’s cost associated with a responsibility violation above which B2 is attracted to potentially source from S is greater with blacklisting than in the base model.
The option for B1 to commit to publish a blacklist can indirectly reduce the responsibility effort by a candidate supplier to B1, by changing B1’s optimal policy from commitment to publish its supplier’s identity to commit only to publish its blacklist.

**Corollary 1.** If \( k < 2E[X] + v(a + s)(1 - \xi - \bar{e})/(p - w)(1 - v\xi)(1 - v(1 - \bar{e})) \), \( w \geq \beta \), \( \tau \geq \underline{\tau} \) and \( \xi < \bar{e} \), then B1 commits only to publish a blacklist and does not commit to publish its supplier’s identity, which results in strictly lower responsibility effort by a candidate supplier to B1 than if B1 could not blacklist, in which case B1 would instead commit to publish its supplier’s identity. The parameter region wherein this occurs is nonempty.

Overall, our findings complement the prior literature and most notably (Chen and Lee 2017) in showing that transparency has important similarities to and some advantages over contractual incentives for supplier responsibility. Like blacklisting, Chen and Lee (2017) show that screening can be accomplished by requiring a supplier to pay for a “responsibility certification.” However, transparency offers four advantages: First, a commitment to blacklisting can spur responsibility effort whereas responsibility certification cannot, because the certification occurs before the supplier decides whether to commit a violation or incur cost to avoid doing so. Second, a blacklisted supplier is prevented from producing for other buyers, whereas a supplier that pays for and fails a responsibility certification presumably “owns” that result and need not disclose it publicly, so could continue production for other buyers. Third, transparency is advantageous for a capital-constrained supplier because it requires no advance payment. Finally, despite being effective in theory, imposing a financial penalty on a supplier for failing an audit may not be feasible in practice. So, the best a buying firm can do is to commit to pay a premium if the supplier passes the audit and withhold payment otherwise. The advantage of transparency is that transparency commitments may be less costly ways to induce responsibility effort than paying a premium, and blacklisting is implementable when a financial penalty is not.

**Unknown violation:** In this second scenario, a candidate supplier to B1 is uncertain whether or not it has a responsibility violation. More specifically, the candidate supplier initially assigns prior probability \( v \) that it has a responsibility violation. The candidate supplier decides how much responsibility effort to exert to eliminate any violations and does not observe whether or not the effort was successful. The candidate supplier also decides whether or not to undergo B1’s audit or decline to do business with B1.

Proposition 5 considers the informational scenario in which a candidate supplier to B1 is uncertain whether or not it has a responsibility violation. More specifically, the candidate supplier initially assigns prior probability \( v \) that it has a responsibility violation. The candidate supplier decides how much responsibility effort to exert to eliminate any violations and does not observe whether or not the effort was successful. The candidate supplier also decides whether or not to undergo B1’s audit or decline to do business with B1.
Proposition 5. Suppose that each candidate supplier to B1 is uncertain whether or not it has a responsibility violation. (a.) In equilibrium, B1 does not commit to publish its blacklist if and only if

\[ w \geq \beta_u \equiv c + \frac{(1 - v(1 - \bar{e}_u))(2 - d) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) + v(1 - e_u)(1 - d)(w - c)E[X] - r(\bar{e}_u)}{k - v(1 - \bar{e}_u)(1 - d)(k - E[X])} \]

(where \( \beta_u > \beta \))

or

\[ w \geq \alpha_u \equiv c + \frac{(1 - vd(1 - e_u))(w - c)E[X] - r(e_u)}{kv(1 - d) + E[X](1 - vd(1 - e_u))} \]

and \( \tau \leq \theta_u \) (where \( \alpha_u > \alpha \), \( \alpha_u < \beta_u \), \( \theta_u < \tau \)).

(b.) An equilibrium exists in which B1 commits to publish its blacklist and its supplier’s identity if and only if

\[ w < \beta_u \quad \text{and} \quad \tau \geq \theta_u. \]

(c.) An equilibrium exists in which B1 commits to publish only its supplier’s identity if and only if

\[ w \geq \beta_u \quad \text{and} \quad \tau \geq \tau. \]

The rationale for Proposition 5a is that commitment by B1 to publish its blacklist would cause a candidate supplier to decline B1’s business when \( w \geq \beta_u \), or when \( w \geq \alpha_u \) and B1 did not commit to publish its supplier’s identity. Unlike the setting of Proposition 4, B1’s expected profit is reduced by having a candidate supplier decline its business. This is because a candidate supplier to B1 is uncertain regarding whether or not it has a violation and may decline B1’s business even though it does not have a violation. Being uncertain whether or not it has a responsibility violation, a candidate supplier is more inclined to undergo B1’s audit at the risk of blacklisting than when it has a known violation, which is reflected in the \( \alpha_u > \alpha \) and \( \beta_u > \beta \) comparison with the thresholds \( \alpha \) and \( \beta \) from Proposition 4. The \( \bar{e}_u \) and \( e_u \) in the definition of \( \beta_u \) and \( \alpha_u \) represent S’s responsibility effort when B1 does and does not commit to publish its blacklist, respectively, and B1 commits to publish its blacklist, and are the unique solutions to

\[ v(2 - d)d \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) - v(1 - d)d \left( (w - c)E[X] + (k - E[X])(w - c) \right) = r'(\bar{e}_u) \]

\[ vd \left( (w - c)E[X] + (w - c)(k - E[X]) \right) = r'(e_u). \]

Consider the parameter region \( w \in [\alpha_u, \beta_u] \), in which a candidate supplier would decline B1’s business if B1 were to commit to publish its blacklist alone, but would undergo B1’s audit if B1 were to commit to publish both its blacklist and its supplier’s identity, thereby attracting B2 to
source from the same supplier. The dual transparency commitment by B1 and potential to sell to B2 would cause a candidate supplier to exert greater responsibility effort, but would have the drawback for B1 and B2 of sharing scarce capacity. Hence when B1 and B2 each has little cost from association with a violation, \( \tau \leq \theta_u \), B1 is unwilling to make the dual transparency commitment and B2 prefers to search for an alternative supplier. Therefore, B1 makes no transparency commitment when \( w \in [\alpha_u, \beta_u) \) and \( \tau \leq \theta_u \).

Together, Proposition 1 and Proposition 5 show that the dual transparency commitments are complements in the parameter region \( w \in [\alpha_u, \beta_u) \). Commitment by B1 to publish a supplier’s identity (the carrot) can motivate a candidate supplier to do business with B1 even when B1 also commits to publish its blacklist (the stick). B1’s commitment to publish its blacklist increases the responsibility effort by a candidate supplier to B1 and can thus motivate B2 to potentially source from the same supplier as B1, thereby making B1’s commitment to publish its supplier’s identity an effective reward. Commitment by B1 to publish its blacklist and its supplier’s identity induces strictly higher responsibility effort from a candidate supplier to B1 than either of those commitments would induce alone. That strict increase in responsibility effort increases the attractiveness of transparency, which is reflected in the threshold \( \theta_u \) being strictly lower than the threshold \( \tau \) from Proposition 1. Due to the complementarity in the dual commitments, in the parameter region \( w \in [\alpha_u, \beta_u) \) and \( \tau \in [\theta_u, \tau) \), B1 commits to publish its blacklist and its supplier’s identity and thereby achieves strictly greater expected profit and responsibility effort from each candidate supplier, whereas making either one of those transparency commitments alone would reduce B1’s expected profit.

Conversely, Corollary 2 shows that in the region \( w < \alpha_u \), having the option to blacklist can result in lower responsibility effort by a candidate supplier to B1 by eliminating B1’s incentive to commit to publish its supplier’s identity.

**Corollary 2.** If \( w < \alpha_u \), \( \tau \leq \tau < \theta_u \) and \( e_u < \bar{e} \), then B1 commits only to publish a blacklist and does not commit to publish its supplier’s identity, which results in strictly lower responsibility effort by a candidate supplier to B1 than if B1 could not blacklist, in which case B1 would instead commit to publish its supplier’s identity.

### 5. Results: Supplier Evasion of a Buyer’s Audit

In reality, some suppliers try to hide responsibility violations in order to pass a buying firm’s audit (Plambeck and Taylor 2016). Whereas (Plambeck and Taylor 2016) model hiding of “unknown” types of violation and consider only blacklisting, this section undertakes a complementary analysis. Specifically, this section makes the opposite informational assumption, that a violation is known to the supplier and considers a supplier’s preferred type of transparency (publishing a supplier’s
identity) in comparison with blacklisting. This section identifies main results that are qualitatively different depending on the sort of transparency or whether violation is known vs. unknown to the supplier.

Building on the “known violation” model in the previous section, we now allow for a candidate supplier to attempt to hide a violation. The sequence of events is that, after a candidate supplier exerts responsibility effort $e$ to eliminate an existing violation, that supplier observes whether or not the violation persists. If the violation persists, the supplier chooses how much hiding effort $e_h$ to exert at cost $r_h(e_h)$. That hiding effort enables the supplier to pass a buying firm’s audit with probability $e_h + (1 - e_h)(1 - d) = (1 - d(1 - e_h))$ despite having a violation. By assumption, each candidate supplier’s hiding cost function $h(e_h)$ and responsibility cost function $r(e)$ both are increasing, twice differentiable and strictly convex, with $r(0) = 0$ and $r_h(0) = 0$.

If B1 is not committed to transparency, the hiding effort for each candidate supplier to B1 is uniquely determined by

$$e_h' \equiv \arg \max \left\{ (1 - d(1 - e_h)) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) + d(1 - e_h)(w - c)k - r_h(e_h) \right\},$$

and the responsibility effort for each candidate supplier to B1 is uniquely determined by

$$e' \equiv \arg \max \left\{ (1 - (1 - e) d(1 - e_h')) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) + (1 - e)d(1 - e_h')(w - c)k - r(e) \right\}.$$

**Commitment to Publish a Supplier’s Identity:** For comparison, consider a transparency equilibrium in which B1 commits to publish its supplier’s identity and B2 takes $S$ as its first candidate supplier. The equilibrium hiding effort for a candidate supplier to B1 is uniquely determined by

$$e_h^* \equiv \arg \max \left\{ (1 - d(1 - e_h)) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) + (1 - d(1 - e_h))^2 \Delta 
+ d(1 - e_h)(w - c)k - r_h(e_h) \right\}$$

and the equilibrium responsibility effort is uniquely determined by

$$e^* \equiv \arg \max \left\{ (1 - (1 - e) d(1 - e_h^*)) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) 
+ \left( e + (1 - e)(1 - d(1 - e_h^*))\right) \Delta + (1 - e)d(1 - e_h^*)(w - c)k - r(e) \right\},$$

where $\Delta$ captures the improvement in the candidate supplier’s expected contribution due to the potential to sell to both buying firms:

$$\Delta \equiv (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) - ((w - c)E[X] + (w - c)(k - E[X])).$$

Proposition 6 shows that transparency (committing to publish a supplier’s identity) causes a candidate supplier with a persistent violation to exert more hiding effort and identifies other factors
that drive up hiding effort. Transparency causes a candidate supplier to exert less responsibility effort if the candidate supplier initially would be sufficiently likely to pass an audit through hiding. Otherwise, when a candidate supplier is unlikely to pass an audit through hiding, transparency causes the candidate supplier to exert more responsibility effort.

Proposition 6. [Commitment to Publish a Supplier’s Identity] (a.) Transparency strictly increases hiding effort by each candidate supplier to B1: \( e_h^* > e_h \). (b.) The resulting transparency equilibrium hiding effort \( e_h^* \) strictly increases with the buying firms’ selling price \( p \). It strictly increases with the supplier’s capacity \( k \) if and only if \( (w - w) > (p - w)/2 \). Both the transparency equilibrium hiding effort \( e_h^* \) and the initial equilibrium hiding effort \( e_h \) without transparency strictly decrease with the supplier’s outside alternative unit price \( w \). (c.) If a candidate supplier initially exerts substantial equilibrium hiding effort, \( e_h^* > \bar{e}_h \), then transparency strictly decreases its responsibility effort: \( e^* < e' \). If a candidate supplier exerts little equilibrium hiding effort even with transparency \( e_h^* < \bar{e}_h \), then transparency strictly increases its responsibility effort: \( e^* > e' \).

The thresholds \( \bar{e}_h \) and \( \bar{e}_h \) are invariant with respect to \( w \), \( p \), and \( k \); closed form expressions for those thresholds are in (87) and (88) in the Appendix.

When a candidate supplier earns little without passing an audit (\( w \) is low), the supplier exerts greater hiding effort, so the condition \( e_h^* > \bar{e}_h \) tends to hold. Then, transparency “backfires” (strictly reduces the supplier’s responsibility effort and strictly increases the supplier’s hiding effort), which implies that B1 should not commit to publish its supplier’s identity. The mechanism by which backfiring occurs is that transparency increases the incentive for the supplier to pass the audit, which drives up hiding effort. The increased hiding effort reduces the value of responsibility effort, causing the supplier to exert less responsibility effort.

On the other hand, even with transparency, a candidate supplier exerts little hiding effort when a candidate supplier has an attractive outside option (\( w \) is high), when buying firms’ selling price \( p \) is low, or when the supplier has little capacity \( k \) and \( (w - w) > (p - w)/2 \), meaning that the supplier has little to gain from negotiating over capacity allocation between B1 and B2. Under those conditions a candidate supplier has little incentive to pass an audit. Then, the direct effect of transparency in increasing a candidate supplier’s responsibility effort (established in Proposition 1a) dominates the countervailing effect of the small increase in hiding effort due to transparency, and Proposition 1a holds. Under those conditions that mitigate hiding, transparency increases responsibility effort.

Commitment to Blacklisting: Recall that blacklisting destroys the supplier’s outside option, reducing \( w \) to 0 in the event that the supplier fails B1’s audit. When B1 commits to blacklisting, the equilibrium hiding effort for a candidate supplier is uniquely determined by

\[
e_{h,b}^* \equiv \arg \max \left\{ (1 - d(1 - e_h)) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - r_h(e_h) \right\},
\]
and the equilibrium responsibility effort is uniquely determined by

\[ e^*_h \equiv \arg \max \left\{ \left( 1 - (1 - e) d(1 - e^*_h, b) \right) \left( (w - c) E[X] + (w - c)(k - E[X]) \right) - r(c) \right\}. \]

Proposition 7 shows that transparency (commitment to blacklisting) increases a candidate supplier’s hiding effort and, depending on the level of hiding effort, can either decrease or increase his responsibility effort. These effects are qualitatively similar to those of the other sort of transparency. However, hiding effort is driven up by entirely different factors under blacklisting than the other sort of transparency.

