Why Customer Service Frustrates Consumers: Using a Tiered Organizational Structure to Exploit Hassle Costs

May 28, 2018

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Acknowledgement: The authors contributed equally to this research and their names appear alphabetically. They are grateful to Vinod Ganne of IIC Services, India for helpful discussions about call center operations, and for helpful input from Mark Bergen, Mary Caravella, Daniel Halbheer, Shijie Lu and participants at the 2016 Berlin IO Day (ESMT), at the 2017 INFORMS Marketing Science Conference, and seminars at Koç University, Eindhoven University of Technology, Tilburg University, University of Maastricht, University of Pennsylvania (Wharton), UC-Riverside, Harbin Institute of Technology, Washington University-St. Louis, Texas A&M, Duke University, University of Connecticut, Fudan University, University of Maryland, London Business School, University College London, University of Florida, and the University of Texas at Dallas.
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Abstract
Many Customer Service Organizations (CSOs) reflect a tiered, or multi-level, organizational structure, which we argue imposes hassle costs for dissatisfied customers seeking high levels of redress. The tiered structure specifies that first-level CSO (e.g. a call center agent) be restricted in its payout authority. Only by escalating a claim to a higher level (e.g. a manager), and incurring extra hassles, can a dissatisfied customer obtain more redress from the firm. We argue that the tiered structure helps the firm to control redress costs by (1) screening less severe claims so that such customers do not escalate their claims to a manager, and (2) screening illegitimate claims. Our main result is that a firm can be more profitable if it uses a tiered CSO to induce consumer hassles. This result is moderated by the firm’s concern for its reputation but not necessarily by competition.

Keywords: Hassle Costs, Customer Service Organization, Customer Complaints, Organizational Structure, Sequential Search Model.
1. Introduction

Any time a consumer purchases a product or service, the possibility of dissatisfaction exists. Regardless of the cause for dissatisfaction, the customer may want to contact the seller’s customer service organization (CSO) to seek restitution. This organization can take the form of an online chatroom with a customer representative, a call center, or even a traditional service desk within the store. Many of these organizations, such as offshore call centers, are characterized by a tiered organizational structure. Call centers that serve Dell, for example, have a set of “Level 1” agents who take the initial call.¹ Such agents are trained to provide standardized resolution options to resolve the caller’s problem. Level 1 agents are limited in their authority to provide redress. If a caller’s problem is not satisfactorily resolved, the caller can escalate her claim to a more senior agent, such as a CSO manager, who is authorized to provide larger compensation.

However, for many customers, dealing with a CSO is time consuming and frustrating. It has been reported that a U.S. consumer spends, on average, 13 hours/yr in calling queues (Time Magazine, 2013). And De Vericourt & Zhou (2005) indicate that callers typically call multiple times about a single issue before they are either satisfied or give up.² The time and effort expended in this process means that unsatisfied customers must incur hassle costs in order to claim redress. The hassle cost associated with the complaint process often leads to frustration,

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¹ Based on interviews with call center managers.
² Desmarais (2010) reports that for a typical call center an average of 1.43 customer calls are needed to resolve a given complaint.
which is revealed in many measures of customer satisfaction.\textsuperscript{3} Gerstner & Libai (2005) suggest that a level of frustration with customer service is persistent over time. Persistent customer frustration, however, seems at odds with the claims of many firms that they are committed to customer service.\textsuperscript{4} This raises the following question: \textit{Why do firms organize their CSOs in a way that consistently leads to customer frustration?} Resolving this question is the focus of this paper.

Hassle costs, and the inevitability of customer frustration with a CSO, are typically explained from an operations perspective. A large literature from operations research points out that, due to the volume of inbound calls and the randomness of their arrivals, eliminating all hassle costs would not justify the operational costs of sufficiently staffing call centers.\textsuperscript{5} Acknowledging this explanation, our research re-examines the issue, but from a marketing perspective. Our results do not contradict the above-mentioned operations explanation, but they do suggest that there may be advantages for the firm to induce customer hassles. We find that, by implementing a tiered CSO, the firm can avoid paying out too much in refunds; in particular, we find that a firm may have no compelling incentive to fully eliminate customer hassle, even if it were operationally feasible to do so.

We study the micro-economic incentives of a dissatisfied customer seeking compensatory redress from a firm’s CSO. Specifically, we develop a model of the complaint process in which customer claims are heard and evaluated by the CSO. In our model, the firm specifies only the limit any CSO agent is authorized to payout. The equilibrium outcome demonstrates that these

\textsuperscript{3} See Brady (2000) and Spencer (2003) for anecdotal accounts and survey results indicating that more than two-thirds of callers are upset with the way their complaints are handled.

\textsuperscript{4} For instance, Delta Airlines, listed as one of the worst companies for customer service by \textit{Business Insider}, claims that “Delta Airlines is committed to the highest standards of customer service” (Nisen 2013).

\textsuperscript{5} See Gans, Koole, & Mandelbaum (2003) or Aksin, Armony, & Mehrotra (2007) for an overview.
payout limits can be specified in a way that forces a dissatisfied customer through a sequential claims process, akin to “jumping through hoops,” in order to obtain compensation. The firm’s choice of these limits imply a tiered, or multi-level, structure that requires any unsatisfied customer to initially voice a complaint with a first-level CSO agent who is limited in his authority to offer redress. Only if the customer feels that offer is too low, will she incur the hassle cost of escalating her claim to a higher level CSO representative (e.g., a manager) who is authorized to provide a higher amount redress.\(^6\)

We show that a tiered structure reduces the firm’s redress costs by screening out claims that are less severe and illegitimate. For example, some customers with less severe complaints do not find the additional hassle of speaking with a manager worthwhile and then settle for a lower compensation. Without a tiered structure, customers are entitled to seek a higher payout without hassles. By structuring the process to include customer hassles, the tiered CSO screens less severe claims so that customers stop at the first-tier and receive lower levels of redress.

The tiered CSO can also help screen illegitimate claims so that claims without proper justification are less likely to obtain higher redress. For instance, a customer can illegitimately claim that her product failed because of faulty manufacturing when, in fact, it was caused by her own misuse. When initially contacting a CSO, the customer is offered a small amount of compensation without fully verifying the cause of the failure. A larger refund is possible, but only if the customer can legitimize her claim. Demonstrating that the product failure was due to poor manufacturing will be a greater hassle if actually due to misuse. Therefore, customers with illegitimate claims are less likely to escalate the claim to a higher level and, therefore, receive

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\(^6\) Despite the occasional reference to an agent (at the first-level of the CSO) and a manager (at the second-level), we do not utilize a principal-agent framework or apply a traditional contract theory approach to organizational design. Instead, our model focuses on the customer’s microeconomic incentives within the complaint process and how the CSO affects this process.
lower payouts. In other words, by exploiting differential rates of hassle costs between illegitimate and legitimate claims, a tiered CSO screens claims even without initially observing the true state of legitimacy.

A collateral benefit of the tiered structure is that it can further control personnel costs if a second level employee is required to approve higher-level redress payouts. By utilizing less-skilled (and cheaper) employees in the first tier, the CSO can screen some claims from reaching higher level employees whose time is more valuable. This role may help explain the trend of firms delegating more authorization to offshore call centers or automated online customer support systems (e.g., Amazon).

We further explore the relationship between a tiered CSO and the firm’s pricing and quality decisions. A firm’s decision regarding product quality determines how often customers claim redress and its pricing decision affects how much compensation customers expect when filing a claim. Generally, high prices and low product quality raise the firm’s redress costs. However, if customers’ traits in the firm’s target market affect how they interact with the CSO, these traits can be a factor in price and quality decisions. In our case, the degree to which customers experience hassles will affect the trade-offs associated with escalating a claim. Our trait of interest is unit hassle cost, which defines the level of annoyance or frustration that an individual experiences should she be inconvenienced. Unit hassle cost can vary across target segments. For instance, navigating a CSO online is generally easier for younger people than for older people (Borowski 2015). Heterogeneity in the degree to which individuals experience hassles is also reflected in survey data from the U.S. Federal Trade Commission, which shows that African Americans and Latinos are less inclined to complain than college-educated whites
(Raval 2016). Moreover, women, relative to men, indicate greater levels of annoyance when dealing with a CSO. If the firm’s target market is more sensitive to hassle costs, then its customers are less likely to escalate claims when dissatisfied. It is then optimal for the firm to reduce the CSO’s first level authorization limit, raise prices, and lower product quality.

It is critical to acknowledge that customer goodwill, repeat purchases, and word-of-mouth are important advantages of an effective CSO, which are well-recognized findings in prior research (e.g., Fornell & Wernerfelt 1987). Therefore, any exploitation of customer hassles via a tiered CSO can risk a firm’s reputation. When such considerations are strong, say for brands that are particularly known for good customer service, we show that the first level authorization is optimally higher than for brands without such a reputation. In fact, we show that if these reputation considerations are strong enough, the firm may actually abandon the tiered CSO structure altogether. Interestingly, our model also suggests that the firm raises price as the concern for reputation becomes stronger. If consumers expect a firm to be cognizant of its reputation in the design of its CSO, then their willingness-to-pay will be higher.

Finally, we extend our model to the case of competition and compare the service levels of a duopolist to that of a monopolist. We show that competition does not necessary lead to higher redress. Competitive firms use price to acquire market share, which, as discussed previously, affects how much redress a consumer can expect from the claims process. Because competition tends to encourage lower prices, our model indicates that competing firms reduce CSO agents’ authorities relative to a monopoly firm. We further compare these service levels in these two market structures by assessing the relative service ratio, which measures the CSO’s first level authority.

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7 See also “Combating Fraud in African American and Latino Communities: The FTC’s Comprehensive Strategic Plan,” A Report to Congress, June 15, 2016.

payout authority relative to the price paid by the customer. We find that the relative service ratio is lower with competition, and that the CSO pays out less upon claim escalation as competitive forces push prices downward. Thus, even if a lower authorization induces more escalation for the duopolist, it can afford to squeeze initial claim offers to a greater extent.

The marketing literature provides a rationale for having a CSO by arguing that, despite the costly endeavor of fielding customer complaints, the CSO helps retain profitable customers for future patronage (Bearden & Teel 1983, Knox & van Oest 2014) and mitigates negative word-of-mouth (Hirschman 1970). From an economic perspective, Fornell & Wernerfelt (1987, 1988) suggest that implementing a CSO program enables a firm to balance the benefits and costs of retaining unsatisfied customers. Other work has reported that a CSO provides valuable firm feedback for improving products and services (Hirschman 1970, Barlow & Møller 2008).9 Acknowledging this prior work, we aim to provide a novel rationale for the tiered organizational structure seen in practice.

We are not the first to study the organizational incentives in handling customer complaints. Most relevantly, Homburg & Fürst (2005) examine two types of incentive systems in order for CSO agents to determine which system leads to higher measures of customer satisfaction and customer loyalty. Similar to that work, we are also interested in a better understanding of the relationship between the CSO’s organizational structure and customer outcomes. However, our focus is on the outcome of redress costs and payouts rather than on customer assessments. As such, our findings provide an alternative, and unexplored, perspective on the organizational features of the CSO.

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9 One related work from the economics literature (Liang 2013) shows how the firm can exploit hassle costs to ensure that complaints hold credible information about the level of quality.
It is also important to put our work in the context of the operations literature on the CSO organization, namely, the call center. Gans et al. (2003) and Aksin et al. (2003) provide an overview of this large body of work. In particular, Gans et al. (2003) suggests that a major objective of this literature is to study models of capacity management—i.e., using routing systems optimization to ensure quality customer responses at low operational costs. Our work, by contrast, takes a marketing perspective to this organizational issue by connecting the CSO organization’s function to pricing incentives and overall profitability of the firm. Thus, while the operations literature is focused on reducing customer hassles, our work suggests that some level of caller dissatisfaction can, in fact, be profitable.  

Our paper also connects to a large literature in marketing and economics that studies warranties (Cooper & Ross 1985, Matthews and Moore 1987, Lutz 1989, Padmanabhan & Rao 1993, Lutz & Padmanabhan 1993), product return policies (Wang 2004, Anderson, Hansen, & Simester 2009, Shulman, Coughlan, & Savaskan 2010, Ofek, Katona, & Sarvary 2011, Gümüş, Ray, & Yin 2013), and money-back guarantees (Heal 1977, Davis, Gerstner, & Hagarty 1995, Moorthy & Srinivasan 1995). A substantial portion of that work examines the forms of redress as a means to either guarantee satisfaction before purchase or reduce the risk of purchase, which is consistent with the CSO role in this paper. Namely, we assume that the CSO is a means of guaranteeing the customer some sort of compensation if she is unsatisfied with her purchase, but are we agnostic to the form of compensation.

