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You Are Judged by the Company You Keep:  
Reputation Leverage in Vertically Related Markets

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# You Are Judged by the Company You Keep: Reputation Leverage in Vertically Related Markets\*

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## Abstract

This paper analyzes a mechanism through which a supplier of unknown quality can overcome its asymmetric information problem by selling via a reputable downstream firm. The supplier's adverse-selection problem can be solved if the downstream firm has established a reputation for delivering high quality with the supplier. The supplier may enter the market by initially renting the downstream firm's reputation. The downstream firm may optimally source its input externally, even though sourcing internally would be better in terms of productive efficiency. Since an entrant in the downstream market may lack reputation, it may suffer from a reputational barrier to entry arising from higher input costs—this constitutes a novel theory of downstream barriers to entry.

JEL Classification: D4, L12, L4, L43, L51, L52

Key Words: Adverse Selection, Certification Intermediary, Incumbency Advantage, Barriers to Entry, Outsourcing, Branding

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# 1 Introduction

In this paper we explore a mechanism through which a reputable downstream firm can leverage its reputation to procure its inputs cheaply in the presence of adverse selection among input suppliers. If the downstream firm lacks reputation with input suppliers it may have to pay a premium for the input. This gives rise to a novel theory of downstream barriers to entry. We also analyze the implications for outsourcing decisions by downstream firms and for the use of from-OEM-to-brand strategy. Outsourcing can be optimal for a downstream firm even when it is equally or more efficient than outsiders in producing an input itself. Firms such as Foxconn, Kia, LG Electronics, and Samsung started out as original equipment manufacturers (OEM) that manufacture products or components for other companies and later established their own brand name. For instance, Foxconn was an input supplier to Apple. According to our mechanism, established brands that are able to ascertain and indirectly certify the quality of the OEM products can provide an entry path for these firms when direct entry to consumer markets is not feasible or too costly. An established brand's ability to certify the quality of its input suppliers can contribute to its lower input price compared to other less-reputed brands—an insight relevant in the case of Apple.

To fix ideas, consider a supplier whose product can be sold either directly to consumers or to downstream firms as an input. However, due to indivisibilities, the supplier cannot use multiple options. The supplier's capability to produce a high-quality product is unknown to consumers and is subject to adverse selection. In contrast, we assume that a downstream firm has the ability to ascertain the quality of its input suppliers. This is a realistic assumption in that small end users lack the knowledge and expertise to assess the quality of unknown suppliers' products, while large industrial firms often have sufficient expertise to ascertain the quality of their business partners' product quality. Due to asymmetric information when selling directly to consumers, a high-quality supplier needs to establish a reputation for its quality with a costly signaling mechanism. For instance, the firm may engage in introductory pricing by selling the product at a discount directly to end consumers (Milgrom and Roberts, 1986).

One possible alternative to building a positive reputation is to sell its product as an input to a downstream firm when high-quality inputs are essential to maintain the quality

of the downstream-stage product. Due to the necessity of high-quality inputs for a high-quality downstream product, the quality of the downstream product can be a signal of input quality. However, this requires that high-quality inputs are converted into high-quality final products—an ability that a downstream firm does not necessarily possess. A downstream firm that is known to be of high quality can resolve the asymmetric information problem faced by the upstream firm, while a downstream firm of unknown ability is less successful to resolve it.

Suppose that the downstream firm is known to be a high-quality producer. This makes the input supplier a willing partner for the reputable downstream-stage monopolist, as its supplier relationship can be a signal of its quality, which enables it to charge a full price commensurate with its quality in the future. Suppose, instead, that the downstream firm is of unknown capability. In such a case, the input supplier may be unwilling to sell to the downstream firm: Even if it offers a higher price than if it were reputable because there is no assurance that its quality can be signaled if the downstream firm fails to deliver high quality.

The signaling mechanism uncovers a novel source of cost advantages for the reputable downstream firm, which leads to a *novel theory of barriers to entry* in which *an incumbent's reputation with its suppliers serves as a mechanism to procure inputs at a lower cost compared to potential entrants*—even at below the input suppliers' marginal cost. This allows the incumbent to maintain the incumbency position even if a potential entrant is more efficient, thus creating a barrier to entry. The incumbent's advantage comes from its ability to “certify” the quality of input suppliers if they are subject to adverse selection due to uncertainty about the quality of their products. We show that even if a potential entrant is equally capable as or more efficient than the incumbent in all aspects, and its own product is not subject to any quality uncertainty once it is introduced to the market, the entrant may still be unable to procure inputs as cheaply as the incumbent firm. This holds as long as its capability is *ex ante* unknown to the suppliers because, when their own types are unknown, the suppliers are concerned about the type of the entrant downstream firm.

In contrast to our theory of entry barriers due to supplier concerns, in the existing literature, reputational entry barriers arise due to consumer uncertainty about the quality of the product they buy. Schmalensee (1982) and Farrell (1986), for instance, consider markets for experience goods in which buyers cannot verify the quality of an entrant's

goods before actually buying and using them. They show that buyers' suspicion about the quality of an entrant's goods serves as an entry barrier due to the "fly-by-night" type entrant's incentives to engage in a hit-and-run strategy. As in Schmalensee (1982) and Farrell (1986), most of the papers on this topic assume that the quality of the entrant's product cannot be ascertained because it is an experience good. In contrast, we assume that the potential entrant is not subject to informational imperfection vis-à-vis consumers. In our model, the entrant's disadvantage is the inability to convince potential input suppliers of its capability when the input suppliers themselves need to establish a positive reputation. In a typical setting in which a product is sold to end consumers, the sellers care only about the price they receive, and the buyers' type is of no concern to the sellers (whereas buyers may be concerned with the sellers' types). In our model, the success of the downstream market product can be a signal of the input suppliers' quality, and the input suppliers are concerned with the buyers' type when their own reputations are at stake. The informational problem at hand is the input suppliers' *ex ante* assessment of the downstream-stage entrant's quality, not the buyers' assessment of the final product.

This paper is closely related to the strand of literature that studies how reputable retailers can use reputation capital to vouch for an upstream partner's quality and, thus, mitigate the adverse-selection problem. Chu and Chu (1994), for example, show how suppliers of high-quality products can use retailers' reputation to signal their quality, whereas suppliers of low-quality products distribute through discounters with no reputation. In a similar vein, Biglaiser (1993) explores the role of an intermediary in a market as agents try to solve the adverse-selection problem; see, also, Biglaiser and Friedman (1994). In these models, the intermediary uses the trust it enjoys with consumers to sell its certification service, and there is only one type of intermediaries. In our setting, consumers observe the quality sold through the intermediary prior to purchase. In line with the work on reputable retailers, we establish the certification role of a reputable downstream firm in Proposition 1. However, in our model, the intermediaries can be of different types in terms of their own production abilities, and this type is possibly unknown to input suppliers. Then, the intermediary may not always be able to certify the quality of the upstream firm, as a low quality experienced with the intermediary does not necessarily imply that the supplier's product is of low quality. Different from previous literature, intermediaries benefit from a good reputation *with input suppliers*, as this improves the prospects of input suppliers to

solve their adverse selection problem and become profitable at later points in time.<sup>1</sup>

In our model, the reputable downstream firm plays the dual role of input purchaser *cum* “certification intermediary.” Regarding the latter, this paper is also related to Lizzeri (1999) and Albano and Lizzeri (2001). Lizzeri (1999) analyzes the role of certification intermediaries in a model of adverse selection. He focuses on the strategic manipulation of information by certification intermediaries and shows that the intermediary’s optimal choice often entails no disclosure or partial disclosure in the form of minimum quality certification. To make this point, Lizzeri allows for a continuum of possible seller types leading to different consumer valuations of the product. As he points out, if there were only two seller types, full disclosure obtains. The objective of his and our paper are markedly different. While Lizzeri (1999) points to the limits of disclosure incentives of intermediaries, our paper considers the difficulties of non-reputable intermediaries to convince upstream sellers of their ability to certify quality and elaborates on the implications for intermediaries in such environments. Albano and Lizzeri (2001) extend Lizzeri’s (1999) analysis to investigate the effects of a certification intermediary on the sellers’ incentives to produce quality goods. They analyze the issue of the optimal degree of information revelation and show that the presence of an intermediary enhances efficiency by increasing the sellers’ incentives to provide high quality, even though the quality is underprovided in equilibrium relative to the full information first best. In their analysis of the role of intermediaries, they assume that the intermediary can credibly *commit* to a disclosure rule to maximize its profits. In our model, the downstream firm can (to some degree) certify the seller’s product quality because its own retail profits are at stake.

Johnson (2012) develops a related idea in the context of exclusive dealing based on a similar informational structure. In particular, he assumes that retailers are in a better position than consumers to ascertain the quality of a new product. He shows that the upstream incumbent may profit from a partially exclusionary dealing policy that contracts with only high-reputation retailers. Essentially, the contract blocks the channel that a potential entrant may use to signal its quality. We similarly assume that downstream firms’ information about trading partners is superior to consumers’. However, the mechanism at

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<sup>1</sup>Alternatively, imperfect competition between upstream products can resolve adverse-selection and moral-hazard problems through the use of a common intermediary or a shared distribution channel (see Garella and Peitz, 2000 and 2007).

work in our model is very different from Johnson's. In Johnson's model, partial exclusion is an entry-detering strategy utilized by the *upstream* incumbent to deny a potential entrant access to the reputation capital of downstream retailers. In contrast, our model focuses on the disadvantage faced by a potential *downstream* entrant, which arises from the upstream firms' uncertainty about the capability of the entrant and their reluctance to supply the entrant when their reputations are at stake.

