Online Appendices for "Strategic Information Sharing of Online Platforms as Resellers or Marketplaces"

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The Appendices include proofs and some of the supplemental materials for the paper. For brevity, we relegate Appendix E, H and I to the technical report version of the paper Zha, Li, Huang, & Yu (2022).

Appendix A: Notations for Threshold Values

Table A1. Threshold values

Thresholds	Meaning
$\gamma_l(\phi)$	The lowest γ that the manufacturer chooses the leaking equilibrium in the reseller model; $\gamma_l(\phi) \in (0,1)$ is the solution of $\frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2} - \frac{2a^2(2-\phi)}{(4-3\gamma)^2} - \frac{\beta\sigma^2}{8} = 0$.
$\gamma_t(\sigma)$	The lowest γ that the total distribution channel profit increases under the strategy SN leaking equilibrium in the reseller model; $\gamma_t(\sigma) \in (0,1)$ is the solution of $\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2} - \frac{\beta\sigma^2}{4} - \frac{6a^2}{(4-3\gamma)^2} = 0$.
$\gamma_r(\phi)$	The lowest γ that strategy SN is better than SS for the platform in the reseller model when the commission fee rate is exogenous; $\gamma_r(\phi)$ is the solution of $3\beta\sigma^2\left(16-\gamma\left(8+\gamma(25-6\gamma-9\gamma^2)\right)\right)+16a^2(2+\phi)-3a^2\gamma\left(8+\gamma\left(17+8\phi-3\gamma\left(2+\gamma(2+\phi)\right)\right)\right)=0$.
$\gamma_1^R(\sigma)$	The lowest γ that strategy SN is better than NS for the platform in the reseller model; $\gamma_1^R(\sigma) \in (0,1)$ is the solution of $\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2} - \frac{3a^2}{(4-3\gamma)^2} + \frac{4(2-\gamma)\beta\sigma^2}{(4-3\gamma)^2} = 0$.
$\gamma_2^R(\sigma)$	The lowest γ that strategy SN is better than SS for the platform in the reseller model, $\gamma_2^R(\sigma) \in (0,1)$ is the solution of $\frac{3(a^2+2\beta\sigma^2)}{(4-3\gamma)^2} - \frac{(a^2+\beta\sigma^2)(7+6\gamma)}{(4-3\gamma^2)^2} + \frac{a^2+\beta\sigma^2}{4-3\gamma^2} = 0$.
$F_1^R(\gamma)$	The lowest F that strategy SN is better than NS for the platform in the reseller model; $F_1^R(\gamma) = \frac{(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2} - \frac{a^2}{(4-3\gamma)^2} + \frac{4(2-\gamma)\beta\sigma^2}{3(4-3\gamma)^2}$.
$F_2^R(\gamma)$	The lowest F that strategy SN is better than SS for the platform in the reseller model; $F_2^R(\gamma) = \frac{(a^2+\beta\sigma^2)\left(16-\gamma\left(8+\gamma(25-6\gamma-9\gamma^2)\right)\right)}{(4-3\gamma)^2(4-3\gamma^2)^2}$.
$\bar{F}^R(\gamma)$, $\bar{F}^M(\gamma)$, $\bar{F}^H(\gamma)$	The highest fulfillment cost in the reseller, marketplace and hybrid models under the wholesale contract, respectively; $\bar{F}^R(\gamma) = \frac{a^2}{(4-3\gamma)^2}$, $\bar{F}^M(\gamma) = \frac{a^2(2+\gamma^2)^2}{(8+\gamma^2)^2}$ and $\bar{F}^H(\gamma) = \frac{a^2(8-\gamma^2)^2}{16\left(8-\gamma(3+2\gamma)\right)^2}$
$\gamma_l^M(\sigma)$	The lowest γ that the manufacturer chooses the leaking equilibrium; $\gamma_l^M(\sigma) \in (0,1)$ is the solution of $a^2(2+\gamma^2)^2 - \gamma(2+\gamma)(8+\gamma^2)\beta\sigma^2 = 0$.

$\gamma_r^M(\sigma)$	The lowest γ that strategy SN is better than SS for the platform in the marketplace model; $\gamma_r^M(\sigma) \in (0,1)$ is the solution of $\frac{a^2(2+\gamma)(6-(1-\gamma)\gamma)}{4(1-\gamma)(8+\gamma^2)} - \frac{3(a^2+\beta\sigma^2)(4-\gamma^2)(2+\gamma^2)^2}{4(1-\gamma^2)(8+\gamma^2)^2} = 0$.
$F^M(\sigma,\gamma)$	The lowest F that strategy SN is better than SS for the platform in the marketplace model; $F^M(\sigma,\gamma) = \frac{3(a^2+\beta\sigma^2)(2-\gamma)(2+\gamma^2)^4}{(8+\gamma^2)^3(6+5\gamma+\gamma^3)}$.
$\hat{\gamma}^H$	The highest γ that strategy SS is better than SN for the platform in the hybrid model; $\hat{\gamma}^H \in (0,1)$ is the solution of $24576 - 6144\gamma - 30592\gamma^2 - 7168\gamma^3 + 8408\gamma^4 + 5064\gamma^5 + 1011\gamma^6 + 68\gamma^7 = 0$.
$\hat{\gamma}^O(\sigma)$	The highest γ that strategy NS is better than SS for the platform in the reseller model under competition outside of the platform; $\hat{\gamma}^O(\sigma)$ is the solution of $\frac{2(a^2+\beta\sigma^2)(20+9\gamma)}{\left(8-3\gamma(1+\gamma)\right)^2} - \frac{2(a^2+\beta\sigma^2)}{8-3\gamma(1+\gamma)} - \frac{8a^2}{(4-3\gamma)^2} - \frac{8\beta\sigma^2}{(4-\gamma)^2} = 0$.
$F^H(\gamma,\sigma)$	The highest F that strategy SS is better than SN for the platform in the hybrid model; $F^H(\gamma,\sigma) = \frac{(a^2+\beta\sigma^2)(8-\gamma^2)^3\left(24576+\gamma\left(-6144+\gamma\left(-30592+\gamma\left(-7168+\gamma\left(8408+\gamma(5064+\gamma(1011+68\gamma))\right)\right)\right)\right)\right)}{4(4+\gamma)\left(64-7\gamma^2(4+\gamma)\right)^2\left(8-\gamma(3+2\gamma)\right)^2\left(112+\gamma(52-\gamma(4+3\gamma))\right)}$.
$\gamma^{OR}(\sigma)$	The lowest γ that strategy SN is better than SS for the platform in the reseller model under competition outside of the platform; $\gamma^{OR}(\sigma) \in (0,1)$ is the solution of $\frac{(a^2+\beta\sigma^2)(2+\gamma)^2(64-\gamma(80+\gamma(25-30\gamma-9\gamma^2)))}{(8-3\gamma(1+\gamma))^2(8-\gamma(4+3\gamma))^2} - \frac{a^2}{(4-3\gamma)^2} = 0$.
γ_1^{OR}	The highest γ that strategy NS is better than the non-leaking equilibrium of SS for the platform in the reseller model under competition outside of the platform; $\gamma_1^{OR} = \frac{1}{3}(6-2\sqrt{3})$.
$\gamma_2^{OR}(\sigma)$	The indifferent point of γ that the platform chooses between strategy NS and the leaking equilibrium of SS under competition outside of the platform when $\phi^{SS*} = \phi_r^{OR}$ in the reseller model; $\gamma_2^{OR}(\sigma) \in (0,1)$ is $\frac{8a^2}{(4-3\gamma)^2} + \frac{8\beta\sigma^2}{(4-\gamma)^2} + \frac{2(a^2+\beta\sigma^2)}{8-3\gamma(1+\gamma)} - \frac{2(a^2+\beta\sigma^2)(20+9\gamma)}{\left(8-3\gamma(1+\gamma)\right)^2} = 0$
$\gamma_3^{OR}(\sigma,F)$	The indifferent point of γ that the platform chooses between strategy NS and the leaking equilibrium of SS under competition outside of the platform when $\phi^{SS*} = \phi_{l1}^{OR}$ in the reseller model; $\gamma_3^{OR}(\sigma,F) \in (0,1)$ is $\pi_o^{NS}(\phi_r^{OR}) = E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]$
$\gamma_1^{OM}(\sigma)$	The indifferent point of γ that the platform chooses between strategy SN and the leaking equilibrium of SS under competition outside of the platform when $\phi^{SS*} = \phi_{l1}^{OR}$ in the marketplace model; $\gamma_1^{OM}(\sigma) \in (0,1)$ is the solution of $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] - E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OM}\right)\right] = 0$.
$\gamma_2^{OM}(\sigma)$	The indifferent point of γ that the platform chooses between strategy SN and the leaking equilibrium of SS under competition outside of the platform when $\phi^{SS*} = \phi_{l1}^{OR}$ in the marketplace model; $\gamma_2^{OM}(\sigma)$ is the solution of $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] - E\left[\pi_{ol}^{SS}(\phi_r^{OM})\right] = 0$ when $F = \frac{a^2(4+\gamma)^2}{\left(16-3\gamma(2+\gamma)\right)^2}$.
$F^{OR}(\sigma,\gamma)$	The lowest F that strategy SN is better than SS for the platform under competition outside of the platform in the reseller model; $F^{OR}(\sigma,\gamma) = \frac{(a^2+\beta\sigma^2)(2+\gamma)^2\left(64-\gamma\left(80+\gamma(25-30\gamma-9\gamma^2)\right)\right)}{(8-3\gamma(1+\gamma))^2\left(8-\gamma(4+3\gamma)\right)^2}$.
$F^{OM}(\sigma,\gamma)$	The lowest F that strategy SN is better than SS for the platform under competition outside of the platform in the marketplace model; $F^{OM}(\sigma,\gamma)$ is the solution of $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] - E\left[\pi_{ol}^{SS}(\phi_r^{OM})\right] = 0$.