Finally, it is important to recognize that other work has considered the impact of hassle cost and firm strategy. In models of organizational economics, Laux (2008) and Simester & Zhang (2014) show how requiring agents to expend hassle costs enable the firm to more

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10 Relatedly, Gerstner, Halbheer, and Koenigsberg (2015) suggest that service failure may be optimally embedded in product design in order to profit from consumers who buy protection from such failures.
efficiently allocate resources. Narasimhan (1984) illustrates how forcing customers to incur hassle costs to redeem coupons facilitates price discrimination. Like those works, our model shows that the firm benefits from exploiting agents’ hassle costs. Other works, notably Hviid & Shaffer (1999), show that hassle costs in claiming refunds are detrimental to firms’ use of price-matching guarantees as a collusive device.

The main model, presented in Section 2, demonstrates in a monopoly setting the screening role of a tiered CSO. In Section 3, we further explore the implications of the tiered CSO structure on the marketing strategies of the firm related to pricing and product design. In Section 4, we extend the main model to considerations of reputation harm. Finally, in Section 5, we consider a duopoly model and compare it to the monopoly model to assess the impact of competition on CSO design. Section 6 offers concluding remarks, and the Appendix provides proofs of all claims in the main text.

2. A Model of the Firm and its CSO

Our first objective is to demonstrate how a CSO can exploit customer hassle costs to screen claims and reduce redress payouts. We consider a monopoly firm choosing its price and its CSO structure that a customer can use for a claim of redress.

The firm sells one product, at price \( P \), which provides a customer utility \( V > 0 \) if the product does not fail. The product fails with probability \( q \in (0,1) \) in which case it gives 0 utility. We call \( q \) the failure rate. Whenever the product fails, the customer contacts the CSO to claim redress up to the amount of \( P \). Even in the event the product does not fail, the customer can make an illegitimate claim. For example, the customer may have violated the terms of the warranty or misused the product. The customer can even lie by saying that the product failed when it did not. Let \( \alpha \in [0,1] \) be the probability of an illegitimate claim given that the product or service does
not fail. Therefore, a claim occurs with probability $\alpha(1 - q) + q$. The CSO cannot directly observe the legitimacy of the claim.

The firm designs the CSO structure by specifying the payout authority at each level of the complaint process. There are two CSO levels. For example, a first-tier CSO representative (agent) receives a customer’s complaint (e.g., a call to the firm’s call center), assesses her claim, and makes an offer of redress. We define $R$ to be the maximum payout to the complaining, or dissatisfied, customer at the first-level of the CSO. If the customer decides to escalate the claim to the second-tier representative (manager), then the maximum authorization is $S \geq R$.\(^\text{11}\)

In our model we make the distinction between the firm’s redress policy and the organizational design of the CSO. The redress policy is captured by the variable $S$, which is the maximum redress available to a customer. This is observable to the consumer at the time of purchase. For instance, firms often post refund and exchange policies for the public to view at any time. It is also noteworthy that the redress policy is typically a function of the sale price or product value. In this section, however, we allow $S$ and $P$ to be chosen independently. Later, we assume that consumers know and expect the firm to refund or exchange up to an amount $S(P)$, which is an increasing function of sale price $P$.

The organizational structure of the CSO is defined by the variable $R$, which is not observed by the consumer. Firms’ decisions about the internal organization are typically not public information though they may be inferred. In fact, we suppose that consumers can rationally anticipate $R$ at the time of purchase even if it is not directly observable. The focus of our research is on the organizational design of the CSO given a redress policy. Optimal exchange

\(^{11}\) We emphasize that our model does not consider the firm’s contracting problem with the CSO, its agents, or its manager. Our notion of organizational design focuses on the customer’s complaint process, as implied by $(R, S)$, and the CSO’s role in screening claims. Furthermore, our occasional use of the “agent” or “manager” is used to help interpret that process and is not studied from a principal-agent framework.
or refund policies have been examined elsewhere (e.g. Matthews and Moore, 1987; Padmanabhan and Rao, 1993; and others). Therefore, much of this article focuses on the firm’s choice of the CSO’s organizational structure, as defined by the first level authorization, $R$, and its properties in equilibrium.

As elaborated in Section 2.1, we are agnostic to decision processes of the agents within the CSO. Rather, we suppose that their decisions cannot be fully specified by the firm. In particular, we model their decisions as a random process affected by the subjective judgment of the employee during the interaction with a complaining customer. Therefore, we suppose that the firm is only able to monitor, and therefore contract upon, the CSO’s payout authorization, $R$. For instance, the CSO employee may have more sympathy for a complaining customer whom she deems polite than for a rude one, all else equal. How much the CSO offers the complaining customer involves some subjectivity, which the firm cannot fully control.

Let $F$ be the expected redress for any consumer who files a complaint. The firm’s redress costs $\Gamma$ are increasing in its redress payout $F(R, S)$. Specifically, for a redress of $F(R, S)$, the firm incurs the cost $\Gamma(F)$, where $\Gamma'(F) > 0$. Let $D(P, R, S)$ represent the firm’s demand function. Then the firm’s profit is

$$\Pi(R, S, P) = P \cdot D(P, R, S) - q\Gamma[F(R, S)].$$

(1)

The model has the following timing: Stage 1: The firm chooses the price $P$ and $S$, followed by $R$; Stage 2: Consumers observe $P$ and $S$ and then make purchasing decisions by rationally anticipating $R$; and Stage 3: Customers contact the CSO if dissatisfied and claim redress.\(^{12}\)

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\(^{12}\) It is reasonable to ask how a consumer in Stage 1 can be assured that the firm will uphold its commitment to providing redress in Stage 3. While this commitment issue is not the focus of our study, one can implement a device to assure that the firm does not renege on its redress policy. Suppose that there is a penalty $T \cdot I_{\{\text{No CSO}\}}$, subtracted from the right-hand side of (1), where $T > 0$ and $I_{\{\text{No CSO}\}}$ takes on unity if the firm abandons its CSO (and offers...
2.1 The Customer Claims Process

Here we specify the micro-economic trade-offs of a dissatisfied customer when interacting with a customer service center to claim a refund. The customer contacts the CSO and presents her case for a refund. Depending on the CSO’s first offer of redress, the customer may choose to escalate the claim for a greater refund. Customers’ claims differ in two dimensions: the severity of the claim and the legitimacy of the claim. The severity of a claim is the degree of compensatory redress it is due and the CSO assesses it through a discussion with the customer.\(^{13}\)

The legitimacy of a claim relates to whether it is covered by the firm’s redress policy.

Formally, the severity of a claim is specified by a random variable \(r_1 \sim U[0, R]\), which represents the monetary offer of redress provided at the first-level of the CSO after a representative agent assesses the claim. The customer may seek a higher amount by escalating her claim to the second level (e.g. a manager). Doing so, however, involves a unit hassle cost, \(c_I > 0\). The unit hassle cost represents time, frustration, or additional effort making the case for a better redress amount.\(^{14}\) Illegitimate claims, which occur when the product does not fail, have larger hassle costs than legitimate claims, which are denoted by \(c_L\) and \(c_I\), respectively, with \(c_I > c_L\).

An example illustrates the two properties of a claim. Suppose a traveler initially contacts the CSO to complain about a recent flight, claiming a flight attendant spilled coffee on him. She
calls and speaks to an agent who initially assesses the severity of the claim. The agent could, for instance, apologize for the inconvenience and the stained clothing then offer a portion $r_1 \in [0, R]$ of the airfare. Unhappy with this payout, the traveler might, either legitimately or illegitimately, seek additional redress by arguing that he suffered skin burns. The agent, unable to verify the legitimacy, explains the terms required for a better payout, which is a letter from a medical doctor testifying that the traveler was actually injured from the hot coffee. The customer who, in fact, was burned has a legitimate claim and can acquire such a letter at a cost of $c_L > 0$. By contrast, the customer who has no injury knows it will be more difficult to find a doctor to produce the required letter. Thus, escalating the claim will require higher hassle costs: $c_I > c_L$.

Suppose the customer escalates the claim and presents her case at the second level. We assume that she receives a draw $r_2 \sim U[r_1, S]$. The upper bound on the support of $r_2$ is assumed to be a full refund of the price paid. The lower bound of the support depends on the first offered refund $r_1$. This assures that a customer obtains a weakly better payout upon escalation, which fits the reality.

Consider the customer’s optimal escalation strategy. For any customer who contacts the CSO and is offered $r_1$, she needs to decide whether to incur the hassle cost to escalate her claim in the hope of obtaining a better refund. The expected incremental benefit from escalation is

$$\int_{r_1}^{S} r_2 f(r_2) dr_2 - r_1.$$

Therefore, the customer will not escalate the claim when her expected payoff is lower than the cost $c_I$. We use $a_i$ to represent the threshold of the refund value for $r_1$.

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15 Crucial for our model is that consumers have expectations on the amount they can possibly recover in the complaint process. As we later see, it is also important that the upper end of the support be an increasing function of the price paid by the consumer. Although the specific assumption that the upper bound equals the price is not essential to our results, it does simplify the analysis.
that makes the customer indifferent between the current offer and the expected benefit of escalating the claim. The optimal escalation rule defines \( a_i \) by the following equation:

\[
\int_{a_i}^{S} r_2 f(r_2) dr_2 - a_i = c_i. \tag{2}
\]

The left-hand side of this equation represents the expected benefit of escalation, which is the mean payout conditional on securing \( r_1 < a_i \). The customer’s optimal threshold \( a_i \) is implicitly defined by (2), which equates the expected benefit with the cost of escalation. This formulation mimics a sequential search model with firm-match values (e.g., Wolinsky 1986). The only distinction is that the payout draw from escalating a claim depends on \( r_1 \). Lemma 1 shows the expression of threshold value \( a_i \) that solves (1).

**Lemma 1** *The customer’s optimal threshold of the refund value is*

\[
a_i = S - 2c_i. \tag{3}
\]

As the payout cap, \( S \), of the payout limit at second CSO level increases, the customer is more likely to escalate the claim. Higher hassle costs reduce the chance she will do so.\(^{16}\)

We focus on values of the unit hassle cost that induce some customers who are not satisfied with the refund and escalate the claim while others are satisfied with the CSO’s first offer. This requires the condition \( a_i \in (0, R) \), which is equivalent to \( c_i \in \left(\frac{S}{6}, \frac{S}{2}\right) \).\(^ {17}\) When \( c_i \) is too

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\(^{16}\) A customer could be subjected to concerns of fairness when reacting to her received offer of \( r_1 \). The economics of fairness would suggest that the customer obtains disutility when receiving an offer such that the split is not deemed equitable. For example, if the customer perceives that the firm is solely at fault for the product failure, she would consider any \( r_1 < S \) inequitable. Incorporating this aspect for a given hassle cost \( c > 0 \) would induce the customer to escalate with a higher probability and induce the firm to raise \( R_1 \) higher than that derived in Lemma 1. We thank an anonymous reviewer for pointing this out.

\(^{17}\) Using (3), the condition \( a \geq 0 \) gives \( c \leq S/2 \). Also, from (2), (6), and \( a \leq R \), we have \( 2c \leq S \leq 6c \), which implies the stated condition.
small, every customer wants to talk to the second-level CSO representative (e.g. a manager). In fact, as can be seen in (3), as \( c_i \to 0 \), the call threshold \( a_i \to S \), which means the customer will always escalate for any \( r_1 < S \), as it costs her nothing to seek the highest possible refund. On the other hand, when \( c_i \) is too large, no one wants to escalate the claim to the CSO’s second-tier.

The condition \( a_i \in (0,R) \) and the uniform distribution of \( r_1 \) mean that customer \( i \in \{I, L\} \) escalates her call with probability \( a_i/R \). Therefore, a customer’s expected hassle cost is \( c_i \left( \frac{a_i}{R} \right) \), which is endogenously determined within the model. In other words, the firm has control over the average amount of hassle costs incurred by the customer through its choice of \( R \). Any reduction in \( R \) raises the customer’s expected hassle costs, which as shown below, reduces the firm’s expected payout. However, as elaborated in Section 4, increasing expected hassle costs could erode customer satisfaction and firm reputation.

### 2.2 The Optimal Authorization Level

For the firm’s authorization level \( R \), the expected redress payment to a customer with hassle cost \( c_i \) is:

\[
F_i(R, S) = E[r_1 | r_1 > a_i] \cdot \Pr[r_1 > a_i] + E_{r_1, r_2}[r_2 | r_1 < a_i] \cdot \Pr[r_1 < a_i],
\]

\( i \in \{I, L\} \). Recall that the firm does not observe the legitimacy of the claim. Therefore, it optimizes with respect the expected refund across both customer types: \( F = \alpha(1 - q)F_I + qF_L \).