Our paper also contributes to the work on branding. Johnson (2013) explores the rent shifting effects of branding by an upstream vs. a downstream firm in a repeated moral hazard environment and identifies the condition under which consumers trust a product in equilibrium when either the upstream or the downstream firm is the bondposter; i.e., the firm that engages in branding. Choi and Jeon (2007) develop a theory of co-branding as a mechanism to leverage one firm's reputation with another. They show that under certain conditions, co-branding that links unknown firms in a new sector with established firms in a mature sector allows the unknown firms to signal a high product quality and establish their own reputations. The literature on umbrella branding (e.g., Wernerfelt, 1988; Choi, 1998; Cabral, 2000; and Hakenes and Peitz, 2008) develops a related idea. It investigates how a firm leverages its reputation capital with an existing product to signal the quality of its *own* new products, rather than "renting" its capital to other firms. Our model expands on these ideas and investigates how a reputable downstream firm can "certify" unknown input suppliers. It can use this leverage to procure inputs at a lower cost, as suppliers are willing to sell at a lower price in return for the reputation boost. The signaling mechanism sheds new light on dynamic brand development strategies for new firms.

The remainder of the paper is organized as follows. In Section 2, we analyze the direct sales channel in isolation as a simple adverse selection model in which a firm of unknown quality can sell only directly to consumers. In Section 3, we introduce a second distribution channel that can be used to signal quality. Thus, the firm can sell its product to consumers directly with introductory pricing or to a reputable downstream firm, which it then uses as an input. We show that a reputable downstream firm can use its reputation to resolve the seller's asymmetric information problem and to extract rents from the seller, while a non-reputable retailer under some conditions has to pay an input price premium. In Section 4, we provide a novel theory of barriers to entry. In Section 5, we explore specific contexts to which the mechanism developed in the paper can be applied. Section 6 concludes.

## 2 Preliminaries: The sellers' direct sales channel

*The adverse selection problem.* We base our analysis on a simple model of adverse selection with an experience good in which the quality of the product is initially the sellers' private information. We consider a two-period model in which the quality of the product is revealed at the end of the first period, once it is consumed. The quality of the product can be high or low. There are two types of sellers, the high type ( $H$ ) and the low type ( $L$ ). High-type sellers are endowed with the ability to produce a high-quality product, while low-type sellers can produce only a low-quality product. Consumers are homogeneous and have unit demand. Their valuation is  $\theta$  for high quality and 0 for low quality.

The measure of sellers is set equal to 1, while the measure of consumers is strictly greater than 1; this implies that there is some unmet demand. Since we assume that each seller can produce only one unit in each period, this implies that there is demand for potentially all the production. A fraction  $\alpha \in (0, 1)$  of sellers is of the high type. The discount factor is  $\delta$ . A high-type seller has a production cost of  $c_H$  whereas a low-type seller has a production cost of  $c_L$  with  $c_H > c_L$ . The higher cost for a high-quality product can represent either a production cost difference or an opportunity cost difference, as, for instance, in Daughety and Reinganum (2005). Regarding the opportunity cost interpretation, all types of sellers have the same production cost of  $c_L$ , but the high type has an option value at  $c_H$ , which represents the value of an alternative use for the product, such as keeping the product (as in Akerlof, 1970). We assume that there are positive gains from trade for the high-quality product; i.e.,  $\theta > c_H$ . A low-quality seller will not be active under full information, as the value of the product is assumed to be zero when the quality is low.

The timing of the game is as follows. First, sellers privately learn their type. In period 1, they set the period-1 price. Consumers observe the period-1 price and update their beliefs about product quality. Then, they make their purchase decision. After purchase, all consumers observe product quality. In period 2, sellers set the period-2 price. Then, consumers make their purchase decision. Depending on the parameter values, we can have different market equilibria.

*Market equilibrium.* We consider Perfect Bayesian Equilibria throughout this paper. In period 2, when the quality of the product is high and consumers are informed of its quality, a seller can command a price of  $\theta$ . A high-quality seller then makes profit  $\theta - c_H$ ,



whereas a low-quality seller cannot make any sales with a payoff of zero. Under asymmetric information about product quality in period 1, we can have three types of market equilibria depending on parameter values. As the high-type seller is more profitable than the low-type seller in the second period, a sacrifice of profits by introductory pricing or dissipative advertising can be a signal to buyers that quality is high (see, e.g., Milgrom and Roberts, 1986). In such a case, we have a separating equilibrium.

In a separating equilibrium, introductory pricing reveals each seller's type in equilibrium. In such an equilibrium, the high type needs to charge a price weakly less than  $c_L$  to be able to signal that its quality is high and to deter the low type's incentives to mimic. The highest such price is  $p_1 = c_L$ . In the second period, consumers know its quality, and the high type can command a price of  $\theta$ . Overall profit is

$$\pi_H = (p_1 - c_H) + \delta(\theta - c_H) = -(c_H - c_L) + \delta(\theta - c_H).$$

For a separating equilibrium to exist, therefore, we need the individual rationality condition for the high type  $\delta(\theta - c_H) \geq c_H - c_L$ .

In addition, we can also have pooling or semi-separating equilibria in which both types of sellers (at least, sometimes) charge the same price, or the market breaks down since the adverse-selection problem cannot be overcome. As the set-up with direct sales is a standard model of signaling, we provide details about the equilibrium analysis including consumer beliefs in Appendix 2.

*Maximal profit of high-quality seller.* When there are multiple equilibria for a given parameter constellation, we select the Pareto-superior equilibria for the sellers. In these equilibria, profits of high-quality sellers are uniquely given by

$$\pi^{\text{direct}} \equiv \begin{cases} (\alpha\theta - c_H) + \delta(\theta - c_H) & \text{if } \alpha\theta \geq c_L \text{ and } \delta(\theta - c_H) \geq c_H - \alpha\theta \\ -(c_H - c_L) + \delta(\theta - c_H) & \text{if } \alpha\theta < c_L \text{ and } \delta(\theta - c_H) \geq c_H - c_L \\ 0 & \text{else} \end{cases} \quad (1)$$

Thus, in a setting in which a seller has access to an alternative sales channel,  $\pi^{\text{direct}}$  constitutes the maximal value of the outside option to that alternative channel. Selling through a downstream firm can be such an alternative channel.

### 3 Selling through a downstream firm with reputational leverage

#### 3.1 Model

We introduce another channel through which a seller can sell its product. More specifically, we assume that the product can also be used as an input to a downstream firm. The seller cannot serve the consumer market and a downstream firm at the same time; this assumption is obviously satisfied with a single unit to be sold in each period. More generally, the rationale for this assumption is that the production of an input for a particular downstream firm requires its customization to fit the exact specifications of the final product for which it is designed.<sup>2</sup> Alternatively, due to contractual reasons, the downstream firm may not allow the seller to use multiple channels.<sup>3</sup>

We make an important assumption about the informational structure of the game; unlike consumers, the downstream firm can ascertain the quality of the product when it is used as an input.<sup>4</sup> This is a reasonable assumption because the downstream firm may be a large enterprise and have enough expertise to evaluate the product, unlike less sophisticated consumers.

The downstream firm either contracts with a seller to supply the input or obtains it from an independent source at the cost of  $\gamma$ . Two interpretations of such an independent source are (i) provision by an established high-quality input provider offering the input at the market price of  $\theta$  (implying that  $\gamma = \theta$ ); or (ii) in-house provision at an opportunity cost  $\gamma$  (see, also, Section 5.1).

The downstream firm can also be of two types. The quality of the downstream product is either high or low. There is complementarity between the input quality and the downstream firm's product quality.<sup>5</sup> In particular, a high-quality input is essential to ensure high quality

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<sup>2</sup>We assume that customization can be adjusted in each period and does not affect the quality of the product.

<sup>3</sup>We can extend this to allow for multiple channels. In this case, in addition to the input price, which is linear in quantity, a fixed fee would need to be introduced to replicate our results.

<sup>4</sup>As we will show below, our main argument does not completely break down when the downstream firm is not an expert and cannot identify the supplier's type.

<sup>5</sup>The downstream firm may also be a provider of a service that uses the supplier's product as an input. In particular, the downstream firm may explain to consumers how to properly use the supplier's product. A reputable downstream firm will always do this well, whereas a downstream firm of low type fails with some probability giving consumers a bad experience.

of the downstream firm's product: regardless of the downstream firm's type, if the input quality is low, the downstream product quality is also low and has a value of zero. Thus, a high-quality input is a necessary condition for a high-quality downstream product. If the input quality is high, it is certain that the high-type downstream firm can produce a high-quality product that has a value of  $\Theta \geq \theta$ . Then, selling through a reputable downstream firm, which is known to be of the high type, provides another channel to signal the input quality.

We postulate that the high-type downstream firm is always active, which is implied by  $\Theta > \gamma + C$ , where  $C$  is the marginal cost of the high-quality downstream firm. However, if the downstream firm's type is low, it can produce a high-quality product with only a probability of  $\rho \in (0, 1)$ , even though the input is of high quality. The idea here is that a low-quality downstream firm endangers the proper functioning of the seller's product. This implies that, when the downstream product turns out to be of high quality, the input must be of high quality. Selling through a low-quality downstream firm carries the risk that the seller's high-quality product does not work properly, which prevents the seller from reaping the benefits of its high-quality product in the second period.