Appendix B: Technical Analysis and Results in the Wholesale Price Contract

We will consider the following four information sharing cases: case NN: not share information with any party; case NS: only share information with the thirty-party retailer of the platform (hereafter referred to retailer); case SN: only share information with the manufacturer; and case SS: share information with both the manufacturer and the retailer.

B1. Reseller Model

We use backward induction to solve the game for each of the four cases. Because the wholesale contract terms are *unobservable*, retailer i's price decision is independent of retailer j's wholesale price, where $i, j \in \{o, r\}$ and $i \neq j$. Then, retailer i will make price decision with a conjecture price of retailer j. Let $\tilde{p}_{ij}$ denote retailer j's belief of retailer i's price p_i. Following Li and Liu (2021), to achieve a Bayesian Nash equilibrium, the two retailers (the platform and retailer) will make their quantity decisions based on their conjectured/believed demands. If retailer i accepts the wholesale contract, he will choose price p_i and quantity Q_i to maximize his expected payoff.

Case SN: Only Share Information with the Manufacturer

In this case, the retailer is uninformed ($X_r = N$), but the manufacturer is informed ($X_m = S$). By observing the manufacturer's wholesale price w_r, the retailer may conjecture the demand signal Y from w_r. However, whether the retailer can infer the demand signal Y depends on the manufacturer. The manufacturer can control whether to disclose the demand signal to the retailer through the wholesale price w_r, that is, the manufacturer will disclose the demand signal to the retailer only if she can benefit from the disclosure. She will set the wholesale price w_r related to the demand signal Y. Then, the retailer can infer the demand signal by w_r. Otherwise, she has no incentive to leak the information to the retailer and set the wholesale price w_r independent of Y. Next, we analyze the two possible scenarios.

First consider the scenario in which the manufacturer discloses the demand signal to the retailer. Then, the retailer will conjecture the demand signal Y from w_r. Following Li and Zhang (2008), we assume that the wholesale pricing policy takes the form of $w_r = f\big(E(\theta|Y)\big)$, that is, $E(\theta|Y) = f^{-1}(w_r)$ for some strictly increasing and differentiable function $f(\cdot)$. The retailer's conjectured quantity and profit function are $Q_r = a + f^{-1}(w_r) - p_r + \gamma\tilde{p}_{or}$ and $\pi_r = (1-\phi)\left(p_r - \frac{w_r}{1-\phi}\right)Q_r - F$, respectively. From the first-order conditions (FOCs), the retailer's best response to w_r is given by $p_r = \frac{1}{2}\left(a + f^{-1}(w_r) + \gamma\tilde{p}_{or} + \frac{w_r}{1-\phi}\right)$, and the platform's best-response price is $p_o = \frac{1}{2}(a + E(\theta|Y) + \gamma\tilde{p}_{ro} + w_o)$.

At Time 1A, the expected profit for the manufacturer conditional on Y is

$$\pi_m = w_o Q_o + \frac{1}{2} w_r (a + f^{-1}(w_r) - p_r + \gamma\tilde{p}_{or}).$$

Let $\mathcal{F}(w_r) = a + f^{-1}(w_r) + \gamma\tilde{p}_{or}$. Because Q_o is independent of w_r, $\frac{\partial \pi_m}{\partial w_r} = \frac{1}{2}\left(\mathcal{F}(w_r) - \frac{2w_r}{1-\phi} + w_r\frac{d\mathcal{F}(w_r)}{dw_r}\right)$. To maximize π_m over w_r, we set the first-order derivative to zero, i.e.,

$$\frac{d\mathcal{F}(w_r)}{dw_r} + \frac{1}{w_r}\mathcal{F}(w_r) = \frac{2}{1-\phi}.$$

The general solution is given by

$$\mathcal{F}(w_r) = \frac{1}{1-\phi}\left(w_r + \frac{c}{w_r}\right). \tag{B1}$$

Because $f^{-1}(w_r)$ strictly increases with w_r, $\frac{df^{-1}(w_r)}{dw_r} = \frac{d\mathcal{F}(w_r)}{dw_r} = \frac{1}{1-\phi}\left(1 - \frac{c}{w_r^2}\right) > 0$ should be satisfied. Then, $c \leq 0$ must hold. From (B4), one can verify the equilibrium wholesale price

$$w_r^{SN} \geq (1-\phi)(a + f^{-1}(w_r) + \gamma\tilde{p}_{or}). \tag{B2}$$

The retailer's best-response quantity is $Q_r = \frac{1}{2}\left(a + f^{-1}(w_r) + \gamma\tilde{p}_{or} - \frac{w_r}{1-\phi}\right)$. To ensure a non-negative quantity of the retailer, the wholesale price should satisfy

$$w_r^{SN} \leq (1-\phi)(a + f^{-1}(w_r) + \gamma\tilde{p}_{or}). \tag{B3}$$

Combining (B2) with (B3), there exists a unique equilibrium wholesale price $w_r^{SN} = (1-\phi)(a + f^{-1}(w_r) + \gamma\tilde{p}_{or})$, which is equivalent to $c = 0$ of equation (B4). Replacing $f^{-1}(w_r)$ with $E(\theta|Y)$, the manufacturer will set the wholesale price $w_r^{SN} = (1-\phi)(a + E(\theta|Y) + \gamma\tilde{p}_{or})$ in equilibrium. This equilibrium can be perfectly conjectured by the retailer and the platform. From the first-order condition on w_o, we have $w_o^{SN} = \frac{1}{2}(a + E(\theta|Y) + \gamma\tilde{p}_{ro})$. Plugging w_o and w_r into the best response prices, a Bayesian Nash equilibrium is found by solving $p_o = \tilde{p}_{or}$ and $p_r = \tilde{p}_{ro}$, simultaneously. Then, the optimal wholesale prices are: $w_r^{SN} =$

$\frac{(4+3\gamma)\left(a+E(\theta|Y)\right)(1-\phi)}{4-3\gamma^2}$ and $w_o^{SN}=\frac{2(1+\gamma)\left(a+E(\theta|Y)\right)}{4-3\gamma^2}$, and the optimal retail prices are $p_r^{SN}=\tilde{p}_{ro}=\frac{(4+3\gamma)\left(a+E(\theta|Y)\right)}{4-3\gamma^2}$ and $p_o^{SN}=\tilde{p}_{or}=\frac{3(1+\gamma)\left(a+E(\theta|Y)\right)}{4-3\gamma^2}$. In equilibrium, the retailer's quantity is $Q_r^{SN}=0$. We define this equilibrium as the leaking equilibrium.

Before charging a side payment from the manufacturer, the ex-ante profits of the platform, manufacturer and retailer are: $E\left[\pi_{ol}^{SN}\right]=\frac{(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2}-F+I_m$, $E\left[\pi_{ml}^{SN}\right]=\frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2}-I_m$, $E\left[\pi_{rl}^{SN}\right]=0$ in the leaking equilibrium ,where the subscript "l" represents the leaking equilibrium.

However, the manufacturer, as a Stackelberg game leader in the price decision stage, may have no incentive to leak the information to the retailer. We next consider the scenario in which the manufacturer does not disclose the demand signal to the retailer. For example, the manufacturer' may set a wholesale price w_r identical to case NN, which is independent of the demand signal Y. Then, the retailer cannot conjecture any demand signal from the wholesale price w_r. Because the retailer cannot infer any demand signal from the wholesale price, his conjectured demand and profit function are $Q_r=a-p_r+\gamma\tilde{p}_{or}$ and $\pi_r=(1-\phi)\left(p_r-\frac{w_r}{1-\phi}\right)Q_r-F$, respectively. Then, the retailer's best response $p_r=\frac{1}{2}\left(a+\gamma\tilde{p}_{or}+\frac{w_r}{1-\phi}\right)$, and the platform's best-response $p_o=\frac{1}{2}(a+E(\theta|Y)+\gamma\tilde{p}_{ro}+w_o)$.