From the firm’s profit function (1), we can see that for any given price \( P \), and redress policy \( S \), maximizing profit is equivalent to minimizing the CSO’s expected refund cost, given that claims of redress are agreeably handled. That is, the firm chooses \( R \) to minimize \( \Gamma(F) \), which is equivalent to minimizing \( F \) because \( \Gamma \) is monotone. We consider three cases of first-level authorization for the CSO. If the optimal first level authorization is \( \hat{R} \), then we say the optimal
structure is tiered if \(0 < \hat{R} < S\). For the corner solution \(\hat{R} = S\), we say that the structure is non-tiered. In this case, the CSO allows the customer to possibly obtain the highest refund with a single representative. Another possibility of a corner solution is \(\hat{R} = 0\), called extreme tiered, in which the CSO assures the initial offer of redress will be unsatisfying and forces any customer to pay \(c > 0\) in order to seek a larger refund. The optimal authorization is specified in the following proposition.

**Proposition 1**

(i) The expected refund for customer \(i \in \{I, L\}\), is given by

\[
F_i = \frac{1}{2} \left[ (S + \frac{1}{2} a_i) \frac{a_i}{S} + (S + a_i) \left( 1 - \frac{a_i}{R} \right) \right].
\]

(ii) The equation

\[
\hat{R} = \sqrt{\frac{S^2}{2} - 2 \left\{ x \left( \hat{R} \right) c_I^2 + \left[ 1 - x \left( \hat{R} \right) \right] c_L^2 \right\}},
\]

where \(x \left( \hat{R} \right) \equiv \frac{(1-q)\alpha \Gamma' \left(F_I\right)}{(1-q)\alpha \Gamma' \left(F_I\right) + q \Gamma' \left(F_L\right)}\), has a unique solution \(\hat{R}\). The solution \(\hat{R}\) defines a threshold \(\hat{c} \equiv \sqrt{\frac{S^2 - 2S\hat{R} + 2\hat{R}^2}{4}} \in \left(0, \frac{S}{2}\right)\) that has the following properties.

(iii) If \(c_I \in \left(\hat{c}, \frac{S}{2}\right)\) then \(\hat{R} \in (0, S)\) is the optimal first-level authorization for the CSO. The CSO is tiered so that it is optimal for the first-level authorization to be less than that of the second-level.

(iv) Otherwise, if \(c_I \in (0, \hat{c}]\), then \(\hat{R} = 0\). The CSO is extreme tiered so that it is optimal to have the dissatisfied customer always escalate the claim.
Proposition 1 assures us a unique solution to the firm’s optimal choice of the first-level authorization for the CSO. The solution given in (6) is a function of a convex combination of 
\( \hat{R}_L \equiv \hat{R}_{q=0} \) and \( \hat{R}_I \equiv \hat{R}_{q=1} \), which are authorization levels if the CSO could observe the legitimacy of the claim. Clearly, the firm should set a lower payout for illegitimate claims, so that \( \hat{R}_I < \hat{R}_L \). However, because the CSO cannot observe legitimacy, the firm sets the first-level authorization in between these extremes; that is, \( \hat{R} \in (\hat{R}_I, \hat{R}_L) \).

The proposition also states that the no-tiered solution, \( \hat{R} = S \), is never optimal. If unit hassle is below \( \hat{c} \), then the CSO should invoke the extreme-tiered structure, with \( \hat{R} = 0 \), and force all customers to escalate their claims.\(^{18}\) Now consider the case of \( c_i \in (\hat{c}, S) \), which implies the optimal tiered structure, with \( 0 < \hat{R} < S \). Under this scenario, complaining customers are divided into two segments: those that are satisfied with a payout of \( r_1 \in [a_i, \hat{R}] \) and those who escalate their claims and incur additional hassle cost \( c_i \). In order to explore meaningful comparative statics of \( \hat{R} \) with respect to other parameters, we shall henceforth focus on the case in which \( c_i \) is large enough to induce a tiered structure.

**Assumption 1:** The unit hassle cost parameter satisfies
\[
c_i \in \Psi \equiv \{ c_i \geq 0 \mid 0 < a_i < \hat{R} < S \} = (\hat{c}, S/2).
\]

Under Assumption 1, it can be verified that the optimal first-level authorization for the CSO and the CSO’s expected redress costs to decrease with hassle cost: \( d\hat{R}/dc_i < 0 \), and

---

\(^{18}\) We consider the hassle cost of the escalation only. There may be hassle costs when making the initial claim as well. This consideration tends to reinforce the tiered structure of the CSO. Specifically, if one incorporates initial hassle costs, then consumers with lower unit hassle cost are more likely to contact the CSO. As long as \( c \) is lower than \( S/2 \), the conditions of Proposition 1 parts (iii) or (iv) imply an extreme-tiered or tiered CSO, respectively.
\[ dF_l(R)/dc_l < 0. \] As the unit hassle cost increases, the portion of customers who will not escalate the claim to the second level increases. It is then optimal to lower \( \hat{R} \) to reduce the compensation offered at the first-level. Overall, the expected payment is lower for the firm when consumers have higher hassle costs.

### 2.3 Screening Roles of a Tiered CSO

The benefit of a tiered CSO structure is best interpreted via its ability to screen customer complaints. For instance, Proposition 1 establishes that the CSO screens out claims with low severity. The condition \( \hat{R} < S \) implies that less severe claims, those with a severity \( r_1 \in [0, \hat{R}] \), pay out \( \hat{R}/2 \) on average. Without a tiered structure, a random customer can complain and obtain \( S/2 \).

Another screening role of the tiered CSO structure implied by Proposition 1 regards the legitimacy of claims. Even though the CSO is unable to directly observe the legitimacy of a claim, the tiered structure exploits differences in hassle costs to ensure that illegitimate claims receive less in redress. Corollary 1 formalizes this finding.

**Corollary 1** For any \( c_l \in \Psi \), the optimal tiered CSO structure defined in Proposition 1 has the following properties.

(i) **The probability that an illegitimate claim is escalated is lower than that of a legitimate claim.** Illegitimate claims receive lower redress than legitimate claims.

(ii) **Legitimate claims receive less redress and more expected hassle costs as the portion of illegitimate claims increases:**

\[
\frac{dF_L(R)}{d\alpha} < 0 \quad \text{and} \quad \frac{d\left(c_{aL}/\hat{R}\right)}{d\alpha} > 0.
\]
The CSO screening role regarding claim legitimacy is expressed by part (i). The tiered CSO structure exploits the difference in unit hassle costs to make it harder for the illegitimate claim to pass the first-level. Part (ii) identifies a negative spillover effect from illegitimate claims to legitimate claims. The negative spillover can be seen in both the lower authorization $\hat{R}$ and the increase in expected hassle cost for customers with legitimate complaints. As the portion of illegitimate claims increases, it is optimal to reduce the first-level authorization in order to reduce redress costs. This is a result of the fact that the CSO in our model cannot observe the claim’s legitimacy.

Screening out less-severe claims can have an additional value to the firm if one assumes the time of second-level CSO employees (e.g. a manager) is more valuable than the first-level employee (agent). The manager typically has higher-level responsibilities that she cannot attend to when fielding an escalated claim. The CSO, therefore, incurs an opportunity cost when allocating the manager’s time to a complaint. Without loss of generality, we normalize the agent’s wage cost to be unity and denote the relative wage cost of the manager to be $w \geq 1$. The expected redress and wage cost to the CSO is then $aF_i + (1 - a)qF_L$, where

$$F_i(R; w) = \frac{1}{2} \left[ (S + \frac{1}{2}a_i + w) \left( \frac{a_i}{R} \right) + (R + a_i) \left( 1 - \frac{a_i}{R} \right) \right].$$

(7)

for $i \in \{I, L\}$ is modified from (3) by inserting $w$ as an additional cost term for the escalated claim. For any relative manager’s wage $w \geq 1$, denote $\hat{R}(w)$ as the optimal authorization of the CSO agent. Corollary 1 shows how the relative wage affects $\hat{R}(w)$.

**Corollary 2** For any $c_i \in \Psi$ and manager’s relative wage $w \geq 1$, the optimal authority given to the CSO agent 1 is increasing in $w$: $\frac{d\hat{R}(w)}{dw} > 0$. 

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If the manager’s time is more valuable \((w > 1)\), then the CSO can protect her from too many calls by screening some of the claims. As her time becomes increasingly valuable, the CSO responds by giving more payout authority to the agent so that the manager responds to fewer complaints.

The result of Corollary 2 may also provide an additional explanation to an observed trend in the customer care industry. For example, some firms delegate more authorization to offshore call centers representatives, while many other firms adopt automated online systems to handle a large portion of customer redress requests (e.g., Amazon). Cost pressure may drive this trend as the domestic employees become more expensive.

### 2.4 Price and Redress Policy Limit

Using the result of Proposition 1, we now examine the firm’s Stage 1 choices of price \(P\) and redress policy \(S\). Our objective is to show the conditions under which a hierarchical CSO structure occurs in equilibrium. Suppose all complaints are legitimate so that \(\alpha = 0\).

There is a mass of one consumers, each defined by the product valuation \(v \sim U[0, \bar{v}]\), and the utility as follows:

\[
u = \begin{cases} 
  v - P & \text{satisfied purchase } (1 - q) \\
  F(R, S) - \frac{a}{R} - P & \text{unsatisfied purchase } (q) \\
  0 & \text{no purchase.}
\end{cases}
\]

The consumer purchases if and only if \(u \geq 0\). and \(\nu(P, S) \equiv \frac{1}{1-q} \{ P - q \left[ F(R, S) - \frac{a}{R} \right] \} \in (0, \bar{v})\) specify the marginal consumer for whom \(u = 0\). The distribution of \(v\) supports a demand, \(1 - \frac{\nu(P, S)}{\bar{v}}\), that is strictly decreasing in \(P\). It also holds that demand is increasing in redress policy \(S\). Thus, the firm chooses \(P\) and \(S\) to maximize \(P \cdot \left(1 - \frac{\nu(P, S)}{\bar{v}}\right) - q \Gamma[F(R, S)]\). In specifying the firm’s redress cost, we recognize that for any refund amount \(F\), there are typically additional
costs beyond \( F \). Therefore we assume the redress cost function \( \Gamma(F) \) to be weakly convex such that \( \Gamma'(F) > 0 \), and \( \Gamma''(F) \geq 0 \). Two examples of this type of redress function is (1) \( \Gamma(F) = KF \), \( K > 0 \); and (2) \( \Gamma(F) = \frac{1}{2} F^2 \). We further require that \( \Gamma(F), \Gamma'(F) \) and \( \Gamma''(F) \) are finite for finite \( F \).

The following result establishes the existence of an equilibrium under this setting.

**Proposition 2** There exist thresholds \( \bar{v}(c, q) > 0 \) and \( \bar{q}(c) > 0 \) with the following property.

If \( \bar{v} < \bar{v} \) and \( 0 < q < \bar{q} \), then there exists a unique profit maximizer \( (P^*, S^*) \) such that \( \nu(P^*, S^*) \in (0, \bar{v}) \); and the equilibrium CSO is tiered: \( \bar{R}(S^*) < S^* \).

This result establishes that when the firm considers its price and redress policy limit, the optimal CSO structure is tiered. Two conditions are sufficient for the existence of an interior optimum because they imply that the firm does not find it optimal to increase consumer utility with \( S \) and simultaneously increase its price \( P \) to capture that additional value. The condition \( \bar{v} < \bar{v} \) means that demand is sufficiently price sensitive that the firm is unwilling to raise price without bound. The condition on the failure rate, \( q < \bar{q} \), means that the product is sufficiently reliable that consumers are not that sensitive to the redress policy. Mathematically, these two conditions imply that the firm’s profit function is quasi-concave in the pair \( (P, S) \), even when the firm’s redress cost function \( \Gamma(F) \) is linear.\(^{19}\)

\(^{19}\) With additional conditions, one can assess the ordering of the optimal \( P^* \) and redress policy \( S^* \). In separate analysis available from the authors, we suppose that \( \bar{v} \) is convex and \( v \) has all its mass at \( \bar{v} \) and show that it is optimal to serve all consumers and that \( P^* < S^* \) for \( \bar{v} \) sufficiently small and that \( P^* > S^* \) for \( \bar{v} \) sufficiently large. If \( \bar{v} \) is small, the firm profits more from assuring consumers of a solid redress policy than from initial revenues on product benefits. The reverse intuition applies for \( \bar{v} \) large.
Unfortunately, Proposition 2 does not offer explicit solutions, which prevents us from deriving more results without additional restrictions. In Section 3 we make several simplifying assumptions to generate additional insights about the tiered CSO and its link with strategic marketing variables.

