

Versioning by Outsourcing

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Motivation

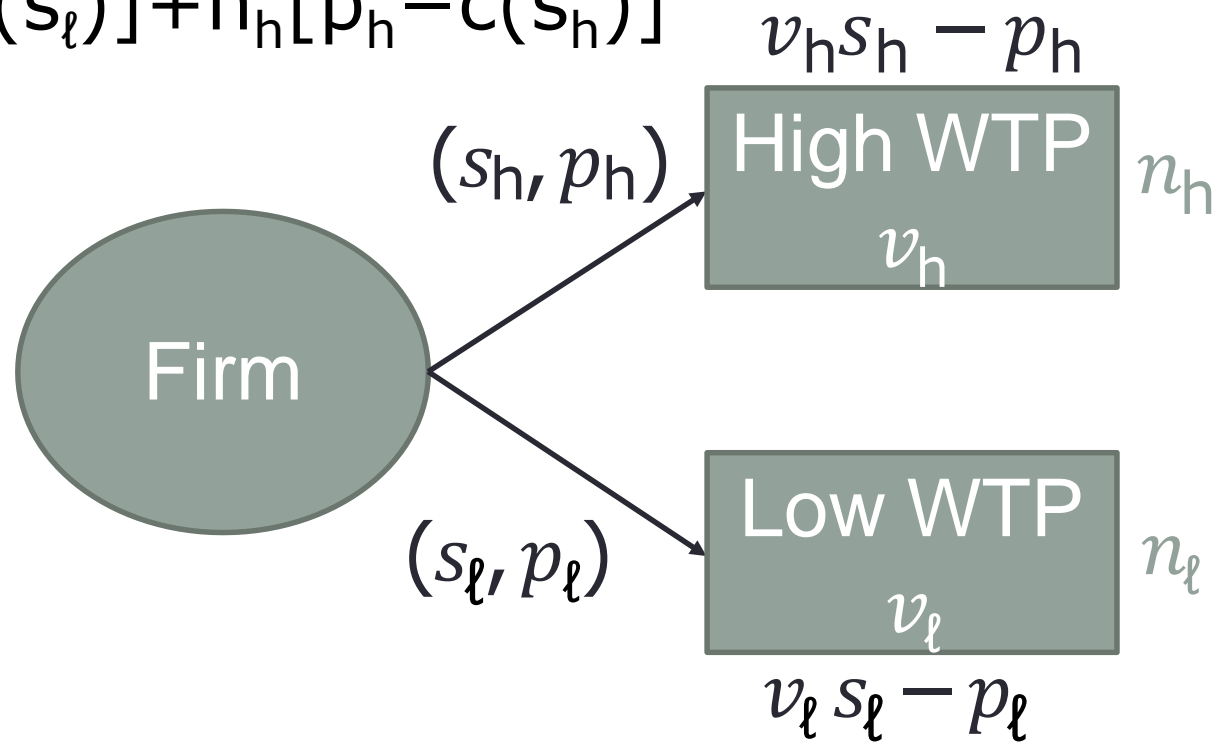
- Versioning is a retail strategy that allows companies to differentiate their products based on unobservable characteristics of consumers.
- Versioning strategies involve other players than just the downstream firms that implement them (e.g. Aircraft cabin segmentation)
- Higher quality → more in-house production, e.g. fashion: in-house *custom-made high-fashion design* vs. outsourced, factory-made *ready-to-wear*
- Higher quality → more outsourcing, e.g., supermarkets selling private labels and national brands
- How does outsourcing affect quality? Welfare implications?
- MS and OR literature on outsourcing & quality: imitation; contractor opportunism; brand image; liability; supply chain disruption