The *timing* of events is as follows. In the *first period*, first, the sellers privately learn their type; the downstream firm's type is either publicly known to be high (reputable downstream firm) or privately learnt by the downstream firm (non-reputable firm). The downstream firm observes the sellers' quality, but consumers do not. Second, the downstream firm makes a take-it-or-leave-it offer to the seller it considers contracting with. Third, the seller may either sell directly to consumers, in which case it sets the retail price and the product is an experience good, or sell the product as an input to the downstream firm, in which case the downstream firm sets the retail price. Fourth, consumers buying from the downstream firm observe the price and the quality of the final product, and update their belief about input quality based on this observation. In the *second period*, the seller again has the choice to sell directly or via the downstream firm. However, we can discard the latter option since the seller cannot lose from selling directly.

We solve for Perfect Bayesian Equilibria in which the sellers extract the maximal surplus from consumers in the direct sales channel and, with this outside option in place, the downstream firm extracts the maximal expected surplus from the seller in the alternative

sales channel.<sup>6</sup>

### 3.2 Reputation leverage using a reputable downstream firm

In this subsection, we consider the situation in which the downstream firm is known to be of the high type. In other words, the downstream firm is able to perfectly disclose the supplier's quality. We analyze how the reputation of the downstream firm can be used as a mechanism to signal the supplier's quality.

For now, we just assume that the high-type downstream firm always makes a high-quality product with the purchase of high-quality input. Since the downstream product is an inspection good,<sup>7</sup> purchasing a low-quality input is not attractive for the downstream firm. Indeed, if the downstream firm deviates and picks a low-quality seller, consumers observe that the downstream product is of low quality. From this they infer that the input is of low quality. Thus, such a deviation cannot be profitable.

Hence, the high-type seller knows that by supplying to the high-type downstream firm, it can signal its quality to consumers and, thus, command a price of  $\theta$  in the second period. This implies that the high-quality seller is willing to supply to the reputable downstream firm whenever its profit is higher or equal to the profit it would make under direct selling; that is,  $(p_R - c_H) + \delta(\theta - c_H) \geq \pi^{\text{direct}}$ , where  $p_R$  is the take-it-or-leave-it offer by the reputable downstream firm and  $\pi^{\text{direct}}$  is given by (1). If  $p_R < \gamma$ , this alternative signaling mechanism also implies that the downstream firm with a reputation is able to (and will) purchase the high-quality input at the price of  $p_R$  due to its ability to certify the quality of the input.

Note that, for simplicity, we focus on the case in which the possibility of selling through a downstream firm does not have a feedback effect on consumers' inference process about the composition of the sellers' types. This would be the case if the measure of the downstream firms were negligible compared to the measure of the suppliers; however, our argument easily generalizes to any fraction of high-type sellers disappearing from the direct sales channel, as discussed below.

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<sup>6</sup> A number of papers on sustainability of reputation through branding select the equilibrium in which the full expected surplus of the uninformed party is selected. In our setting, this is an equilibrium outcome in the modified game in which sellers (who do not compete along the direct sales channel) compete for being contracted as input provider by the downstream firm.

<sup>7</sup> Our insight also holds in a setting in which the downstream firm produces an experience good and incurs sufficiently high reputation costs such that a deviation to low-quality product provision is unprofitable.

We summarize our finding in the following proposition.<sup>8</sup>

**Proposition 1** *If  $(\gamma - c_H) + \delta(\theta - c_H) \geq \pi^{direct}$ , in any equilibrium, the seller sells the input to the reputable downstream firm in the first period. It sells at price  $p_R < \gamma$  in the first period and sells directly at price  $\theta$  in the second period.*

When the market for direct selling to consumers is characterized by pooling or separating equilibria, the condition in the proposition above can be written as  $\gamma \geq p_1 = \max[\alpha\theta, c_L]$ . In the case of market collapse, the condition can be written as  $\gamma \geq c_H - \delta(\theta - c_H)$ . Clearly, if  $\gamma$  were too low, the downstream firm would not engage the seller upstream, even though it could obtain a price below the seller's cost. The minimum value of  $\gamma$  required for the seller to use an alternative signaling channel of a reputable downstream firm depends on the equilibrium played in the subgame under direct selling. If seller types pool under direct selling, we must have  $\gamma \geq \alpha\theta$  (which must be larger than  $c_L$ ) for the seller to choose selling through the reputable downstream firm. If this holds, the downstream firm pays  $p_R = \alpha\theta$  for the input, which may well be less than  $c_H$ . If seller types separate or semi-separate under direct selling, we must have  $\gamma \geq c_L$ . If this holds, the downstream firm pays  $p_R = c_L$  for the input, which is definitely less than  $c_H$ . If the market breaks down under direct selling, we must have  $\gamma + \delta\theta \geq (1 - \delta)c_H$ . If this holds, the downstream firm pays  $p_R = \hat{p}_1 = c_H - \delta(\theta - c_H)$  for the input, which is definitely less than  $c_H$ .

In other words, when the downstream firm optimally decides not to use its independent source at cost  $\gamma$ , the high-quality seller may use the downstream firm as a signaling device if it pools with the low-quality type under direct selling or if there is market breakdown under direct selling. It may even do so if it separates under direct selling, albeit at a greater price discount compared to what it achieves when selling through the downstream firm.

*Discussion.* We restricted the analysis to the case in which the fraction of high-quality sellers who contract with downstream firms is negligible. Introducing a measure  $\mu > 0$  of downstream firms implies that the composition of sellers left for direct selling changes. We assume that downstream firms cater to a different set of consumers or that consumer demand is sufficiently large to accommodate all potential production; that is, the measure

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<sup>8</sup>If the downstream firm cannot make a take-it-or-leave-it offer to a chosen high-quality input supplier, but the downstream firm picks such a supplier and then the two negotiate about the price, as long as negotiations are successful with positive probability, the chosen input supplier will engage with the downstream firm and use selling through the downstream firm to resolve its asymmetric information problem under direct selling.

of consumers exceeds  $1 + \mu$ . Since downstream firms contract with high-quality sellers, the fraction of high-type sellers left for direct selling decreases from  $\alpha$  to  $(\alpha - \mu)/(1 - \mu)$  for  $\mu < \alpha$  and 0 otherwise. Thus, it becomes more difficult to sustain pooling among sellers; for  $\theta(\alpha - \mu)/(1 - \mu) > c_L$  a pooling equilibrium does not exist. Hence, the larger  $\mu$  is, the less attractive the outside option is for sellers to sell directly. This strengthens our result about the signaling role of the downstream firm.

We assumed that the downstream firm observes the quality of the input. Note, however, that we can dispense with this assumption when the downstream firm makes a take-it-or-leave-it offer that a low-quality seller would always reject, but that a high-quality seller will accept, and gives positive rents for the downstream firm. This is satisfied for the profit-maximizing  $p_R$  if a separating equilibrium is played in the case of direct selling, in which  $p_R \leq c_L$ , and, therefore, a low-cost input seller has no incentive to contract with the downstream firm. Thus, our assumption that the downstream firm is an expert in judging the seller's type is essential whenever consumers cannot infer high quality prior to purchase under direct selling in the first period—i.e., when the high type does not fully separate under direct selling.

We assumed that supplier and downstream firm operate on separate markets and, thus, do not compete with each other in the second period. In Section 5.2, we explain what happens under competition and when a downstream firm will continue to contract with the supplier in the first period.

Finally, we were silent about the welfare implications when the quality-disclosure mechanism through a supply relationship with a reputable firm becomes available, compared to the case in which introductory pricing in the direct sales channel is the only way to signal quality. In Appendix 3, we develop the welfare analysis and show under which conditions the availability of the alternative sales channel increases welfare. In particular, if the market collapses under direct sales, this is necessarily the case. By contrast, if the market under direct sales features separation of seller types the opposite holds true.

### 3.3 Unknown downstream type and the limits of reputation leverage

While a reputable downstream firm is of high quality, a non-reputable downstream firm can be of high or low quality. Let  $\beta \in (0, 1)$  be the *a priori* probability that the non-reputable downstream firm is of the high type. Hence, if a high-type seller sells to a non-reputable

downstream firm, the final product does not always deliver high quality. The seller can reveal its quality to consumers only with a probability of  $\sigma = \beta + (1 - \beta)\rho$ . Consumers then face the inference problem about whether the bad performance was caused by the input being low-quality or the downstream firm being of the low type.

We assume that a seller can reveal its high quality via its vertical relationship with a downstream firm only if the downstream firm produces a high-quality final product. This means that sellers are not able to claim the high quality of their inputs for products that have failed.

By contrast, suppose that there exists an equilibrium in which consumers always attribute the failure of the final product to the low quality of the downstream firm. With such beliefs, there would be room for a shoddy downstream firm that never delivers high quality to profitably operate in the market. Such a downstream firm could contract with a low-quality input supplier, as the low-type seller then receives a future profit of  $\delta(\theta - c_L)$  that can be shared between low-quality seller and the shoddy downstream firm—this is larger than the future profit  $\delta(\theta - c_H)$  that could be shared if the shoddy downstream firm contracted with a high-quality input supplier. Thus, in an extended model in which shoddy downstream firms can become active, product failure has to be associated with low input quality.

In the remainder of this section, we show that there are limits of reputation leverage when the downstream type is unknown. A high-quality seller may not be willing to sell its product at the same price offered by a reputable downstream firm because there is a risk that the downstream firm will not be able to deliver a high-quality final product and, thus, the seller's high quality may not be revealed in the market. This implies that a non-reputable downstream firm may end up paying a higher input price vis-à-vis a reputable firm.