3. Marketing Strategy and the Tiered CSO

In this section we further explore the implications of the tiered CSO structure on the marketing strategies of the firm related to pricing and product design. We then assess the conditions under which a tiered CSO is more profitable than no CSO at all. A few simplifications are made in order to arrive at tractable solutions. First, similarly to Proposition 2, we assume all claims in customer segments are legitimate so that $\alpha = 0$ and the customer’s unit hassle cost $c = c_L \in \Psi$. Second, we invoke a simplification on the redress policy: $S(P) = P$. Such a policy simply guarantees the customer no more than a full refund when dissatisfied. Third, we assumed the demand is fixed so that $v = V$ for all consumers.

For a given price $P$ and CSO design $\hat{R}(P)$, consumers will buy if and only if $u \geq 0$, which is equivalent to:

$$P \leq q \left[ F \left( \hat{R}(P) \right) - \frac{a}{\hat{R}} c \right] + (1 - q) V.$$  \hspace{1cm} (8)

We make a restriction on $V$ so that (8) holds strictly in equilibrium:

**Assumption 2**: $V > V(q, c)$.

The lower bound $V(q, c)$ is specified in the Appendix. Assumption 2 implies a fixed market size and greatly simplifies the pricing problem in this monopoly model and in the duopoly model of Section 4.
We restrict our attention of the redress cost function to be strictly convex. First, it has been shown that offering compensation to some customers encourages others to seek redress. Ma et al. (2015), most notably, show empirical evidence that, anytime a customer receives redress for a public complaint on social media it raises other customers’ expectations about the benefit of complaining to the firm and encourages more complaints. Second, higher payouts often require approval by managers whose time is more costly.\textsuperscript{20} The following assumption on $\Gamma$ is made to incorporate these additional costs.

**Assumption 3:** $\Gamma''/\Gamma' \geq 1/F$.

The assumption asserts that the CSO’s cost is convex so that marginal costs $\Gamma'$ increases at least quadratic in $R$.

### 3.1 Pricing

The firm chooses $P$ to maximize $\Pi(P; q, c) = P - q\Gamma[F(P, c)]$, where redress payout $F(P, c)$ embeds the optimal authorization $R(P) = \sqrt{P^2/2 - 2c^2}$ from Proposition 1 for $c = c_I = c_L$ and $S = P$. Assumptions 2 and 3 imply that the firm’s pricing problem has a tractable solution. Specifically, Assumption 2 assures that price determines the revenue of the firm, not the number of sales. Assumption 3, along with the micro-foundations of our claims-process model in Section 2, together ensure that $\Pi(P; q, c)$ is strictly concave and therefore has a unique interior maximizer $P^*$. Therefore, the optimal price balances the marginal revenue from the consumer with the expected marginal redress cost, which is increasing in $P$. Proposition 3 describes some additional properties of $P^*$.

\textsuperscript{20} While, in practice, this takes on the form of a step function, whereby the payouts above certain thresholds require approval by more costly employees (e.g. managers), it can be approximated by a convex cost function. See McNeile and Roubtsova (2013) for an illustration of business processing models used to implement payout authorizations.
**Proposition 3** Under Assumptions 1, 2, and 3 we have the following.

(i) There is a unique price $P^*$ that maximizes $\Pi(P; q, c)$. Furthermore, $P^*$ is decreasing in $q$ and (weakly) increasing in $c$.

(ii) The corresponding equilibrium payout authorization $\hat{R}(P^*)$ is decreasing in $q$ and $c$.

(iii) Firm’s equilibrium profit $\Pi^*$ is decreasing in $q$ and increasing in $c$.

Proposition 3 indicates how the CSO’s tiered structure interacts with the firm’s pricing decision. As the failure rate $q$ increases, the firm optimally reduces its price to avoid higher expected payouts. Correspondingly, as the price decreases, the firm reduces the refund authorization in order to keep redress costs down, as indicated in part (ii). Now consider the impact of unit hassle cost $c$. As a customer’s hassle cost increases, the firm can charge a higher price because the firm is more certain that dissatisfied customers will be less inclined to seek a large refund. This permits the firm to raise its price knowing that expected refunds could be lower, as indicated in part (i) of the proposition. Less direct is the impact of unit hassle cost on the CSO’s first-level authorization. There are two counter-acting effects. Although from Section 2.2 we know that for any given price, the optimal $\hat{R}(P)$ decreases with $c$; however, from part (i) we also see that a higher hassle cost increases the optimal price, which subsequently raises the CSO’s first-level authorization. But the impact through price is second-order so that the downward effect of unit hassle cost on $\hat{R}(P^*)$ dominates the upward effect.

The envelope theorem applied to $\Pi^*(P^*; q, c)$ shows part (iii) of Proposition 3. Increasing $q$ lowers the equilibrium price as a stronger chance of product failure exists, which raises the
firms redress costs \( (d\Pi^*/dq < 0) \). When hassle costs are increasing, however, the firm sees an increase in profit \( (d\Pi^*/dc > 0) \), since the firm pays out less in redress and charges higher prices.

Finally, we note that the weak inequality condition in Assumption 3 does not rule out that \( P^* \) may be invariant to \( c \). This happens precisely when Assumption 3 holds with equality; otherwise, \( P^* \) is strictly increasing in hassle costs. To obtain tractable results in the following analysis, we specify a functional form\(^{21}\) for the cost function \( \Gamma(R) \) by modifying Assumption 3:

**Assumption 3':** \( \Gamma(F) = F^2/2 \).

The specification in the above assumption implies that Assumptions 1 and 2 have closed form equivalents:

**Assumption 1:** \( c \in \Psi = \left( \frac{1}{\sqrt{2q}}, \frac{1}{q} \right) \), for \( q \in (0,1) \).

**Assumption 2:** \( V > V(q, c) \equiv \frac{2}{q(1-q)} - \frac{1}{1-q} \sqrt{\frac{2-2cq}{1+cq}} \).

The implied forms of Assumptions 1 and 2 are established in the Appendix (Lemmas A1 and A2) and will be useful for the remainder of the analysis. Recall that Assumption 1 asserts that unit hassle costs are not too small, which guarantees that all customers escalate claims, and not too large that no customer escalates a claim. In other words, Assumption 1 implies that the optimal CSO is tiered. Assumption 2 assures that a consumer’s expected value of the product exceeds the equilibrium price and all costs associated with product failure.

### 3.2 Failure Rate

We now consider the case in which the firm has some control of the failure rate, \( q \). For instance, the firm can invest in R&D or quality control to design the product with a lower likelihood of

\(^{21}\) The subsequent results are not reliant on this specification of \( \Gamma \). Numerical analyses supporting this claim are available upon request.
failure. We want to understand how the role of unit hassle costs affects the firm’s product design. The game timing in this section is the following: Stage 1: The firm chooses the failure rate $q$, followed by the price $P$, and then $R$; Stage 2: Consumers observe $q$ and $P$, then make their purchasing decisions; and Stage 3: Customers contact the CSO if dissatisfied.

Extending the model of Section 3.1, we add a “design” stage of the start of the game in which the firm can invest $G(q)$ into reducing the failure rate. Specifically, let $G(q) = \beta \left( \frac{1}{q^2} - 1 \right)$, where $\beta > 0$ is the parameter affecting the rate of which production costs decrease in $q$. In this formulation, a product that never dissatisfies ($q = 0$) is infinitely costly while a product that always fails ($q = 1$) costs nothing. Furthermore, the more reliable the product (lower $q$), the marginally more expensive to produce it; thus, $G''(q) > 0 > G'(q)$. The firm chooses the $q$ to maximize $\Pi^*(q) - G(q)$. The cubic specification provides enough curvature to guarantee an interior solution to this optimization.

**Proposition 4** Let $0 < \beta < \frac{1}{12c^2}$. Under Assumptions 1, 2, and 3’, suppose the failure rate, $q$, is chosen by the firm to maximize $\Pi^*(q) - G(q)$.

(i) The optimal failure rate, $q^*(c) = \sqrt{\frac{1-\sqrt{1-12c^2\beta}}{2c^2}}$, is increasing in $c$.

(ii) The maximized profit $\Pi^*(q^*) - G(q^*)$ is increasing in $c$.

The firm optimally increases the failure rate as the customer’s unit hassle costs increase. Because customers are less inclined to escalate calls, the firm’s redress payouts are reduced and the firm can afford to cut back its investment in satisfaction (larger $q$). Part (ii) confirms that overall profit is increasing in $c$ despite the increase in complaints.
3.3 Endogenous CSO and the Necessity of Hassle Cost

When is it profitable to provide a tiered CSO instead of no CSO? In this section, we add a stage 0 to the game in Section 3.1 in which the firm decides whether to provide a CSO. Our objective is to identify conditions on the level of unit hassle costs necessary for the firm to profitably provide a CSO.

We start with the situation in which the firm offers no CSO. In this case, customers will buy if and only if \( P \leq V(1 - q) \). Charging customers their full value, we see that the firm’s profit without a CSO is

\[
\Pi^N = P^N = V(1 - q).
\]  
(9)

The profit to the firm using a CSO is

\[
\Pi^* = \frac{1 + c^2 q^2}{q},
\]  
(10)

which is derived from Proposition 2 under Assumption 3’. Comparing (10) with the profit in (9), we generate the following result.

**Proposition 5** Suppose Assumptions 1, 2, and 3’ hold and fix \( q \in (0,1) \).

(i) If \( V \in \left( V(q, c), \frac{2}{q(1-q)} \right) \neq \emptyset \) then there exists a \( \hat{c} < 1/q = \sup \Psi \) such that: \( \Pi^* > \Pi^N \)

if and only if \( c > \hat{c} \).

(ii) Otherwise, \( \Pi^* < \Pi^N \) for all \( c \in \Psi \).

This proposition states precise conditions under which the firm implements a tiered CSO. Part (i) shows that offering redress via a CSO is profitable if and only if customers’ unit hassle costs are sufficiently large. It is important to bear in mind that consumers in our model are rational and therefore know their hassle cost can be exploited by the firm. When hassle costs are large enough
\( c > \hat{c} \), the consumer buys on the hope that the product satisfies and will not incur the hassle of pursuing a refund. For small hassle costs, \( c < \hat{c} \), the firm does not find it worthwhile to offer redress through a CSO. Thus, Proposition 5 establishes that sufficient hassle costs are a necessary condition for the provision of a tiered CSO. The condition on \( V \) can be understood by looking at the opportunity cost of using a CSO. The optimal price \( P^* \) with a CSO does not directly depend on \( V \) under Assumption 2. Without a CSO, by contrast, the optimal price \( P^N \) depends directly on \( V \). As \( V \) increases, the value of the product is sufficiently large that the firm would rather offer no CSO and set the price directly equal to consumer’s expected value, \( V(1 - q) \). Thus, as part (ii) of Proposition 5 confirms, if \( V \) is sufficiently large, then a CSO is unprofitable for the firm.

4. Controlling Reputational Harm

A natural rationale for a firm to provide a CSO is to maintain its reputation through enhanced customer satisfaction. We omitted this rationale in the abovementioned model in order to show how a CSO could be structured to control redress costs through the exploitation of hassle costs. However, it is important to acknowledge that if a customer experiences frustrations with the CSO, the firm runs the risk of harming its reputation. For example, a dissatisfied customer may decide not to buy again from this firm or to spread negative word-of-mouth that discourages other potential sales (Hirschman 1970). In this section, we consider reputation concerns in the context of the model to understand how they affect the optimal CSO structure and initial product price.

To incorporate concerns of reputational harm implied by customer frustrations, we introduce a reduced-form reputation concern function, \( \Lambda(F) \), which depends directly on how much redress the dissatisfied customer receives. A higher payoff means the firm is less
concerned about its reputation, so that $\Lambda'(F) > 0$. For simplicity, we assume that the firm’s reputation concern is linear in expected payout, where the $\lambda > 0$ is the reputation coefficient: $\Lambda(F) = \lambda F$. The firm’s objective, therefore, is to maximize the following:

$$\Pi_{\lambda}(P; q, c) = P - q\{\Gamma[F(R, P, c)] - \lambda F(R, P, c)\},$$

(11)

with respect to $R$, then $P$. As might be expected, when the firm faces the threat of reputation damage from inducing customer hassles, the CSO should increase the authorization of its agents. Proposition 6 formalizes this result and identifies parametric boundaries for the CSO to remain a tiered organization. It further explores the impact of reputation concerns on price.