At Time 1A, the manufacturer's expected profit is $\pi_m=w_oQ_o+w_rQ_r$. From the first-order conditions and the anticipation of the platform's and retailer's best-response, the informed manufacturer will set wholesale prices $w_r=\frac{1}{2}(1-\phi)(a+\gamma\tilde{p}_{or})$ and $w_o=\frac{1}{2}(a+E(\theta|Y)+\gamma\tilde{p}_{ro})$. Using the same approach as the leaking equilibrium, we obtain the wholesale prices are: $w_r^{SN}=\frac{2a(1-\phi)}{4-3\gamma}$ and $w_o^{SN}=\frac{2a}{4-3\gamma}+\frac{E(\theta|Y)}{2}$, and the optimal retail prices are $p_r^{SN}=\tilde{p}_{ro}=\tilde{p}_{or}=\frac{3a}{4-3\gamma}$ and $p_o^{SN}=\frac{3a}{4-3\gamma}++\frac{3E(\theta|Y)}{4}$ in equilibrium. One may find that the manufacturer's wholesale price w_r^{SN*} and the retailer's price p_r^{SN} are independent of the demand signal Y. We define this equilibrium as the non-leaking equilibrium.

Before charging a side payment from the manufacturer, the ex-ante profits of the platform, manufacturer and retailer are: $E[\pi_{on}^{SN}]=a^2K_o^R+\frac{\beta\sigma^2}{16}-F+I_m$, $E[\pi_{mn}^{SN}]=a^2K_m^R+\frac{\beta\sigma^2}{8}-I_m$, $E[\pi_{rn}^{SN}]=a^2K_r^R-F$ in the non-leaking equilibrium ,where the subscript "n" represents the non-leaking equilibrium.

For a given commission fee rate ϕ and side payment I_m, the manufacturer can choose to leak the information or not by choosing her wholesale prices. It depends on which equilibrium brings a higher profit for the manufacturer. If and only if $\gamma\le\gamma_l(\phi)$, $E\left[\pi_{ml}^{SN}\right]-E[\pi_{mn}^{SN}]\le 0$, and the manufacturer will choose the non-leaking equilibrium, where $\gamma_l(\phi)\in(0,1)$ is the solution of $\frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2}-\frac{2a^2(2-\phi)}{(4-3\gamma)^2}-\frac{\beta\sigma^2}{8}=0$. Otherwise, $E\left[\pi_{ml}^{SN}\right]-E[\pi_{mn}^{SN}]\ge 0$, and the manufacturer will choose the leaking equilibrium.

Given the commission fee rate, the platform will charge a maximum side payment to ensure that the manufacturer agrees to accept the platform's information sharing contract, i.e. $I_{ml}^{SN}=\frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2}-a^2K_m^{WR}$ in the leaking equilibrium and $I_{mn}^{SN}=\frac{\beta\sigma^2}{8}$ in the non-leaking equilibrium. Then, the ex-ante profits of the platform, manufacturer and retailer are: $E\left[\pi_{ol}^{SN}\right]=\frac{3(1+\gamma)^2(a^2+B)}{(4-3\gamma^2)^2}-a^2K_m^{WR}-F$, $E\left[\pi_{ml}^{SN}\right]=a^2K_m^R$, $E\left[\pi_{rl}^{SN}\right]=0$ in the leaking equilibrium and $E[\pi_{on}^{SN}]=a^2K_o^R+\frac{3\beta\sigma^2}{16}-F$, $E[\pi_{mn}^{SN}]=a^2K_m^R$, $E[\pi_{rn}^{SN}]=a^2K_r^R-F$ in the non-leaking equilibrium.

Backward to Time 0A, the platform's problem is to maximize its profit by choosing the commission fee rate ϕ. Because K_m^R strictly decreases with ϕ and K_o^R strictly increases with ϕ, we have $E[\pi_o^{SN}]$ strictly increases with ϕ in both the leaking and non-leaking equilibrium. Then, the platform will charge the commission fee rate $\phi^{SN}=1$ in the leaking equilibrium and $\phi^{SN}=\phi_r^R$ in the non-leaking equilibrium, where $\phi_r^R=1-\frac{(4-3\gamma)^2F}{a^2}$ is the solution of $a^2K_r^R-F=0$.[1]

The solutions of cases NN, NS and SS are similar to the non-leaking equilibrium of case SN, and we omit it

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[1] To ensure ϕ_r^R is non-negative, we assume that the fulfillment cost is not sufficiently large in the reseller model, i.e. $F<\frac{a^2}{(4-3\gamma)^2}$. For any $F\in\left[0,\frac{a^2}{(4-3\gamma)^2}\right)$, we have $\phi_r^R\in(0,1]$.

here. After charging side payments, the ex-ante profits of the platform, manufacturer and retailer in the reseller model with the wholesale contract are list in Table B1:

Table B1. Ex-ante profits of involved parties in the reseller model under the wholesale contract

	Case NN	**Case SN**		**Case NS**	**Case SS**
		Leaking	**Non-leaking**		
ϕ^*	ϕ_r^R	1	ϕ_r^R	ϕ_r^R	ϕ_r^R
$E[\pi_m]$	$a^2K_m^R$	$a^2K_m^R$	$a^2K_m^R$	$a^2K_m^R$	$a^2K_m^R$
$E[\pi_r]$	$a^2K_r^R - F$	0	$a^2K_r^R - F$	$a^2K_r^R - F$	$a^2K_r^R - F$
$E[\pi_o]$	$a^2K_o^R + \frac{\beta\sigma^2}{4} - F$	$\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2} - a^2K_m^R - F$	$a^2K_o^R + \frac{3\beta\sigma^2}{16} - F$	$a^2K_o^R + \frac{4(2-\gamma)\beta\sigma^2}{(4-3\gamma)^2} - F$	$a^2K_o^R + \frac{6\beta\sigma^2}{(4-3\gamma)^2} - F$

Note: $K_o^R = \frac{1+3\phi}{(4-3\gamma)^2}$, $K_m^R = \frac{2(2-\phi)}{(4-3\gamma)^2}$, and $K_r^R = \frac{(1-\phi)}{(4-3\gamma)^2}$.

B2. Marketplace model

In the marketplace model, the wholesale price w_r is observable for both the manufacturer and the retailer, and there is a game of perfect information in terms of the wholesale price contract.

Case SN

For informed manufacturer and uninformed retailer, only the manufacturer can observe the demand signal Y before determining her prices. The same as the reseller model, there are two possible equilibria in case SN: the leaking equilibrium and the non-leaking equilibrium.

In the leaking equilibrium, similar to the reseller model, we assume that $E(\theta|Y)$ in the form of $w_r = g\big(E(\theta|Y)\big)$, that is, $E(\theta|Y) = g^{-1}(w_r)$ for some strictly increasing and differentiable function $g(\cdot)$. From the FOC of the retailer's problem, the best response price is given by $p_r = \frac{a+g^{-1}(w_r)}{2-\gamma} + \frac{(2+\gamma^2)w_r}{(4-\gamma^2)(1-\phi)}$. Then, the manufacturer's best-response is $p_o = \frac{a+g^{-1}(w_r)}{2-\gamma} + \frac{3\gamma w_r}{(4-\gamma^2)(1-\phi)} + \frac{E(\theta|Y)-g^{-1}(w_r)}{2}$. Backward to Time 1A, the expected profit for the manufacturer conditional on Y is $(1-\phi)p_o\ Q_o + w_rQ_r - F$. To maximize it over w, we set the first-order derivative to zero, i.e.,

$$\frac{dG(w_r)}{dw_r} = \frac{\alpha w_r}{G(w_r)} - \beta, \tag{B4}$$

where $G(w_r) = \gamma(2+\gamma)^2(-1+\phi)^2\big(a+g^{-1}(w_r)\big) + (8-4\gamma+4\gamma^3+\gamma^4)(1-\phi)w_r$, $\alpha = (2-\gamma)^2(1+\gamma)(2+\gamma)^3(2+\gamma^2)(1-\phi)^2$, and $\beta = 3\gamma(4-\gamma^2)(1-\phi)$. To solve the general solutions of (B4), we have the following two equilibrium wholesale prices: $w_{r1} = -\frac{\gamma(2+\gamma)(1-\phi)}{8+\gamma^2}\big(a+g^{-1}(w_r)\big)$ and $w_{r2} = \frac{(2+\gamma))(1-\phi)}{2(1-\gamma^2)}\big(a+g^{-1}(w_r)\big)$. Because $w_{r1} < 0$, the manufacturer will set the wholesale price $w_r^{SN} = w_{r2} = \frac{(2+\gamma)(1-\phi)}{2(1-\gamma^2)}\big(a+E(\theta|Y)\big)$ in equilibrium. In equilibrium, the retailer's belief/conjecture $E(\theta|Y) = g^{-1}(w_r^{SN})$ is fulfilled and thus the manufacturer's and retailer's pricing decisions are $p_o^{SN} = \frac{(1+2\gamma)\left(a+E(\theta|Y)\right)}{2(1-\gamma^2)}$ and $p_r^{SN} = \frac{(2+\gamma)\left(a+E(\theta|Y)\right)}{2(1-\gamma^2)}$, respectively.