As is standard in the signaling literature, there can be three types of equilibria in the input market facing the downstream firm whose type is unknown to the seller: pooling equilibrium, separating equilibrium, and semi-separating equilibrium. To obtain a unique prediction for each type of equilibrium, we select the equilibrium that supports the highest possible equilibrium payoff for the high-quality downstream firm; thus, we obtain the minimal premium a non-reputable downstream firm has to pay. In the pooling equilibrium, in which both types of the downstream firms offer the same price, the high-quality down-

stream firm needs to compensate the upstream firm's risk. In the separating equilibrium, the high-quality downstream firm needs to pay a sufficiently high price to the upstream seller to signal its type. Either way, the high-quality downstream firm without reputation ends up paying more than the reputable firm.

We first consider a pooling equilibrium to illustrate the idea of the reputation advantage in the input market and then show that the same insight remains valid in the other types of equilibria. In a pooling equilibrium, the seller cannot distinguish the high-type downstream firm from the low type, and the downstream firm pays the same input price regardless of its type. In such an equilibrium, the high-quality seller is willing to supply to the non-reputable downstream firm (instead of selling directly to consumers) only if

$$(p_{NR} - c_H) + \delta\sigma(\theta - c_H) \geq \pi^{\text{direct}},$$

where  $p_{NR}$  is the price offered by a non-reputable downstream firm, and  $\sigma = \beta + (1 - \beta)\rho$  denotes the *ex ante* probability that the final product of the downstream firm of unknown type will be of high quality. Off-equilibrium beliefs must be such that neither the high-type nor the low-type downstream firm have an incentive to deviate. For instance, sellers may hold out-of-equilibrium beliefs such that they deem the downstream firm to be of low quality if the input price is less than the putative equilibrium price.

Note that the reputable firm, in contrast, can offer a price  $p_R$  such that

$$(p_R - c_H) + \delta(\theta - c_H) \geq \pi^{\text{direct}}.$$

This implies that

$$p_{NR} = p_R + \Delta, \text{ where } \Delta = \delta(1 - \sigma)(\theta - c_H) = \delta(1 - \beta)(1 - \rho)(\theta - c_H).$$

In other words, a non-reputable downstream firm needs to pay a premium of  $\Delta = \delta(1 - \beta)(1 - \rho)(\theta - c_H)$ , compared to a reputable downstream firm. The lower  $\beta$  and  $\rho$ , the higher the premium the downstream firm needs to pay.

For the sake of argument, we now focus on the case in which the equilibrium is a separating one in the subgame in which the sellers sell directly to consumers.<sup>9</sup> Thus, we

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<sup>9</sup>Other cases can be analyzed in a similar way.



have  $\pi^{\text{direct}} = c_L - c_H + \delta(\theta - c_H)$ . Then, the reputable downstream firm can acquire its input at the price of  $p_R = c_L$ . The input acquisition cost for the non-reputable firm is  $p_{NR} = p_R + \Delta = c_L + \Delta$ .

For this to be an equilibrium input price for the downstream firm, the low type should be willing to pay this price. Recall that the downstream firm incurs a constant marginal cost of  $C$ .<sup>10</sup> Thus, we must have

$$\rho\Theta - (p_{NR} + C) = \rho\Theta - [c_L + \delta(1 - \beta)(1 - \rho)(\theta - c_H) + C] \geq 0.$$

This condition can be equivalently written as

$$\rho \geq \rho^* = \frac{C + c_L + \delta(1 - \beta)(\theta - c_H)}{\Theta + \delta(1 - \beta)(\theta - c_H)}. \quad (2)$$

**Lemma 1** *For  $\rho \geq \rho^*$ , there exists a pooling equilibrium in which all types of the downstream firm participate in the market and pay the same input price of  $p_{NR} = c_L + \delta(1 - \beta)(1 - \rho)(\theta - c_H)$ . The input cost premium that the non-reputable downstream firm needs to pay is given by  $\Delta = \delta(1 - \beta)(1 - \rho)(\theta - c_H)$ , which is decreasing in  $\rho$ .*

There does not exist a pooling equilibrium that gives higher profit to the downstream firm. If condition (2) is not satisfied (i.e.,  $\rho < \rho^*$ ), then there is no pooling equilibrium in which both types participate and pay the same input price. When  $\rho < \rho^o = \frac{c_L + C}{\Theta}$ , the low type cannot profitably participate in the market, even if it can purchase the high-quality input at the lowest possible price  $c_L$ . Thus, any downstream firm that is willing to offer an input price of  $c_L$  must be of the high type. In this case, the non-reputable downstream firm does not face any cost disadvantage vis-à-vis a reputable one. We turn to this situation when analyzing separating equilibria next.

In a separating equilibrium, the non-reputable high-type downstream firm would be willing to pay up to  $\Theta - C$ , whereas the low-type firm would be willing to pay only up to  $\rho\Theta - C$ . Thus, in a separating equilibrium, the high-type firm can reveal its type by offering a price of  $\rho\Theta - C$ . If the downstream firm sets a price below  $\rho\Theta - C$ , sellers believe that the downstream firm must be of the low type. When  $\rho$  is sufficiently high and close to 1

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<sup>10</sup>In Section 4 in which we analyze reputational downstream barriers to entry we consider the possibility that a non-reputable downstream entrant is more efficient.

(more precisely, if  $\rho > \rho^{**}$  where  $\rho^{**} = \frac{C+c_L+\delta(\theta-c_H)}{\Theta+\delta(\theta-c_H)} > \rho^*$ ), the cost of separation for the high type becomes too high and the separating equilibrium fails to exist. We summarize our finding in the following lemma (the proof is relegated to Appendix 1).

**Lemma 2** *For  $\rho \in [0, \rho^{**}]$ , there is a separating equilibrium. For  $\rho < \rho^o (= \frac{c_L+C_E}{\Theta})$ , the low type does not participate in the market, and the high type pays a price of  $p_{NR} = c_L$  for the input. For  $\rho > \rho^o$ , the high type signals its type by paying a price of  $p_{NR} = \rho\Theta - C (> c_L)$ , and the input price premium due to a lack of reputation is given by  $\Delta = \delta\lambda(1-\rho)(\theta - c_H) = \rho\Theta - [C + c_L]$ . For  $\rho > \rho^{**}$ , there is no separating equilibrium.*

There does not exist a separating equilibrium that gives higher profit to the downstream firm.

For  $\rho \in [\rho^o, \rho^*]$ , there exists a semi-separating equilibrium in which the low-type downstream firm uses a mixed strategy of participating in the market with a positive probability of  $\eta$ . Let  $\lambda$  denote the probability that the participating downstream firm is low-type when high-type always participates. Then, we have

$$\lambda = \frac{(1-\beta)\eta}{\beta + (1-\beta)\eta}.$$

Note that  $\lambda(\in [0, \beta])$  is increasing in  $\eta$ . Then,  $\eta$  is implicitly determined by the following condition:

$$\rho\Theta = c_L + \delta\lambda(1-\rho)(\theta - c_H) + C, \text{ where } \lambda = \frac{(1-\beta)\eta}{\beta + (1-\beta)\eta}. \quad (3)$$

For  $\rho \in [\rho^o, \rho^*]$ , the participation probability of the low-type downstream firm  $\eta$  is increasing in  $\rho$ . In this equilibrium, the input price is given by  $p_{NR} = c_L + \delta\lambda(1-\rho)(\theta - c_H) = \rho\Theta - C$ ; at this price, the low-type downstream firm is indifferent between participating and not participating in the market. For any price less than this, sellers hold the belief that the product is necessarily of low quality. The premium that the non-reputable downstream firm pays vis-à-vis a reputable one is given by  $\Delta = \delta\lambda(1-\rho)(\theta - c_H) = \rho\Theta - [C + c_L]$ .

**Lemma 3** *For  $\rho \in [\rho^o, \rho^*]$ , there exists a semi-separating equilibrium in which the high-type downstream firm always participates, and the low-type downstream firm participates with probability  $\eta$  defined by (3). The non-reputable downstream firm pays the input price of  $p_{NR} = c_L + \delta\lambda(1-\rho)(\theta - c_H) = \rho\Theta - C$ . The input cost premium due to the lack of*

reputation in the input market is given by  $\Delta = \delta\lambda(1 - \rho) (\theta - c_H) = \rho\Theta - [C + c_L]$ , which is increasing in  $\rho$ .

Note that the price  $p_{NR}$  set in the semi-separating equilibrium is the same as the input price in the separating equilibrium. The only difference is that in the separating equilibrium, only the high-type downstream firm participates, whereas in the semi-separating equilibrium the low type participates with positive probability. As a result, sellers prefer the equilibrium in which downstream firms separate, while downstream firms are indifferent between the two types of equilibria.

Taking all three lemmas above and selecting the equilibrium that is Pareto-superior for the downstream firm, we can conclude that for  $\rho < \rho^o$ , a separating equilibrium will be played that is essentially the same as the full information equilibrium. Here, the non-reputable downstream firm pays the same price as the reputable downstream firm.

For  $\rho \in [\rho^o, \rho^*)$ , there are both separating and semi-separating equilibria. However, under our selection rule, the input price is the same across both types of equilibria. The only difference is in terms of the participation probability of a low-type non-reputable downstream firm. In the separating equilibrium, the low type does not participate. In the semi-separating equilibrium, low-type downstream firm participates with a positive probability. Sellers are better off with this alternative signaling channel in the separating equilibrium, whereas they are indifferent in the semi-separating equilibrium.

For  $\rho \in [\rho^*, \rho^{**})$ , there are both pooling and separating equilibria. However, downstream firms strictly prefer pooling equilibria.