Related literature

- When are versioning and 2nd-degree PD profitable?
 - Mussa & Rosen (1978, JET) & [many extensions](#): vertical integration
 - Yehezkel (2008, RJE): outsourcing but exogenous quality
 - We add outsourcing and endogenous quality choice
- Price discrimination and vertical relations
 - DeGraba (1990, AER) & [many extensions](#): 3rd degree input PD
 - Miravete, Seim, & Thurk (2019, WP): 3rd degree PD and input prices
 - We study downstream versioning and input prices
- Make-or-buy and investment
 - Economides (1999, IJIO); Hagiu & Wright (2018, MS); Loertscher & Riordan (2019, AEJ:Micro): Single-product firms
 - We study multiproduct firms

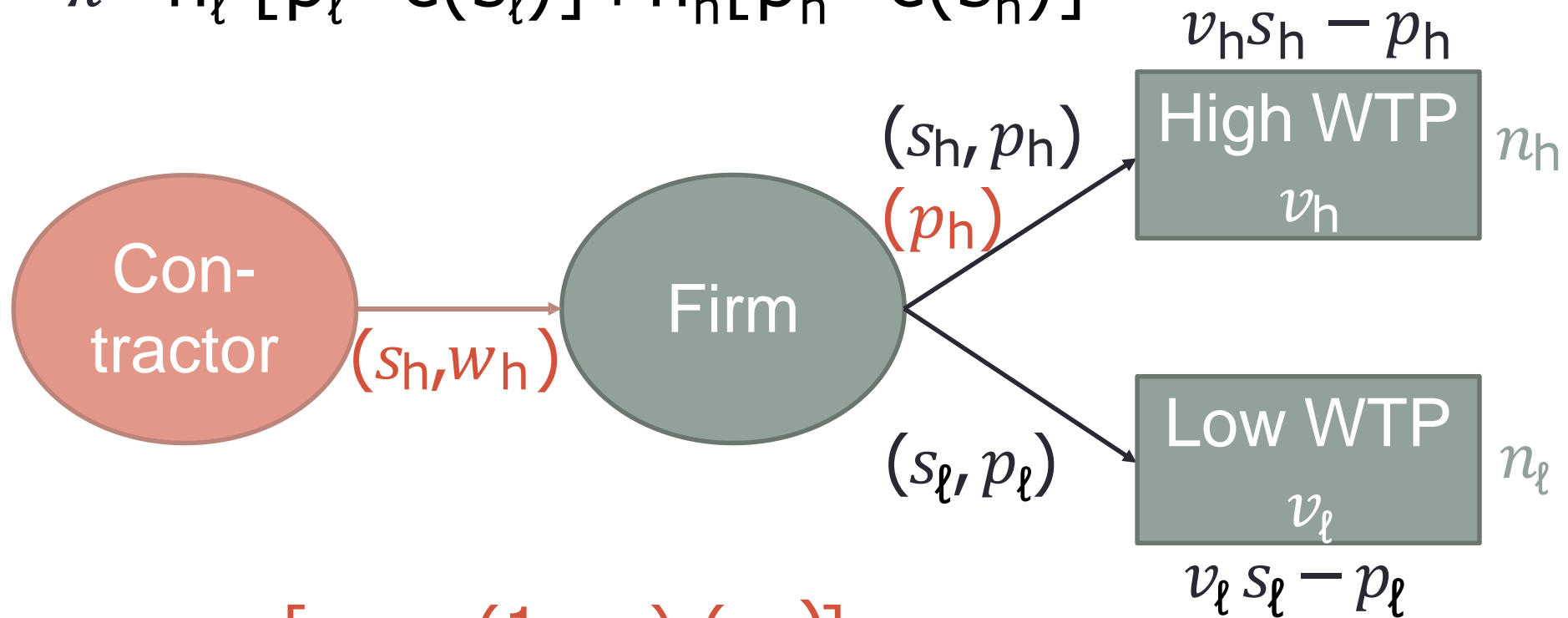
The model

$$\pi = n_\ell [p_\ell - c(s_\ell)] + n_h [p_h - c(s_h)]$$



The model

$$\pi = n_\ell [p_\ell - c(s_\ell)] + n_h [p_h - c(s_h)]$$



$$\pi_C = n_h [w_h - (1 - e)c(s_h)]$$

$$\pi_F = n_\ell [p_\ell - c(s_\ell)] + n_h [p_h - w_h]$$

Social optimum benchmark

Welfare=consumers' utility + profits

$$\max W = n_\ell [v_\ell s_\ell - c(s_\ell)] + n_h [v_h s_h - (1-e)c(s_h)]$$

$$\rightarrow s_\ell^* = (c')^{-1}(v_\ell)$$

$$\rightarrow s_h^*(e) = (c')^{-1}\left(\frac{v_h}{1-e}\right)$$

In-house production vs. outsourcing

- v_i is private information. The firms cannot distinguish the two types of consumers.
- The firm extracts all CS from the low-type consumers (participation constraint) and pays an *information rent* (incentive compatibility constraint) to the high-type consumers.

In-house production vs. outsourcing

- In-house production
 1. The firm sets the qualities
 2. The firm sets the retail prices

In-house production vs. outsourcing

- In-house production

1. The firm sets the qualities

$$s_\ell^{**} = (c')^{-1}\left(v_\ell - \frac{n_h(v_h - v_\ell)}{n_\ell}\right) < s_\ell^* \text{ and } s_h^{**} = s_h^*(0) = (c')^{-1}(v_h)$$

Downward distortion of s_ℓ (to \downarrow info rent)

2. The firm sets the retail prices

$$p_\ell = s_\ell v_\ell \text{ and } p_h = s_h v_h - s_\ell (v_h - v_\ell)$$

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- In-house production