**Proposition 7.** [Commitment to Blacklisting] (a.) Transparency strictly increases hiding effort by each candidate supplier to B1: \( e^*_{h,b} > e'_h \). (b.) The resulting equilibrium hiding effort \( e^*_{h,b} \) strictly increases with the probability of detecting a violation \( d \), the wholesale price \( w \), and the supplier’s outside alternative unit price \( w \). The initial equilibrium hiding effort \( e'_h \) also strictly increases with the probability of detecting a violation \( d \) and the wholesale price \( w \), but strictly decreases with supplier’s outside alternative unit price \( w \). (c.) If a candidate supplier initially exerts substantial equilibrium hiding effort, \( e^*_h > e'_h \), then transparency strictly decreases its responsibility effort: \( e^*_h < e' \). If a candidate supplier exerts little equilibrium hiding effort even with transparency \( e^*_{h,b} < e^*_{h,b} \), then transparency strictly increases its responsibility effort: \( e^*_h > e' \). (d.) \( e_{h,b} \leq e_h \) and \( e_{h,b} \leq e^*_h \).

The thresholds \( e_{h,b} \) and \( e^*_{h,b} \) are invariant with respect to \( w, d, \) and \( w \); closed form expressions for those thresholds are in (93) and (94) in the Appendix.

The intuition for Proposition 7a and 7c is fundamentally the same as the intuition for Proposition 6a and 6c provided above, because both forms of transparency increase a candidate supplier’s incentive to pass the audit.

Proposition 7b and c imply that commitment to blacklisting backfires (strictly increases hiding effort and strictly decreases responsibility effort) when the buyer’s audit is effective (\( d \) is high) or the nominal wholesale price \( w \) is high. High \( d \) (meaning that the audit is likely to detect a violation that the candidate supplier fails to hide) makes hiding effort highly valuable, both with and without the commitment to blacklisting. Similarly, high \( w \) increases the incentive for the supplier to pass the audit, which exacerbates hiding both with and without the commitment to blacklisting. Under either condition, the high level of hiding makes the marginal value of responsibility effort low, so that commitment to blacklisting and associated increase in hiding effort cause the supplier to exert less responsibility effort.

Proposition 7b and c also imply that commitment to blacklisting backfires when a candidate supplier earns little without passing an audit (\( w \) is low). Without transparency, the supplier exerts greater hiding effort, so the condition \( e'_h > e_{h,b} \) tends to hold, which leads to backfiring.
However, commitment to blacklisting is most harmful in terms of increasing the supplier's hiding effort when the supplier has an attractive outside option $w$, because then hiding effort is initially low without blacklisting and increases to a high level with threat of blacklisting eliminating the valuable outside option. A large increase in hiding effort makes a correspondingly large reduction in the value of responsibility effort, so the sufficient condition for commitment to blacklisting to increase the supplier's responsibility effort $\epsilon^*_h, b < \epsilon_{h,b}$ tends not to hold when $w$ is large.

Together, Proposition 7a,c,d and Proposition 6a,c imply that commitment to blacklisting is more prone than the other form of transparency to backfire (strictly increase hiding effort and strictly decrease responsibility effort).

**Corollary 3.** If $\epsilon'_h > \bar{\epsilon}_h$ so commitment to publish a supplier's identity backfires, then commitment to blacklisting also backfires. The parameter region wherein commitment to blacklisting backfires and commitment to publish a supplier's identity does not is nonempty.

The rationale for Proposition 7d and the Corollary is that publishing a supplier's identity rewards a candidate supplier if and only if he passes both buying firms' audits, whereas blacklisting penalizes a supplier if and only if that supplier fails B1's audit. In the former case the candidate supplier must pass two audits sequentially to reap the reward, whereas in the latter the candidate supplier faces only one. The need to pass two audits rather than one increases the value of responsibility effort by more than that of hiding effort, because if a candidate supplier eliminates a violation he is guaranteed to pass both audits, whereas if the candidate supplier passes the first audit through hiding, he can still fail the second audit. In that manner, commitment to publish a supplier's identity outperforms commitment to blacklisting by favoring responsibility effort relatively more than hiding effort.

A related insight is that B2's commitment to audit before sourcing from a candidate supplier, by favoring responsibility over hiding effort by a candidate supplier, can motivate B1 to commit to publish its supplier's identity, and thereby increase the expected profit of B2, B1 and the supplier.

For comparison, formal results for the unknown violation model are provided in the Appendix. Whereas our analysis above assumed that a violation is known to a candidate supplier, the opposite assumption (a candidate supplier chooses hiding and responsibility effort while uncertain whether or not he has a violation) is favorable for transparency, in three ways. First, in contrast to Propositions 6a and 7a, each sort of transparency commitment can strictly decrease the equilibrium hiding effort for an unknown violation. Second, each sort of transparency commitment is less prone to backfire for unknown than known violations. Third, a candidate supplier exerts less hiding effort with an unknown violation than with a known violation.
6. Conclusion

This paper shows how one particular sort transparency commitment by a buying firm— to publish the identities of its suppliers—motivates costly effort by candidate suppliers to eliminate their social and environmental violations and thereby pass the buying firm’s audit. By publishing a supplier’s identity, the buying firm signals that the supplier is qualified and responsible, which attracts other buying firms to source from the supplier.

The main drawback for the buying firm is that, in the event of high demand, competition for the supplier’s capacity causes the buying firm to pay a higher price or suffer shortage.

By examining that trade-off between responsibility and capacity in a game theoretic model, the paper identifies the conditions under which that sort of transparency commitment increases a buying firm’s expected profit:

1. if the buying firm sources from a supplier with a responsibility violation, that sourcing relationship and violation are likely to be exposed, or
2. such exposure would impose large brand damage or other costs on the buying firm, or
3. the buying firm has a slim contribution margin, or
4. the buying firm’s cost of identifying, qualifying, and auditing a candidate supplier is high.

The first condition is manifest today in the apparel and electronics industries, wherein buying firms face increasing NGO scrutiny and risk of exposure and publicity of suppliers’ responsibility violations. The second condition presumably holds for the most prominent of those buying firms, who would suffer the greatest brand damage from negative publicity of a supplier’s violations. Hence the first two conditions help to explain why buying firms in the apparel and electronics industries are beginning to publish the identities of their suppliers and why Nike and Apple were leaders in doing so. The first two conditions also help to explain why some buying firms (notably Unilever) commit to publish only the identities of suppliers of a particular input (palm oil, in the case of Unilever) regarding which they face the greatest scrutiny and potential for brand damage.

The third condition above helps to explain the observation that luxury brands and automakers lag behind other buying firms in transparency about their suppliers.

One rationale for the fourth condition is that when the cost of identifying and qualifying a supplier is high, transparency attracts another buying firm to share a supplier, rather than incur high cost to get a dedicated supplier. A second rationale is that a buying firm’s investment in identifying, qualifying and auditing a candidate supplier goes to waste if that candidate fails. The transparency commitment, by motivating candidates to exert complementary costly effort to eliminate violations and win the buying firm’s business, reduces the expected number of candidate suppliers a buying firm must identify and evaluate before successfully establishing a sourcing relationship with one of them. As a real example, to increase a candidate supplier’s incentive to exert costly effort in an
attempt to develop a truck to meet an ambitious energy efficiency standard, FedEx (in partnership with NGO Environmental Defense) committed to make complementary efforts and, in the event of success in meeting the standard, promote the supplier’s truck to other buyers.

A buying firm’s commitment to publish its suppliers’ identities increases the expected profit of its candidate suppliers and selected suppliers, and also increases the expected profit of a buying firm attracted by that transparency to source from the same supplier.

Helping to improve suppliers’ productivity can be complementary to publishing suppliers’ identities, in motivating greater responsibility effort by candidate suppliers and increasing a buying firm’s expected profit. This observation is consistent with Nike’s efforts to help its suppliers adopt lean manufacturing practices while publishing its suppliers’ identities, and the subsequent reduction in the frequency of failed audits by its suppliers. If a supplier is demand-constrained, the prospects of increased demand through transparency and variable cost reduction are complementary in increasing the supplier’s incentive to pass a responsibility audit. If responsible buying firms offer a sufficiently high price to a supplier, transparency and expanded capacity are complementary in increasing the supplier’s incentive to pass a responsibility audit.

The paper also examines a second sort of transparency commitment, to publish a terminated supplier’s identity and responsibility violation following a failed audit. That deters other buyers from sourcing from the supplier, so is called blacklisting. Like a commitment to publish suppliers’ identities, commitment to blacklisting motivates responsibility effort from a candidate supplier. One advantage of blacklisting is that blacklisting is ex post costless for a buying firm (whereas the other sort of transparency generates the costs of sharing a supplier with limited capacity). A second advantage is that blacklisting can screen out a candidate supplier with a known violation. For those reasons, in a simple model, a buying firm should always commit to blacklist a supplier that fails an audit due to a known violation. However, commitment to blacklisting can cause a buying firm to not commit to publish suppliers’ identities, and thus, indirectly, result in lower responsibility effort by a candidate supplier than if the buying firm were to commit to publish suppliers’ identities.

Given those results alone, one would be surprised that in reality, though a coalition of apparel buyers have committed to blacklisting Bangladeshi suppliers with major safety violations, commitment to blacklisting is not widespread. Through model extensions, the paper develops two explanations for that observation. One explanation is that the threat of blacklisting can cause a buying firm to lose a good candidate supplier that is uncertain whether or not it has a violation. Then, publishing suppliers’ identities can attract candidate suppliers to undergo an audit despite the risk of blacklisting, making the two forms of transparency complementary and jointly optimal. Otherwise, the buying firm should refrain from blacklisting.
The second explanation is that either sort of transparency commitment motivates candidate suppliers to attempt to hide violations, particularly known violations, and thus can backfire by causing candidate suppliers to exert less effort to eliminate responsibility violations. Moreover, commitment to blacklisting is more prone to backfire than is commitment to publish suppliers’ identities.

References


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Preliminaries:

The optimal effort for S: Due to being interior solutions to (1) and (2), $\varepsilon$ and $\bar{\varepsilon}$ satisfy:

$$d \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - d(w - c)k = r'(\varepsilon),$$

(23)

$$2 - d)d \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right)$$

$$- (1 - d)d \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - d(w - c)k = r'(\bar{\varepsilon}).$$

(24)

By $r''(\varepsilon) > 0$, these conditions are also sufficient. The left-hand side (LHS) of (24) is strictly greater than that of (23) because $d \in (0, 1), p > w > w', k < 2E[X]$ (because $X_1 + X_2 > k$ with probability 1), and $k > E[X]$. Therefore, conditions $r'(0) < d((w - c)E[X] + (w - c)(k - E[X])) - d(w - c)k$ and $r'(1) > (2 - d)d((p - c)(2E[X] - k) + 2(w - c)(k - E[X])) - (1 - d)d((w - c)E[X] + (w - c)(k - E[X])) - d(w - c)k$ guarantee that solutions to (23) and (24) are interior; i.e., $(\varepsilon, \bar{\varepsilon}) \in (0, 1)$.

Under the alternative assumption that S chooses responsibility effort $e$ under uncertainty (with prior probability $v$ of having a responsibility violation) and detects and eliminates the violation (if one exists) with probability $e$, the expressions for the equilibrium effort levels are as follows:

$$vd \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - vd(w - c)k = r'(\varepsilon),$$

(25)

$$v(2 - d)d \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right)$$

$$- v(1 - d)d \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - vd(w - c)k = r'(\bar{\varepsilon}).$$

(26)

Expressions for Thresholds: Proposition 1 characterizes the region in which a transparency equilibrium exists. For that purpose, define

$$\tau = \frac{1 - (1 - d)\bar{\varepsilon}(1 - \bar{\varepsilon})v}{(1 - d)(\bar{\varepsilon} - \varepsilon)v} \forall 0,$$

(27)

and

$$\tau_2 = \left\{ \begin{align*} \frac{ad}{1 - d} + \frac{1 - (1 - d)^2(1 - \bar{\varepsilon})(1 - \varepsilon) v}{(1 - d)v(\bar{\varepsilon} - \varepsilon + d(1 - \bar{\varepsilon})(1 - (1 - \bar{\varepsilon})v))} & \forall 0. \end{align*} \right.$$  

(28)

Proof of the Core Outcome When Both B1 and B2 Source from the Same Supplier:

If both B1 and B2 source from the same supplier S, negotiation occurs by which S allocates its capacity between the buying firms, B1 has contribution of $(p - w)(k - x_2)$, B2 has contribution of $(p - w)(k - x_1)$, and S has contribution of $(p - c)k - (p - w)(k - x_2) - (p - w)(k - x_1)$. In terms of the contribution for each of the 3 firms, this is the unique core outcome. The rationale is simple.
B1 must obtain contribution of \((p - w)(k - x_2)\), at least, because if B1 refuses to renegotiate the contract that specifies the unit price \(w\), S will choose to sell quantity \(k - x_2\), at least, to B1 at price \(w\) per unit. That quantity \(k - x_2\) is the supplier’s residual capacity after meeting all the demand from B2. B1 cannot obtain strictly greater contribution than \((p - w)(k - x_2)\). If B1 were to obtain contribution \(\varepsilon + (p - w)(k - x_2)\) with \(\varepsilon > 0\) then, because the total contribution is at most \((p - c)k\), B2 and S together would earn contribution of less than \((p - c)k - (\varepsilon + (p - w)(k - x_2))\) < \((p - c)k - \varepsilon + (w - c)(k - x_2)\). That could not occur, because B2 and S could each achieve strictly higher contribution by cooperating to allocate \(x_2\) units of S’s capacity to B2 while S sells \(k - x_2\) to B1 at the contracted unit price \(w\) and B2 and S together would generate contribution of \((p - c)k + (w - c)(k - x_2)\). Hence B1 obtains contribution \((p - w)(k - x_2)\). By the same logic, B2 obtains contribution \((p - w)(k - x_1)\) and S obtains contribution \((p - c)k - (p - w)(k - x_2) - (p - w)(k - x_1)\).

**Conditions for Ex Post Optimality of Responsibility-Auditing a Candidate Supplier and Sourcing from that Supplier if and only if the Supplier Passes the Audit:** In our analysis below, we break ties between sourcing from a current candidate supplier and continuing the supplier search and qualification process in favor of sourcing from the current supplier.