**Proposition 6** Let $\bar{V}$ be the consumer’s willingness-to-pay. (Defined in the Appendix.)

If $\lambda < \bar{\lambda} \equiv \frac{3\bar{V}}{4} - \frac{c^2}{\bar{V}}$, the optimal price $\bar{P}$ and authorization level $\bar{R}$ then satisfy $\bar{R} < \bar{P}$, so that the CSO is tiered. Otherwise, for $\lambda \geq \bar{\lambda}$, the optimal CSO is non-tiered: $\bar{R} = \bar{P}$. Furthermore, let $\bar{\lambda} \equiv \sqrt{\frac{\bar{V}^2}{2} - 2c^2}$. Then, under Assumption 3’, the firm’s optimal price $\bar{P}$ and authorization level $\bar{R}$ is described as follows.

(i) If $\lambda \in (0, \bar{\lambda}]$ then $\bar{R} = \sqrt{\frac{\bar{P}^2}{2} - 2c^2}$ and $\bar{P}$ uniquely solves (11). Furthermore, $\bar{P} > P^*$ and $\bar{R} > R^*$.

(ii) Otherwise, if the reputation coefficient is sufficiently large: $\lambda \in [\bar{\lambda}, \bar{\lambda})$ then

$$\bar{R} = \lambda + \sqrt{\lambda^2 - \left(\frac{\bar{V}^2}{2} - 2c^2\right)} > \bar{R} \text{ and } \bar{P} = \bar{V}.$$

(iii) Stronger reputation concerns (increasing $\lambda$), implies larger payouts from the CSO’s first-level, $\partial \bar{R} / \partial \lambda > 0$, and weakly higher prices, $\partial \bar{P} / \partial \lambda \geq 0$. 

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If the concern for reputation is below this threshold (\( \lambda < \tilde{\lambda} \)), the CSO will be tiered. However, if concerns of reputational harm are sufficiently strong, \( \lambda > \tilde{\lambda} \), then the firm sets \( \bar{R} \) to the maximum level to ensure customer satisfaction. If reputation concerns are moderate, then part (ii) says that the optimal price is the corner solution, extracting all surpluses from the consumer. The firm has an incentive to raise price to cover its extra redress payout. Note that reputation is harmed not by high prices, but by squeezing the customer’s compensation for an unsatisfying product or service. That is, the firm passes on any cost of maintaining its reputation to the customer via a higher initial price. This intuition applies to part (i) as well with the exception that price is an interior solution and mimics the solution of Proposition 3. Part (iii) states this idea in the form of comparative statics on \( \lambda \).

There are several, more general, implications about CSO design from this proposition. First, a firm that is concerned about reputation damage from exploiting consumer hassle costs must offer more redress, which although not surprising, is reassuring. Second, the proposition confirms that, even with reputation damage concerns, the firm can still exploit consumer hassle costs via a tiered CSO. However, this ability is not limitless; if reputation concerns are sufficiently large (\( \lambda > \tilde{\lambda} \)), the firm allows the possibility of full redress without escalation.

5. Competition

Do competitive forces hinder the firm’s ability to exploit consumer hassle cost in attempt to control its redress costs? In this section, we consider an extension of the model by incorporating two competing firms, the purpose of which is to study whether competition always leads to a higher redress.

Suppose two firms, \( A \) and \( B \), are each located at opposite end of the unit interval line (i.e., a Hotelling model). A unit mass of consumers are uniformly distributed along the line with the
unit transportation cost \( t > 0 \). Every consumer buys no more than one unit. We also assume both products have the same failure rate \( q \) for simplicity. Let \( P_j \) and \( R_j \) denote the price and the CSO’s first-level authorization for firm \( j \in \{A, B\} \). For a consumer who purchased at firm \( j \), her escalation threshold is given by \( a_j \). The game timing is the following: Stage 1: Firms simultaneously decide whether to provide a CSO and set their prices \( P_j \); if a firm chose to provide a CSO and it subsequently chooses \( R_i \); Stage 2: Consumers observe \( P_j \) and then formalize their expected utility from each firm by rationally anticipating \( R_i \), then make purchase decisions; and Stage 3: Customers contact the appropriate CSO if dissatisfied. We maintain Assumptions 1, 2, and 3’.

Consider the consumer located at \( x \in [0,1] \) deciding which firm to patronize. She compares the expected utility of both firms, each of which has taken over the possibility that a product may fail with probability \( q \). The utility of a consumer buying from \( A \), in all possible situations, is given by

\[
u(j, x) = \begin{cases} F(R_j, P_j) - c \frac{a_j}{R_j} - P_j - td(j, x) & \text{buy from } j \text{ with a CSO and product fails } (q) \\ -P_j - td(j, x) & \text{buy from } j \text{ with no CSO and product fails } (q) \\ V - P_j - td(j, x) & \text{otherwise } (1 - q) \end{cases}
\]

where \( d(A, x) = x = 1 - d(B, x) \).

Let \( W_j = q \left[ F(R_j, P_j) - c \left( \frac{a_j}{R_j} \right) \right] * I_{j \text{ offers CSO}} \), where \( I_{j \text{ offers CSO}} \) is an indicator function. The demand and profits for firm \( j \) can then be expressed, respectively, by

\[
D_j = \frac{(W_j - P_j) - (W_{-j} - P_{-j}) + t}{2t} \quad \text{and} \quad \Pi_j = D_j \left[ P_j - q \Gamma \left( F(R_j, P_j) \right) \right] * I_{j \text{ offers CSO}}
\]
for $j, -j \in \{A, B\}$ with $-j \neq j$. These expressions indicate that offering a CSO increases demand for a firm by assuring consumers that some level of redress is available in the event of product failure. Increasing demand in this way comes at the cost $q\Gamma(F)$.

Suppose both firms offer a CSO and that prices $(P_A, P_B)$ were chosen at the beginning of stage 1. As previously noted in the timing of this game, consumers cannot observe the first-level authorization for the CSO at firm $j$, but they can rationally anticipate $R_j$ in equilibrium. Formally, this implies that firm’s $j$’s profit maximization of $\Pi_j$, with respect to $R_j$, is equivalent to the minimization of $q\Gamma(R_j, P_j)$. Therefore, for any pair of prices $(P_A, P_B)$, the equilibrium authorization assigned for the CSO’s first-level is

$$\hat{R}_j = \sqrt{\frac{P_j^2}{2} - 2c^2}. \quad (12)$$

Turning to the pricing decision, we see that any equilibrium price $P_j^{**}$ must satisfy the firm’s first order condition:

$$\frac{\partial \Pi_j}{\partial P_j} = \frac{\partial D_j}{\partial P_j}[P_j - q\Gamma(F_j)] + D_j \left[1 - q\Gamma'(F_j)\frac{\partial F_j}{\partial P_j}\right] = 0. \quad (13)$$

We know from the monopoly case in Proposition 3, that the second term of (13) is zero at the monopoly price $P^*$. Furthermore, the first term is negative for a downward sloping demand curve. Hence, in any symmetric equilibrium, the duopoly price $P^{**}$ is lower than the monopoly price $P^*$.

For brevity, and without loss of insight, we do not examine here the cases in which one or more firms do not offer a CSO. The Appendix provides an analysis of these cases to derive a sufficient condition for the equilibrium in which both firms offer a CSO.

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22 Proof that demand $D_j$ is downward-sloping is given in the Appendix.
Proposition 7: For the duopoly model, there exists a cutoff point $\bar{c} > 0$ (defined in the Appendix) such that both firms adopt a CSO in equilibrium if $c > \bar{c}$. The equilibrium CSO structure is tiered, so that $\hat{R}(P^{**}) = \sqrt{\frac{(P^{**})^2}{2} - 2c^2} < P^{**}$. Equilibrium prices and first-level CSO authorizations are lower in a duopoly than in a monopoly: $P^{**} < P^*$ and $\hat{R}(P^{**}) < \hat{R}(P^*)$.

The condition $c > \bar{c}$ in Proposition 7 has a similar intuition as the condition $c > \hat{c}$ of Proposition 5. Implementing a CSO is prohibitively costly if all dissatisfied customers can claim a full refund at no cost. Only if the customer’s personal effort in seeking redress is sufficiently costly, then offering redress becomes a profitable means to generate value.

Proposition 7 also lets us compare the service levels across the two market structures. For instance, it establishes that the first-level CSO authorizations are lower in a duopoly than in a monopoly. Competitive pressure on prices drives this result. As was the case in the monopoly model, the optimal $\hat{R}(P)$ is increasing in price. This directly implies that the expected redress payment is lower in a duopoly than in a monopoly (i.e., $F^{**} < F^*$). With lower prices, the maximum amount of redress a customer can claim is lower, so firms can afford to squeeze redress payouts to keep costs down.

We can take this the comparison a bit further by evaluating redress levels relative to prices. We use the following measure:

**Definition:** The relative service ratio is $RS(R, P) \equiv \frac{F(R, P)}{P}$. 

The relative service ratio measures satisfaction relative to the price the customer pays. It means for one dollar a customer spends on the product, \( RS \in [0,1] \) is the percentage of price this customer is expected to receive if she finds the product unsatisfactory and makes a claim with the CSO. In the following corollary, we compare this measure of service provision across a monopoly and a duopoly.

**Corollary 3:** *For the equilibrium described in Proposition 7,*

1. Relative service ratios are lower in a duopoly than in a monopoly; and
2. Customers’ expected hassle costs are lower in a duopoly than in a monopoly.

Thus, our competition model suggests that consumers have a worse CSO in terms of redress payouts relative to price. This results owes to the fact that the optimal authorization level \( \hat{R}(P) \) is concave in price, which can be seen in (6) and (12). Recall that, for a given price, both the monopolist and the competitive firms in our model optimize profits by the minimization redress payout, \( F(R, P) \). The choice of \( R \) controls this payout by balancing the probability of escalating a claim and the amount offered during the initial claim. When price is relatively low, the firm’s trade-off is shifted to the latter incentive. At low prices, the firm’s cost of an escalated claim is relatively smaller than at higher prices. By contrast, when price is relatively high, the firm is more inclined to avoid escalated claims and raises \( R \) to a greater extent.

**6. Conclusion**

As many marketers proclaim a commitment to customer service, persistent frustration among customers seems to continue when dealing with firms’ CSOs. It has been suggested that some degree of customer frustration is an inevitable part of modern business (Chen et al. 2012). A
common explanation for this perpetual occurrence is that logistical and operational difficulties are associated with the elimination of all customer unhappiness. Our research suggests that this frustration may actually be embedded in the CSO design. We posit that a firm may intentionally structure its CSO to systematically exploit consumer hassle costs. By requiring a dissatisfied customer to “jump through hoops,” the firm pays out less in refunds. The tiered CSO structure screens complaints that are less severe while simultaneously mitigating illegitimate claims.

Our model allows us to connect the CSO design with certain traits of a firm’s target market. Making such a connection is motivated by studies suggesting that consumers in some segments (e.g., the elderly and minorities) are more adversely affected for a given type of hassle. All else equal, a firm targeting such a segment can charge higher prices, offer poorer quality, and provide less compensation. Of course, price, product design, and redress levels are determined by many factors not considered in our model. Furthermore, we cannot argue that a market segment’s unit hassle cost is the only decisive factor for these strategic decisions. Nevertheless, our model is the first to suggest that such a factor may affect prices and product quality, even if to a modest degree.

It is also important to acknowledge that a firm’s ability to exploit customer hassle costs is tempered by concerns over potential harm to its reputation or customer relationships in the long run. As we show, the tiered CSO may still be effective at controlling redress costs and screening claims in the presence of reputational concerns. However, for brands that rely heavily on a reputation of good customer service through word-of-mouth in the long term, a CSO that leads to customer frustration may be suboptimal.

Another possible reason for customers to escalate the claim is due to fairness concerns. If a customer feels the CSO’s first offer of redress is unfair, she may seek to talk with the manager
even if there is little financial gain from doing so. Incorporating fairness concerns, therefore, may be a useful direction for future research.