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- Outsourcing

1. The firm sets the quality s_ℓ and the contractor s_h
2. They bargain over the wholesale price w_h
3. The firm sets the retail prices

$$p_\ell = s_\ell v_\ell \text{ and } p_h = s_h v_h - s_\ell (v_h - v_\ell)$$

Bargaining over the wholesale price w_h

Nash bargaining solution:

$$w_h = \arg \max (\pi_F - \pi_F^0)^\beta \times (\pi_C - \pi_C^0)^{1-\beta}$$

where $\pi_C^0 = 0$ and

$$\pi_F^0 = \begin{cases} \pi_{F1}^0 = (n_\ell + n_h)[v_\ell s_\ell - c(s_\ell)] & \text{if } n_\ell/n_h \geq r(s_\ell) \\ \pi_{F2}^0 = n_h[v_h s_\ell - c(s_\ell)] & \text{otherwise.} \end{cases}$$

Case 1: All consumers served if negotiations fail

→ $w_{h1}(s_\ell, s_h)$ for high n_ℓ/n_h

Case 2: Only the high-type consumers served if negotiations fail

→ $w_{h2}(s_\ell, s_h)$ for low n_ℓ/n_h

Quality choices under outsourcing

- Firm: $d\pi_F / ds_\ell = 0$
- Contractor: $d\pi_C / ds_h = 0$

- From the FOCs

$$\rightarrow s_{\ell 1}^{**} = (c')^{-1} \left(v_\ell - \frac{(v_h - v_\ell)\beta n_h}{n_\ell + (1-\beta)n_h} \right) \text{ and } s_{h1}^{**} = (c')^{-1} \left(\frac{v_h}{1-e} \right)$$

$$\rightarrow s_{\ell 2}^{**} = (c')^{-1} \left(v_\ell - \frac{(v_h - v_\ell)(2\beta - 1)n_h}{\beta n_\ell + (1-\beta)n_h} \right) \text{ and } s_{h2}^{**} = (c')^{-1} \left(\frac{v_h}{1-e} \right)$$

Implications

- There exist a threshold \hat{r} such that the equilibrium low-end quality is $s_{\ell 2}^{**}$ if $n_\ell/n_h < \hat{r}$ and $s_{\ell 1}^{**}$ otherwise.
- **Proposition 1:** Compared to the full in-house production case, outsourcing yields a strictly higher quality s_ℓ^{**} and a (strictly) higher quality s_h^{**} whenever the independent contractor is (strictly) more cost-efficient.

$$s_{\ell 2}^{**} > s_{\ell 1}^{**} > s_\ell^{**} \text{ and } s_{h 2}^{**} = s_{h 1}^{**} > s_h^{**} \text{ iff } e > 0$$

Note: $dw_{hi}(s_\ell, s_h)/ds_\ell < 0$ bargaining effect

Low-end quality higher under outsourcing because negative effect of s_ℓ on high-end profit is not fully internalized (less severe downward distortion).