Because the remaining of the solution is similar to case SN under the reseller model, we omit it here.

After charging side payments, the ex-ante profits of the platform, manufacturer and retailer in the marketplace model with the wholesale price contract are list in Table B2:

Table B2. Ex-ante profits of involved parties in the marketplace model under the wholesale price contract

	Case NN	**Case SN**		**Case NS**	**Case SS**
		Leaking	**Non-leaking**		
ϕ^*	ϕ_r^M	ϕ_m^M	ϕ_r^M	ϕ_r^M	ϕ_r^M
$E[\pi_m]$	$a^2K_m^M - F$	$a^2K_m^M - F$	$a^2K_m^M - F$	$a^2K_m^M - F$	$a^2K_m^M - F$
$E[\pi_r]$	$a^2K_r^M - F$	0	$a^2K_r^M - F$	$a^2K_r^M - F$	$a^2K_r^M - F$
$E[\pi_o]$	$a^2K_o^M$	$\frac{(1+2\gamma)(a^2+\beta\sigma^2)}{4(1-\gamma^2)} - a^2K_m^M$	$a^2K_o^M + \frac{\beta\sigma^2}{4}$	$a^2K_o^M + \frac{\beta\sigma^2}{4}$	$a^2K_o^M + \left(\frac{3}{4} + \frac{1}{2-2\gamma} + \frac{36}{(8+\gamma^2)^2} - \frac{11}{8+\gamma^2}\right)\beta\sigma^2$

Note: $K_o^M = \frac{(3\gamma^5-5\gamma^4+4\gamma^3-36\gamma^2-16\gamma-112)\phi}{4(1-\gamma)(8+\gamma^2)^2}$, $K_m^M = \frac{\left(12+\gamma(4+\gamma+\gamma^2)\right)(1-\phi)}{4(1-\gamma)(8+\gamma^2)}$, $K_r^M = \frac{(2+\gamma^2)^2(1-\phi)}{(8+\gamma^2)^2}$, and $\phi_r^M = 1 - \frac{(8+\gamma^2)^2F}{a^2(2+\gamma^2)^2}$.

Appendix C: Technical Analysis and Results in the Two-part Tariff Contract

C1. Reseller Model

Case SN

In this case, the retailer is uninformed ($X_r = N$), but the manufacturer is informed ($X_m = S$). For informed manufacturer and uninformed retailer, only the manufacturer can observe the demand signal Y. At Time 1B, if the manufacturer leaks the information with the two-part tariff contract terms (w_r, f_r), the retailer will conjecture/infer the demand signal Y from both the wholesale price w_r and the fixed fee f_r. We assume that the expected demand signal Y takes the form of $E(\theta|Y) = g(w_r, f_r)$, where the function $g(\cdot)$ strictly increases with w_r and f_r. The retailer's quantity and profit function are $Q_r = a + g(w_r, f_r) - p_r + \gamma\tilde{p}_{or}$ and $\pi_r = (1-\phi)\left(p_r - \frac{w_r}{1-\phi}\right)Q_r - f_r - F$, respectively. Then, the retailer's best response to w_r is given by $p_r = \frac{1}{2}\left(a + g(w_r, f_r) + \gamma\tilde{p}_{or} + \frac{w_r}{1-\phi}\right)$, and the platform's best-response price is $p_o = \frac{1}{2}(a + E(\theta|Y) + \gamma\tilde{p}_{ro} + w_o)$.

Backward to Time 1A, the manufacturer will maximize her profit by charging the largest fixed fee, which subjects to the retailers' participation constraint $\pi_r \geq 0$. To avoid trivial case, we assume that the retailer's profit strictly decreases with f_r. Then, in the retailer's perspective, the manufacturer will charge a fixed fee satisfying the following equation: $\pi_r = 0$ in equilibrium, which can be rewritten as:

$$f_r = \frac{\left((1-\phi)(a+g(w_r,f_r)+\gamma\tilde{p}_{or})+w_r\right)^2}{4(1-\phi)} - F. \quad \text{(C1)}$$

Given the manufacturer's two-part tariff contract terms (w_r, f_r), the retailer can derive a unique $g(w_r, f_r)$ from equation (C1). Comparing the optimal fixed fee with case SS, (C1) indicates that the value of $E(\theta|Y)$ can be perfectly conjectured/inferred by the retailer from the manufacturer's two-part tariff contract terms (w_r, f_r). Anticipating the retailer's response, the manufacturer is willing to leak the demand signal to the retailer by charging a fixed fee in form of $f_r = \frac{\left((1-\phi)(a+E(\theta|Y)+\gamma\tilde{p}_{or})+w_r\right)^2}{4(1-\phi)} - F$ in equilibrium.

Because the remaining of the solution is similar to case SN under the reseller model, we omit it here.

One can find that the leaking equilibrium of strategy SN is the same as strategy SS, representing a full information sharing case. Since the retailer channel is coordinated in the two-part tariff, the non-leaking equilibrium is not beneficial to the manufacturer. Therefore, the manufacture will always choose to leak the information to the retailer, and we omit the derivation process of non-leaking equilibrium here.

Table C1. Ex-ante profits of involved parties in the reseller model under the TPT contract

	Case NN	Case SN	Case NS	Case SS
ϕ^*	ϕ_l^{TR}	ϕ_h^{TR}	ϕ_l^{TR}	ϕ_h^{TR}
$E[\pi_m]$	$a^2K_m^{TR} - 2F$	$a^2K_m^{TR} - 2F$	$a^2K_m^{TR} - 2F$	$a^2K_m^{TR} - 2F$
$E[\pi_r]$	0	0	0	0
$E[\pi_o]$	$a^2K_o^{TR} + \frac{\beta\sigma^2}{4}$	$a^2K_o^{TR} + \frac{2\beta\sigma^2}{(2-\gamma)^2}$	$a^2K_o^{TR} + \frac{2(1-\gamma)\beta\sigma^2}{(2-\gamma)^2}$	$a^2K_o^{TR} + \frac{2\beta\sigma^2}{(2-\gamma)^2}$

Note: $K_o^{TR} = \frac{\phi}{(2-\gamma)^2}$, $K_o^{TR} = \frac{(2-\phi)}{(2-\gamma)^2}$, $\phi_l^{TR} = 1 - \frac{(2-\gamma)^2 F}{a^2}$ and $\phi_h^{TR} = 1 - \frac{(2-\gamma)^2 F}{a^2+\beta\sigma^2}$.

C2. Marketplace Model

Table C2. Ex-ante profit of involved parties in the marketplace model under the TPT contract

	Case NN	Case SN	Case NS	Case SS
ϕ^*	ϕ_l^{TM}	ϕ_h^{TM}	ϕ_l^{TM}	ϕ_h^{TM}
$E[\pi_m]$	$a^2K_m^{TM} - 2F$	$a^2K_m^{TM} - 2F$	$a^2K_m^{TM} - 2F$	$a^2K_m^{TM} - 2F$
$E[\pi_r]$	0	0	0	0
$E[\pi_o]$	$a^2K_o^{TM}$	$a^2K_o^{TM} + \frac{\left(8+\gamma^2(9+\gamma)\right)\beta\sigma^2}{4(1-\gamma)(4+5\gamma^2)}$	$a^2K_o^{TM} + \frac{\beta\sigma^2}{4}$	$a^2K_o^{TM} + \frac{\left(8+\gamma^2(9+\gamma)\right)\beta\sigma^2}{4(1-\gamma)(4+5\gamma^2)}$

Note: $K_o^{TM} = \frac{\left(8+\gamma^2(9+\gamma)\right)\phi}{4(1-\gamma)(4+5\gamma^2)}$, $K_m^{TM} = \frac{\left(8+\gamma^2(9+\gamma)\right)(1-\phi)}{4(1-\gamma)(4+5\gamma^2)}$, $\phi_h^{TM} = 1 - \frac{(4+5\gamma^2)^2 F}{(a^2+\beta\sigma^2)(2+\gamma^2)^2}$, and $\phi_l^{TM} = 1 - \frac{(4+5\gamma^2)^2 F}{a^2(2+\gamma^2)^2}$.