Finally, we study the impact of competition on the tiered CSO design. The main goal of this extension is to see whether, under certain scenarios, competition may worsen customer service. Comparing a duopoly model with the main monopoly model, we found that competitive pressure on prices induces a firm to restrict the first level authorization of the CSO to a greater degree. Lower prices not only lower the amount claimed by customers, they also induce the firm to squeeze payouts proportionally more than the monopolist. By construction, our model did not capture the case where a firm can credibly commit on their service level before purchase, which allows a competitive firm to use its CSO to gain market share. More research is thus needed to fully assess the impact of competition on a firm’s CSO design.
References


**Appendix**
Lemma 1

For \( r_2 \sim U(a, S) \), the corresponding pdf is \( f(r_2) = \frac{1}{S-a} \). Inserting this into (2),
\[
\int_a^S r_2 f(r_2) dr_2 - a = \int_a^S (r_2 - a) \frac{1}{S-a} dr_2 = \frac{1}{2} (S - a) = c,
\]
and solving for \( a \) gives Eq. (3). □

Proof of Proposition 1

First we derive the expression for \( F_i \) using (4). We can write the expected payment for the escalation:
\[
E[r_2 | r_1 < a_i] = \int_r^S r_2 f(r_2) dr_2 = \frac{1}{2} r_2^2 \frac{1}{1 - \frac{r_2}{S}} = \frac{1}{2} (S + r_2).
\]

We can then write
\[
E_{r_1,r_2}[r_2 | r_1 < a_i] = \int_a^S r_2 f(r_2) dr_2 = \frac{1}{2} r_2^2 \frac{1}{1 - \frac{r_2}{S}} = \frac{1}{2} r_2 + \frac{1}{4} a_i.
\]

We also know that the expected refund from the first-level CSO is
\[
E[r_1 | r_1 > a_i] = \int_{a_i}^R r_1 f(r_1) dr_1 = \frac{1}{2} r_1^2 \frac{1}{1 - \frac{r_1}{S}} = \frac{1}{2} (R + a_i).
\]

Applying the derivations above and noting that the probability of resolution with the agent is \( 1 - a_i/R \) and upon escalation is \( a_i/R \), (4) implies the expression in (5) and proves part (i).

Next we solve \( \min_R \Gamma(F) \) by taking the first-order condition with respect to \( R \):
\[
\frac{\partial \Gamma(F)}{\partial R} = (1 - q) a \Gamma'(F_i) R \left[ 1 + (-S + \frac{1}{2} a_i) \frac{a_i}{R^2} \right] + q \Gamma'(F_L) R \left[ 1 + (-S + \frac{1}{2} a_L) \frac{a_L}{R^2} \right] = 0. \tag{A1}
\]

After inserting the expression for \( a_i = S - 2c_i \) from Lemma 1, we arrive at the expression in (6).

First, we can see that the RHS of (6) resides in \((0, S)\) as long as \( c_i \in \left(0, \frac{S}{2}\right)\), for \( i \in \{I, L\} \). It follows immediately that any solution to (6) implies \( \hat{c} \in \left(0, \frac{S}{2}\right) \). To complete the proof of part
(ii), it remains to show there exists a unique \( \hat{R} \in (0, S) \) to solve (6). To do that, first notice that

\[
F_i = \frac{1}{2} \left[ \frac{s^2 - 2c_i^2}{R} + R \right].
\]

Then define \( \hat{R}_i \equiv \sqrt{\frac{s^2}{2} - 2c_i^2} \) and rewrite (6) as

\[
R = \sqrt{x(R)\hat{R}_i^2 + [1 - x(R)]\hat{R}_L^2},
\]

(A2)

We now apply a fixed-point argument to show the unique existence of a solution. The order on unit hassle cost \( c_i > c_L \) directly implies that \( \hat{R}_i < \hat{R}_L \). Now we show that the RHS of (A2) is a monotone decreasing function of \( R \) between \( (\hat{R}_i, \hat{R}_L) \). To see that, observe that \( \hat{R} \) uniquely minimizes \( F_i \) (since under Assumption 1 we have \( \frac{\partial^2 F_i}{\partial R^2} = \frac{2a_i(P - 2a_i)}{r_i^2} > 0 \)). Therefore, \( F_i \) is increasing in \( (\hat{R}_i, \hat{R}_L) \) while \( F_L \) is decreasing. We also have that \( \Gamma' \) is an increasing function, by assumption. Therefore \( x(R) = \frac{(1 - q)\alpha T'(F_L)}{(1 - q)\alpha T'(F_i) + qT'(F_L)} \) is increasing in \( R \) when \( R \in (\hat{R}_i, \hat{R}_L) \), but \( 1 - x(R) = \frac{qT'(F_i)}{qT'(F_i) + qT'(F_L)} \) is decreasing. Hence the RHS of (A2) is monotonically decreasing in \( R \in (\hat{R}_i, \hat{R}_L) \). This is sufficient to guarantee a unique fixed point \( \hat{R} \) that solves (5). This completes part (ii).

Finally we establish parts (iii) and (iv). If \( \hat{R} \) satisfies (A1), then we know it minimizes \( \Gamma(F) \) because

\[
\frac{\partial^2 \Gamma(F)}{\partial R^2} = (1 - q)\alpha \left[ \Gamma''(F_i) \frac{\partial F_i}{\partial R} + \Gamma'(F_i) \left( \frac{\partial F_i}{\partial R} \right)^2 \right] + q \left[ \Gamma''(F_L) \frac{\partial F_L}{\partial R} + \Gamma'(F_L) \left( \frac{\partial F_L}{\partial R} \right)^2 \right] > 0.
\]

Next we specify the sufficient conditions that for the tiered \((\hat{R} > 0)\) and the extreme-tiered CSO.

If the CSO is tiered, \( \hat{R} > 0 \) and the expected redress cost \( \Gamma_{R>0}(F) = (1 - q)\alpha \Gamma(F_i) + q \Gamma(F_L) \),

and when CSO is extreme tiered, \( \hat{R} = 0 \), the expected redress cost \( \Gamma_{R=0}(F) = (1 - q)\alpha \Gamma(S/2) + q \Gamma(S/2) \). We first see that \( F_i(\hat{R}) < F_L(\hat{R}) \) for any \( R \) because \( F_i(R) = \frac{1}{2} \left[ \frac{s^2 - 2c_i^2}{R} + R \right] \) is decreasing in \( c_i \). Hence, \( \Gamma(S/2) < \Gamma[F_i(\hat{R})] \). Immediately, we can see that \( \hat{R} = 0 \) is optimal since \( \Gamma_{R>0}(F) > \Gamma_{R=0}(F) \). That profit ordering translates to the inequality

\[
\frac{1}{2} \left[ \frac{s^2 - 2c_i^2}{R} + R \right] > \frac{S}{2},
\]

and yields the condition \( c_i < \hat{c} \). Thus, the condition given in part (iv) is sufficient for the optimality of \( \hat{R} = 0 \), the extreme tiered solution. A necessary and sufficient condition for the
tiered structure to be optimal is $\Gamma(S/2) > \Gamma[F_I(\hat{R})]$, which yields the condition $c_I > \hat{c}$, as given in part (iii). □

**Proof of Corollary 1**

The first claim in part (i) follows from the fact that $a_I > a_L$, which is directly implied by Lemma 1 and the ordering $c_L < c_I$. The second claim of part (i) is a direct result of $F_I < F_L$ as shown in the proof of Proposition 1. Part (ii) follows directly from evaluating the derivatives expressed in the corollary. □

**Proof of Corollary 2**

The result follows from the fixed-point argument used to prove Proposition 1 and observing that $\hat{R}_I$ and $\hat{R}_L$ are both increasing in $w \geq 1$, which can be seen by inspection of (7). □

**Proof of Proposition 2**

Under Proposition 1 with $\alpha = 0$, we have $\hat{R} = \sqrt{\frac{S^2}{2} - 2c^2} < S$ as long as $S > 2c$. Therefore, it is sufficient to establish our result by showing that, under the conditions stated in the proposition, that there exists an interior maximizer of the firm’s profit

$$\pi = P \cdot \left[1 - \frac{1}{\bar{v}} v(P,S)\right] - q \Gamma[F(\hat{R},S)],$$

where

$$v(P,S) = \frac{1}{(1-q)} \left[P - \frac{1}{2} \frac{1}{\sqrt{\frac{S^2}{2} - 2c^2}} \left(\frac{S^2}{2} - 2c^2\right)^{\frac{1}{2}} \bar{v}\right].$$

Let $(P^*, S^*)$ a potential solution to the two first order conditions:

$$\frac{\partial \pi}{\partial P} = 1 - \frac{1}{\bar{v}} v(P^*,S^*) - \frac{1}{\bar{v}(1-q)} P^* = 0 \quad (A3)$$

$$\frac{\partial \pi}{\partial S} = -\frac{1}{\bar{v}} \frac{\partial v(P,S)}{\partial S} P^* + q \Gamma'(F) \frac{\partial F}{\partial S} = \frac{1}{\bar{v} \sqrt{2(1-q)(2c+S^*)} \sqrt{(S^*)^2 - 4c^2} P^* - q \Gamma'(F) \frac{S^*}{\sqrt{2(1-q)(2c+S^*)} \sqrt{(S^*)^2 - 4c^2} P^*}} = 0. \quad (A4)$$

The solution $(P^*, S^*)$ is a local maximizer if the Hessian matrix
\[ H(P^*, S^*) \equiv \left( \begin{array}{cc} \frac{\partial^2 \pi}{\partial p^2} & \frac{\partial^2 \pi}{\partial S \partial p} \\ \frac{\partial^2 \pi}{\partial p \partial S} & \frac{\partial^2 \pi}{\partial S^2} \end{array} \right) = \left( \begin{array}{cc} -\frac{2}{\bar{v}(1-q)} & -\frac{1}{\bar{v}} \frac{\partial \pi}{\partial S} \\ -\frac{\partial v}{\partial S} & -p \left( \frac{\partial^2 \pi(P, S)}{\partial S^2} \right) - q \left[ \Gamma''(F) \frac{\partial^2 F}{\partial S^2} + \Gamma'''(F) \frac{\partial F}{\partial S} \right] \end{array} \right) \]

is negative definite for well-defined conditions on \( \bar{v} \) and \( \hat{q} \). From (A3) it is immediate that \( \frac{\partial^2 \pi}{\partial p^2} < 0 \).

Expanding the other diagonal term yields

\[ \frac{\partial^2 \pi}{\partial S^2} = \frac{p}{\bar{v}} \left[ \frac{2\sqrt{2}c^2q(4c-S)}{(1-q)(2c-S)(2c+S)^2\sqrt{S^2-4c^2}} \right] - q \left[ -\Gamma''(F) \frac{2\sqrt{2}c^2}{(S^2-4c^2)^{3/2}} + \Gamma'''(F) \frac{S}{\sqrt{2\sqrt{S^2-4c^2}+S^2}} \right] = \]

\[ -\frac{2\sqrt{2}c^2q}{(S^2-4c^2)^{3/2}} \left[ \frac{p}{\bar{v}} \left( \frac{4c-S}{(1-q)(2c+S)} - \Gamma'(F) \right) \right] - q \Gamma''(F) \frac{S}{\sqrt{2\sqrt{S^2-4c^2}+S^2}} \]

which is negative if \( c > 4S \) and

\[ \bar{v} < \hat{v} \equiv \frac{p(4c-S)}{\Gamma'(F)(1-q)(2c+S)}. \]

The determinant

\[ |H(P^*, S^*)| = \frac{\partial^2 \pi}{\partial p^2} \cdot \frac{\partial^2 \pi}{\partial S^2} - \left( \frac{\partial^2 \pi}{\partial p \partial S} \right)^2, \]

is positive if

\[ \frac{c^2}{(S^2-4c^2)} \left[ \frac{2\sqrt{2}q}{(S^2-4c^2)\sqrt{S^2-4c^2}} \left[ \frac{p}{\bar{v}} \left( \frac{4c-S}{(1-q)(2c+S)} - \Gamma'(F) \right) \right] + q \Gamma''(F) \frac{S}{\sqrt{2\sqrt{S^2-4c^2}+S^2}} \right] \cdot \frac{2}{\bar{v}(1-q)} > \]

\[ \left[ q(\sqrt{S^2+2cS-4c^2}) \frac{\sqrt{2\sqrt{S^2-4c^2}}}{\sqrt{2\sqrt{S^2-4c^2}+S^2}} \right]^2, \]

or

\[ \left\{ \frac{4\sqrt{2}c^2}{\sqrt{S^2-4c^2}} \left[ \frac{p}{\bar{v}} \left( \frac{4c-S}{(1-q)(2c+S)} - \Gamma'(F) \right) \right] \right\} > \frac{q}{\bar{v}(1-q)} \left[ \frac{S^2+2cS-4c^2}{\sqrt{2}(2c+S)} \right]^2. \]