Implications

- Proposition 2:

- i) Outsourcing occurs iff $e > \hat{e}_i(\beta)$ with $\hat{e}_i'(\beta) < 0, i \in \{l, h\}$
- ii) When outsourcing enhances cost-efficiency ($e \geq 0$), it improves social welfare if $n_l/n_h \geq \hat{r}$ and if $n_l/n_h < \hat{r}$ & $\beta \geq 0.5$.

- The quality of the high-end version is set at the socially optimal level regardless of whether it is outsourced or produced in-house (considering cost efficiency under outsourcing).

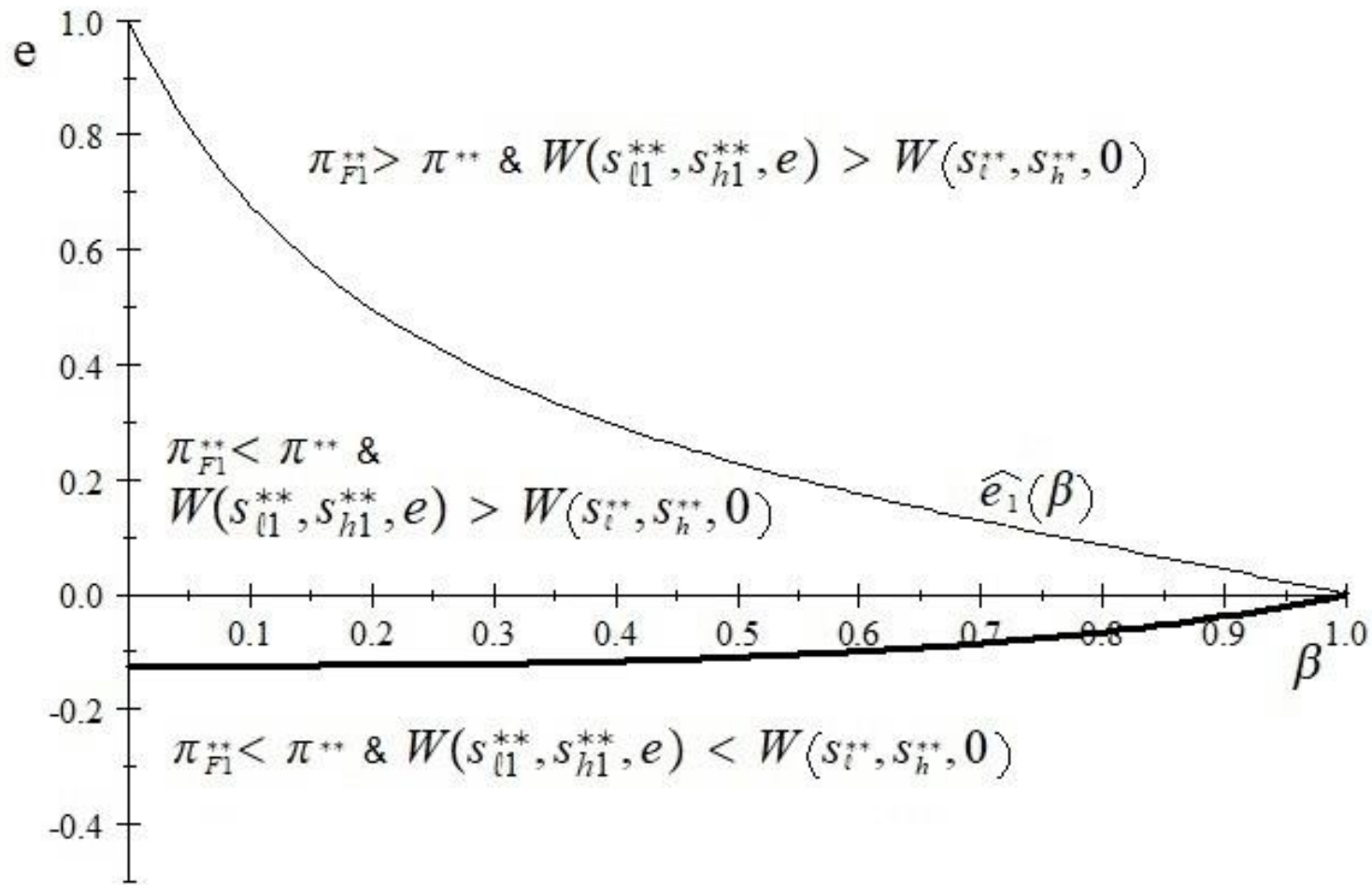
- $s_{l2}^{**} > s_l^* > s_{l1}^{**} > s_l^{**}$ for $\beta < 0.5$