For  $\rho > \rho^{**}$ , there is only a pooling equilibrium. From the perspective of the downstream firms' profits, the multiple equilibria issue arises only for the parameter region of  $\rho \in [\rho^*, \rho^{**})$ . In this case, we select the equilibrium that the downstream firm prefers (i.e., the pooling equilibrium). This does not affect any of our qualitative results because if the separating equilibrium is chosen, our argument concerning the reputation advantage is strengthened.

With our equilibrium selection in place, we summarize our discussions above in the following proposition.

**Proposition 2** *Let  $\Delta$  be the input acquisition cost premium that a non-reputable downstream firm needs to pay compared to a reputable one. There is no premium if  $\rho < \rho^o =$*

$\frac{c_L + C}{\Theta}$ . The non-reputable downstream firm pays a premium of  $\Delta = \rho\Theta - [C + c_L]$ , which is increasing in  $\rho$  for  $\rho \in [\rho^o, \rho^*]$ . For  $\rho \geq \rho^*$ , the non-reputable downstream firm pays a premium of  $\Delta = \delta(1 - \beta)(1 - \rho)(\theta - c_H)$ , which is decreasing in  $\rho$ . Thus, the premium is non-monotonic in  $\rho$  and highest when  $\rho$  is at  $\rho^*$ .

Figure 1 illustrates the input acquisition cost premium paid by a non-reputable downstream firm,  $\Delta$ , as a function of  $\rho$ . As discussed above, if the low-type downstream firm is sufficiently separate from the high type ( $\rho$  close to zero), the non-reputable firm does not need to pay an input acquisition cost premium. The input acquisition cost premium is first weakly increasing and then decreasing in  $\rho$ ; it is largest at value  $\rho^*$  at which point at the boundary of the regions where the selected separating and pooling equilibrium touch.

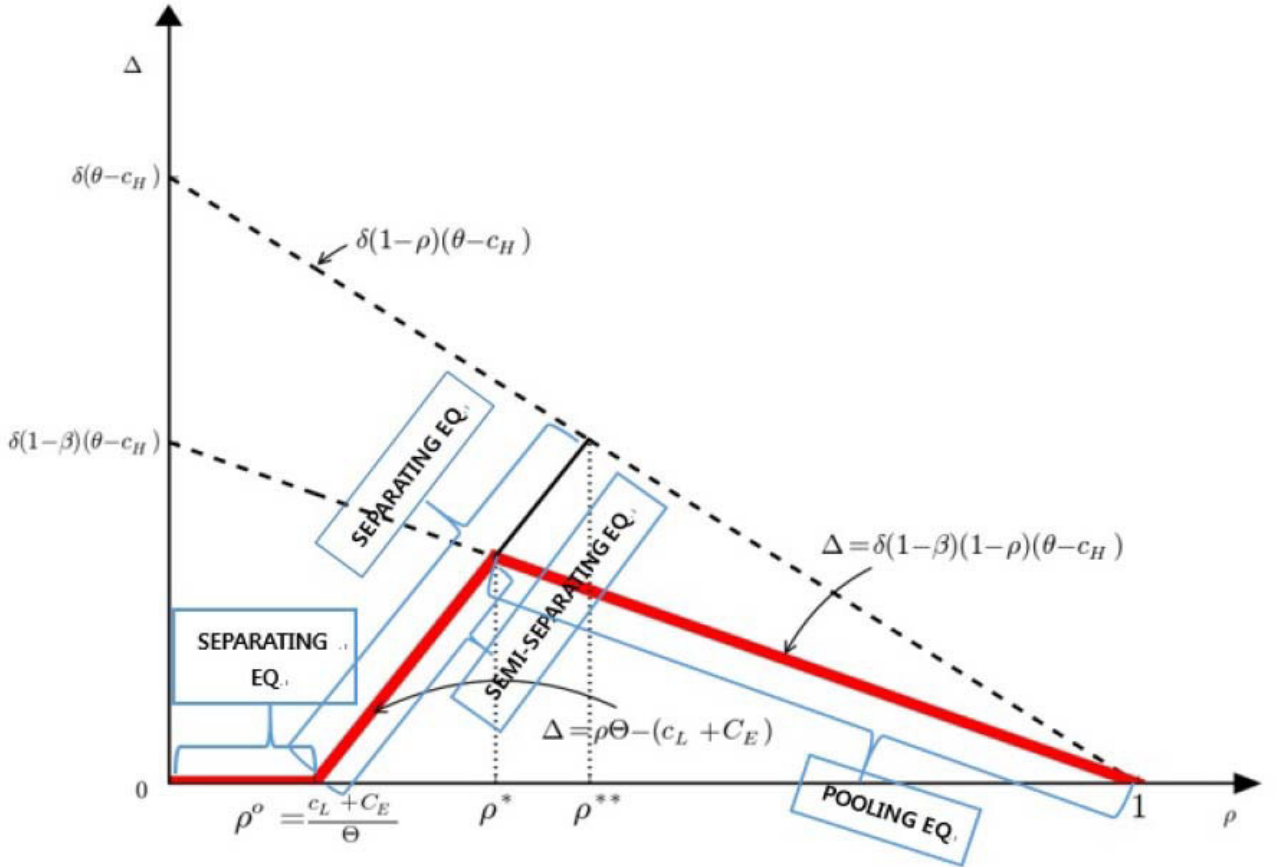


Figure 1. Lack of Reputation and the Input Acquisition Cost Premium

## 4 A novel theory of downstream barriers to entry

In this section, we embed our mechanism in a model with potential downstream entry. There is an incumbent ( $I$ ) in the downstream market that is known to be of high type. The high-type seller knows that by supplying to the high-type downstream firm, it can signal its quality to consumers, and, thus, command a price of  $\theta$  in the second period. This implies that the high-type seller is willing to supply to the reputable incumbent at any price higher or equal to the price with which it can signal its quality. In other words, the incumbent firm with a reputation is able to purchase the high-quality input at the price of  $p_I = c_L$  due to its ability to certify the quality of the input. Let us assume that the incumbent's cost of production in addition to the input price is given by  $C$ .

There is a potential entrant ( $E$ ) at the downstream stage who can decide to enter in period 0 at cost  $\varepsilon$ . The potential entrant, which can be either of the high type or the low type, knows its type prior to entry, but its type remains private information. We denote by  $\beta \in (0, 1)$  the *a priori* probability that the potential entrant is of high type. However, we assume that once the downstream product is produced, consumers can ascertain its quality. In other words, the entrant's downstream product is an inspection good, as in the case of the incumbent. If the potential entrant produces a high-quality product, it does not need any introductory pricing to signal its quality and could command a price of  $\Theta$  in the market, when not competing with the incumbent. This means that the potential entrant does not face any disadvantage vis-a-vis the incumbent due to uncertainty about the quality of its own product. Thus, we rule out the entry barrier created by the presence of "hit-and-run" entrants and abstract from the mechanism analyzed in Farrell (1986). The entrant at the downstream stage will certainly face additional barriers to entry if the product is an experience good.

To focus on the entrant's disadvantage in the input market, we construct our model in such a way that all other potential channels of entry barrier are blocked, and the entrant is on a level playing field with the incumbent. In this spirit, we also endow the entrant with the same ability to ascertain the input quality as the incumbent. The potential entrant has a production cost advantage of  $C_E < C$ . This implies that a high-type potential entrant is a more-efficient producer than the incumbent. In other words, absent the asymmetric information problem that the potential entrant faces, the entrant enjoys a cost advantage

when delivering the final good to consumers. In this case, if the incumbent and the entrant operate in the same homogeneous product market and compete in a Bertrand fashion in the product market, the high-type entrant will make a positive profit, while the incumbent will make zero profit.

The entry barrier we identify in this model is the potential entrant’s disadvantage in the input market. Can the potential entrant procure its input as cheaply as the incumbent? One assumption we adopt is that the seller does not know the potential entrant’s type. Thus, there is asymmetry in the information structure before and after the entrant’s production. Once the entrant produces a final product, its type can be revealed in the product market. However, before production takes place, there is no way for the input supplier to ascertain the entrant’s type or the quality of its product. We assume that a contract with the potential entrant that is contingent on the realized final product qualities is not feasible. The inability to write a contingent contract can be justified by the problem of verifiability in courts (Hart and Grossman, 1986; Hart and Moore, 1990).

Due to asymmetric information, as our analysis in Section 3 shows, even if the potential entrant is more efficient, the disadvantage in its procurement cost may put it at an overall disadvantage if the input price premium it has to pay is high enough. In particular, when the two types of the downstream firm pool, entry may be blocked if the input cost premium the entrant has to pay is such that

$$\Delta > (C - C_E),$$

where  $\Delta = \delta(1 - \beta)(1 - \rho) (\theta - c_H)$  (compare Figure 1). More generally, if the two downstream firms offer differentiated products, the entrant may enjoy a positive profit; however, its disadvantage due to the input price premium it has to pay may limit the entrant’s profits to such an extent that it cannot recover its entry costs. This provides a novel theory of barriers to entry.

Our model, therefore, provides a novel and unexplored channel through which the incumbency advantage can be obtained. Often, the incumbent’s cost advantage is attributed to its ability to buy in bulk and to monopsonic power. For instance, Apple’s success and its huge margin on its products are often attributed to its “big discounts on parts, manu-

facturing capacity, and air freight” because of its volume and ruthlessness in bargaining.<sup>11</sup> Our model suggests that another source of the low input price and its cost advantage can be Apple’s ability to certify the quality of its input suppliers. Input suppliers can garner instant credibility by being designated as an Apple supplier, and they are willing to supply at a low price to establish themselves as a high-quality producer, which enables them to receive high prices in the market down the road.