Recall that two types of perfect Bayesian equilibria exist for the game between B1, B2, and candidate suppliers. In the first type of equilibrium, a candidate supplier has potential to supply either B1 or B2, but not both. We now verify in this equilibrium that responsibility-auditing a candidate supplier and sourcing from that supplier if and only if the supplier passes the audit is ex post optimal for B1 and for B2 if (5) holds. Undertaking supplier search and qualification is ex post optimal (than not sourcing) if the buying firm’s expected profit from this process is strictly greater than 0, \(\pi > 0\). \(\tau > (p - w)E[X]\) and \(\pi > 0\) guarantee that it is optimal ex post for the buying firm to continue the supplier search process and not source from a candidate supplier if that supplier failed the audit. For a buying firm to find it optimal ex post to source from a candidate supplier that passed the audit, the buying firm’s expected profit from that supplier (excluding sunk costs) must be greater than the expected profit from continuing the supplier search process; i.e., \((p - w)E[X] - v(1 - \xi)(1 - d)\tau / (1 - vd(1 - \xi)) \geq \pi\). This inequality holds by \(a > 0\), \(s \geq 0\), \((v, d, \xi) \in (0, 1)\). In equilibrium, responsibility effort by any candidate supplier is \(\xi\) and the expected profit of a buying firm (B1 or B2) is \(\pi\). If a buying firm deviates by not auditing, the buying firm’s expected profit is \((p - w)E[X] - v(1 - \xi)\tau - s\). Auditing a candidate supplier is therefore ex post optimal for a buying firm if and only if \(\pi > (p - w)E[X] - v(1 - \xi)\tau - s\), which is equivalent to (5).

We now focus our attention to the transparency equilibrium and prove that responsibility-auditing a candidate supplier and sourcing from that supplier if and only if the supplier passes the audit is ex post optimal for B1 if (6) holds. In a transparency equilibrium, B1 chooses to reveal its supplier’s identity (over not making a transparency commitment, which would lead to an expected...
profit of $\pi$) and obtains an expected profit of $\pi_{t1}$ by doing so. This implies that $\pi_{t1} \geq \pi$. Then, $\pi > 0$ leads to $\pi_{t1} > 0$, which ensures that undertaking supplier search and qualification is ex post optimal for B1 (than not sourcing). $\pi_{t1} > 0$ together with $\tau > (p - w)E[X]$ and $2E[X] > k$ ensure that continuing the supplier search process and not sourcing from a candidate supplier is ex post optimal for B1 if the supplier failed the audit. Sourcing from a candidate supplier that passes the audit is ex post optimal for B1 if B1’s expected profit from that supplier (excluding sunk costs) must be greater than the expected profit from continuing the supplier search process; i.e., $(p - w)((1 - d(1 - q))(k - E[X]) + d(1 - q)E[X]) - (1 - q)\tau \geq \pi_{t1}$ wherein $q$ is the likelihood that the supplier does not have a violation given that it has passed the audit which satisfies $q = (1 - v(1 - \bar{e}))/((1 - vd(1 - \bar{e})))$. By simple algebra, this inequality can be verified to hold, due to $a > 0$, $s \geq 0$ and $(v, d, \bar{e}) \in (0, 1)$. In the transparency equilibrium, responsibility effort by a candidate supplier to B1 is $\bar{e}$ and B1’s expected profit is $\pi_{t1}$. If B1 deviates by not auditing, B1’s expected profit is $vd(1 - \bar{e})(p - w)E[X] + (1 - vd(1 - \bar{e}))(p - w)(k - E[X]) - v(1 - \bar{e})\tau - s$. Therefore, auditing is ex post optimal for B1 if and only if $\pi_{t1} > vd(1 - \bar{e})(p - w)E[X] + (1 - vd(1 - \bar{e}))(p - w)(k - E[X]) - v(1 - \bar{e})\tau - s$, or equivalently, (6).

Finally, we prove that, in a transparency equilibrium, responsibility-auditing S and sourcing from S if and only if S passes the audit is ex post optimal for B2 if (7) holds. In a transparency equilibrium, B2 chooses to take B1’s supplier S as its first candidate and not search for and qualify alternative suppliers, which implies that $\pi_{t2} \geq \pi$. Then, $\pi > 0$ leads to $\pi_{t2} > 0$, which ensures that undertaking supplier search and qualification is ex post optimal for B2 (than not sourcing). For sourcing from S to be ex post optimal for B2 if S has passed B2’s audit, B2’s expected profit from S (excluding sunk costs) must be greater than continuing the supplier search process: i.e., $(p - w)(k - E[X]) - v(1 - \bar{e})(1 - d(1 - \bar{e}))^2\tau/(1 - vz) > k$ with probability 1) lead to $\pi > (p - w)(k - E[X]) - \tau$, which implies that it is ex post optimal for B2 to continue the supplier search process and not source from S if S fails B2’s audit. In a transparency equilibrium, B1’s supplier S chooses the responsibility effort $\bar{e}$ and B2’s expected profit is $\pi_{t2}$. If B2 deviates by not auditing, B2’s expected profit is $(p - w)(k - E[X]) - (1 - q)\tau$, where $q$ is the likelihood that S does not have a violation after observing that it is revealed as B1’s supplier; by rational expectations, $q = (1 - v(1 - \bar{e}))/((1 - vd(1 - \bar{e})))$. Then, auditing is ex post optimal for B2 if and only if (7) holds. In the event that S fails B2’s audit, ex post optimality conditions for B2 to responsibility-audit an alternative candidate supplier and source from that supplier if and only if the supplier passes the audit are the same as in the first type of equilibrium, which are derived above.
Proofs of the Analytical Results in Section 3

The following Lemma compares the buying firms’ expected profits in a transparency equilibrium (if it exists), which will be instrumental in proving Proposition 1.

**Lemma 1.** *B2’s expected profit in a transparency equilibrium is strictly greater than B1’s expected profit:*

\[ \pi_{t2} > \pi_{t1} \]  

**Proof of Lemma 1:** Note that \( \pi_{t2} = (q + (1 - q)(1 - d))(p - w)(k - E[X]) - (1 - q)(1 - d)\tau - a + d(1 - q)\pi \) with \( q = (1 - v(1 - \bar{e}))/ (1 - vd(1 - \bar{e})) \). By simple algebra, the expected contribution of B1 and B2 can be shown to be equivalent. B1 incurs greater auditing, search, and responsibility-related costs in expectation because \((d, \bar{e}, v) \in (0, 1) \) implies \( 1 - vd(1 - \bar{e}) > 1 - d \), which together with \( \bar{e} \in (0, 1) \) leads to the coefficients of \( a, s \) and \( \tau \) in the expression for \( \pi \) being strictly greater than the respective coefficients in the expression for \( \pi_{t2} \).

**Proof of Proposition 1:** (a.) The LHS of (24) is strictly greater than that of (23) because \( p > w > w, d \in (0, 1), 2E[X] > k \) (due to \( X_1 + X_2 > k \) with probability 1), and \( k > E[X] \). The result then follows from the strict convexity of \( r(\cdot) \).

(b.) With B1’s commitment to publish its supplier’s identity, B2 chooses S as its first candidate supplier if and only if

\[ (q + (1 - q)(1 - d))(p - w)(k - E[X]) - (1 - q)(1 - d)\tau - a + d(1 - q)\pi \geq \pi, \]  

where \( q \) is the likelihood B2 assigns to S not having a violation after S is revealed as B1’s supplier, the LHS of (30) represents B2’s expected profit by taking S as its first candidate supplier, and the right-hand side (RHS) is B2’s expected profit from searching for a different candidate supplier and never sourcing from S. In a transparency equilibrium, by rational expectations, \( q = 1 - v(1 - \bar{e})/(1 - vd(1 - \bar{e})) \), so (30) is equivalent to \( \pi_{t2} \geq \pi \). This condition is satisfied if and only if \( \tau \geq \tau_2 \), with \( \tau_2 \) defined in (28).

The first type of equilibrium in which B2 does not source from S and a candidate supplier to B1 exerts \( \bar{e} \) exists if and only if the LHS of (30) evaluated at \( q = (1 - v(1 - \bar{e}))/ (1 - vd(1 - \bar{e})) \) is less than or equal to \( \pi \), or equivalently if and only if \( \tau \leq \tau_2 \) with

\[ \tau_2 = \left( -\frac{ad}{1 - d} + \frac{(1 - (1 - d)^2)(1 - \bar{e})v(1 - s + (1 - vd(1 - \bar{e}))(p - w)(2E[X] - k))}{vd(1 - d)(1 - \bar{e})(1 - (1 - \bar{e})v)} \right) \lor 0. \]
By simple algebra, it is straightforward to verify that $\tau_2 \geq \tau'_2$. When B1 is committed to publish its supplier’s identity, in the region where both types of equilibria exist ($\tau \in [\tau_2, \tau'_2]$), the equilibrium in which B2 chooses S as its first candidate supplier and S exerts greater effort $\bar{e}$ leads to higher expected profit for B2 and S each and is more likely to be preferred. As a result, we proceed by focusing our attention to the region $\tau \geq \tau_2$ (in which B2 is attracted to take S as its first candidate and S exerts responsibility effort $\bar{e}$) in order to characterize the conditions for the transparency equilibrium to occur in the remainder of the proof.

For $\tau \geq \tau_2$, B1 obtains expected profit $\pi_{t1}$ by committing to publish its supplier’s identity. Without such commitment, B1 obtains $\pi$. B1 commits to publish supplier identity if and only if $\pi_{t1} \geq \pi$, which is equivalent to $\tau \geq \tau'$, with $\tau$ defined in (27). Therefore, a transparency equilibrium exists if and only if $\tau \geq \max(\tau, \tau_2')$. By Lemma 1, B2 is strictly better off than B1 in a transparency equilibrium, $\pi_{t2} > \pi_{t1}$, which implies that $\tau > \tau_2$.

(c.) If $\tau > 0$, the derivatives of $\tau$ (defined in (27)) with respect to $a$ and with respect to $s$ are both $-d/(1-d)$, which is negative due to $d \in (0,1)$. The derivative of $\tau$ with respect to $v$ is $-(1 - (1 - d)^2)d\nu^2(1-\bar{e})(1-\epsilon)(p-w)(2E[X] - k)/((1-d)(\bar{e} - \epsilon)v^2)$, which is negative due to $p > w$, $k < 2E[X]$, $\bar{e} > \epsilon$ (due to Proposition 1a), and $(v, d, \epsilon, \bar{e}) \in (0,1)$. Therefore, $\tau$ is strictly decreasing with $s$, $a$ or $v$ if $\tau > 0$.

$\tau = 0$ if and only if the numerator of the first expression on the RHS of (27) is nonpositive; i.e.,

$$
1 - (1 - (1 - d)^2)(1 - \bar{e})v(1 - vd(1 - \epsilon)) \leq 0. \quad (32)
$$

By (24), $d \in (0,1)$, $k < 2E[X]$ and strict convexity of $r(\cdot)$, $\bar{e}$ is strictly increasing with $p$, while by (23) $\epsilon$ is independent of $p$. Let $\epsilon = \inf\{\bar{e} - \epsilon : p \geq w\} > 0$ by (23) and (24), strict convexity of $r(\cdot)$, $\bar{e}$ strictly increasing with $p$, $d \in (0,1)$, $w > w$, and $k > E[X]$. Then, noting that $(v, d, \bar{e}) \in (0,1)$, (32) holds for any $p \leq \bar{p}$ with

$$
\bar{p} \equiv w + \epsilon d(a + s)v/((1 - vd(1 - \epsilon))(2E[X] - k)). \quad (33)
$$

By simple algebra, (32) also holds for $s \geq s$ or $a \geq a$ where $s$ and $a$ are defined as

$$
s \equiv \frac{(1 - (1 - (1 - d)^2)(1 - \bar{e})v)(1 - vd(1 - \epsilon))(p-w)(2E[X] - k)}{d(\bar{e} - \epsilon)v} - a, \quad (34)
$$

$$
a \equiv \frac{(1 - (1 - (1 - d)^2)(1 - \bar{e})v)(1 - vd(1 - \epsilon))(p-w)(2E[X] - k)}{d(\bar{e} - \epsilon)v} - s. \quad (35)
$$

**Proof of Proposition 2:** S’s expected profit in a transparency equilibrium satisfies

$$
(\bar{e} + (1 - \bar{e})(1 - d)^2)((p-c)(2E[X] - k) + 2(w-c)(k-E[X]))
$$
\[ + (1 - \bar{e})(1 - d) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) + (1 - \bar{e})d(w - c)k - r(\bar{e}) \]

\[ > \left( \varepsilon + (1 - \varepsilon)(1 - d)^2 \right) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) \]

\[ + (1 - \varepsilon)(1 - d) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) + (1 - \varepsilon)d(w - c)k - r(\varepsilon) \]

\[ > \left( \varepsilon + (1 - \varepsilon)(1 - d) \right) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) + (1 - \varepsilon)d(w - c)k - r(\varepsilon), \quad (36) \]

where the first inequality is by the optimality of \( \bar{e} \) and strict convexity of \( r(\cdot) \), and the second inequality is due to \( p > w > w \), \( E[X] < k < 2E[X] \), \( \varepsilon \in (0, 1) \). Since the quantity in the last line of above is \( S \)'s expected profit in an equilibrium in which \( S \) has potential to supply \( B_1 \) but not \( B_2 \), (36) establishes the result.

**Proof of Proposition 3**: (a.) By the implicit differentiation of (24),

\[ \frac{d\bar{e}}{dk} = \frac{(1 - (1 - d)^2)(2w - p - w)}{r''(\bar{e})}, \quad (37) \]

which is positive if and only if \( (w - w) > (p - w)/2 \) due to \( d \in (0, 1) \) and strict convexity of \( r(\cdot) \). The LHS of (23) equals \( d(w - w)E[X] \), which implies that \( k \) has no effect on \( \varepsilon \). To show the third part of (a.), we suppose that \( \tau \) equals the first expression in the RHS of (27) and show that \( \tau \) strictly decreases with \( k \) if (8) holds. By differentiating (27), we obtain \( \partial \tau / \partial k = (-1 + (1 - (1 - d)^2)(1 - \bar{e})v)(1 - vd(1 - \bar{e}))(p - w)/(p(1 - d)(\bar{e} - \varepsilon)) \) and \( \partial \tau / \partial \bar{e} = -(2E[X] - k)(1 - vd(1 - \bar{e}))(1 - (1 - d)^2)/(1 - \varepsilon)v)(p - w)/(p(1 - d)(\bar{e} - \varepsilon)^2) \), which are both negative due to \( k < 2E[X] \), \( (v, d, \varepsilon, \bar{e}) \in (0, 1) \), \( p > w \) and \( \bar{e} > \varepsilon \) (by Proposition 1a). Therefore, \( \partial \tau / \partial k < 0 \) and \( \partial \tau / \partial \bar{e} < 0 \) together with (37) lead to \( d\tau / dk < 0 \) if \( (w - w) > (p - w)/2 \). In the region where \( k \) is sufficiently high that \( \tau = 0 \), the result holds weakly.