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Implications

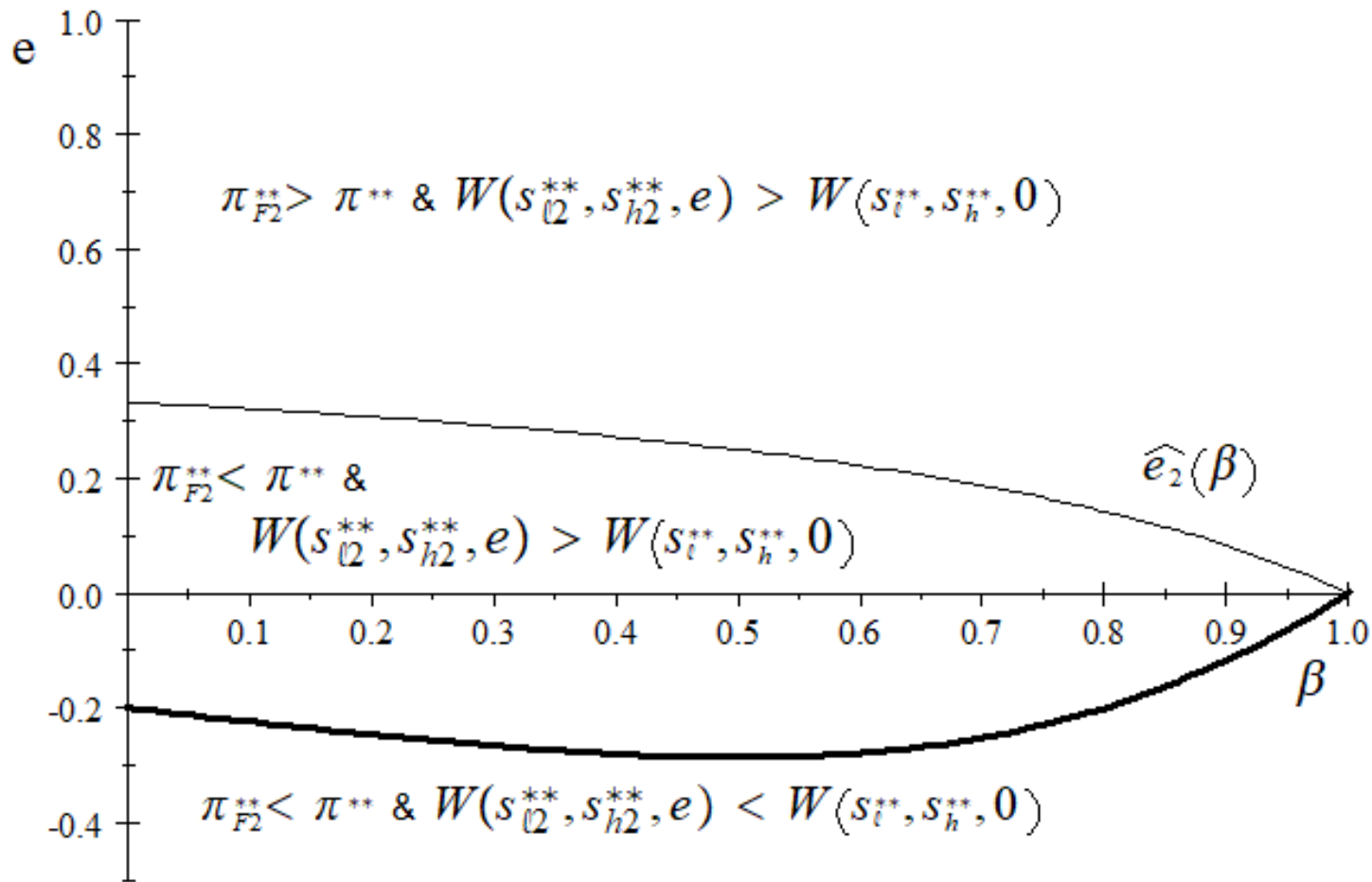
- Under asymmetric information, the quality of the low-end version is *distorted downward* due to the information rent obtained by high-type consumers.
- The bargaining effect implies that a higher quality of the low-end version leads to a decrease in the wholesale price of the high-end version and can help *mitigate this downward distortion*.
- Additionally, if outsourcing enhances cost-efficiency, it leads to an increase in the quality of the high-end version, resulting in welfare gains.