## 5 Applications and extensions

In Section 3, we demonstrated how the reputation of the downstream firm vis-à-vis input suppliers (i.e., whether or not it is known to be of high quality) affects the price it pays for the input. Our simple model has several important applications, which we discuss below. We also argue that our insights hold in an alternative setting with a single available seller.

### 5.1 Outsourcing/offshoring decision

One of the most important decisions in procurement and supply chain management is a make-or-buy decision: what to produce internally and what to outsource. The usual explanation for outsourcing is that the outside firms are simply more efficient and produce more cheaply. Some of the most cited benefits of outsourcing include economies of scale, risk pooling, and reduced capital investment. In particular, outsourcing allows a firm to focus on its core competency and provides opportunities to reduce costs by relying on outsiders who can aggregate multiple orders to reap the economies of scale (Simchi-Levi et al., 2008). Our model provides an interesting twist in the outsourcing decision. In our model, outsourcing can take place even when the firm is equally efficient or even more efficient than outsiders. The reason is that the input supplier is willing to supply below its cost to signal its quality. If the input supplier is less efficient, outsourcing may well be socially inefficient (compare Appendix 3).

Consider the separating equilibrium when the input suppliers sell directly to consumers. Then, the high-type input supplier needs to sell at the price of  $p_1 \leq c_L$  to signal its quality. For this signaling strategy to be viable, we assume that the high-type producer can recoup its loss in the first period with its second-period profit; that is,  $\delta(\theta - c_H) \geq (c_H - c_L)$ . In

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<sup>11</sup>See Satariano and Burrows (2011).

addition, we assume that the downstream firm is able to produce a high-quality input more efficiently at a cost of  $\gamma (< c_H)$ .

Under such conditions, the downstream firm's input acquisition cost is  $c_L$ , while its internal input acquisition cost is  $\gamma$ . As long as  $\gamma > c_L$ , the downstream firm would prefer to engage in outsourcing, even though it can produce the input more efficiently. This provides a new rationale for outsourcing. In our model, outsourcing is a mechanism to extract rents from willing partners who are eager to receive a seal of approval from reputable firms. From this, we can conclude that the firm plays a dual role of input purchaser and quality-certifying intermediary.

We can derive qualitatively the same results when we analyze a pooling equilibrium or consider a game in which consumers bid up the price of the product until the price equals consumers' willingness to pay, as, for example, in Tadelis (1999) and Cabral (2000), among others. If the pooling equilibrium prevails in the consumer market, the established firm can acquire its input at the price of  $p_1 = \alpha\theta$ . With this modification, it can be easily verified that all the remaining results hold, as in the separating equilibrium. In particular, if  $c_H > \gamma > \alpha\theta (> c_L)$ , the downstream firm has incentives to engage in outsourcing even though it has the capability to produce as efficiently as or more efficiently than the outside firm. It is cheaper to outsource at the price of  $\alpha\theta$  than to produce internally at the cost of  $\gamma$ .

## 5.2 Dynamic market entry strategy: From OEM to brand name

An original equipment manufacturer (OEM) is a firm that manufactures products or components for other companies to resell or to incorporate into a product labeled under the purchasing company's brand name. Many firms from East Asia start out as OEMs for major firms and then later establish their own brand name. For instance, Samsung was initially an OEM but is now considered one of the world's leading brands in flat-panel screens and smartphones. In a similar vein, LG Electronics initially took OEM orders before establishing its own global brand in the international market. Kia Motors served as an OEM for Ford before selling cars under its own brand name overseas. Relatedly, Foxconn is one of the leading contract manufacturers, producing for Dell, Apple, and Intel among others. Over the years it established the Foxconn and other consumer brands to sell computer parts directly to final consumers. Other examples include HTC, Huawei, and Lenovo (formerly



Legend).

Our model suggests that this type of strategy is more effective when the OEM is from a developing country. The usual explanation in the literature is that firms in developing countries often lack technical capability and effective production systems, which results in the production of low-end and poor-quality products. OEM contract arrangements with firms in advanced countries allow them to gain access to advanced production and technological skills, offering a vehicle to enter foreign markets and upgrade their capabilities. This process helps enhance the perceived quality and image of the OEM's products, which enables them to eventually sell products under their own brand name (Cheng, et al., 2005). Gereffi (1999), for instance, provides a detailed analysis of the global apparel industry in which he documents the instrumental role of branded marketers in upgrading overseas suppliers' technical and organizational capabilities. Our model provides an alternative mechanism through which being an OEM can be an effective strategy to enter foreign markets; even when firms already have sufficient capability to produce high-quality products, and, thus, no technical learning is involved, OEM contracts can be valuable in facilitating future entry with firms' own brand names by providing a seal of approval for consumers who are uncertain about their capabilities to produce high-quality products. For this to work, consumers must receive information about the OEM firm that contributed to the product they bought from the downstream firm. This may happen through media coverage or word-of-mouth. For instance, Foxconn received wide press coverage after it became contract manufacturer of Apple.

To formally develop this idea, consider a situation in which introductory pricing to signal quality is too costly, and, thus, there is no separating equilibrium. Once again, assume that high quality has a production cost of  $c_H$ , whereas low quality has a production cost of  $c_L$  with  $c_H > c_L$ . The high-quality input supplier needs to sell at the price of  $p_1 \leq c_L$  to signal its quality. If  $\delta(\theta - c_H) < (c_H - c_L)$ , the high-quality seller cannot recoup its loss from introductory pricing in the future, and a separating equilibrium does not exist. In a pooling equilibrium, consumers are willing to pay only up to  $\alpha\theta$ . For a pooling equilibrium to exist, it is required that  $\alpha\theta \geq c_L$ . Thus, a pooling equilibrium exists only when the a priori probability of the high type,  $\alpha$ , is sufficiently high—that is,  $\alpha \geq \alpha^* = c_L/\theta$ .

As the high-quality OEM becomes an original brand manufacturer (OBM) in the second period, its profit may be different from  $\theta - c_H$ . First, it adds a downstream activity in

the second period. Second and more importantly, it may become a competitor to the downstream firm. Thus, we may write more generally  $\pi^2$  instead of  $\theta - c_H$  as the second-period profit of the OBM. Then, also the downstream firm has to take into account that it faces competition from the initial OEM in the second period. If direct selling features pooling, our analysis is not affected and a less-efficient OEM may supply the downstream firm in the first period. If, however, there were no trade when only the direct selling channel is available to the OEM, the downstream firm may optimally decide not to contract with the OEM so as to avoid competition in the second period. Thus, a more-efficient OEM may be excluded from the market.

For simplicity, we return to the specification in which second-period profit of the high-quality OEM is  $\theta - c_H$ . We can interpret  $\alpha$  to reflect the overall technical capability of firms in an economy, with more advanced countries having a higher  $\alpha$ . If a firm is based in a less developed country, consumers will associate the firm with a lower  $\alpha$ . Thus, if  $\delta(\theta - c_H) < (c_H - c_L)$  and  $\alpha < \alpha^*$ , there is no way for a firm of unknown quality to directly enter the consumer market. However, if there is an established firm that can purchase the product as an input, the firm may be able to enter the market. As before, we assume that the established firm can ascertain the quality of the product that can be used as an input. It can offer a price of  $\hat{p}_1 = c_H - \delta(\theta - c_H)$ , which is, once again, lower than the cost of internal production, even if the established firm is equally efficient as the outside input suppliers.<sup>12</sup>

Therefore, established firms that are able to ascertain and indirectly certify the quality of the OEM products can provide an alternative entry path for the supplying firm when direct entry to consumer markets is not feasible. This is more likely to hold for firms from developing countries and may explain why firms that make a transition from OEM to OBM are predominantly from developing countries. The price path is also consistent with the evidence that original brand manufacturers receive much higher margins compared to OEMs.<sup>13</sup> The theory is also consistent with Ghosh and John's (2009) empirical finding that firms are more likely to choose branded component contracts when the supplier's brand name adds significant differentiation.

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<sup>12</sup>If the input supplier has any bargaining power, then the input acquisition price will be somewhere between  $c_H$  and  $c_H - \delta(\theta - c_H)$ .

<sup>13</sup>Yang and Wu (2008) quote Gerhard Schen, general manager of Mingde Musik in China, as saying "[I]n the OEM business, you only get one-eighth of the pie, but with your own brand, you get a bigger chunk of the profits."

Case studies of OEM firms that made successful transitions to OBMs also document conflicts with their customers when OEM firms cultivated their own brand names, with OEM customers threatening to reduce or withdraw OEM contracts (Yang and Wu, 2008; Cheng et al., 2005). This type of conflict is often attributed to OEM clients’ perception of OEMs as potential competitors once they establish their own brands. In our model, separation will take place even if there is no direct competition and the relationship is purely vertical; after establishing a reputation via OEM relationships, OEMs do not see any reason to supply at a low price when they are able to sell at a higher price in the open market. From the perspective of OEM clients, the cost of purchasing through OEMs with established reputations is simply too costly. Thus, the optimal strategy of OEM clients is to find another willing partner that needs to establish a reputation. Our model implies that OEM clients will use a revolving list of OEMs.