Appendix D: Analysis for Hybrid Model and Competition Outside the Platform

D1. Hybrid Model

Table D1. Ex-ante profits of involved parties in the hybrid model

	Case NN	Case SN		Case NS	Case SS
		Leaking	Non-leaking		
ϕ^*	ϕ_r^H	1	ϕ_r^H	ϕ_r^H	ϕ_r^H
$E[\pi_m]$	$a^2K_m^H - F$	$a^2K_m^H - F$	$a^2K_m^H - F$	$a^2K_m^H - F$	$a^2K_m^H - F$
$E[\pi_r]$	$a^2K_r^H - F$		$a^2K_r^H - F$	$a^2K_r^H - F$	$a^2K_r^H - F$
$E[\pi_o]$	$a^2K_o^H + \frac{\beta\sigma^2}{4} - F$	$(a^2 + \beta\sigma^2)(K_{ol}^H + K_{ml}^H) - a^2K_m^H - F$	$a^2K_o^H + (K_{on}^H + K_{mn}^H)\beta\sigma^2 - F$	$a^2K_o^H + \frac{8\beta\sigma^2}{(4-\gamma)^2} - F$	$a^2K_o^H + (K_o^H + K_m^H + K_r^H)\beta\sigma^2$

Note: $K_o^H = \frac{\left((8-\gamma^2)^2+(4+\gamma)\left(112+\gamma(52-\gamma(4+3\gamma))\right)\phi\right)}{16\left(8-\gamma(3+2\gamma)\right)^2}$, $K_m^H = \frac{\left(64(4-3\phi)+\gamma\left(160(1-\phi)+\gamma(10-\gamma(8+\gamma)-26\phi+2\gamma(4+\gamma)\phi)\right)\right)}{8\left(8-\gamma(3+2\gamma)\right)^2}$, $K_r^H = \frac{(8-\gamma^2)^2(1-\phi)}{16\left(8-\gamma(3+2\gamma)\right)^2}$, $K_{on}^H = \frac{256+\gamma\left(128(-1+\phi)-\gamma\left(48+\gamma^2(4-\phi)(1-\phi)^2+16(7-\phi)\phi-8\gamma(1-\phi)(2-5\phi)\right)\right)}{4\left(32+\gamma^2(-1+\phi)\right)^2}$, $K_{ol}^H = \frac{(2+\gamma)^2\left((8-\gamma^2)^2+(2+\gamma)(8+3\gamma)(16+(2-\gamma)\gamma)\phi\right)}{\left(64-7\gamma^2(4+\gamma)\right)^2}$, $K_{mn}^H = \frac{512-\gamma^2\left(208+\gamma\left(48+\gamma(5-\phi)\right)(1-\phi)-32\phi\right)(1-\phi)}{4\left(32+\gamma^2(-1+\phi)\right)^2}$, $K_{ml}^H = \frac{(2+\gamma)^2\left(384+256\gamma+28\gamma^2-8\gamma^3-\gamma^4-(2+\gamma)(8+3\gamma)(16+(2-\gamma)\gamma)\phi\right)}{\left(64-7\gamma^2(4+\gamma)\right)^2}$. ϕ_r^H is the solution of $a^2K_r^H - F = 0$.[2]

D2. Competition outside the platform

When considering the competition outside the platform, the outsider retailer will conjecture the demand signal from the manufacturer's wholesale price in the leaking equilibrium of case SS. The proof step is similar to the case SN of the reseller model in Appendix B. However, both the platform retailer and the outsider retailer will conjecture the demand signal in the leaking equilibrium of case SN. To achieve the leaking equilibrium, we assume the wholesale price policy takes the form of $w_r = f\left(E(\theta|Y)\right)$ and $w_s = g\left(E(\theta|Y)\right)$, that is, $E(\theta|Y) = f^{-1}(w_r)$ and $E(\theta|Y) = g^{-1}(w_s)$ for some strictly increasing and differentiable functions $f(\cdot)$ and $g(\cdot)$. In equilibrium, $E(\theta|Y) = f^{-1}(w_r) = g^{-1}(w_s)$ can be perfectly conjectured by the two retailers. Similar proof is omitted.

D2.1. Reseller model

Table D2. Ex-ante profits of involved parties under competition outside of the platform

	Case NN	Case SN		Case NS	Case SS	
		Leaking	Non-leaking		Leaking	Non-leaking
ϕ^*	ϕ_r^{OR}	1	ϕ_r^{OR}	ϕ_r^{OR}	$\min\{\phi_r^{OR}, \phi_{l1}^{OR}\}$	ϕ_r^{OR}
$E[\pi_m]$	$a^2L_m^R$	$a^2L_m^R$	$a^2L_m^R$	$a^2L_m^R$	$a^2L_m^R$	$a^2L_m^R$
$E[\pi_r]$	$a^2L_r^R - F$	0	$a^2L_r^R - F$	$a^2L_r^R - F$	$a^2L_r^R - F$	$a^2L_r^R - F$
$E[\pi_s]$	$a^2L_s^R - F$	0	$a^2L_s^R - F$	$a^2L_s^R - F$	0	$a^2L_s^R - F$
$E[\pi_o]$	$a^2L_o^R + \frac{\beta\sigma^2}{4} - F$	$3(a^2 + \beta\sigma^2)L^{R\prime} - a^2L_m^R - F$	$a^2L_o^R + \frac{3\beta\sigma^2}{16} - F$	$a^2L_o^R + \frac{8\beta\sigma^2}{(4-\gamma)^2} - F$	$6(a^2 + \beta\sigma^2)L^R - a^2(L_m^R + L_r^R) - F$	$a^2L_o^R + \frac{24\beta\sigma^2}{(8-3\gamma)^2} - F$

Note: $L_o^R = \frac{(1+3\phi)}{(4-3\gamma)^2}$, $L_r^R = \frac{1-\phi}{(4-3\gamma)^2}$, $L_m^R = \frac{2(3-\phi)}{(4-3\gamma)^2}$, $L_s^R = \frac{1}{(4-3\gamma)^2}$, $L^R = \frac{(2+\gamma)^2}{\left(8-3\gamma(1+\gamma)\right)^2}$. ϕ_{l1}^{OR} is the solution of $(a^2 + \beta\sigma^2)(4-2\phi)L^R - a^2L_m^R - \frac{8(2-\phi)}{(8-3\gamma)^2}\beta\sigma^2 = 0$. $\phi_r^{OR} = 1 - \frac{F(4-3\gamma)^2}{a^2}$ is the solution of $a^2L_r^R - F = 0$.[3]

D2.2. Marketplace Model

Table D3. Ex-ante profits of involved parties with competition outside of the platform

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[2] To ensure ϕ_r^H is non-negative, we assume the fulfillment cost is not sufficiently large, i.e. $F < \frac{a^2(8-\gamma^2)^2}{16\left(8-\gamma(3+2\gamma)\right)^2}$. For any $F \in \left[0, \frac{a^2(8-\gamma^2)^2}{16\left(8-\gamma(3+2\gamma)\right)^2}\right)$, we have $\phi_r^H \in (0,1]$.

[3] To ensure ϕ_r^{OR} is non-negative, we assume the fulfillment cost is not sufficiently large, i.e. $F < \frac{a^2(1-\phi)}{(4-3\gamma)^2}$. For any $F \in \left[0, \frac{a^2(1-\phi)}{(4-3\gamma)^2}\right)$, we have $\phi_r^{OR} \in (0,1]$.

	Case NN	Case SN		Case NS	Case SS	
		Leaking	Non-leaking		Leaking	Non-leaking
ϕ^*	ϕ_r^{OM}	ϕ_{l2}^{OM}	ϕ_r^{OM}	ϕ_r^{OM}	$\min\{\phi_r^{OM}, \phi_{l1}^{OM}\}$	ϕ_r^{OM}
$E[\pi_m]$	$a^2L_m^M - F$	$a^2L_m^M - F$	$a^2L_m^M - F$	$a^2L_m^M - F$	$a^2L_m^R - F$	$a^2L_m^M - F$
$E[\pi_r]$	$a^2L_r^M - F$	0	$a^2L_r^M - F$	$a^2L_r^M - F$	$a^2L_r^M - F$	$a^2L_r^M - F$
$E[\pi_s]$	$a^2L_s^M - F$	0	$a^2L_s^M - F$	$a^2L_s^M - F$	0	$a^2L_s^M - F$
$E[\pi_o]$	$a^2L_o^M$	$\frac{(2+\gamma)^2(a^2+\beta\sigma^2)}{(4-\gamma(2+\gamma))^2} - a^2L_m^M$	$a^2L_o^M + \frac{\beta\sigma^2}{4}$	$a^2L_o^M + \frac{\beta\sigma^2}{4}$	$(a^2+\beta\sigma^2)(L_{ol}^M + L_{ml}^M + L_{rl}^M) - a^2(L_m^R + L_r^R) - F$	$a^2L_o^M + \frac{448+48\gamma(6+\gamma)\beta\sigma^2}{(32-3\gamma^2)^2}$