(b.) By implicit differentiation of (24) and noting that \( w = c \),

\[ \frac{d\bar{e}}{dc} = -\frac{(2 - d)dk - (1 - d)dE[X]}{r''(\bar{e})} < 0, \quad (38) \]

where the inequality is due to \( E[X] < k < 2E[X] \), \( d \in (0, 1) \) and strict convexity of \( r(\cdot) \). By implicit differentiation of (23) and noting that \( w = c \),

\[ \frac{d\varepsilon}{dc} = -\frac{dE[X]}{r''(\varepsilon)} < 0, \quad (39) \]

where the inequality is due to \( E[X] > 0 \) (which is implied by \( x_1 + x_2 > k \) with probability 1 and \( k > 0 \), \( d \in (0, 1) \), and strict convexity of \( r(\cdot) \). The result that decreasing the production cost \( c \) strictly increases \( \bar{e} - \varepsilon \) if and only if (9) follows from (38) and (39).

It remains to show that, for \( w = c \), a decrease in production cost \( c \) strictly reduces \( \tau \) if and only if (10) and \( \tau > 0 \). In the region where the first expression in the RHS of (27) is negative, \( \tau = 0 \) and hence \( \tau \) is invariant with respect to \( c \). In the region where \( \tau \) equals the first expression in the RHS
of (27), $\tau$ is affected indirectly by $c$ through $\bar{e}$ and $e$. The derivatives of $\tau$ with respect to $e$ and $\bar{e}$ are

$$\frac{\partial \tau}{\partial \bar{e}} = \frac{(2E[X] - k)(1 - vd(1 - e))(1 - (1 - (1 - d)^2)(1 - \bar{e})v)(p - w)}{v(1 - d)(\bar{e} - e)^2}$$

$$\frac{\partial \tau}{\partial e} = \frac{(2E[X] - k)(1 - vd(1 - \bar{e}))(1 - (1 - (1 - d)^2)(1 - \bar{e})v)(p - w)}{v(1 - d)(\bar{e} - e)^2},$$

which together with (38) and (39) lead to

$$\frac{d\tau}{dc} = \frac{d(2E[X] - k)(p - w)}{v(1 - d)(\bar{e} - e)^2}
\left[ -\frac{(1 - vd(1 - e))(1 - (1 - (1 - d)^2)(1 - \bar{e})v)E[X]}{r''(e)}
+\frac{(1 - vd(1 - e))(1 - (1 - (1 - d)^2)(1 - \bar{e})v)((2 - d)k - (1 - d)E[X])}{r''(\bar{e})} \right].$$

For $\tau > 0$, $d\tau/dc > 0$ if and only if the term in squared brackets above is positive because $(v, d) \in (0, 1)$, $E[X] < k < 2E[X]$, $\bar{e} > e$ (by Proposition 1a), and $p > w$. The term in squared brackets is positive if and only if (10) is satisfied, which establishes the result.

If suppliers are not demand-constrained, each supplier’s total production cost equals $ck$ (regardless of B1 or B2’s decisions) and is independent of the supplier’s responsibility effort. As a result, $\bar{e}$ and $e$ are invariant with respect to $c$, which leads $\tau$ to be invariant with respect to $c$ as well.

**Proofs of Robustness Results**

**S can Fully Satisfy the Realized Demand from Both Buying Firms with Positive Probability:** We first provide the generalized expressions for a candidate supplier’s optimal responsibility effort, buying firms’ expected profits, and thresholds for the transparency equilibrium to occur. In an equilibrium with potential to supply B1 but not B2, the optimal responsibility effort for each candidate supplier is uniquely determined by (1), as in the base model. Hence the expected discounted profit for each buying firm is $\pi$. In a transparency equilibrium, a candidate supplier to B1 has potential to supply both B1 and B2, and hence, the optimal responsibility effort for a candidate supplier to B1 is uniquely determined by

$$\bar{e} = \arg\max \left\{ (e + (1 - e)(1 - d)^2) \left( E \left[ ((p - c)(X_1 + X_2 - k) + (w - c)(2k - X_1 - X_2)) 1\{X_1 + X_2 > k\} \right]
+ E \left[ ((w - c)(X_1 + X_2) + (w - c)(k - X_1 - X_2)) 1\{X_1 + X_2 \leq k\} \right]\right)
+ (1 - e)(1 - d)d ((w - c)E[X] + (w - c)(k - E[X])) + (1 - e)d(w - c)k - r(e) \right\}. \quad (40)$$

The expected profit for B1 is

$$\pi_{e1} = \frac{vd(1 - d)(1 - \bar{e})(p - w)E[X] + \left(1 - v(1 - (1 - d)^2)(1 - \bar{e})\right) \chi - v(1 - \bar{e})(1 - d)\tau - a - s}{1 - vd(1 - \bar{e})}.$$
wherein $\chi$ is B1’s expected contribution in the event that both buying firms source from S; i.e.,

$$\chi = (p - w) \left( E[(k - X_2)1\{X_1 + X_2 > k\}] + E[X_1 1\{X_1 + X_2 \leq k\}] \right). \quad (41)$$

By symmetry, $\chi$ is also B2’s expected contribution in the event that both buying firms source from S. The expected discounted profit for B2 is

$$\pi_{t2} = \frac{1}{1 - \nu d (1 - \bar{e})} \left( \chi - \nu d (1 - \bar{e}) \left( (2 - d) \chi - (1 - d) (p - w) E[X] \right) \right)$$

$$\quad - \frac{a \left( 1 - \nu d \left( (1 - \bar{e}) \left( (1 - (1 - d) v \right) v \right) \right) + (1 - d) d (1 - \bar{e}) v s + v (1 - d)^2 (1 - \bar{e}) \tau}{(1 - \nu d (1 - \bar{e})) (1 - \nu d (1 - \bar{e}))}.$$

The threshold for transparency equilibrium to occur and the threshold for B2 to take S as its first candidate supplier are given by the following expressions, respectively:

$$\bar{\tau} \equiv \frac{(1 - (1 - (1 - d)^2) (1 - \bar{e}) v \left( 1 - \nu d (1 - \bar{e}) \right) \left( (p - w) X + \chi - d (\bar{e} - \bar{e}) (a + s) v \right)}{(1 - d) (\bar{e} - \bar{e}) v} \vee 0, \quad (42)$$

and

$$\pi_{t2} = \frac{1 - \nu d (1 - \bar{e}) (1 - (1 - d)^2) (1 - \bar{e}) v \left( 1 - \nu d (1 - \bar{e}) \right) \left( (p - w) X + \chi - d (\bar{e} - \bar{e}) (a + s) v \right)}{(1 - d) (\bar{e} - \bar{e}) v} \vee 0. \quad (43)$$

Now, we prove Propositions 1 for the generalized model. To establish $\bar{e} > \bar{e}$, it suffices to show that

$$E \left[ ((p - c) (X_1 + X_2 - k) + (w - c) (2k - X_1 - X_2)) 1\{X_1 + X_2 > k\} \right]$$

$$+ E \left[ ((w - c) (X_1 + X_2) + (w - c) (k - X_1 - X_2)) 1\{X_1 + X_2 \leq k\} \right] \geq (w - c) E[X] + (w - c) (k - E[X]), \quad (44)$$

which holds due to $p > w > w, k > E[X], X \geq 0$ and $X_1 + X_2 > k$ with positive probability.

Proof of Proposition 1b follows similarly to its proof for the base model, but with generalized expressions for $\pi_{t1}, \pi_{t2}, \bar{\tau}$, and $\pi_{t2}$ provided above. For Proposition 1c, the derivatives of $\bar{\tau}$ with respect to $a$ and $s$ remain equivalent to the respective derivatives in the base model. For $\bar{\tau} > 0$, the derivative of $\bar{\tau}$ with respect to $v$ is $-(1 - (1 - (1 - d)^2) d v^2 (1 - \bar{e}) (1 - \bar{e}) ((p - w) E[X] - \chi)) / ((1 - d) (\bar{e} - \bar{e}) v^2)$, which is negative because $(v, d, \bar{e}, \bar{e}) \in (0, 1), \bar{e} > \bar{e}$ and

$$(p - w) E[X] > \chi, \quad (45)$$

(with (45) implied by (41), $p > w$ and $X_1 + X_2 > k$ with positive probability). Therefore, $\bar{\tau}$ is strictly decreasing with $s, a$ or $v$ for $\bar{\tau} > 0$.

$\bar{\tau} = 0$ if and only if the numerator of the first term on the RHS of (42) is nonpositive; i.e.,

$$\left( 1 - (1 - (1 - d)^2) (1 - \bar{e}) v \right) \left( 1 - \nu d (1 - \bar{e}) \right) \left( (p - w) E[X] - \chi \right) - d (\bar{e} - \bar{e}) (a + s) v \leq 0. \quad (46)$$
By (40), \( \frac{d\bar{e}}{dp} = (1 - (1 - d)^2)Pr(X_1 + X_2 > k)/r''(\bar{e}) > 0 \) (where the inequality follows from \( X_1 + X_2 > k \) with positive probability, \( r(\cdot) \) being strictly convex, \( d \in (0, 1) \)), while \( \epsilon \) is independent of \( p \). Let \( \epsilon = \inf\{\bar{e} - \epsilon : p \geq w\} \). \( \epsilon > 0 \) follows from first-order conditions for finding \( \bar{e} \) and \( \epsilon \), the fact that \( \bar{e} \) is strictly increasing with \( p \), \( k \geq X \) and \( X \geq 0 \) with probability 1, \( X_1 + X_2 > k \) with positive probability, \( w > w \) and \( d \in (0, 1) \). Then, (46) holds for any \( p \leq \bar{p} \) with

\[
\bar{p} \equiv w + vd\epsilon(a + s)/\left(E[(X_1 + X_2 - k)1\{X_1 + X_2 > k\}] (1 - vd(1 - \bar{e}))\right).
\]

By simple algebra, (46) also holds for \( s \geq s \) or \( a \geq a \) where \( s \) and \( a \) are defined as

\[
s \equiv \frac{1 - (1 - (1 - d)^2)(1 - \bar{e})v}{d(\bar{e} - \epsilon)v} \left(1 - vd(1 - \bar{e})\right)\left((p - w)E[X] - \chi\right) - a,
\]

\[
a \equiv \frac{1 - (1 - (1 - d)^2)(1 - \bar{e})v}{d(\bar{e} - \epsilon)v} \left(1 - vd(1 - \bar{e})\right)\left((p - w)E[X] - \chi\right) - s.
\]

Proposition 2 follows from the comparison of (1) and (40), \( d \in (0, 1) \), and noting that \( S \) obtains greater expected contribution in the event it passes both buying firms’ audits; i.e., (44) holds.

The first part of Proposition 3a follows from the implicit differentiation of (40),

\[
\frac{d\bar{e}}{dk} = \frac{(1 - (1 - d)^2)(2(w - c) - (p - c) - (w - c))Pr(X_1 + X_2 > k)}{r''(\bar{e})},
\]

(47)

which is positive if and only if \( (w - w) > (p - w)/2 \) due to \( d \in (0, 1) \), \( X_1 + X_2 > k \) with positive probability, and strict convexity of \( r(\cdot) \). The second part of Proposition 3a follows from the base model. To show the third part of Proposition 3a, suppose that \( \bar{\tau} \) equals the first expression in the RHS of (42) and observe that \( \partial\bar{\tau}/\partial\bar{e} \) satisfies

\[
\frac{\partial\bar{\tau}}{\partial\bar{e}} = \frac{(1 - vd(1 - \bar{e}))\left(1 - (1 - (1 - d)^2)(1 - \bar{e})v\right)\left((p - w)E[X] - \chi\right)}{v(1 - d)(\bar{e} - \epsilon)^2} < 0,
\]

(48)

where the inequality is due to \( (v, d, \epsilon, \bar{e}) \in (0, 1), \bar{e} > \epsilon \), and (45). By (47), \( d\bar{e}/dk > 0 \) if \( (w - w) > (p - w)/2 \), and hence, to show that \( \bar{\tau} \) is decreasing with \( k \), it suffices to show that \( \partial\bar{\tau}/\partial k < 0 \). \( \partial\tau/\partial k < 0 \) follows from \( \partial\bar{\tau}/\partial \chi < 0 \) (by \( (v, d, \epsilon, \bar{e}) \in (0, 1) \) and \( \bar{e} > \epsilon \) and \( d\chi/dk = (p - w)Pr(X_1 + X_2 > k) > 0 \) (by \( p > w \) and \( X_1 + X_2 > k \) with positive probability). In the region where \( k \) is sufficiently high that \( \bar{\tau} = 0 \), the result holds weakly.

We now prove Proposition 3b for the generalized model. By implicit differentiation of the first-order conditions of the RHS of (40) and noting that \( w = c \),

\[
\frac{d\bar{e}}{dc} = \frac{(2 - d)d(kPr(X_1 + X_2 > k) + E[(X_1 + X_2)1\{X_1 + X_2 \leq k\}]) - (1 - d)dE[X]}{r''(\bar{e})} < 0,
\]

(49)
where the inequality is due to $X_1 < k$ with probability 1, $X_1 + X_2 > k$ with positive probability, $d \in (0,1)$ and strict convexity of $r(\cdot)$. $d\bar{e}/dc < 0$ follows from the base model. By (39) and (49), decreasing the production cost $c$ strictly increases $\bar{e} - \bar{e}$ if and only if

$$\frac{r''(\bar{e})}{r''(\bar{e})} < \frac{(2-d)(kPr(X_1 + X_2 > k) + E[(X_1 + X_2)1\{X_1 + X_2 \leq k\}]) - (1-d)E[X]}{E[X]}.$$ 

To prove the fourth part of Proposition 3b under the generalized model, note that in the region where the first expression in the RHS of (42) is negative, $\tau = 0$ and hence $\tau$ is invariant with respect to $c$. In the region where $\tau$ equals the first expression in the RHS of (42), $c$ affects $\tau$ indirectly through $\bar{e}$ and $\bar{e}$. The derivatives of $\tau$ with respect to $\bar{e}$ and $\bar{e}$ are

$$\frac{\partial \tau}{\partial \bar{e}} = - \frac{(1-vd(1-\bar{e}))(1 - (1 - (1-d)^2)(1-\bar{e})v)((p-w)E[X] - \chi)}{v(1-d)(\bar{e} - \bar{e})^2},$$

$$\frac{\partial \tau}{\partial \bar{e}} = \frac{(1-vd(1-\bar{e}))(1 - (1 - (1-d)^2)(1-\bar{e})v)((p-w)E[X] - \chi)}{v(1-d)(\bar{e} - \bar{e})^2},$$

which together with (39) and (49) lead to

$$\frac{d\tau}{dc} = \frac{d((p-w)E[X] - \chi)}{v(1-d)(\bar{e} - \bar{e})^2} \left[ (1-vd(1-\bar{e}))(1 - (1 - (1-d)^2)(1-\bar{e})v)((2-d)(kPr(X_1 + X_2 > k) + E[(X_1 + X_2)1\{X_1 + X_2 \leq k\}]) - (1-d)E[X]) \right.$$

$$\left. - \frac{(1-vd(1-\bar{e}))(1 - (1 - (1-d)^2)(1-\bar{e})v)E[X]}{r''(\bar{e})} \right].$$

For $\tau > 0$, $d\tau/dc > 0$ if and only if the term in squared brackets above is positive by $(v,d) \in (0,1)$, $\bar{e} > \bar{e}$, and (45). The term in squared brackets is positive if and only if

$$\frac{r''(\bar{e})}{r''(\bar{e})} < \frac{(1-vd(1-\bar{e}))(1 - (1 - (1-d)^2)(1-\bar{e})v)((2-d)(kPr(X_1 + X_2 > k) + E[(X_1 + X_2)1\{X_1 + X_2 \leq k\}]) - (1-d)E[X])}{(1-vd(1-\bar{e}))(1 - (1 - (1-d)^2)(1-\bar{e})v)E[X]}.$$ 

The rationale for $\bar{e}$, $\bar{e}$ and $\tau$ being invariant with respect to $c$ follows from the rationale provided for the base model in the Proof of Proposition 3.