Another application of our theory is the market for baseband processors used in cell phones and, in particular, the role of Apple as a reputable downstream firm for nascent baseband processor suppliers. The Federal Trade Commission (FTC) finds that “Apple is a particularly important OEM from the perspective of a nascent baseband processor supplier and confers benefits on a nascent supplier that make the supplier a stronger contender for other OEMs’ business.”<sup>14</sup> The FTC provides five instances of such benefits. Two of them are “(c.) A nascent supplier achieves technical validation by demonstrating its ability to meet Apple’s demanding technical requirements [...] (e.) A nascent supplier obtains a reputational halo effect from selling to Apple. This reputational boost may help a supplier win sales at other OEMs.”<sup>15</sup> This suggests that Apple provides a seal of approval to a nascent supplier if they contract with each other. The supplier can then sell to other OEMs (possibly at a higher price). Selling to other OEMs who cannot ascertain the quality of the supplier here replaces the direct sales channel in our model.

### 5.3 Input as a scarce resource: The case of a single seller

Our analysis so far has applied to markets in which downstream firms can always find high-quality sellers as input suppliers, and the contracting between downstream firms and sellers

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<sup>14</sup>Federal Trade Commission’s Complaint for Equitable Relief, *Federal Trade Commission v. Qualcomm, Inc.*, No. 5:17-cv-00220, at para. 129 (N.D. Cal., Jan. 17, 2017).

<sup>15</sup>Federal Trade Commission’s Complaint for Equitable Relief, *Federal Trade Commission v. Qualcomm, Inc.*, No. 5:17-cv-00220, at para. 129 (N.D. Cal., Jan. 17, 2017).

does not change the overall type composition of those sellers who sell directly. Formally, this means that the fraction of sellers who sell through downstream firms is negligible.<sup>16</sup> The other extreme is a situation in which all high-type input suppliers contract with a single downstream firm. To analyze such a situation, suppose that there is a single seller.

The equilibrium characterization in which only direct selling is available to the seller remains unchanged. However, in the presence of a reputable downstream firm, our analysis needs modification. Suppose that the parameter constellation is such that supplier types pool under direct selling. In our analysis so far, the corresponding profit of the high type under direct selling has defined the outside option when contracting with a downstream firm. This is no longer the case: if consumers held equilibrium beliefs of the pooling equilibrium under direct selling also in the presence of a downstream firm, the high-type seller would contract with the downstream firm, whereas the low-type seller would sell directly. Thus, consumer beliefs are not confirmed because they expect the high type with prior probability when buying directly from the seller, and there cannot be pooling of supplier types, when the alternative channel is available. Hence, the outside option gives a profit weakly less than  $\pi^{\text{direct}}$ .

Since a downstream firm may not encounter a high-quality supplier, the question arises whether it would be willing to contract with a low-quality seller. Under our assumption that low-quality input always leads to a low-quality final product of the downstream firm, this can never be the case. However, when we also relax this assumption and postulate that low-quality input only reduces the probability that the final product is high-quality, the downstream firm may be tempted to accept a low-quality input, especially if the alternative supply is very costly; i.e.,  $\gamma$  large. If this were the case, consumers could no longer make a perfect inference about seller type. Thus, the question arises how the downstream firm can defend its reputation by refusing to contract with a low-quality seller and, instead, source at cost  $\gamma$ . Following Choi (1998), one can extend the model to consider a discrete time, infinite horizon setting, in which the downstream firm sells a product in every period. Along the equilibrium path, it rejects low-quality suppliers because consumers would no longer trust the downstream firm and expect it to take in the seller of any type if, in the

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<sup>16</sup>We briefly commented on relaxing this assumption in the previous section.

past, the product had failed.<sup>17</sup>

Returning to our two-period model, when a reputable incumbent and a non-reputable entrant downstream firm compete in the downstream market, they also compete to contract for supply from the high-quality seller. Due to the lack of reputation, the high-type entrant is at a disadvantage compared to the incumbent when bidding for the input. Therefore, the incumbent will procure the input from the high-quality seller, whereas the entrant has to procure from an alternative source at cost  $\gamma$ . Following the argument in Section 4, the resulting input price premium that the entrant has to pay creates a barrier to entry. When entry nevertheless takes place, our model predicts that incumbents prevail in the bidding for scarce inputs from non-established input suppliers, while non-reputed downstream firms have to resort to alternative sources of supply.

## 6 Concluding remarks

In this paper, we have developed the idea that a firm’s customer relationships can signal the quality of its product. A downstream firm can take advantage of this signaling mechanism and utilize its reputation to procure inputs at a lower cost than it would have to pay to procure it from a different firm known to be of high quality.

Embedded into a setting with downstream competition, a reputable downstream firm is able to maintain the incumbency position even if the potential entrant lacking such a reputation is more efficient, thus creating an entry barrier. The incumbent’s advantage comes from its ability to “certify” the quality of input suppliers if they are subject to adverse selection due to uncertainty about the quality of their products. This provides a new rationale for the incumbency advantage and the persistence of monopoly. We also explored how the mechanism considered in the paper can be applied to other contexts, such as outsourcing and dynamic entry strategies for unknown brand names.

The mechanism can also be applied to young scholars’ incentives to work with established scholars in their early careers. Choi and Jeon (2007) interpret the coauthoring relationship between a junior and a senior scholar in terms of co-branding, in which coauthorship with established scholars can be used to signal a junior scholar’s ability. Of course, in the setting

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<sup>17</sup>This insight also applies to the setting with many sellers if the number of downstream firms exceeds the number of high-quality sellers; i.e.,  $\mu > \alpha$ .

of collaboration in the academic market, there is no monetary price associated with the transactions. Instead, the division of the workload may replace the role of price in the relationship.

In our setting, junior and senior scholars have complementary abilities. A reputed senior scholar is able to polish a paper such that it is appreciated by the reviewers. A non-reputed senior scholar is less likely to do a good job in polishing a paper. One implication of our model is that junior scholars will be willing to shoulder the bulk of work when they work with reputed senior scholars. Thus, these scholars engage in a mutual beneficial relationship,<sup>18</sup> and reputed senior scholars have to work little compared to junior scholars. Also, reputed senior scholars have a significant advantage vis-à-vis non-reputed ones in terms of productivity, as the reputed has to work less compared to the non-reputed scholar.

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<sup>18</sup>Zuckerman (1967, p. 396) quotes an unnamed Nobel laureate in physics: “.. it clearly did my student... no harm at all to have me as a second author of the paper. It called people’s attention to the paper who might otherwise not [have] read it at all... Nor as a matter of fact, did it do me any harm.”

## Appendix 1: Relegated proof of Lemma 2

The lowest price at which the high-type sellers are willing to sell to downstream firms is  $c_L$ . If  $\rho < \rho^o$ , participation is simply not profitable for the low-type downstream firm. As a result, a downstream firm that is willing to offer a price of  $c_L$  must be of the high type. For  $\rho > \rho^o$ , the low-type downstream firm has incentives to participate with an input price of  $c_L$ . Therefore, for separation to take place, the high-type downstream firm needs to offer a higher input price that would discourage the low-type firm to match. Therefore, the high-type downstream firm needs to offer  $p_{NR} = \rho\Theta - C(> c_L)$  when  $\rho > \rho^o$ . However, if  $\rho$  is sufficiently large, it becomes too costly to separate, and the high-type firm has incentives to deviate. To see this, suppose that a high-type downstream firm deviates and does not offer the putative equilibrium price of  $p_{NR} = \rho\Theta - C$ . Then, in the worst case, it will be conceived to be of low type. In such a case, the high-quality seller would be willing to supply at a price of  $c_L + \delta(1 - \rho)(\theta - c_H)$ , which is lower than the equilibrium price  $p_{NR}$  when  $\rho > \rho^{**}$ . Thus, a separating equilibrium does not exist when  $\rho > \rho^{**}$ .

## Appendix 2: Relegated analysis of equilibria in the direct sales channel

In this Appendix, we provide more details of the market equilibrium analysis for the case of direct sales channel. We characterize separating, pooling, semi-separating and no trade equilibrium. We select the equilibrium that is Pareto-superior for the sellers. The same equilibrium profits obtain when eliminating equilibrium-dominated strategies (on equilibrium-dominated strategies, see, e.g., Fudenberg and Tirole, 1991). When we consider the full model in which a seller has access to an alternative sales channel, the profit from direct channel serves as the outside option value. Thus, the focus on the maximal profit stacks the deck against us.

### Separating equilibrium

Consider a separating equilibrium in which introductory pricing can reveal each seller's type in equilibrium. In such an equilibrium, the high type needs to charge a price weakly less than  $c_L$  to signal that its quality is high and to deter the low type's incentives to mimic. For any separating equilibrium with a price strictly less than  $c_L$  for the low type firm, a separating equilibrium with the price of the low-type firm is Pareto-superior (as the high-type firm is better off). In the Pareto superior equilibrium, as the low type firm does

not charge below  $c_L$  regardless of how such a price would be interpreted by the buyers, the high type firm can signal its signal with the price of  $p_1 = c_L$ . The low type firm does not sell in equilibrium.<sup>19</sup> To have this price configuration as an equilibrium, we can specify the following beliefs: consumers believe that the product is of high quality if and only if  $p_1 \leq c_L$ . Otherwise, consumers believe that the product is of low quality.<sup>20</sup> Alternatively, if we consider the pricing game in which consumers bid up the price, then  $p_1 = \bar{p}_1 = c_L$  is the unique equilibrium.

In the second period, consumers know its quality, and the high type can command a price of  $\theta$ . Overall profit is

$$\pi_H = (p_1 - c_H) + \delta(\theta - c_H) = -(c_H - c_L) + \delta(\theta - c_H).$$

For such a separating equilibrium to exist, therefore, we need the following individual rationality condition for the high type:

$$\delta(\theta - c_H) \geq c_H - c_L \tag{4}$$

The high-type firm makes a loss of  $(c_H - c_L)$  in the first period to signal its quality with an introductory pricing, which needs to be made up by the future profit when its quality is revealed. The condition says that the high-type firm's second-period profit is sufficiently high to recoup the first-period loss. In the separating equilibrium, only the high-quality product is sold in both periods, and the low-quality firm is unable to sell. If the separating equilibrium exists, it is also efficient.