Note: $L_o^M = \frac{4(28+3\gamma(6+\gamma))\phi}{(16-3\gamma(2+\gamma))^2}$, $L_r^M = \frac{(4+\gamma)^2(1-\phi)}{(16-3\gamma(2+\gamma))^2}$, $L_m^M = \frac{(128+\gamma(80+\gamma(13-11\phi)-64\phi)-96\phi)}{(16-3\gamma(2+\gamma))^2}$, $L_s^M = \frac{(4+\gamma)^2}{(16-3\gamma(2+\gamma))^2}$, $L_{ol}^M = \frac{4(2+\gamma)^2(28+3\gamma(6+\gamma))\phi}{(32-\gamma^2(13+3\gamma))^2}$, $L_{ml}^M = \frac{(2+\gamma)^2(96+\gamma(64+11\gamma))(1-\phi)}{(32-\gamma^2(13+3\gamma))^2}$ and $L_{rl}^M = \frac{(2+\gamma)^2(4+\gamma)^2(1-\phi)}{(32-\gamma^2(13+3\gamma))^2}$. $\phi_r^{OM} = 1 - \frac{F(16-3\gamma(2+\gamma))^2}{a^2(4+\gamma)^2}$ is the solution of $a^2L_r^M - F = 0$ and ϕ_{l1}^{OM} is the solution of $(a^2+\beta\sigma^2)L_{ml}^M - a^2L_m^M - \frac{4(96+\gamma(64+11\gamma))(1-\phi)\beta\sigma^2}{(32-3\gamma^2)^2} = 0$.

Appendix F. Robustness Checks of Our Model

F1. The Positive Order Quantity Constraints of the Retailer

F1.1. Reseller Model

In practice, if the manufacturer sets a sufficiently high wholesale price, retailers may have other supplier option to ensure their order quantities to be strictly positive. In order to make the model more realistic, we extend to consider the scenario where the retailer can order a strictly positive quantity in the leaking equilibrium and examine the robustness of our model.

In strategy SN under the leaking equilibrium, we consider that the manufacturer has an upper-bound wholesale price to ensure the retailer's quantity not lower than a strictly positive threshold (i.e., $Q_r \geq \lambda$). Otherwise, the retailer will choose other suppliers. We assume that λ is not so large (i.e., $0 < \lambda \leq \frac{a}{4-3\gamma}$) such that the case of no information sharing will trigger this wholesale price constraint. In the retailer's perspective, to ensure his quantity $Q_r = \frac{1}{2}\left(a + f^{-1}(w_r) + \gamma\tilde{p}_{or} - \frac{w_r}{1-\phi}\right) \geq \lambda$, the manufacturer will lower her wholesale price, that is, $w_r \leq (1-\phi)(a + f^{-1}(w_r) + \gamma\tilde{p}_{or} - 2\lambda)$. Replacing $f^{-1}(w_r)$ with $E(\theta|Y)$, the manufacturer will set a highest wholesale price $w_r = (1-\phi)(a + E(\theta|Y) + \gamma\tilde{p}_{or} - 2\lambda)$ in equilibrium. From the first-order condition on w_o, we have $w_o^{SN} = \frac{1}{2}(a + E(\theta|Y) + \gamma\tilde{p}_{ro})$. Using the same approach as case SN in Appendix B1, the ex-ante profits of the platform, manufacturer and retailer are: $E[\pi_{ol}^{SN}] = a^2K^R + \frac{3(1+\gamma)^2\beta\sigma^2}{(4-3\gamma^2)^2} + \lambda^2\phi - a^2K_m^R - F$, $E[\pi_{ml}^{SN}] = a^2K_m^R$, and $E[\pi_{rl}^{SN}] = (1-\phi)\lambda^2 - F$ in the leaking equilibrium and $E[\pi_{on}^{SN}] = a^2K_o^R + \frac{3\beta\sigma^2}{16} - F$, $E[\pi_{mn}^{SN}] = a^2K_m^R$, $E[\pi_{rn}^{SN}] = a^2K_r^R - F$ in the non-leaking equilibrium, where $K^R = \frac{3a^2(1+\gamma)^2 + a(16+6\gamma-9\gamma^2(2+\gamma))\lambda - (32-39\gamma^2+9\gamma^4)\lambda^2}{a^2(4-3\gamma^2)^2}$. Backward to Time 0A, the platform will charge the commission fee rate $\phi^{SN} = 1 - \frac{F}{\lambda^2}$ in the leaking equilibrium and $\phi^{SN} = \phi_r^R$ in the non-leaking equilibrium.

Let $\hat{\gamma}^R$ denote the solution of $48a + 27a\gamma^4 - \gamma^2(75a - 60\lambda) - \gamma(24a - 48\lambda) - 64\lambda + 9\gamma^3(2a - 5\lambda) = 0$, $\tilde{F}^R = \lambda^2$, and $\hat{F}^R(\sigma,\gamma)$ denote the solution of $E[\pi_{ol}^{SN}(\phi^{SN*})] - E[\pi_o^{SS}(\phi_r^R)] = 0$. We have the following proposition.

Proposition F1. (Optimal Information Sharing Strategy in the Reseller Model under Wholesale Contract) *Given the retailer's order quantity constraint:* $Q_r \geq \lambda$,

(i) *the platform will share information with the manufacturer only if* $\gamma > \hat{\gamma}^R$ *and* $F < \min\{\hat{F}^R(\sigma,\gamma), \tilde{F}^R\}$;

(ii) *Otherwise, (a) if* $\gamma > \frac{1}{2}$, *the platform will share information with both parties; (b) if* $\gamma < \frac{1}{2}$, *the platform will share information with the retailer only.*

F1.2. Marketplace Model

Using the same approach as case SN in Appendix B1, the ex-ante profits of the platform, manufacturer and retailer are: $E[\pi_{ol}^{SN}] = a^2K^M + \lambda^2\phi + \frac{(1+2\gamma)\beta\sigma^2}{4(1-\gamma^2)} - a^2K_m^M$, $E[\pi_{ml}^{SN}] = a^2K_m^M - F$, $E[\pi_{rl}^{SN}] = (1-\phi)\lambda^2 - F$ in the leaking equilibrium and $E[\pi_{on}^{SN}] = a^2K_o^M + \frac{\beta\sigma^2}{4}$, $E[\pi_{mn}^{SN}] = a^2K_m^M - F$, $E[\pi_{rn}^{SN}] = a^2K_r^M - F$ in the non-leaking equilibrium, where $K^M = \frac{a^2(1+2\gamma)+2a(2+\gamma^2)\lambda-(8+\gamma^2)\lambda^2}{4a^2(1-\gamma^2)}$. Backward to Time 0A, the platform will charge the commission fee rate $\phi^{SN} = 1 - \frac{F}{\lambda^2}$ in the leaking equilibrium and $\phi^{SN} = \phi_r^M$ in the non-leaking equilibrium.

Proposition F2. (Optimal Information Sharing Strategy in the Marketplace Model under Wholesale Contract)
Given the retailer's order quantity constraint: $Q_r \geq \lambda$, the platform will always share information with both the manufacturer and retailer.

F2. Heterogeneous Fulfillment Costs
F2.1. Reseller Model

Although the fulfillment costs of the platform channel and the retailer channel are different (i.e., $F_o \neq F_r$), the equilibriums remain unchanged because the fulfillment cost is a fixed fee. However, the differentiated fulfillment costs may have impact on the optimal commission fee rate.

Backward to Time 0A, the platform's optimal commission fee rates in caseS NN, NS and SS are:$\phi^{NN} = \phi^{NS} = \phi^{SS} = \phi_r^R(F_r)$, where $\phi_r^R(F_r) = 1 - \frac{(4-3\gamma)^2 F_r}{a^2}$ is the solution of $a^2 K_r^R - F_r = 0$. In case SN, the platform will charge the commission fee rate $\phi^{SN} = 1$ in the leaking equilibrium and $\phi^{SN} = \phi_r^R(F_r)$ in the non-leaking equilibrium.

To summarize, the optimal commission fee rate is independent of F_o and the platform's optimal information sharing strategy remains unchanged in the reseller model with wholesale contract.