**Proofs of the Analytical Results in Section 4**

The following lemma establishes the dependence of $\tau_{\bar{e}}$ on $\bar{e}$, which will be instrumental in the subsequent proofs.

**Lemma 2.** $\tau_{\bar{e}}$ is strictly decreasing with the responsibility effort by a candidate supplier to $B1 \bar{e}$ if $\tau_{\bar{e}} > 0$. 

Proof of Lemma 2: If $\tau_2 > 0$, by (43), $\partial \tau_2 / \partial \bar{e}$ is given by

$$
\frac{\partial \tau_2}{\partial \bar{e}} = \left(1 - vd(1 - \bar{e})\right) \frac{s - (p - w)(1 - vd(1 - \bar{e}))(2E[X] - k)}{v \left(\bar{e} - \bar{e} + d(1 - \bar{e})\left(1 - v(1 - \bar{e})\right)^2\right)}.
$$

By (43), $s - (p - w)(1 - vd(1 - \bar{e}))(2E[X] - k) < 0$ is a necessary condition for $\tau_2 > 0$ because $(d, v, \bar{e}) \in (0, 1)$, $a > 0$ and $\bar{e} > \bar{e}$. Then, the expression for $\partial \tau_2 / \partial \bar{e}$ above is negative.

Proof of Proposition 4: To prove the proposition, we first derive the optimal effort by a candidate supplier to B1 and the supplier’s expected profit under different cases relating to B1’s transparency commitment and B2’s decision to take S as a candidate or not, and use these expressions to characterize the equilibria when 12 commits to publish its blacklist only and to publish its blacklist and the supplier’s identity.

Optimal Effort by a Candidate Supplier to B1: Suppose that B1 is committed to publish the blacklist. In the case where a candidate supplier declines B1’s business upon having a persistent violation and B2 takes S as its first candidate, the optimal effort $\bar{e}_s$ is found from

$$
\arg \max_{e} \left\{ e \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) + (1 - e)(w - c)k - r(e) \right\}.
$$

In the case where a candidate supplier declines B1’s business upon having a persistent violation and B2 does not source from S, the optimal effort $\bar{e}_s$ is found from

$$
\arg \max_{e} \left\{ e \left( (w - c)E[X] + (k - E[X])(w - c) \right) + (1 - e)(w - c)k - r(e) \right\}.
$$

In the case where a candidate supplier accepts B1’s business upon having a persistent violation and B2 takes S as its first candidate, the optimal effort $\bar{e}_p$ is found from

$$
\arg \max_{e} \left\{ e + (1 - e)(1 - d) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) + (1 - e)(1 - d) \left( (w - c)E[X] + (k - E[X])(w - c) - r(e) \right) \right\}.
$$

In the case where a candidate supplier accepts B1’s business upon having a persistent violation and B2 does not source from S, the optimal effort $\bar{e}_p$ is found from

$$
\arg \max_{e} \left\{ e + (1 - e)(1 - d) \left( (w - c)E[X] + (k - E[X])(w - c) - r(e) \right) \right\}.
$$

The optimal effort by a candidate supplier to B1 under these different contingencies satisfy:

$$
(p - c)(2E[X] - k) + 2(w - c)(k - E[X]) - (w - c)k = r'(\bar{e}_s),
$$

$$
(w - w)E[X] = r'(\bar{e}_s),
$$

$$
(2 - d)d \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) - (1 - d)d \left( (w - c)E[X] + (w - c)(k - E[X]) \right) = r'(\bar{e}_p)
$$

$$
d \left( (w - c)E[X] + (w - c)(k - E[X]) \right) = r'(\bar{e}_p).
$$
By \( w > c, (d,k) > 0 \), and \( r(\cdot) \) being strictly convex, we have
\[
\bar{e}_p > \bar{e} \quad \text{and} \quad e_p > e
\]
where \( \bar{e} \) and \( e \) are equilibrium effort levels when B1 is committed to only publish its supplier’s identity found from (24) and (23). We also observe that
\[
\bar{e}_s > \bar{e} \quad \text{and} \quad e_s > e
\]
where \( e_s > e \) is by \( d \in (0,1) \) and \( r(\cdot) \) being strictly convex. \( \bar{e}_s > \bar{e} \) is by \( r(\cdot) \) being strictly convex and
\[
(p - c)(2E[X] - k) + 2(w - c)(k - E[X]) - (w - c)k > (1 - (1 - d)^2) ((p - c)(2E[X] - k) + 2(w - c)(k - E[X]) - (w - c)k)
\]
\[
> (1 - (1 - d)^2) ((p - c)(2E[X] - k) + 2(w - c)(k - E[X])) - (1 - d)d ((w - c)E[X] + (k - E[X])(w - c)) - d(w - c)k
\]
where the first inequality above is due to \( d \in (0,1) \), and the second inequality is due to \( w > w \) and \( d \in (0,1) \). Finally,
\[
\bar{e}_p > e_p
\]
follows from
\[
(p - c)(2E[X] - k) + 2(w - c)(k - E[X]) > (w - c)k > (w - c)E[X] + (w - c)(k - E[X]),
\]
which is satisfied due to \( p > w > w, k > E[X] \), and \( r(\cdot) \) is strictly convex.

**Expected Profit of a Candidate Supplier to B1:** First, note that a candidate supplier to B1 always accepts B1’s business if the supplier does not have a violation because the supplier will pass B1’s audit for sure and will strictly benefit from selling to B1 (and potentially to B2) than to other buyers by \( w > w \). Now, suppose that the candidate supplier finds out that it has a persistent violation after exerting responsibility effort. In the case where the supplier declines B1’s business, the supplier’s expected profit is
\[
(w - c)k.
\]
If B1 is committed to publish its blacklist, S’s expected profit by accepting B1’s business is
\[
(1 - d) ((w - c)E[X] + (w - c)(k - E[X])).
\]
If B1 is committed to publish its blacklist and its supplier’s identity, in the case where a candidate supplier to B1 accepts B1’s business and B2 does not source from S, the supplier’s expected profit is equal to (60). In the case where a candidate supplier to B1 accepts B1’s business and B2 takes S as its first candidate, the supplier’s expected profit equals

\[(1-d^2)((p-c)(2E[X]-k) + 2(w-c)(k-E[X])) + d(1-d)\left((w-c)E[X] + (w-c)(k-E[X])\right).\]  

(61)

Note that (61) is strictly greater than (60) by (58).

**Equilibrium under B1’s Commitment to Publish Only its Blacklist:** A candidate supplier, upon having a persistent violation, chooses to decline B1’s business if and only if (59) is greater than (60), which is equivalent to \(w \geq \alpha\), with \(\alpha\) defined as in the statement of part (c.). B1’s expected profit with the commitment is

\[
\begin{align*}
(p-w)E[X] - (a+s)/(1-v(1-e_\ast)) & \quad \text{if } w \geq \alpha, \\
(p-w)E[X] - (v(1-d)(1-e_p)\tau + a + s)/(1-vd(1-e_p)) & \quad \text{otherwise,}
\end{align*}
\]

Equilibrium under B1’s Commitment to Publish its Blacklist and Its Supplier’s Identity: We identify three cases.

**Case 1:** \(w < \alpha\): In this case, a candidate supplier to B1 does not decline B1’s business. B2 chooses S as its first candidate if and only if

\[q + (1-q)(1-d)\left((p-w)(k-E[X]) - (1-q)(1-d)\tau - a + d(1-q)\pi \right) \geq \pi,
\]

(62)

where \(q\) is the likelihood B2 assigns to S not having a violation after S is revealed as B1’s supplier, LHS of (62) represents B2’s expected profit by taking S as its first candidate supplier, and RHS is B2’s expected profit from searching for a different candidate supplier and never sourcing from S. LHS of (62) is strictly increasing with \(q\) (because the derivative with respect to \(q\) is \(d(p-w)(k-E[X]) + (1-d)\tau > 0\) by \(p > w, d \in (0,1), k > E[X]\), and \(\tau \geq 0\)). Consequently, B2 will choose S as the candidate supplier if and only if \(q \geq \tilde{q}\), where \(\tilde{q}\) is the value of \(q\) at which (62) is satisfied at equality. Given B2’s sourcing decision and the definitions of \(e_p\) and \(\tilde{e}_p\), S’s optimal effort given B2’s beliefs can be characterized as follows:

\[
e^\ast = \begin{cases} 
  e_p & \text{if } q < \tilde{q} \\
  \{e_p, \tilde{e}_p\} & \text{if } q = \tilde{q} \\
  \tilde{e}_p & \text{otherwise.}
\end{cases}
\]

(63)

By rational expectations, the likelihood B2 assigns to S not having a violation \(q\) in equilibrium is equal to the probability that S does not have a violation given that S chooses the optimal equilibrium responsibility effort \(e^\ast\), passes B1’s audit and is revealed as the supplier; i.e.,

\[q = \frac{1 - v(1 - e^\ast)}{1 - vd(1 - e^\ast)},
\]

(64)
It follows from (63) and (64) that there exists two types of equilibria: an equilibrium exists in which $B_2$ sources from $S$ and $S$ exerts $\tilde{e}_p$ if and only if $\tau \geq \gamma$, where $\gamma$ is given by

$$
\gamma = \left( -\frac{ad}{1-d} + \frac{\left(1 - (1 - d)^2\right)}{(1-d)v} \left( -s + \left(1 - vd(1 - \tilde{e})\right) (p - w)(2E[X] - k) \right) \right).
$$

(65)

Note that this expression is identical to $\tau_2$ in (28) with $\tilde{e}$ replaced by $\tilde{e}_p$. By (55), $\tilde{e}_p > \tilde{e}$ which by Lemma 2 leads to

$$
\gamma < \tau_2.
$$

Moreover, there is a second equilibrium in which $B_2$ does not source from $S$ and $S$ exerts $\varepsilon_p$ if and only if $\tau \leq \eta$, where $\eta$ is given by

$$
\eta = \left( -\frac{ad}{1-d} + \frac{\left(1 - (1 - d)^2\right)}{(1-d)v} \left( -s + \left(1 - vd(1 - \tilde{e})\right) (p - w)(2E[X] - k) \right) \right).
$$

(66)

Notice that $\eta$ is identical to $\tau_2$ in (28) with $\tilde{e}$ replaced by $\tilde{e}_p$. By (57), $\tilde{e}_p > \tilde{e}$ which by Lemma 2 leads to

$$
\gamma < \eta.
$$

When both types of equilibria exist, we focus on a transparency equilibrium in which $S$ exerts higher responsibility effort and $B_2$ takes $S$ as its first candidate supplier. Therefore, for $\tau \geq \gamma$, $B_2$ sources from $S$ and $S$ exerts the responsibility effort $\tilde{e}_p$, and for $\tau < \gamma$, $B_2$ does not source from $S$ and $S$ exerts the responsibility effort $\varepsilon_p$.

**Case 2: $\alpha \leq w < \beta$:** In this case, upon finding out it has a persistent violation, a candidate supplier to $B_1$ does not decline $B_1$’s business if it expects to be approached by $B_2$ with probability 1 and declines $B_1$’s business if it expects that $B_2$ will take a different candidate supplier.

If the candidate supplier to $B_1$ expects to be approached by $B_2$, the equilibrium is identified as above in Case 1: There exists an equilibrium in which $B_2$ takes $S$ as its first candidate and $S$ exerts $\tilde{e}_p$ if and only if $\tau \geq \gamma$ with $\gamma$ defined in (65). Alternatively, a candidate supplier to $B_1$ declines $B_1$’s business upon having a persistent violation and $B_2$ never sources from $S$ if and only if $\tau \leq \eta

$$
\eta = \frac{(p - w)(2E[X] - k) \left(1 - vd(1 - \varepsilon)\right) - vd(1 - \varepsilon)a - s}{v(1-d)(1-\varepsilon)}.
$$

(67)

This equilibrium is the unique pure strategy equilibrium for $\tau \leq \eta$. Note that $\gamma$ and $\eta$ are similar to $\tau_2$ in (28) in the base model with $\tilde{e}$ replaced by $\tilde{e}_p$ and 1, respectively. $\tilde{e}_p > \tilde{e}$ by (55), and by $\tilde{e}_p$ being an interior solution, $\tilde{e}_p < 1$, which by Lemma 2 leads to

$$
\eta < \gamma < \tau_2.
$$
Now, we establish the existence of a unique mixed strategy equilibrium for any $\tau \in (\eta, \gamma)$ in the region $\alpha < \underline{w} < \beta$. In a mixed strategy equilibrium, a candidate supplier to B1 is indifferent between declining or not declining B1’s business upon having a persistent violation, which by (59), (61), and (60) can be written as

$$
(w - c)k = ((1 - d)(1 - y) + yd(1 - d))((w - c)E[X] + (\underline{w} - c)(k - E[X]))
$$

$$
y(1 - d)^2((p - c)(2E[X] - k) + 2(w - c)(k - E[X]))
$$

where $y$ is the probability that B2 takes S as its candidate supplier. By Intermediate Value Theorem, there exists a unique $y \in (0, 1)$ that satisfies the equation above because the RHS of the equation above is strictly increasing with $y$ (due to $d \in (0, 1)$ and (58)), equals $(1 - d)((w - c)E[X] + (\underline{w} - c)(k - E[X]))$ at $y = 0$ (which is less than $(\underline{w} - c)k$ for $\underline{w} \alpha > \alpha$ by (11)) and equals $d(1 - d)((w - c)E[X] + (\underline{w} - c)(k - E[X])) + (1 - d)^2((p - c)(2E[X] - k) + 2(w - c)(k - E[X]))$ at $y = 1$ (which is greater than $(\underline{w} - c)k$ for $\underline{w} < \beta$ by (12)).