### **Pooling and semi-separating equilibria**

In a pooling equilibrium, no signaling through price takes place. In equilibrium, both types of firms sell in the market with the same price, and consumers cannot distinguish one from another before consuming the product. As a result, consumers are willing to pay only up to the expected value of the product, that is, the highest price that can be charged in a pooling equilibrium is  $\bar{p}_1 = \alpha\theta$ . In the second period, the quality is revealed, with the high-quality firm commanding a price of  $\theta$  and the low-quality firm exiting the market.

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<sup>19</sup>We make a tie-breaking assumption that the low quality firm does not sell when its profit is zero. This assumption is made to avoid the open set problem.

<sup>20</sup>It can be easily verified that the specified beliefs are consistent with Bayes' rule.



Overall the highest profit for the high-quality firm in a pooling equilibrium is

$$\pi_H = (\alpha\theta - c_H) + \delta(\theta - c_H).$$

For a pooling equilibrium to exist, we need two conditions:

$$\bar{p}_1 = \alpha\theta \geq c_L \tag{5}$$

$$(\alpha\theta - c_H) + \delta(\theta - c_H) \geq 0. \tag{6}$$

The first condition above is the individual rationality (IR) condition for the low type, and the second condition is for the high type. When both IR conditions are satisfied, we can have a multiplicity of pooling equilibria. More specifically, any price  $p_1 \in [\max(c_L, c_H - \delta(\theta - c_H)), \alpha\theta]$  can be sustained as the equilibrium pooling price in the first period with both firms selling. To sustain any price in this range as an equilibrium, we can specify out-of-equilibrium beliefs such that consumers believe that the product is of low quality if the price is higher than the putative equilibrium price.

We select the Pareto-superior equilibrium for the sellers and, thus, we have  $p_1 = \bar{p}_1 = \alpha\theta$ . Alternatively, if we consider the pricing game in which consumers bid up the price, then  $p_1 = \bar{p}_1 = \alpha\theta$  is the unique equilibrium.

If condition (5) is not satisfied and (6) is, then there is a semi-separating equilibrium in which the market price of the input is  $c_L$ , with the low-type firm selling with a probability of  $\alpha(\theta - c_L)/[(1 - \alpha)c_L]$  and the high-type firm always selling. With Bayes' rule, the equilibrium posterior beliefs in the semi-separating equilibrium can be derived as

$$\tilde{\alpha}(H|p_1 = c_L) = \frac{\alpha}{\alpha + (1 - \alpha)\frac{\alpha(\theta - c_L)}{(1 - \alpha)c_L}} = \frac{c_L}{\theta}$$

Out-of-equilibrium can be specified as in the separating equilibrium, that is, consumers believe that the product is of high quality if  $p_1 < c_L$ . Otherwise, consumers believe that the product is of low quality. The high-type firm makes profit  $-(c_H - c_L) + \delta(\theta - c_H)$ , which is the same as in a separating equilibrium.

We observe that the pooling equilibrium is Pareto-superior if it exists, as  $\alpha\theta \geq c_L$  implies that the high-quality firm's profit is larger under pooling than separation or semi-separation. This also holds for the low-quality firm.

### Market collapse with no trade

If high-type firms cannot overcome the adverse-selection problem in the market, there is no trade. This would be the case if the production cost of the high-quality product is close to the value of the product  $\theta$ , relatively large compared to  $c_L$ , and the probability of the high type,  $\alpha$ , is low. More precisely,

$$\delta(\theta - c_H) < (c_H - c_L) \text{ and } \alpha < \alpha^* = \frac{c_L}{\theta}. \quad (7)$$

Because of the first inequality, high-quality sellers do not have an incentive to sell at a price below  $c_L$  (since future gains cannot compensate for current losses). At a price greater or equal to  $c_L$  low-type sellers will be active. Thus, consumers can expect a gross surplus of at most  $\alpha\theta$ . By the second inequality, this is less than  $c_L$  and, thus, consumers are not willing to buy at any price greater or equal to  $c_L$ . Hence, it does not matter at which price a profit-maximizing seller offers its product, since the seller will always generate zero sales.

The market also collapses if

$$\delta(\theta - c_H) < c_H - \alpha\theta \text{ and } \alpha > \alpha^* = \frac{c_L}{\theta}. \quad (8)$$

Here, consumers would buy at prices above  $c_L$  under pooling, as long as the price is less or equal to  $\alpha\theta$ . At such a price, low-quality sellers have a strict incentive to be active at such a price. Thus, their expected gross surplus is at most  $\alpha\theta$ . For any price weakly less than this term, by the first of the two inequalities, high-quality sellers would make losses. Thus, they are not setting a price at which consumers would buy and the market breaks down.

### Appendix 3: Welfare implications from introducing a reputable downstream firm

Recall that the downstream firm has an independent source of its input, which it can procure at the cost of  $\gamma$  and which can serve additional demand. To reduce the number of cases to consider, let us assume that  $\gamma \leq \theta$ . When the inequality is strict, this assumption implies that the most efficient use of the product we consider is to sell directly (leading to first-period welfare  $[\Theta - C - \gamma] + [\theta - c_H]$  because the downstream firm sources at cost  $\gamma$ ) rather than using it as an input for a downstream firm (leading to first-period welfare  $\Theta -$

$C - c_H$ ). The welfare implications of reputation leverage hinge crucially on the equilibrium that prevails under independent selling—i.e., whether the market collapses due to adverse selection when only introductory pricing is available, or whether the market survives adverse selection under separating, semi-separating, or pooling. Our welfare analysis is performed in the base model in which the ratio of downstream firms to sellers is negligible. This means that we are evaluating the welfare effect of allowing sellers to sell through downstream firms locally at  $\mu = 0$ . Our analysis can easily be extended to  $\mu > 0$ , in which case we would need to take consumers' inferences into account—we address this case at the end of this subsection.

If the market collapses due to adverse selection, the availability of the alternative signaling mechanism with reputation leverage is unambiguously welfare-enhancing. For instance, this would occur if (7) or (8) is satisfied together with the following condition:

$$\hat{p}_1 = c_H - \delta(\theta - c_H) < \gamma.$$

If (7) or (8) hold, separating, semi-separating, and pooling equilibria in the subgame of the direct sales channel fail to exist, which leads to a market collapse when quality can be signaled only with the price instrument. The inequality above is the condition that contracting with the input supplier is more cost-effective for the downstream firm with reputation than obtaining the input from the independent source.

With our assumption that  $\gamma \leq \theta$ , signaling by supplying to a reputable downstream firm is welfare-reducing if the market equilibrium in the alternative distribution channel is characterized by a separating equilibrium. The reputable downstream firm's input acquisition from a seller is purely a rent extraction device that diverts resources from the more productive use. The consumers are worse off and the downstream firm is better off, whereas the seller is indifferent when the downstream firm makes a take-it-or-leave-it offer.<sup>21</sup>

If the equilibrium with introductory pricing is a pooling one, and reputation leverage with a downstream firm is also feasible, the welfare effect depends on the details of the model. With our assumption that the production of the low-quality product is inefficient, a pooling equilibrium entails inefficiency, which increases with the fraction of low-type

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<sup>21</sup>If we assume that the upstream firm has some bargaining power and the input acquisition price is negotiated, then both the upstream firm and the downstream firm will be better off at the expense of consumers.

sellers being  $(1 - \alpha)$ . The conditions for there to be a pooling equilibrium are given by inequalities (5) and (6). In addition, for the reputation leverage mechanism to be effective, we need  $\gamma > \alpha\theta$ . Taken together, the condition for a pooling equilibrium to exist and for the reputation leverage mechanism to apply is given by:

$$\max \left[ \frac{c_L}{\theta}, \frac{c_H - \delta(\theta - c_H)}{\theta} \right] < \alpha < \frac{\gamma}{\theta}.$$

In the welfare analysis until now, we considered a single downstream firm possibly contracting with one supplier. However, if the number of downstream firms is negligible compared to the number of sellers, the use of downstream firms by sellers does not change the composition of suppliers using direct sales. For a meaningful welfare analysis, the number of downstream firm must, therefore, be non-negligible.<sup>22</sup> If, in particular, all high-type sellers could sell through downstream firms, then a supplier who does not supply to a downstream firm would be considered a low-quality supplier. As a result, the availability of an alternative signaling mechanism would then eliminate the inefficient production of low-quality products in a pooling equilibrium. To compare welfare under introductory pricing and reputation leverage, we need only compare the first-period social surplus. The total surplus in the first period with reputation leverage is given by  $\alpha(\Theta - c_H)$ , while it is  $\alpha(\Theta - \gamma) + \alpha\theta - [\alpha c_H + (1 - \alpha)c_L]$  with independent selling by input suppliers. Thus, the availability of reputation leverage is welfare-enhancing if and only if  $\alpha < \hat{\alpha} = c_L/(\theta - \gamma + c_L)$ .

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<sup>22</sup>The measure of consumers must then be sufficiently large such that there is unmet demand even when all downstream firms obtain the input from an alternative source. We thus focus on the welfare effects due to the asymmetric information problem facing suppliers and abstract from competition effects that would arise when suppliers and downstream firms who source from an independent source compete with each other for consumers.

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