F2.2. Marketplace Model

Backward to Time 0A, the platform will charge the highest commission fee rate $\phi^{NN} = \phi^{NS} = \phi^{SS} = \min\{\phi_r^M(F_r), \phi_o^M(F_o)\}$, where $\phi_r^M(F_r) = 1 - \frac{(8+\gamma^2)^2 F_r}{a^2(2+\gamma^2)^2}$ and $\phi_o^M(F_o) = 1 - \frac{4(1-\gamma)(8+\gamma^2)^2 F_o}{a^2(4-\gamma)(2+\gamma)^2(4-(1-\gamma)\gamma)}$. Using the same method, the platform's optimal commission fee rates in case NS and NN are: $\phi^{NN*} = \phi^{NS*} = \phi^{SS*} = \min\{\phi_r^M(F_r), \phi_o^M(F_o)\}$. In case SN, the platform will charge the commission fee rate $\phi^{SN*} = \phi_m^M(F_o)$ in the leaking equilibrium and $\phi^{SN*} = \min\{\phi_r^M(F_r), \phi_o^M(F_o)\}$ in the non-leaking equilibrium, where where $\phi_m^M(F_o) = 1 - \frac{4(1-\gamma)(8+\gamma^2)F_o}{a^2(12+\gamma(4+\gamma+\gamma^2))}$.

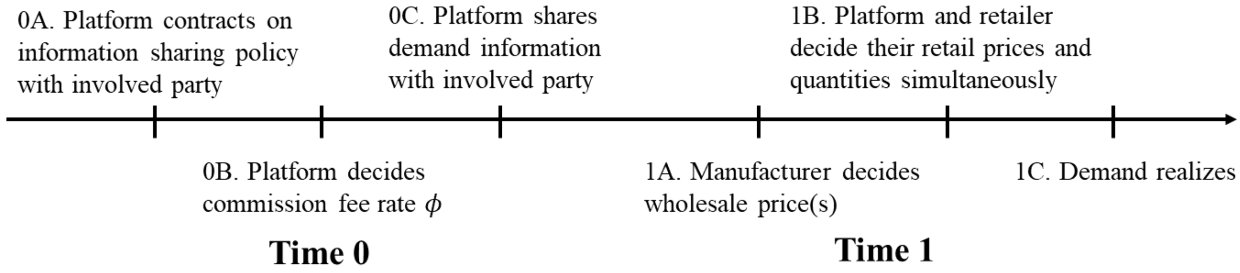
Let $\gamma_d^M(\sigma) = \max\{\gamma_l^M(\sigma), \gamma_o^M(\sigma)\}$, where $\gamma_o^M(\sigma)$ is the solution of $a^2(1+2\gamma)(8+\gamma^2)^2 - \beta\sigma^2(48 + 36\gamma^2 - 3\gamma^6) = 0$, $F_o^M(\gamma,\sigma) = \frac{3(a^2+\beta\sigma^2)(4-\gamma)(2-\gamma)(2+\gamma)^3(4-(1-\gamma)\gamma)(2+\gamma^2)}{8(1-\gamma)(1+\gamma)(8+\gamma^2)^2(12-\gamma(4-(2-\gamma)\gamma))}$, $\mu(\gamma,\sigma) = \frac{3(a^2+\beta\sigma^2)(4-\gamma^2)(2+\gamma^2)^4}{(1+\gamma)(8+\gamma^2)^2\left(112+\gamma\left(16+\gamma\left(36-\gamma(4-\gamma(5-3\gamma))\right)\right)\right)}$ and $\kappa(\gamma) = \frac{4(1-\gamma)(2+\gamma^2)^2}{112+\gamma\left(16+\gamma\left(36-\gamma(4-\gamma(5-3\gamma))\right)\right)}$. We have the following proposition.

Proposition F3. (Optimal Information Sharing Strategy in the Marketplace Model)
(i) The platform will always share information with the manufacturer;
(ii) (a) Suppose $F_o \leq (1+\delta^M(\gamma))F_r$, if and only if $a^2/3 < \beta\sigma^2 < 3a^2$, $\gamma > \gamma_d^M(\sigma)$ and $F_r > \mu(\gamma,\sigma) + \kappa(\gamma)F_o$, the platform will share information with the manufacturer only; (b) Suppose $F_o > (1+\delta^M(\gamma))F_r$, if and only if $\beta\sigma^2 > a^2/3$, $\gamma > \gamma_l^M(\sigma)$ and $F_o < F_o^M(\gamma,\sigma)$, the platform will share information with the manufacturer only.
(iii) Otherwise, the platform will share information with both parties.

Appendix G. Alterative Timeline

Some industrial practice provides evidence that changing the commission rate may be easier than information sharing in some cases, which is opposite to the basic model assuming that the platform decides on the commission fee rate before its contract on information sharing. In this section, we consider the alternative timeline in which the platform determines the commission fee rate *after* contracting on the information sharing. The sequence of events is illustrated in Figure G1 as follows. Specifically, the platform contracts on information sharing policies and side payments $\{I_m, I_r\}$ as well with involved parties at Time 0A, and determines the commission fee rate ϕ at Time 0B.

Figure G1. Sequence of Events under the Wholesale/Reseller Model



With backward induction, the optimal wholesale price and retail price response function at Time 1 remain unchanged, and we only need to discuss the change of optimal decisions at Time 0A and Time 0B. For analytical convenience, we consider the following two scenarios to characterize the sequence of commission fee rate decision:

Scenario 1 (S1): The commission fee rate is decided **before** the contract on information sharing. Denote the optimal profits of the platform, supplier and retailer as $\pi_{o1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right)$, $\pi_{m1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right)$ and $\pi_{r1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right)$, where $\left(I_{m1}^{i*}, I_{r1}^{i*}; \phi_1^{i*}\right)$ are the optimal solutions in this scenario and $i = \{NN, NS, SN, SS\}$ is the platform's information sharing strategy.

Scenario 2 (S2): The commission fee rate is decided **after** the contract on information sharing. Denote the optimal profits of the platform, supplier and retailer as $\pi_{o2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$, $\pi_{m2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$ and $\pi_{r2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$, where $\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$ are the optimal solutions in this scenario.

Note that, S1 refers to our basic model. Comparing S1 and S2, we derive the following proposition.

Proposition G1. *Changing the game sequence of the commission fee rate and information sharing contract will not affect the platform's optimal decisions in different channel structures.*

Appendix J. Proofs

For brevity, we use profit(s) to represent ex-ante profit(s).

Proof of Lemma 1.

From Appendix B, in the reseller model, sharing information with the manufacturer only will induce the leaking and non-leaking equilibrium. For given commission fee rate ϕ and side payment I_m, the manufacturer can choose to leak the information or not by choosing her wholesale prices. It depends on the two equilibriums which gives a higher profit for the manufacturer. By comparing the manufacturer's profits under the two equilibria, we have $E\left[\pi_{ml}^{SN}\right] - E\left[\pi_{mn}^{SN}\right] = \frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2} - \frac{2a^2(2-\phi)}{(4-3\gamma)^2} - \frac{\beta\sigma^2}{8}$, which increases with ϕ. If and only if $\gamma \le \gamma_l(\phi)$, $E\left[\pi_{ml}^{SN}\right] - E\left[\pi_{mn}^{SN}\right] \le 0$ and the manufacturer will choose the non-leaking equilibrium, where $\gamma_l(\phi) \in (0,1)$ is the solution of $\frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2} - \frac{2a^2(2-\phi)}{(4-3\gamma)^2} - \frac{\beta\sigma^2}{8} = 0$. Otherwise, $E\left[\pi_{ml}^{SN}\right] - E\left[\pi_{mn}^{SN}\right] \ge 0$ and the manufacturer will choose the leaking equilibrium.

From the equation $\frac{2(1+\gamma)^2(a^2+\beta\sigma^2)}{(4-3\gamma^2)^2} - \frac{2a^2(2-\phi)}{(4-3\gamma)^2} - \frac{\beta\sigma^2}{8} = 0$, we have $\frac{\partial\phi}{\partial\gamma} = -\frac{1}{8(4-3\gamma^2)^3}(4-3\gamma)\left(16(1+\gamma)(4+3\gamma^2) + B\left(256 + \gamma\left(64 - 3\gamma\left(128 - \gamma\left(16 + 27\gamma(4-\gamma^2)\right)\right)\right)\right)\right) < 0$. Then, $\frac{\partial\gamma_l(\phi)}{\partial\phi} < 0$. □

Proof of Lemma 2.

(i) From case SN of Appendix B, in the non-leaking equilibrium, the platform's profit is $E[\pi_{on}^{SN}] = a^2K_o^R + \frac{3\beta\sigma^2}{16} - F$. Because the total distribution channel profit difference between cases SN and NN $E[\pi_{on}^{SN}] - E[\pi_o^{NN}] = -\frac{\beta\sigma^2}{16} < 0$, the non-leaking equilibrium will hurt the platform's profit and total distribution channel profit.