In the mixed strategy equilibrium, B2 must be indifferent between taking S as its first candidate supplier or searching for an alternative supplier:

$$
(q + (1 - q)(1 - d)) (p - w)(k - E[X]) - (1 - q)(1 - d)\tau - a + d(1 - q)\pi = \pi,
$$

where $q$ is the likelihood B2 assigns to S not having a violation after S is revealed as B1’s supplier. LHS of the equation above, which captures B2’s expected profit by taking S as a candidate supplier, is strictly greater than $\pi$ for $q = 1$ and $\tau > \eta$, whereas it is strictly less than $\pi$ at $q = (1 - v(1 - \bar{e}_p))/(1 - vd(1 - \bar{e}_p))$ for $\tau < \gamma$ by the definitions of $\eta$ and $\gamma$ as in (67) and (65) respectively. Hence, there exists a unique $\hat{q}$ in equilibrium that satisfies

$$
\hat{q} \in \left((1 - v(1 - \bar{e}_p)) / (1 - vd(1 - \bar{e}_p)), 1\right)
$$

and that leads to B2 being indifferent between taking S as a candidate supplier and not sourcing from S at any $\eta < \tau < \gamma$.

By rational expectations, $\hat{q}$ must equal the probability that S does not have a violation given that S exerted optimal responsibility effort $e^*$ and chose not to decline B1’s business with probability $z$;

$$
\hat{q} = \frac{1 - v(1 - e^*)}{1 - v(1 - e^*) (1 - z(1 - d))}.
$$

The optimal responsibility effort for S $e^*$ is found by solving

$$
\max_e \left\{ (ey + (1 - e)z(1 - d)^2y) ((p - c)(2E[X] - k) + 2(w - c)(k - E[X])) + (1 - e)(1 - z)(w - c)k + (e(1 - y) + (1 - e)(1 - d)z(1 - y + dy)) ((w - c)E[X] + (w - c)(k - E[X])) - r(e) \right\}.
$$
\( e^* \) can be found from the first-order conditions, which using (68) can be simplified to
\[
y ((p-c)(2E[X]-k)+2(w-c)(k-E[X]))+(1-y)((w-c)E[X]+(w-c)(k-E[X]))-(w-c)k = r'(e^*).
\]
(70)

By (52), (51), the strict convexity of \( r(\cdot) \), and the linearity of the LHS of the equation with respect to \( y \), there exists a unique solution \( e^* \in (e_s, \bar{e}_s) \) to the equation above given \( y \in (0,1) \), which is the solution to (68). Moreover,
\[
e^* < \bar{e}_p,
\]
because by (68), the left-hand side of the equation (70) is equal to \( y(1-(1-d)^2)((p-c)(2E[X]-k)+2(w-c)(k-E[X]))+((1-y)d-(1-d)dy)((w-c)E[X]+(w-c)(k-E[X])) \), which is strictly increasing with \( y \) by (58) and is equal to the LHS of the equation (53) at \( y=1 \).

Finally, given \( e^* \), there exists a unique \( z \) that satisfies (69) such that \( \hat{q} \in ((1-v(1-\bar{e}_p))/(1-vd(1-\bar{e}_p)),1) \), because the right-hand side of (69) is strictly decreasing with \( z \), equals 1 at \( z=0 \) and equals \( (1-v(1-e^*))/(1-vd(1-e^*)) < (1-v(1-\bar{e}_p))/(1-vd(1-\bar{e}_p)) \) at \( z=1 \). This establishes the existence and uniqueness of a mixed strategy equilibrium for any \( \tau \in (\eta, \gamma) \) in the region \( \alpha < w < \beta \).

Now, we analyze the equilibria for \( w = \alpha \) and \( \eta \leq \tau < \gamma \). The indifference condition for \( S \) in (68) is satisfied if and only if \( y=0 \) by the definition of \( \alpha \), and therefore, \( B_2 \) does not source from \( S \) with probability 1. \( S \) is indifferent between declining and not declining \( B_1 \)'s business, and by our initial assumption for the knife-edge case with two equilibria, we focus on the equilibrium in which \( S \) declines \( B_1 \)'s business with probability 1 in the region \( w = \alpha \) and \( \eta \leq \tau < \gamma \).

**Case 3:** \( w \geq \beta \): In this case, \( S \) declines \( B_1 \)'s business upon finding out that it has a persistent violation because \( w \geq \beta \) is equivalent to (61) being less than (59), which by (58) also implies that (60) is less than (59). In this parameter region, \( B_2 \)'s expected profit from taking an alternative supplier as the candidate continues to be \( \pi \) while \( B_2 \)'s expected profit by taking \( S \) as the candidate supplier is \( (p-w)(k-E[X]) - a \) (because a candidate supplier does not decline \( B_1 \)'s business and is revealed as \( B_1 \)'s supplier if and only if it does not have a violation in this case). Consequently, \( B_2 \) chooses \( S \) as its first candidate supplier if and only if
\[
\tau \geq \gamma = \frac{(2E[X]-k)(1-vd(1-\epsilon))(p-w)s-adv(1-\epsilon)}{v(1-d)(1-\epsilon)},
\]
does not source from \( S \) otherwise. For \( \tau \geq \gamma \), the optimal responsibility effort for \( S \) is \( \bar{e}_s \), and for \( \tau < \gamma \), the optimal responsibility effort for \( S \) is \( e_s \).

(a.) We prove the result by contradiction. Suppose that \( B_1 \) does not publish its blacklist in equilibrium. We will show that there exists a profitable deviation in which \( B_1 \) would publish the blacklist. By the analysis of the base model, for \( \tau < \tau \), \( B_1 \) does not commit to publish its supplier's identity
in equilibrium and has the expected profit \( \pi \), whereas for \( \tau \geq \tau \), an equilibrium exists in which B1 commits to publish its supplier’s identity and thereby earns \( \pi_{t1} \). However, for \( \tau < \tau \), B1 strictly benefits from deviating and committing to publish its blacklist because B1’s expected profit with this commitment is

\[
\begin{align*}
\begin{cases}
(p - w)E[X] - (a + s)\left(1 - v\left(1 - \bar{e}_s\right)\right) & \text{if } w \geq \alpha, \\
(p - w)E[X] - \left(a + s + v\left(1 - \bar{e}_p\right)\left(1 - d\right)\tau / \left(1 - vd\left(1 - \bar{e}_p\right)\right)\right) & \text{otherwise,}
\end{cases}
\end{align*}
\]

and this expression is strictly greater than \( \pi \) because \( \bar{e}_p > \bar{e} \) for \( w < \alpha \) as shown in (55), and for \( w \geq \alpha \) by \( \bar{e}_s > \bar{e} \) as shown in (56).

For \( \tau \geq \tau \), we now show that B1 strictly benefits from committing to publish its blacklist in addition to the supplier’s identity. B1’s expected profit with this commitment is

\[
\begin{align*}
\begin{cases}
\left((p - w)\left(1 - v(1 - \bar{e}_p)\left(1 - (1 - d)^2\right)\right)\left(k - E[X]\right) + vd(1 - d)(1 - \bar{e}_p)E[X]\right) \\
- v(1 - \bar{e}_p)(1 - d)\tau - a - s) / (1 - vd(1 - \bar{e}_p)) & \text{if } w < \beta, \\
(p - w)(k - E[X]) - (a + s) / (1 - v(1 - \bar{e}_s)) & \text{otherwise,}
\end{cases}
\end{align*}
\]

because it has been established in the analysis of B1’s commitment to publish its blacklist and its supplier’s identity that for \( w < \beta \) B2 takes S as its first candidate supplier in the region \( \tau \geq \gamma \) where \( \gamma < \tau_2 \), and for \( w \geq \beta \) a candidate supplier to B1 declines B1’s business upon finding out a persistent violation. B1’s expected profit is greater than \( \pi_{t1} \) because \( \bar{e}_p > \bar{e} \) for \( w < \beta \) as shown in (55), and for \( w \geq \beta \) by \( \bar{e}_s > \bar{e} \) as shown in (56) and \( \tau > (p - w)E[X] \).

(b.) In the event that B1 is committed to publish its supplier’s identity and B2 takes S as its candidate supplier, B1’s commitment to publish also its blacklist strictly increases the responsibility effort because \( \bar{e}_p > \bar{e} \) and \( \bar{e}_s > \bar{e} \) by (55) and (56). In the event that B1 is not committed to publish its supplier’s identity or that B1 is committed to publish its supplier’s identity and B2 does not source from S, B1’s commitment to publish also its blacklist strictly increases the responsibility effort because \( e_p > e \) and \( e_s > e \) by (55) and (56).

(c&d.) These parts are immediate from the above analyses of the equilibria under B1’s commitment to publish only its blacklist and B1’s commitment to publish its blacklist and its supplier’s identity.

(e.) As established in part (a.), in equilibrium, B1 commits to publish its blacklist. Therefore, we now characterize B1’s decision for whether to publish the blacklist only or blacklist and the supplier’s identity, together with the equilibrium responsibility effort for a candidate supplier to B1 and B2’s supplier selection decision for each sample path.

As shown in Case 1 of the equilibrium under B1’s commitment to publish its blacklist and its supplier’s identity analyzed above, for \( w \geq \alpha \), an equilibrium exists in which B2 takes S as its first
candidate and a candidate supplier to B1 exerts the responsibility effort $\bar{e}_p$ if and only if $\tau \geq \gamma$. B1’s expected profit in this parameter region is

$$\left( p - w \right) \left( 1 - v(1 - \bar{e}_p) \left( 1 - (1 - d)^2 \right) \left( k - E[X] \right) + vd(1 - d)(1 - \bar{e}_p)E[X] \right) - v(1 - \bar{e}_p)(1 - d)\tau - a - s$$

$$\frac{1 - vd(1 - \bar{e}_p))}{1 - vd(1 - \bar{e}_p)}$$

(71)

Otherwise, B2 does not source from S and a candidate supplier to B1 exerts the effort $\underline{e}_p$, as in the case where B1 is committed to publish only is blacklist. B1’s expected profit without the commitment to publish its supplier’s identity is

$$(p - w)E[X] - \frac{v(1-d)(1-\underline{e}_p)\tau + a + s}{1 - vd(1 - \underline{e}_p)}.$$  

(72)

An equilibrium exists in which B1 commits to publish also the supplier’s identity if and only if (71) is greater than (72), or equivalently, if and only if $\tau \geq \theta$. It remains to show that $\theta > \gamma$, or equivalently, when B1 chooses to publish its supplier’s identity, B2 will choose to take S as its first candidate supplier. Note that B1 and B2’s expected profit in an equilibrium where B1 publishes its supplier’s identity and B2 takes S as its first candidate are identical to $\pi_{t1}$ in (3) and $\pi_{t2}$ in (4), respectively, with $\bar{e}$ replaced by $\bar{e}_p$. Lemma 1 can be extended in a straightforward manner to show that B2’s expected profit is strictly greater than B1’s expected profit. Moreover, B2’s expected profit by not sourcing from S is $\pi$, whereas B1’s expected profit by not publishing the supplier’s identity is (72), which is strictly greater than $\pi$ because $\underline{e}_p > \underline{e}$ by (55), $(v, d) \in (0, 1)$, and $a > 0$. Hence, if B1 optimally chooses to publish its supplier’s identity, B2 optimally chooses to take S as its first candidate supplier, and it must be that $\theta > \gamma$.

As shown in Case 2 of the equilibrium under B1’s commitment to publish its blacklist and its supplier’s identity analyzed above, for $\alpha \leq w < \beta$, a candidate supplier to B1 declines B1’s business if it has a persistent violation and expects not to supply to B2, and a candidate supplier to B1 does not decline B1’s business if it expects B2 to source from B1’s selected supplier S with probability 1. In Case 2, it has been shown that an equilibrium exists in which B2 takes S as its first candidate supplier and a candidate supplier to B1 exerts the responsibility effort $\bar{e}_p$ if and only if $\tau \geq \gamma$. B1’s expected profit in this parameter region is

$$(p - w) \left( 1 - v(1 - \bar{e}_p) \left( 1 - (1 - d)^2 \right) \left( k - E[X] \right) + vd(1 - d)(1 - \bar{e}_p)E[X] \right) - v(1 - \bar{e}_p)(1 - d)\tau - a - s$$

$$\frac{1 - vd(1 - \bar{e}_p))}{1 - vd(1 - \bar{e}_p)}$$

(73)

Without the commitment to publish the supplier’s identity, a candidate supplier to B1 exerts the effort $\underline{e}_s$ and declines B1’s business if it has a persistent violation, and B1’s expected profit is

$$(p - w)E[X] - \frac{a + s}{1 - v(1 - \underline{e}_s)}.$$  

(74)
An equilibrium exists in which B1 commits to publish also the supplier’s identity if and only if 
(73) is greater than (74), or equivalently, if and only if $\tau \leq \theta$.

It has also been shown in Case 2 that a unique mixed strategy equilibrium exists for $\alpha < w < \beta$ and $\tau \in (\eta, \gamma)$ in which B2 takes S as its first candidate supplier and a candidate supplier to B1 does not decline B1’s business with positive probability and the optimal responsibility effort for the candidate supplier is found from (70). B1’s expected profit in this parameter region is

$$
(1 - v(1 - e^*)) (p - w) (y(k - E[X]) + (1 - y)E[X]) - v(1 - e^*)z(1 - d)\tau - a - s
\frac{+ v(1 - e^*)z(1 - d)(p - w)((1 - y + yd)(p - w)E[X] + y(1 - d)(p - w)(k - E[X]))}{1 - v(1 - e^*)(1 - z(1 - d))},
$$

Where $(e^*, z, y)$ are independent of $\tau$. Without the commitment to publish the supplier’s identity, a candidate supplier to B1 exerts the effort $e_s$ and declines B1’s business if it has a persistent violation, and B1’s expected profit is given by (74). An equilibrium exists in which B1 commits to publish also the supplier’s identity if and only if the expression above is greater than (74), which by $(z, e^*, d, v) \in (0, 1)$ is equivalent to $\tau \leq \theta$.