Numerical illustration



$$c(s) = s^2/2, n_l = 1, n_h = 2, v_h = 1.5, v_l = 1$$

Numerical illustration



$$c(s) = s^2/2, n_l = 1, n_h = 2, v_h = 1.5, v_l = 1$$

Extensions

1. **Reversible outsourcing**: In case of failed negotiations, the firm retains the flexibility to implement versioning.

- qualities are determined by maximizing the total industry profit
- outsourcing increases welfare when $e > 0$

2. **Irrecoverable costs**: quality improvements also involve irrecoverable upfront investments (negative disagreement payoff for the contractor)

- unless the contractor can enhance quality at a significantly lower investment cost than the firm, the existence of investment costs reduces the profitability of outsourcing both for the firm and from a social welfare perspective.

Extensions

3. Price elastic demands: $v \sim u(0,1)$ and $e = 0$

→ Both s_ℓ and s_h are higher when s_h is outsourced (str. comp.)

4. Outsourcing the low-end version

→ increases s_ℓ iff $e \geq 0$ but may reduce s_h

In case of failed negotiations, the high-end version is either sold to high-type consumers at the same price as when negotiations succeed or sold to all consumers at a lower price for the same quality.

Versioning or pooling?

- Same approach as in Salant (1989, QJE): Pooling occurs if
 1. low-end version not offered ($s_l \leq 0$)
 2. both qualities reach the threshold s_{max}
 3. low-end version has higher quality than high-end version ($s_l \geq s_h$)
- High-end version outsourced: s_l and s_h increase
 1. pooling where $s_l \leq 0$ less likely
 2. pooling where $s_l \geq s_{max}$ and $s_h \geq s_{max}$ more likely
 3. pooling where $s_l \geq s_h$ never happens
- Low-end version outsourced: s_l increases and s_h decreases
 1. pooling where $s_l \leq 0$ less likely
 2. pooling where $s_h \geq s_l \geq s_{max}$ less likely
 3. pooling where $s_l \geq s_h$ may happen

Concluding remarks

- Outsourcing the high-end version may alleviate the downward distortion in quality for the low-end version compared to when the firm produces both versions in-house.
- If outsourcing leads to improvements in cost-efficiency, quality of the high-end version tends to increase, resulting in overall welfare gains.
- Integration with cost-inefficient contractor may harm welfare.

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Thank you