The above is equivalent to the condition

\[ q < \frac{4\sqrt{2} \left( \frac{p}{(1-q)(2c+S)} \bar{v} \Gamma'(F) \right)}{4\sqrt{2} \left( \frac{p}{(1-q)(2c+S)} \bar{v} \Gamma'(F) \right) + \sqrt{\frac{S^2-4c^2}{2c^2} \left( \frac{S^2+2cS-4c^2}{S+2c} \right)^2}. \]

To see that this condition implies a well-defined bound for \( q \), note that \( \sqrt{\frac{S^2-4c^2}{2c^2} \left( \frac{S^2+2cS-4c^2}{S+2c} \right)^2} \) is positive and bounded for \( S \in [2c, 4c] \). Also, \( \frac{p}{(1-q)(2c+S)} - \bar{v} \Gamma'(F) \) is positive and bounded for \( S \in [2c, 4c] \),
when $\bar{v} < \dot{v}$. Therefore, there must exist a $\dot{q} \in (0, 1)$ such that when $q < \dot{q}$, we have $\frac{\partial^2 \pi}{\partial \dot{P}^2} \cdot \frac{\partial \dot{P}}{\partial S} \cdot \frac{\partial^2 \pi}{\partial S^2} > 0$. Hence, the claim is established whenever $S \in [2c, 4c]$. Numerical analyses confirm the existence of constellations $(c, q, \Gamma(F), \bar{v})$, with $\bar{v} \in (0, \dot{v})$ and $q \in (0, \dot{q})$, such that $S^* \in [2c, 4c]$ and $P^* < \infty$. ■

Proof of Proposition 3

Part (i) is established directly. The solution $P^*$ to the firm’s first-order condition

$$\frac{d \Pi}{d P} = 1 - q \Gamma' \left( \frac{\partial \bar{R}}{\partial P} \right) = 0,$$

(A5)

is unique if $\frac{d^2 \Pi}{d P^2} < 0$. We can show this using Assumption 3 and noting that $\frac{\partial^2 \bar{R}}{\partial P^2} < 0$:

$$\frac{d^2 \Pi}{d P^2} = -q \left\{ \Gamma'' \left( \frac{\partial \bar{R}}{\partial P} \right)^2 + \Gamma' \left( \frac{\partial^2 \bar{R}}{\partial P^2} \right) \right\} < -q \Gamma' \left( \frac{\partial \bar{R}}{\partial P} \right) \left( \frac{1}{\bar{R}} \right) + \left( \frac{\partial^2 \bar{R}}{\partial P^2} \right) = -q \Gamma' \left( \frac{1}{2 \bar{R}} \right) < 0.$$

Part (ii) can be shown using the Implicit Function Theorem applied to the first-order condition (A5). For the variable $q$ we have

$$\frac{\partial P^*}{\partial q} = -\left( \frac{\frac{\partial^2 \Pi}{\partial q \partial P}}{\frac{\partial^2 \Pi}{\partial P^2}} \right),$$

We know from part (i) that the denominator is negative. Therefore, the sign of $\partial P^*/\partial q$ has the same sign as

$$\frac{\partial^2 \Pi}{\partial q \partial P} = -\Gamma' \left( \frac{\partial \bar{R}}{\partial P} \right),$$

which is negative. For the variable $c$ we have

$$\frac{\partial P^*}{\partial c} = -\left( \frac{\frac{\partial^2 \Pi}{\partial c \partial P}}{\frac{\partial^2 \Pi}{\partial P^2}} \right).$$

Knowing that the denominator is negative, we can establish the claim by showing that numerator is negative:

$$\frac{\partial^2 \Pi}{\partial c \partial P} = -q \left\{ \Gamma'' \frac{\partial \bar{R}}{\partial c} \frac{\partial \bar{R}}{\partial P} + \Gamma' \left( \frac{\partial^2 \bar{R}}{\partial c \partial P} \right) \right\} < -q \Gamma' \left( \frac{\partial \bar{R}}{\partial c} \right) \left( \frac{1}{\bar{R}} \right) + \left( \frac{\partial^2 \bar{R}}{\partial c \partial P} \right) = -q \Gamma' \{0\} = 0,$$

which uses Assumption 3 and the fact that $\frac{\partial \bar{R}}{\partial c} < 0$ to obtain the inequality and the explicit functional form of $\bar{R}$ to obtain the subsequent equality. Finally, part (iii) is confirmed by the Envelope Theorem:

$$\frac{\partial \Pi^*}{\partial q} = -\Gamma < 0 \quad \text{and} \quad \frac{\partial \Pi^*}{\partial c} = -q \Gamma' \left( \frac{\partial \bar{R}}{\partial c} \right) > 0.$$

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Proof of Proposition 4

The maximization of $\Pi^*(q) - G(q) = \frac{1+q^2c^2}{q} - \beta \left(\frac{1}{q^3} - 1\right)$ with respect to $q$ implies the first-order condition

$$1 - c^2q^2 - \frac{3\beta}{q^2} = 0,$$

with the two positive solutions:

$$q_1 = \sqrt{\frac{1-\sqrt{1-12c^2\beta}}{2c^2}} \quad \text{and} \quad q_2 = \sqrt{\frac{1+\sqrt{1-12c^2\beta}}{2c^2}}.$$

The second-order condition is simply $q^2 < 6\beta$. Therefore, any optimum must satisfy the condition $0 \leq (q^*)^2 \leq 6\beta$. This condition is impossible for $q_2$, but holds for $q_1$ under the proposition’s condition that $0 < \beta < \frac{1}{12c^2}$. To show part (i), that $q^* \equiv q_1$ is increasing, directly take the derivative:

$$\frac{\partial q^*}{\partial c} = \frac{1-6c^2\beta\sqrt{1-12c^2\beta}}{c^2\sqrt{2-24c^2\beta}\sqrt{1-12c^2\beta}},$$

the denominator of which is positive. The sign of the numerator is also positive under the condition $0 < \beta < \frac{1}{12c^2}$. Hence, $q^*$ increasing in $c$. Part (ii) follows from the Envelope Theorem applied to $\Pi^*(q^*) - G(q^*)$:

$$\frac{\partial[\Pi^*(q) - G(q)]}{\partial c} = \frac{\partial}{\partial c} \left[\frac{1+q^2c^2}{q} - \beta \left(\frac{1}{q^3} - 1\right)\right] > 0. \quad \blacksquare$$

We now establish a set of intermediate results needed for Proposition 4.

Lemma A.1

The set $\Psi$ defined in Assumption 1 is equivalent to $\Psi = \left(\frac{1}{2\sqrt{q}}, \frac{1}{q}\right)$ under Assumption 3’.

Proof of Lemma A.1

From Assumption 1, $\Psi \equiv \{c \geq 0|0 < a < \hat{R}(P^*)\}$. Using equilibrium solutions from Proposition 4 with the simplification of Assumption 3’, we can derive the bounds on $c$ such that $0 < a < \hat{R}(P^*)$. The condition $0 < a = P^* - 2c$ requires

$$c < \frac{P^*}{2} = \frac{1}{q} \iff cq < 1,$$

which holds under Assumption 1. The condition $a < \hat{R}(P^*)$ requires
\[ P^* - 2c < \sqrt{\frac{P^*}{2} - 2c^2} \iff \frac{P^*}{6} < c < \frac{P^*}{2} \iff \frac{1}{3} < cq < 1. \]

We now derive the bounds on \( c \) that guarantee an interior optimum to the CSO’s design: \( 0 < \hat{R} \). This condition follows from the optimality of \( \hat{R} \): \( F(0, P^*) > F(\hat{R}, P^*) \), equivalently,

\[ F(\hat{R}, P^*) = \sqrt{\frac{(P^*)^2}{2} - 2c^2} < \frac{P^*}{2} = F(0, P^*) \iff c > \frac{1}{\sqrt{2q}}. \]

Since \( \sqrt{2} < 3 \), this latter condition is the lower bound for \( c \). Thus, \( \frac{1}{\sqrt{2q}} < c < \frac{1}{q} \) precisely defines the conditions of \( \Psi \). ■

**Lemma A.2**

Define the bound on \( V \) as follows:

\[ V(q, c) \equiv \frac{2}{q(1-q)} - \frac{1}{1-q} \sqrt{\frac{2-2cq}{1+qc}}. \tag{A6} \]

(i) If \( V > V(q, c) \) then condition (8) holds in equilibrium for all \( c \in \Psi \).

(ii) \( V(q, c) < \frac{2}{q(1-q)} \) for all \( c \in \Psi \).

**Proof of Lemma A.2**

By definition of \( V(q, c) = \frac{P^*}{1-q} - \frac{q}{1-q} \left[ F(\hat{R}(P^*), P^*) - \frac{a}{\hat{R}(P^*)} c \right] \). We notice that \( F(\hat{R}(P^*), P^*) = \hat{R}(P^*) = \sqrt{\frac{(P^*)^2}{2} - 2c^2} \). Submit \( \hat{R}(P^*) \) and \( P^* = \frac{q}{q} \) into \( V(q, c) \) and simplify the expression we have (A6). Therefore, for all \( c \in \Psi \) such that \( V > V(q, c) \), we have (8). For part (ii), when \( c \in \Psi = \left( \frac{1}{\sqrt{2q}}, \frac{1}{q} \right) \), \( 2 - 2cq \) is strictly positive, therefore \( V(q, c) < \frac{2}{q(1-q)} \). ■

**Proof of Proposition 5**

Offering the CSO is more profitable than not if and only if \( \Pi^* = \Pi(P^*; c, q) > \Pi^N \), or equivalently

\[ \frac{1+q^2c^2}{q} > (1-q)V \iff c > \hat{c} \equiv \sqrt{(1-q)q^2-1}. \]

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Since we know $V(q, c) < \frac{2}{q(1-q)}$ by Lemma A.2, there exists values $V \in \left( V(q, c), \frac{2}{q(1-q)} \right)$. For such $V$, we see that $\dot{c} \equiv \frac{\sqrt{(1-q)q^2-1}}{q} < \frac{1}{q}$. Hence, there exists a $\dot{c}$ such that when $c \in \left( \dot{c}, \frac{1}{q} \right) \cap \Psi \neq \emptyset$, $\Pi^* > \Pi^N$. Otherwise, if $q(1-q)V > 2$, we have $\dot{c} > c$ for all $c \in \Psi$, which means $\Pi^* < \Pi^N$. This establishes part (ii).

**Proof of Proposition 6**

The customer’s willingness-to-pay $\bar{V}$ is defined as the right-hand-side of (8), which is the expected value of purchase including expected hassles and redress levels. For any optimal solution of (11), first assume that $\lambda$ leads to a tiered CSO. Later we verify that $\lambda < \bar{\lambda}$ is necessary and sufficient for a tiered CSO. We start with the optimality condition, for an interior maximizer $\bar{R}$, of (11):

$$\frac{\partial \Pi_{\lambda}(P; q, c)}{\partial R} = -q \left( \frac{\partial F(R; P, c)}{\partial R} \right) \{\Gamma'[F(R, P, c)] - \lambda\} = 0. \quad (A7)$$

This condition is satisfied if either one of the following conditions holds:

$$\frac{\partial F(R; P, c)}{\partial R} = 0; \quad (A8)$$

$$-\Gamma'[F(R, P, c)] + \lambda = 0. \quad (A9)$$

Since we know that $\frac{\partial^2 F}{\partial R^2} > 0$, the first condition is solved by $\bar{R}$, which minimizes $F$:

$$\bar{R} \equiv \sqrt{\frac{P^2}{2} - 2c^2} = \arg\min_R F(R, P, c). \quad (A10)$$

Under (A7), $\bar{R}$ cannot be optimal if $-\Gamma'(F) + \lambda > 0$ because raising $F$ increases profits; therefore, (A8) holds at the optimum only if $-\Gamma'(F) + \lambda \leq 0$. Now suppose that it holds with equality, so that $\Gamma'(F) = \lambda$. Then, under Assumption 3', $\Gamma'(F) = F = \lambda$, an equation that has two roots, $\bar{R} = \lambda + \sqrt{\lambda^2 - \bar{R}^2}$ and $\bar{R} = \lambda - \sqrt{\lambda^2 - \bar{R}^2}$, only the first of which is a feasible solution. To see that the second root is not a feasible solution, first define $F_\equiv \min_R F(R, P, c) =$
\[ F(\hat{R}, P, c). \] We know from Proposition 3 that \( \hat{F} = \hat{R} \), so that implies \( F(\hat{R}, P, c) = \lambda \geq \hat{R} \).