As shown in Case 3 of the equilibrium under B1’s commitment to publish its blacklist and its supplier’s identity analyzed above, for $w \geq \beta$, a candidate supplier to B1 declines B1’s business upon finding a persistent violation. An equilibrium exists in which a candidate supplier to B1 exerts the responsibility effort $\bar{e}_s$ and B2 takes S as its first candidate supplier if and only if $\tau \geq \gamma$. B1’s expected profit with publishing its supplier’s identity and blacklist is

$$
(p - w)(k - E[X]) - \frac{a + s}{1 - v(1 - \bar{e}_s)}.
$$

(75)

Otherwise $(\tau < \gamma)$, B2 does not source from S and a candidate supplier to B1 exerts the responsibility effort $e_s$, as in the case where B1 is committed to publish only is blacklist. B1’s expected profit without the commitment to publish its supplier’s identity is

$$
(p - w)E[X] - \frac{a + s}{1 - v(1 - e_s)}.
$$

(76)

An equilibrium exists in which B1 commits to publish also the supplier’s identity if and only if (75) is greater than (76), or equivalently, if and only if $k \geq 2E[X] + v(a + s)(1 - e_s - \bar{e}_s)/((p - w)(1 - ve_s)(1 - v(1 - \bar{e}_s)))$.

**Proof of Corollary 1:** In the absence of the option to blacklist, a transparency equilibrium exists in the region $\tau \geq \tau$ in which B1 reveals its supplier’s identity, B2 takes B1’s supplier as its first candidate supplier, and a candidate supplier to B1 chooses responsibility effort $\bar{e}$. With the option to blacklist, it follows from Proposition 4 that, in the region specified in the statement of the Corollary, B1 publishes only the blacklist in equilibrium and a candidate supplier to B1 chooses
the responsibility effort $\bar{e}_s$. Then, the responsibility effort of a candidate supplier to B1 is lower with the option to blacklist because $\bar{e}_s < \bar{e}$. We use a numerical example to establish the existence of the parameter region defined in the statement of the Corollary. Suppose $p = 1$, $c = 0$, $w = 0.2$, $w = 0.036$, $k = 2$, $E[X] = 1.2$, $d = 0.8$, $v = 0.5$, $\tau = 5.954$, $a = 0.055$, $s = 0.002$, and $r(e) = e^2$. In this region, $\tau = 5.946$ and $\beta = 0.036$, while a candidate supplier to B1 chooses the equilibrium responsibility effort $\bar{e} = 0.296$ in the absence of blacklisting and $\bar{e}_s = 0.082$ with blacklisting.

**Proof of Proposition 5:** We first derive the optimal effort by a candidate supplier to B1 and its expected profit under different cases relating to B1’s transparency commitment and B2’s supplier selection decisions, and use these expressions to characterize the equilibria when B1 commits to publish its blacklist only and to publish its blacklist and the supplier’s identity.

**Optimal Effort by a Candidate Supplier to B1:** Suppose that B1 is committed to publish its blacklist. If a candidate supplier to B1 does not decline B1’s business and expects B2 to take S as its first candidate supplier, the optimal effort $\bar{e}_u$ is found from

$$
\max_e \left\{ (1 - v(1 - e)(1 - (1-d)^2)) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) + v(1 - e)(1 - d)(w - c)(k - E[X]) + (w - c)(k - E[X]) - r(e) \right\}.
$$

If a candidate supplier to B1 does not decline B1’s business and expects not to supply B2, the optimal effort $\bar{e}_u$ is found from

$$
\max_e \left\{ (1 - vd(1 - e)) \left( (w - c)(k - E[X]) + (w - c)(k - E[X]) - r(e) \right) \right\}.
$$

The optimal effort by a candidate supplier to B1 under these contingencies satisfy:

$$
v \left( 1 - d^2 \right) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) - v(1 - d)d \left( (w - c)(k - E[X]) + (w - c)(k - E[X]) \right) = r'(\bar{e}_u)
$$

$$
vd \left( (w - c)(k - E[X]) + (w - c)(k - E[X]) \right) = r'(\bar{e}_u).
$$

In the base model in which B1 does not publish its blacklist, the optimal efforts by a candidate supplier to B1 when B2 takes S as its first candidate supplier or when B2 does not source from S are found from the following expressions, respectively:

$$
v(1 - d^2)(p - c)(2E[X] - k) + 2(w - c)(k - E[X])
$$

$$
- v(1 - d)d((w - c)(k - E[X]) + (w - c)(k - E[X])) = r'(\bar{e})
$$

$$
vd((w - c)(k - E[X]) + (w - c)(k - E[X])) - vd(w - c)(k - E[X]) = r'(\bar{e}).
$$

By $(v, d) \in (0, 1)$, $k > 1$ and $w > c$, we have

$$
\bar{e}_u > \bar{e} \text{ and } \bar{e}_u > \bar{e}.
$$

(77)
**Expected Profit of a Candidate Supplier to B1:** In the case where a candidate supplier to B1 declines B1’s business, the supplier’s expected profit is

\[(w - c)k.\]  

(78)

If B1 is committed to publish its blacklist only or if B1 is committed to publish its blacklist and the supplier’s identity and a candidate supplier to B1 expects not to supply B2, the candidate supplier’s expected profit by not declining B1’s business is

\[
(1 - vd(1 - e_u)) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - r(e_u). 
\]

(79)

If B1 is committed to publish its blacklist and the supplier’s identity and a candidate supplier to B1 expects B2 to take S as its first candidate supplier, the candidate supplier’s expected profit by not declining B1’s business is

\[
\left( 1 - v(1 - \bar{e}_u) \left( 1 - (1 - d)^2 \right) \right) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) 
+ v(1 - \bar{e}_u)(1 - d) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - r(\bar{e}_u). 
\]

(80)

Note that (80) is strictly greater than (79); i.e.,

\[
\max_{e} \left\{ \left( 1 - v(1 - e) \left( 1 - (1 - d)^2 \right) \right) \left( (p - c)(2E[X] - k) + 2(w - c)(k - E[X]) \right) 
+ v(1 - e)(1 - d) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - r(e) \right\} 
> \max_{e} \left\{ (1 - vd(1 - e)) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - r(e) \right\}, 
\]

(81)

by (58) and \(d \in (0, 1).\)

We analyze the equilibria under publishing the blacklist only, the supplier’s identity only, or both in three different regions:

**Case 1:** \(w < \alpha_u;\) The condition \(w < \alpha_u\) is equivalent to (78) being strictly less than (79), which by (81) also implies that (78) is strictly less than (80). Therefore, a candidate supplier to B1 does not decline B1’s business if B1 is committed to publish its blacklist.

If B1 is committed to publish its blacklist and its supplier’s identity, the equilibrium can be analyzed in a similar manner to the Case 1 in the proof of Proposition 4. Therefore, an equilibrium exists in which B2 takes B1’s selected supplier S as its first candidate and a candidate supplier to B1 exerts \(\bar{e}_u\) if and only if \(\tau \geq \gamma_u\), where \(\gamma_u\) is given by

\[
\gamma_u = \left( \frac{ad}{1 - d} + \frac{1 - (1 - (1 - d)^2) \left( 1 - \bar{e}_u \right) v \left( -s + (1 - vd(1 - \bar{e}_u)) (p - w)(2E[X] - k) \right)}{(1 - d) v \left( \bar{e}_u - \bar{e} + d(1 - \bar{e}_u) \left( 1 - (1 - d)v \right) \right) \left( 1 - (1 - d)^2 \right)} \right). 
\]

(82)
Note that this expression is identical to $\tau^2$ in (28) with $\bar{e}$ replaced by $\bar{e}_u$. By (77), $\bar{e}_u > \bar{e}$ which by Lemma 2 leads to

$$\gamma_u < \tau^2.$$ 

Using $\gamma_u < \tau^2$ and (77) (i.e., commitment to publish the blacklist increases the responsibility effort), we can show similarly to Proposition 4a that in equilibrium B1 commits to publish its blacklist. Then, we can show similarly to Proposition 4e (Case 1) that an equilibrium exists in which B1 also commits to publish the supplier’s identity if and only if $\tau \geq \theta_u$ and $\tau \geq \gamma_u$. (Details are omitted for brevity.)

It remains to show that $\theta_u > \gamma_u$, or equivalently, when B1 chooses to publish its supplier’s identity, B2 will choose to take S as its first candidate supplier. Note that B1 and B2’s expected profit in an equilibrium where B1 publishes its supplier’s identity and B2 takes S as its first candidate are identical to $\pi_{11}$ in (3) and $\pi_{22}$ in (4), respectively, with $\bar{e}$ replaced by $\bar{e}_u$. Lemma 1 can be extended in a straightforward manner to show that B2’s expected profit is strictly greater than B1’s expected profit. Moreover, B2’s expected profit by not sourcing from S is $\pi$, whereas the expression for B1’s expected profit by not publishing the supplier’s identity is identical to the expression of $\pi$ with $\xi$ replaced by $\xi_u$. B1’s expected profit is greater than $\pi$ because $\xi_u > \xi$ by (77), $(v,d) \in (0,1)$, $a > 0$, $s \geq 0$ and $\tau \geq 0$. Hence, if B1 optimally chooses to publish its supplier’s identity, B2 optimally chooses to take S as its first candidate supplier, and it must be that $\theta_u > \gamma_u$.

**Case 2: $\alpha_u \leq \omega < \beta_u$:** This condition is equivalent to (78) being greater than (79) and strictly less than (80). (Note that $\beta_u > \alpha_u$ is due to (81)). Therefore, a candidate supplier to B1 declines B1’s business when B1 is committed to publish only its blacklist or when B1 is committed to publish its blacklist and its supplier’s identity and a candidate supplier to B1 does not expect to supply B2. However, a candidate supplier to B1 does not decline B1’s business when B1 is committed to publish both its blacklist and its supplier’s identity and the supplier expects B2 to take S as its first candidate supplier. Consequently, B1 does not commit to publish its blacklist only because B1 earns positive expected profit without a transparency commitment whereas B1’s commitment to publish only the blacklist yields zero profits.

Therefore, B1 compares whether to publish only the supplier’s identity or to publish the supplier’s identity and the blacklist in this region. First, we consider the equilibrium under B1’s commitment to publish its blacklist and its supplier’s identity. As argued in Case 1, when B1 is committed to the supplier’s identity and the blacklist, an equilibrium exists in which B2 takes S as its first candidate supplier and a candidate supplier to B1 exerts $\bar{e}_u$ if and only if $\tau \geq \gamma_u$ where $\gamma_u$ is found
from \((82)\) and satisfies \(\gamma_u < \bar{\epsilon}_2\). Moreover, for \(\tau \geq \gamma_u\), by committing to publish both the supplier’s identity and the blacklist, B1 earns
\[
(p - w) \left( 1 - v(1 - \bar{\epsilon}_u) \right) \left( 1 - (1 - d)^2 \right) \left( k - E[X] \right) + vd(1 - d)(1 - \bar{\epsilon}_u)E[X] \right) - v(1 - d)(1 - \bar{\epsilon}_u)\tau - a - s \\
1 - vd(1 - \bar{\epsilon}_u)
\]
whereas B1’s expected profit without the transparency commitment equals \(\pi\). By \((77)\) and Proposition 1a, \(\bar{\epsilon}_u > \bar{\epsilon} > \bar{\epsilon}_1\), which implies that \((83)\) is greater than \(\pi\) if and only if \(\tau \geq \theta_u\).

We can show that \(\theta_u > \gamma_u\), or equivalently, when B1 chooses to publish its supplier’s identity and blacklist, B2 will choose to take S as its first candidate supplier. Note that B1 and B2’s expected profit in an equilibrium where B1 publishes its supplier’s identity and B2 takes S as its first candidate are identical to \(\pi_{11}\) in \((3)\) and \(\pi_{21}\) in \((4)\), respectively, with \(\bar{\epsilon}\) replaced by \(\bar{\epsilon}_u\). Lemma 1 can be extended in a straightforward manner to show that B2’s expected profit is strictly greater than B1’s expected profit. Moreover, B2’s expected profit by not sourcing from S and B1’s expected profit by not publishing the supplier’s identity and blacklist are \(\pi\). B1’s expected profit is greater than \(\pi\) because \(e_u > \bar{\epsilon}\) by \((77)\), \((v, d) \in (0, 1), a > 0, s \geq 0\) and \(\tau \geq 0\). Hence, if B1 optimally chooses to publish its supplier’s identity and blacklist, B2 optimally chooses to take S as its first candidate supplier, and it must be that \(\theta_u > \gamma_u\).

Proposition 1 shows that B1 commits to publish its supplier’s identity and thereby earns \(\pi_{11} \geq \pi\) if and only if \(\tau \geq \bar{\tau}\). By \((77)\), \(\bar{\epsilon}_u > \bar{\epsilon}\) which together with \(\tau > (p - w)E[X]\) leads to \((83)\) being strictly greater than \(\pi_{11}\). Therefore, \((83)\) being greater than \(\pi_{11}\) and \(\pi\) in the region \(\tau \geq \theta_u\), B1 commits to publish its blacklist and its supplier’s identity and earns greater profits by doing so if and only if \(\tau \geq \theta_u\).

**Case 3:** \(w \geq \beta_u\): This condition is equivalent to \((78)\) being greater than \((80)\), which by \((81)\) also implies that \((78)\) is strictly greater than \((79)\). In this region, a candidate supplier to B1 declines B1’s business when B1 is committed to publish its blacklist (regardless of B1’s commitment to publish the supplier’s identity). In the base model, B1 earns positive expected profit \((\pi > 0)\) without transparency commitment by assumption and B1 commits to publish the supplier’s identity and increases its expected profit by doing so if and only if \(\tau \geq \bar{\tau}\). Therefore, an equilibrium exists in which B1 commits to publish only its supplier’s identity if and only if \(\tau \geq \bar{\tau}\).

Parts (a-c.) directly follow from the analysis above. Finally, we establish that \(\alpha_u > \alpha\) and \(\beta_u > \beta\).

Note that for any \(w \leq \alpha\), we observe that
\[
(w - c)k \leq (1 - d) \left( (w - c)E[X] + (k - E[X])(w - c) \right) < (1 - vd) \left( (w - c)E[X] + (k - E[X])(w - c) \right) - r(e) \\
\leq \max_{e \geq 0} \left\{ (1 - vd(1 - e)) ( (w - c)E[X] + (k - E[X])(w - c) - r(e) \right\},
\]
where the first inequality is due to the definition of $\alpha$, the second inequality is due to $(v, d) \in (0,1)$, $w = w > c$ and $k > E[X]$, and the third inequality is due to the equality of the expressions on the right and left-hand sides at $e = 0$ and the maximization at the right-hand side. Therefore for any $w \leq \alpha$, (78) is strictly less than (79), implying that $w < \alpha_w$. This is true for any $w \leq \alpha$ if and only if $\alpha < \alpha_w$. $\beta_u > \beta$ can be proven following similar steps as above.

**Proof of Corollary 2:** In the absence of the option to blacklist, a transparency equilibrium exists in the region $\tau \geq \tau$ in which B1 reveals its supplier’s identity, B2 takes B1’s supplier as its first candidate supplier, and a candidate supplier to B1 chooses responsibility effort $\bar{e}$. With the option to blacklist, it follows from Proposition 5 that, in the region specified in the statement of the Corollary, B1 publishes only the blacklist in equilibrium and a candidate supplier to B1 chooses the responsibility effort $e_u$. Then, the responsibility effort of a candidate supplier to B1 is lower with the option to blacklist because $e_u < \bar{e}$. We use a numerical example to establish the existence of the parameter region defined in the statement of the Corollary. Suppose $p = 1, c = 0, w = 0.5, w = 0.01, k = 2, E[X] = 1.2, d = 0.8, v = 0.619, \tau = 3.08, a = 0.02, s = 0$, and $r(e) = e^2$. In this region, $\tau = 3.084$ and $\alpha_u = 0.212$, while a candidate supplier to B1 chooses the equilibrium responsibility effort $\bar{e} = 0.321$ in the absence of blacklisting and $c_s = 0.151$ with blacklisting.

**Proofs of the Analytical Results in Section 5**

**Proof of Proposition 6:** (a.) The first-order condition for finding the equilibrium hiding effort is

$$d \left(2(1 - d(1 - e^*_h))\Delta + (w - w)E[X]\right) = r'_h(e^*_h).$$

(84)

By implicit differentiation, $d e^*_h / d \Delta = 2d(1 - d(1 - e^*_h)) / (r''_h(e^*_h) - 2d^2 \Delta)$, for which the denominator is negative by the second-order conditions. Then, $e^*_h \geq e^*_h$ follows from $e^*_h$ strictly increasing with $\Delta$ because $(d, e^*_h) \in (0,1)$ and $e^*_h = e'_h$ at $\Delta = 0$.

(b.) That $e^*_h$ is strictly increasing with $p$ and with $k$ if and only if $(w - w) > (p - w)/2$ follows from the differentiation of $\Delta$ with respect to $p$ and $k$ and the fact that $e^*_h$ is strictly increasing with $\Delta$. $e^*_h$ strictly decreases with the supplier’s outside alternative unit price $w$ because implicit differentiation of (84) leads to $d e^*_h / dw = -d(2(1 - d(1 - e^*_h))(k - E[X]) + E[X]) / \left(r''_h(e^*_h) - 2d^2 \Delta\right)$, for which the denominator is negative by the second-order conditions and the numerator is negative by $(d, e^*_h) \in (0,1), E[X] < k < 2E[X]$. $e^*_h$ strictly decreasing with $w$ follows from the analysis of $d e^*_h / dw$ at $\Delta = 0$.

(c.) Below, we use $e^*_h(z)$ to refer to the equilibrium hiding effort when the magnitude of the improvement in expected contribution from transparency is $z$. We show that $e^* > e'$ if $e^*_h < e^*_h$ by showing that $e^*$ strictly increases with $z$ in this parameter region (because $e'$ corresponds to the equilibrium hiding effort for $z = 0$). Similarly, we show that $e^* < e'$ if $e^*_h > e^*_h$ by showing that $e^*$ strictly decreases with $z$ in this parameter region.
The first-order condition for finding the equilibrium responsibility effort (given the improvement in expected contribution from transparency $z$) is

$$d(1 - e^*_h(z)) \left([(w - c)E[X] + (w - c)(k - E[X])] + (2 - d(1 - e^*_h(z)))d(1 - e^*_h(z))z - d(1 - e^*_h(z))(w - c)k = r'(e^*). \right)$$

By implicit differentiation of (85) with respect to $z$ and using (84) to simplify the numerator, we obtain

$$\frac{de^*}{dz} = \frac{(2 - d(1 - e^*_h(z)))d(1 - e^*_h(z)) - 2d(1 - d(1 - e^*_h(z)))r'_h(e^*_h(z))/r''_h(e^*_h(z))}{r''(e^*)}. \tag{86}$$

Define $e_h$ and $\bar{e}_h$ as

$$e_h = e^*_h \lor 0, \tag{87}$$

$$\bar{e}_h = e^m_h \lor 0, \tag{88}$$

with $e_{h,1}$ and $e_{h,2}$ satisfying the following equations, respectively:

$$\max_{e_h \in [0,1]} \begin{cases} r'_h(e_h) \\ r''_h(e_h) \end{cases} = \frac{(2 - d(1 - e^*_h))(1 - e^*_h)}{2(1 - d(1 - e^*_h))}, \tag{89}$$

$$\min_{e_h \in [0,1]} \begin{cases} r'_h(e_h) \\ r''_h(e_h) \end{cases} = \frac{(2 - d(1 - e^m_h))(1 - e^m_h)}{2(1 - d(1 - e^m_h))}.$$

$\bar{e}_h \geq e_h$ because $(2 - d(1 - e_h))(1 - e_h)/(2(1 - d(1 - e_h)))$ is strictly decreasing with $e_h$ (by $d \in (0,1)$).

If $e^*_h < e_h$, then $e^*_h(z) < e_h$ for all $z \in [0,\Delta]$ (because the proof of part (a) established that the equilibrium hiding effort increases with the magnitude of the improvement in expected contribution from transparency). Then, (86) evaluates to a positive value because $r(\cdot)$ is strictly convex and $d \in (0,1)$, which establishes the proof. Conversely, if $e'_h > \bar{e}_h$ then $e^*_h(z) > e_h$ for all $z \in [0,\Delta]$ and (86) evaluates to a negative value.

**Proof of Proposition 7:** (a-b.) Note that the supplier’s objective can be rewritten as

$$\max_{e_h} \left\{ (1 - e_h)d \left([(w - c)k - \delta] + (1 - d(1 - e_h)) \left([(w - c)E[X] + (w - c)(k - E[X])] - r_h(e_h) \right) \right\},$$

where $\delta \equiv (w - c)k$ is the contribution loss due to blacklisting. Then, we proceed by showing that $e^*_{h,b}$ strictly increases with $\delta$ to establish the dependence for transparency. The first-order condition for finding the equilibrium hiding effort is

$$d \left([(w - w)E[X] + \delta] = r'_h(e^*_{h,b}). \tag{90}$$

By implicit differentiation, $de^*_{h,b}/d\delta = d/r''_h(e^*_{h,b})$, which is positive because $d \in (0,1)$ and $r_h(\cdot)$ is strictly convex. Furthermore, $de^*_{h,b}/dw = (w - w)E[X]/r''_h(e^*_{h,b})$ and
\( \frac{de_{h,b}^*}{dw} = d(k - E[X])/r''_h(e_{h,b}^*) \) are all positive because \( d \in (0, 1), k > E[X] > 0, w > w > c, \delta > 0, \) and \( r(\cdot) \) is strictly convex.

That \( e'_h \) strictly decreases with \( w \) follows from Proposition 6b. The first-order conditions for finding \( e'_h \) is equivalent to (90) at \( \delta = 0 \). Then, that \( e'_h \) strictly increases with \( d \) and \( w \) follows similarly to the analysis of how \( e'_h \) varies with \( d \) and \( w \).

(c.) We use \( e_{h,b}^*(z) \) to refer to the equilibrium hiding effort when the magnitude of contribution loss from transparency is \( z \). We show that \( e^*_h > e' \) if \( e_{h,b}^* < \xi_{h,b} \) by showing that \( e^*_h \) strictly increases with \( z \) in this parameter region (because \( e' \) corresponds to the equilibrium hiding effort for \( z = 0 \)). Similarly, we show that \( e^*_h < e' \) if \( e_{h,b}^* > \bar{e}_{h,b} \) by showing that \( e^*_h \) strictly decreases with \( z \) in this parameter region.

The first-order condition for finding the equilibrium responsibility effort (given the contribution loss from transparency \( z \)) is

\[
d(1 - e_{h,b}^*(z))(w - w)E[X] + z) = r'(e_h^*). \tag{91}
\]

By implicit differentiation of (91) with respect to \( z \) and using (90) to simplify the numerator, we obtain

\[
\frac{de_{h,b}^*}{dz} = \frac{d}{r''_h(e_{h,b}^*)} = \frac{d}{1 - e_{h,b}^*(z) - r'_h(e_{h,b}^*)} \left( \frac{r'_h(e_{h,b}^*)}{r''_h(e_{h,b}^*)} \right). \tag{92}
\]

Define \( \xi_{h,b} \) and \( \bar{e}_{h,b} \) as the value of \( e_h \) that satisfy the following equations, respectively:

\[
\xi_{h,b} = \max \left\{ 1 - \max_{e_h \in [0, 1]} \left( \frac{r'_h(e_h)}{r''_h(e_h)} \right), 0 \right\}, \tag{93}
\]

\[
\bar{e}_{h,b} = \max \left\{ 1 - \min_{e_h \in [0, 1]} \left( \frac{r'_h(e_h)}{r''_h(e_h)} \right), 0 \right\}. \tag{94}
\]

If \( e_{h,b}^* < \xi_{h,b} \), then \( e_{h,b}^*(z) < \xi_{h,b} \) for all \( z \in [0, \delta] \) (because the proof of part (a) established that the equilibrium hiding effort increases with the magnitude of the contribution loss from transparency). Then, the RHS of (92) evaluates to a positive value because \( r(\cdot) \) is strictly convex and \( d \in (0, 1) \), which establishes the proof. Conversely, if \( e_{h,b}^* > \bar{e}_{h,b} \) then \( e_{h,b}^*(z) ) > \xi_{h,b} \) for all \( z \in [0, \delta] \) and (92) evaluates to a negative value.

(d.) It follows from (87) that if \( \max_{e_h \in [0, 1]} \{r'_h(e_h)/r''_h(e_h)\} \leq 1 \) then by simple algebra \( \xi_{h,b} > 0 \). Then, \( \xi_{h,b} \geq \xi_{h,b} \) follows by comparing (93) with (87) and noting that \( (2 - d(1 - e_h))(1 - e_h)/(1 - d(1 - e_h)) \geq 1 - e_h \) for \( e_h \geq 0 \) and \( (2 - d(1 - e_h))(1 - e_h)/(1 - d(1 - e_h)) \) is strictly decreasing with \( e_h \) when \( d \in (0, 1) \). If \( \max_{e_h \in [0, 1]} \{r'_h(e_h)/r''_h(e_h)\} > 1 \), then \( \xi_{h,b} = \xi_{h,b} = 0 \). Comparison of \( \bar{e}_{h,b} \) and \( \bar{e}_{h,b} \) follows similarly.
Proof of Corollary 3: By Proposition 7d, if \( e'_h > \bar{e}_h \) implies \( e'_h > \bar{e}_{h,b} \) so the backfiring condition under commitment to blacklisting holds. We use a numerical example to establish the existence of a parameter region wherein commitment to blacklisting backfires and commitment to publish a supplier’s identity does not: Suppose \( r(e) = e^2 \), \( r_h(e_h) = e_h^2 \), \( p = 5.58 \), \( w = 4.3 \), \( c = 1 \), \( d = 0.5 \), \( E[X] = 1 \), \( k = 1.15 \). Without transparency, the optimal responsibility and hiding efforts are \( e' = 0.07 \) and \( e'_h = 0.06 \), respectively. With B1’s commitment to publish its supplier’s identity the optimal responsibility and hiding efforts are \( e^* = 0.29 \) and \( e^*_h = 0.5 \), respectively, whereas with blacklisting the optimal responsibility and hiding efforts are \( e^*_b = 0.058 \) and \( e^*_{h,b} = 0.94 \), respectively.

Unknown Violation: We now assume that the supplier chooses the optimal responsibility and hiding effort simultaneously and without observing whether or not there is a violation.

If B1 is not committed to transparency, the optimal responsibility and hiding efforts for each candidate supplier to B1 are uniquely determined by

\[
(e'_u, e'_{h,u}) \equiv \arg \max \left\{ v \left( e + (1 - e) \left( 1 - d(1 - e_h) \right) \right) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) \\
+ vd(1 - e)(1 - e_h)(w - c)k - r(e) - r_h(e_h) \right\},
\]

(95)

Commitment to Publish a Supplier’s Identity: For comparison, consider a transparency equilibrium in which B1 commits to publish its supplier’s identity and B2 takes \( S \) as its first candidate supplier. The equilibrium responsibility and hiding efforts for a candidate supplier to B1 are uniquely determined by

\[
\arg \max \left\{ v \left( e + (1 - e) \left( 1 - d(1 - e_h) \right) \right) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) \\
+ v \left( e + (1 - e)(1 - d(1 - e_h))^2 \right) \Delta + vd(1 - e)(1 - e_h)(w - c)k - r(e) - r_h(e_h) \right\}.
\]

(96)

where \( \Delta \) captures the improvement in the candidate supplier’s expected contribution when the supplier sells to both buying firms, as in the analysis of a known violation. The objective in (96) is equivalent to the objective in (95) for \( \Delta = 0 \). The next proposition characterizes a sufficient condition under which B1’s commitment to publish its supplier list backfires by reducing the responsibility effort by a candidate supplier to B1 and develops differentiated insights from the known violation scenario. In the proposition below (and in Proposition 9), \( \hat{e}_h \) is the solution to

\[
d(1 - \hat{e})(w - \hat{e}) = r'_h(\hat{e}_h),
\]

(97)

where \( \hat{e} \) is the supplier’s optimal responsibility effort in a transparency equilibrium without hiding, which maximizes the objective in (2).
Proposition 8. [Commitment to Publish a Supplier’s Identity:] (a.) If \( \hat{e}_h > \bar{e}_h \), then transparency strictly decreases the responsibility effort of a candidate supplier to B1. (b.) Hiding effort of a candidate supplier to B1 may strictly decrease with transparency. (c.) If \( \hat{e}_h > \bar{e}_h \) so commitment to publish a supplier’s identity backfires with an unknown violation, then commitment to publish a supplier’s identity also backfires with a known violation.

The proof of Proposition 8 is available from the authors upon request.

Commitment to Blacklisting: When B1 commits to blacklisting, the equilibrium responsibility and hiding efforts for a candidate supplier are uniquely determined by

\[
\text{arg max} \left\{ v \left( e + (1 - e) (1 - d(1 - e_h)) \right) \left( (w - c)E[X] + (w - c)(k - E[X]) \right) - r(e) - r_h(e_h) \right\}, \tag{98}
\]

The next proposition characterizes a sufficient condition under which B1’s commitment to blacklisting backfires by reducing the responsibility effort by a candidate supplier to B1 and develops differentiated insights from the known violation scenario.

Proposition 9. [Commitment to Blacklisting:] (a.) If \( \hat{e}_h > \bar{e}_{h,b} \), then transparency strictly decreases the responsibility effort of a candidate supplier to B1. (b.) Hiding effort of a candidate supplier to B1 may strictly increase with transparency. (c.) If \( \hat{e}_h > \bar{e}_{h,b} \) so commitment to blacklisting backfires with an unknown violation, then commitment to blacklisting also backfires with a known violation.

The proof of Proposition 9 is available from the authors upon request.