Therefore, we can rule out the second root as follows:

\[ \hat{R} = \lambda - \sqrt{\lambda^2 - \hat{R}^2} \geq \hat{R} \quad \text{or equivalently} \quad \lambda^2 - \hat{R}^2 \leq (\lambda - \hat{R})^2, \]

which is impossible for \( \lambda > 0 \) and \( \hat{R} > 0 \). Hence, \( \hat{R} = \lambda + \sqrt{\lambda^2 - \hat{R}^2} \) whenever \( \Gamma'(F) = \lambda \). For the optimal price, we examine the first derivative of \( \Pi(P; q, c) \) with respect to price

\[ \frac{\partial \Pi_{\lambda}(P; q, c)}{\partial P} = 1 - q \left( \frac{\partial F}{\partial R} \frac{\partial R^*}{\partial P} + \frac{\partial F}{\partial P} \right) [\Gamma'(F) - \lambda]. \tag{A11} \]

From (A11) we can see that it is always positive under the condition \( \Gamma'(F) = \lambda \). Thus, the optimal price \( \bar{P} \) is a corner solution at the maximum value of \( \bar{V} \). Substituting \( \bar{P} = \bar{V} \) in (A8) gives the expression for \( \hat{R} \) in part (ii) of the proposition. We thus have shown part (ii).

Now suppose \( -\Gamma'(F) + \lambda < 0 \), so that \( F(\hat{R}) > \lambda \), which violates (A9). Thus, (A8) is the optimality condition for any \( P \), which we know from Proposition 3 yields: \( \hat{R} = \bar{R} = \sqrt{\frac{p^2}{2} - 2c^2} \).

Using (A11), we solve \( \frac{\partial \Pi_{\lambda}(P; q, c)}{\partial P} = 0 \), which has a unique solution \( \bar{P} \), without closed form. We see that \( \frac{\partial \Pi_{\lambda}(P; q, c)}{\partial P} = 0 \) collapses to the firm’s first-order condition in Section 3.1 when \( \lambda = 0 \); that is, \( \bar{P} = P^* \). It is evident from (A11) that \( \bar{P} \) is increasing in \( \lambda \) so that \( \bar{P} > P^* \) for \( \lambda > 0 \). This establishes part (i) of the proposition. Part (iii) of the proposition follows directly from the above.

Now we establish the boundary conditions defined by \( \hat{\lambda} \) and \( \bar{\lambda} \). Setting \( \bar{P} = \bar{V} \) and solving \( \hat{R} = \lambda + \sqrt{\lambda^2 - \hat{R}^2} \) for \( \lambda \), yields the expression for \( \hat{\lambda} \) as given in the statement of the proposition.

Finally, we show that \( \lambda < \hat{\lambda} \) is necessary and sufficient for the optimal CSO to be tiered. By definition, a tiered CSO requires \( \hat{R} < \bar{P} \). Using the expressions in part (ii), this requires \( \lambda < \hat{\lambda} \equiv 3\bar{V}/4 - c^2/\bar{V} \). It is readily verified that \( \hat{\lambda} < \bar{\lambda} \), so that the condition for part (ii) is not vacuous.
Proof of Proposition 7

We first establish that when firms offer a CSO, demand $D_J$ is downward-sloping for all $c \in \Psi$.

Start by expanding the terms $W_J$:

$$W_J = q \left[ F(R_J, P_J) - \frac{a_j}{R_j} c \right] - P_J = \frac{1}{2} q \left[ \frac{1}{2} a_j^2 + R_j \right] - P_J,$$

which uses the substitution that $a_j = P_j - 2c$ and the corresponding simplification of

$$F(R_J, P_J) - \frac{a_j}{R_j} c = \frac{1}{2} \left[ (P_j + \frac{1}{2} a_A) \frac{a_j}{R_j} + (R_j + a_A) \left( 1 - \frac{a_j}{R_j} \right) \right] - \frac{a_j}{R_j} c$$

$$= \frac{1}{2} \left[ (P_j - \frac{1}{2} a_j - 2c) \frac{a_j}{R_j} + R_j \right] = \frac{1}{2} \left[ \frac{1}{2} a_j^2 + R_j \right].$$

Therefore, with some simplification, we have an expression for $D_J$:

$$D_J = \frac{W_j - W_{-j} + t}{2t} = \frac{\frac{1}{2} \left[ \frac{1}{2} a_j^2 + R_j \right] - P_j - \frac{1}{2} \left[ \frac{1}{2} a_j^2 + R_j \right] + P_{-j} + t}{2t} = \frac{\frac{1}{2} \left[ \frac{1}{2} a_j^2 - 4P_j c \right] - P_j - \frac{1}{2} \left[ \frac{1}{2} a_j^2 - 4P_j c \right] + P_{-j} + t}{2t}.$$

Now we can assess the slope of demand by evaluating the sign of

$$\frac{\partial D_j}{\partial P_j} = -1 - \frac{\sqrt{2}c q}{\sqrt{-4c^2 + P_j^2}} + \frac{\sqrt{2}P_j q}{\sqrt{-4c^2 + P_j^2}} - \frac{P_j^2 q}{\sqrt{2(2c + P_j)} \sqrt{-4c^2 + P_j^2}}. \quad (A12)$$

We show that the maximum value of (A12) is negative for all $c \in \Psi$. The partial derivative with respect to $c$:

$$\frac{\partial^2 D_j}{\partial P_j \partial c} = \frac{2 \sqrt{2} c (4c - P_j) q}{(2c - P_j)(2c + P_j)^2 \sqrt{-4c^2 + P_j^2}}. \quad (A13)$$

Because the denominator is positive for $c < P_j / 2$, we can see that the sign of $4c - P_A$ determines the sign of (A13). Furthermore, $c > \frac{P_j}{4}$ implies $\frac{\partial^2 D_j}{\partial P_j \partial c} < 0$ and $c < \frac{P_A}{4}$ implies $\frac{\partial^2 D_j}{\partial P_j \partial c} > 0$.

Therefore, $\frac{\partial D_j}{\partial P_j}$ is maximized at $c = \frac{P_j}{4}$. Hence,

$$\frac{\partial D_j}{\partial P_j} < \bigg|_{c = \frac{P_A}{4}} = -1 - \frac{\sqrt{2}c q}{\sqrt{12c^2}} + \frac{\sqrt{2}4c q}{\sqrt{12c^2}} - \frac{16c^2 q}{\sqrt{26c^2} \sqrt{12c^2}} = -1 + \sqrt{\frac{3q}{3\sqrt{6}}} - \frac{3\sqrt{\frac{3q}{3\sqrt{6}}}}{3\sqrt{6}} = 0.$$
which demonstrates the claim that $D_j$ is downward sloping.

The remainder of the proof proceeds as follows. We first prove the proposition’s claims on equilibrium prices and CSO structure if both firms offer a CSO. Subsequently, we establish that if $c$ exceeds a threshold, then each firm offers a CSO in equilibrium. Suppose both firms offer a CSO and that prices $(P_A, P_B)$ were chosen at the beginning of stage 1. The logic in the main text before the proposition’s statement establishes that the equilibrium authorization for the CSO’s first-level minimizes $q\Gamma(F_j)$, which is equivalent to minimizing

$$F_j(R_j, P_j) = \frac{1}{2} \left( \frac{P_j^2 - 2c^2}{R_i} + R_i \right),$$

and yields the solution given in (13). This is a minimizer because $\frac{\partial^2 F_j}{\partial R_j^2} > 0$. The subsequent text establishes that the solution to (13) is less than the optimal price $P^*$ for the monopoly firm, which is the solution to (A2) from the proof of Proposition 4. Symmetry of the game implies that the solution $P^{**}$ to (14) is the same for both firms. Thus, we have $P^{**} < P^*$, which implies that $\hat{R}(P^{**}) < \hat{R}(P^*)$ because $\hat{R}(P)$ is increasing in $P$. Finally, this price maximizes profits for each firm if the second order condition is satisfied. The second derivative of profits, expressed as

$$\frac{\partial^2 \Pi_j}{\partial P_j^2} = \frac{\partial^2 D_j}{\partial P_j^2} [P_j - q\Gamma(F_j)] + 2 \frac{\partial D_j}{\partial P_j} \left[ 1 - q\Gamma'(F_j) \frac{\partial F_j}{\partial P_j} \right] - D_j q \left[ \Gamma'' \left( \frac{\partial F_j}{\partial P_j} \right)^2 + \Gamma' \left( \frac{\partial^2 F_j}{\partial P_j^2} \right) \right],$$

is shown to be negative for $c \in \left( \frac{P}{4}, \frac{P}{2} \right)$. The first term is negative under this condition on $c$ because

$$\frac{\partial^2 D_j}{\partial P_j^2} = \frac{2c^2(4c-P)q}{(2c-P)(2c+P)^2(4c^2-4c^2-P^2)} < 0.$$  \quad (A14)

The second term is negative because demand is downward-sloping and the bracketed expression
is positive, which can be seen from (13). Finally, it was shown in the proof of Proposition 4 that the bracketed expression of the third term is positive. This completes the first part of the proof.

We now show that there exists a \( \hat{c} > 0 \) such that offering a CSO is the equilibrium outcome for any \( c > \hat{c} \). Consider an outcome with both firms setting symmetric prices, \( P \). If firm \( A \) offers a CSO, and \( B \) does not then firm \( A \)’s demand is

\[
\tilde{D}_A = \frac{1}{2} + \frac{\bar{w}_A}{2t} > \frac{1}{2},
\]

where \( \bar{w}_A = q \left[ F(R) - c \left( \frac{a}{R} \right) \right] = \frac{qaP}{2R} > 0 \). Firm \( A \)’s profit is then \( \tilde{\Pi}_A = \tilde{D}_A [P - q \Gamma(F)] \) or

\[
\tilde{\Pi}_A = \left[ \frac{1}{2} + \frac{qaP}{2R} \right] \left[ P - \frac{qR^2}{2} \right] = \frac{P}{2} + \frac{qaP^2}{2R} - \frac{qR^2}{2} \left( \frac{1}{2} + \frac{qaP}{2R} \right).
\]

Firm \( B \)’s profit is bounded by \( P/2 \) because \( \tilde{\Pi}_B = (1 - \tilde{D}_A)P < P/2 \). We can show that as \( c \uparrow P/2 \), we have \( \tilde{\Pi}_A > P/2 \). That is,

\[
\tilde{\Pi}_A > \frac{P}{2} \iff P^2 > 2t \frac{R^3}{a} \left[ \frac{1}{2} + \frac{qP}{2} \left( \frac{a}{R} \right) \right].
\]

The right-hand side expression in the above condition converges to zero as \( c \to P/2 \). This is verified by applying l’Hôpital’s Rule to the following limits:

\[
\lim_{c \to P/2} \frac{R^3}{a} = \lim_{c \to P/2} \frac{6cR^3}{2} = \lim_{c \to P/2} 3c \sqrt{\frac{P^2}{2} - 2c^2} = 0,
\]

and

\[
\lim_{c \to P/2} \frac{a}{R} = \lim_{c \to P/2} \frac{-2}{-2cR^{-1}} = 0.
\]

Therefore, by continuity, there exists a \( \hat{c}(P) \) such that \( \tilde{\Pi}_A > \frac{P}{2} > \tilde{\Pi}_B \) for any symmetric prices \( P > 0 \) and \( c > \hat{c}(P) \). This implies that for any symmetric prices, offering a CSO is a dominant strategy. Define \( \hat{c} \equiv \max \left\{ \frac{P^*}{4}, \hat{c}(t), \hat{c}(P^*) \right\} < \frac{P^*}{2} \), which collects the condition on (A12) above.
as well as the two symmetric equilibrium prices when both firms offer a CSO \( P = P^{**} \) and both not offering a CSO \( P = t \), from the simple Hotelling model without a CSO.

**Proof of Corollary 3**

To show part (i), simply apply the definition at an arbitrary price:

\[
RS(\tilde{R}(P), P) = \frac{F(\tilde{R}, P)}{P} = \frac{\sqrt{\frac{P^2}{2} - 2c^2}}{P},
\]

which uses the fact that \( F(\tilde{R}, P) = \tilde{R}(P) \) in equilibrium of the duopoly and monopoly. This is clearly an increasing function of \( P \). The claim is established by the ordering \( P^{**} < P^* \).

To show part (ii), we differentiate the expected hassle cost, \( c \frac{a_j}{\tilde{R}_j} \), with respect to price, \( P \):

\[
\frac{d}{dP} \left\{ c(P - 2c) \left[ \frac{P^2}{2} - 2c^2 \right]^{-\frac{1}{2}} \right\} = \frac{2\sqrt{2c}}{(2c + P)\sqrt{P^2 - 4c^2}}.
\]

This derivative is clearly is positive, which implies that expected hassle cost is increasing in price. Part (ii) follows directly form the ordering on equilibrium prices.