(ii) In the leaking equilibrium, the retailer's profit is zero. The total distribution channel profit difference between case SN and NN is $\Delta_t^{SN} = \frac{(a^2+\beta\sigma^2)(7+6\gamma)}{(4-3\gamma^2)^2} - \frac{a^2+\beta\sigma^2}{4-3\gamma^2} - \frac{\beta\sigma^2}{4} - \frac{6a^2}{(4-3\gamma)^2}$. There exist a threshold $\gamma_t(\sigma) \in (0,1)$ such that $\Delta_t^{SN} > 0$ if $\gamma > \gamma_t(\sigma)$ and $\Delta_t^{SN} \le 0$ if $\gamma \le \gamma_t(\sigma)$, where $\gamma_t(\sigma)$ is the solution of $\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2} - \frac{\beta\sigma^2}{4} - \frac{6a^2}{(4-3\gamma)^2} = 0$. Then, if the competition intensity γ is large than $\gamma_t(\sigma)$, total distribution channel profit increases.

(iii) From the equation $\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2}-\frac{\beta\sigma^2}{4}-\frac{6a^2}{(4-3\gamma)^2}=0$, we have $\frac{\partial\beta\sigma^2}{\partial\gamma}=-\frac{24a^2(4-3\gamma^2)\left(224+\gamma\left(32-3\gamma\left(120-\gamma\left(68+9\gamma(14-3\gamma(1+\gamma))\right)\right)\right)\right)}{(4-3\gamma)^3\left(4+3\gamma(-8-12\gamma+3\gamma^3)\right)^2}<0$ always holds. Then, $\frac{\partial\gamma_t(\sigma)}{\partial\sigma}=\frac{\frac{\partial\beta\sigma^2}{\partial\sigma}}{\frac{\partial\beta\sigma^2}{\partial\gamma_t(\sigma)}}<0$. □

Proof of Lemma 3.

From Appendix B, for a given commission fee rate, the platform's profit difference between cases NS and NN is $\frac{(16+(8-9\gamma)\gamma)\beta\sigma^2}{4(4-3\gamma)^2}>0$ always holds. Then, strategy NN is not the optimal strategy and the platform will always share its information.

From Lemmas 1 and 2, the non-leaking equilibrium will hurt the platform's profit. Then, if and only if $\gamma>\gamma_l(\phi)$, the platform has the incentive to share information with the manufacturer only. For a given commission fee rate, the platform's profit difference between cases SS and NS is: $\frac{2(2\gamma-1)\beta\sigma^2}{(4-3\gamma)^2}$. Then, strategy NS is better than SS if $\gamma<\frac{1}{2}$ and an opposite outcomes occurs if $\gamma>\frac{1}{2}$.

If $\gamma<\frac{1}{2}$, strategy NS is better than SS, and we only need to compare the case NS and SN. The platform's profit difference between cases SN and NS is: $\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2}-\frac{2(2-\phi)}{(4-3\gamma)^2}<0$ always holds for any $\gamma\in\left(0,\frac{1}{2}\right)$ and $\phi\in(0,1)$. Then, strategy NS is the optimal strategy when $\gamma<\frac{1}{2}$.

If $\gamma>\frac{1}{2}$, strategy SS is better than NS, and we only need to compare cases SS and SN. The platform's profit difference between cases SN and SS is: $V_o^R=-\frac{3\beta\sigma^2\left(16-\gamma\left(8+\gamma(25-6\gamma-9\gamma^2)\right)\right)+16a^2(2+\phi)-3a^2\gamma\left(8+\gamma\left(17+8\phi-3\gamma(2+\gamma(2+\phi))\right)\right)}{(4-3\gamma)^2(4-3\gamma^2)^2}$. If and only $\gamma>\gamma_r(\phi)$, $V_o^R>0$, where $\gamma_r(\phi)\in(0,1)$ is the solution of $3\beta\sigma^2\left(16-\gamma\left(8+\gamma(25-6\gamma-9\gamma^2)\right)\right)+16a^2(2+\phi)-3a^2\gamma\left(8+\gamma\left(17+8\phi-3\gamma\left(2+\gamma(2+\phi)\right)\right)\right)=0$.

Then, we can conclude that: (i) if and only if $\gamma>\max\{\gamma_l(\phi),\gamma_r(\phi)\}$, strategy SN is the optimal strategy. (ii) Otherwise, strategy SS is the optimal strategy if $\gamma>\frac{1}{2}$ and strategy NS is the optimal strategy if $\gamma<\frac{1}{2}$. □

Proof of Lemma 4.

See the solutions in the reseller model of Appendix B. □

Proof of Proposition 1.

From Lemma 2, the non-leaking equilibrium will hurt the platform's profit. We will only consider the leaking equilibrium in case SN when comparing the platform's information strategies. Because the optimal commission fee rate in case SN is $\phi^{SN*}=1$, the manufacturer's profit difference between cases SN and NN is $E[\pi_{ml}^{SN}]-E[\pi_m^{NN}]=\frac{\gamma\left(16(8+\gamma-6\gamma^2)+\beta\sigma^2(32+40\gamma-9\gamma^3)\right)}{8(4-3\gamma)^2(4-3\gamma^2)^2}>0$ always holds ($\gamma_l(1)=0$). It indicates that the manufacturer will always choose the leaking equilibrium if the platform chooses strategy SN. Then, we only need to consider the leaking equilibrium in case SN.

Next compare cases SN with the leaking equilibrium, NS and SS. (1) From the results of Table B1 in Appendix B, in the reseller model with the leaking equilibrium, the platform's profit difference between cases SN and NS is: $E[\pi_{ol}^{SN}]-E[\pi_o^{NS}]=\Pi_1^R(F)=3F-\left(\frac{2(9a^2+4\beta\sigma^2)}{3(4-3\gamma)^2}+\frac{4\beta\sigma^2}{12-9\gamma}-\frac{(a^2+\beta\sigma^2)(7+6\gamma)}{(4-3\gamma^2)^2}+\frac{a^2+\beta\sigma^2}{4-3\gamma^2}\right)$, which increases with the fulfillment cost F. Because $F\le\frac{a^2}{(4-3\gamma)^2}$ in the reseller model, if and only $\Pi_1^R\left(F=\frac{a^2}{(4-3\gamma)^2}\right)=\frac{3a^2}{(4-3\gamma)^2}-\left(\frac{2(9a^2+4\beta\sigma^2)}{3(4-3\gamma)^2}+\frac{4\beta\sigma^2}{12-9\gamma}-\frac{(a^2+\beta\sigma^2)(7+6\gamma)}{(4-3\gamma^2)^2}+\frac{a^2+\beta\sigma^2}{4-3\gamma^2}\right)>0$, which is equivalent to $\gamma>\gamma_1^R(\sigma)$, there exists a threshold $F_1^R(\sigma,\gamma)$ such that $\Pi_1^R(F)>0$ if $F>F_1^R(\sigma,\gamma)$, where $\gamma_1^R(\sigma)$ is the solution of $\frac{3(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2}-\frac{3a^2}{(4-3\gamma)^2}+\frac{4(2-\gamma)\beta\sigma^2}{(4-3\gamma)^2}=0$ and $F_1^R(\sigma,\gamma)=\frac{(a^2+\beta\sigma^2)(1+\gamma)^2}{(4-3\gamma^2)^2}-\frac{a^2}{(4-3\gamma)^2}+\frac{4(2-\gamma)\beta\sigma^2}{3(4-3\gamma)^2}$. Then, the leaking equilibrium of strategy SN is better than NS if $\gamma>\gamma_1^R(\sigma)$ and $F>F_1^R(\sigma,\gamma)$. (2) The platform's profit difference between cases SN and SS is: $E\left[\pi_{ol}^{SN}\right]-E[\pi_o^{SS}]=\Pi_2^R(F)=3F-\frac{3(a^2+\beta\sigma^2)\left(16-\gamma\left(8+\gamma(25-6\gamma-9\gamma^2)\right)\right)}{(4-3\gamma)^2(4-3\gamma^2)^2}$, and increases with F. If and only if $\gamma>\gamma_2^R(\sigma)$, there exists a threshold $F_2^R(\sigma,\gamma)$ such that $\Pi_2^R(F)>0$ if $F>F_2^R(\sigma,\gamma)$, where $\gamma_2^R(\sigma)$ is the solution of $\frac{3(a^2+2\beta\sigma^2)}{(4-3\gamma)^2}-\frac{(a^2+\beta\sigma^2)(7+6\gamma)}{(4-3\gamma^2)^2}+\frac{a^2+\beta\sigma^2}{4-3\gamma^2}=0$ and $F_2^R(\sigma,\gamma)=\frac{(a^2+\beta\sigma^2)\left(16-\gamma\left(8+\gamma(25-6\gamma-9\gamma^2)\right)\right)}{(4-3\gamma)^2(4-3\gamma^2)^2}$. Then, strategy SN is better than SS if $\gamma>\gamma_2^R(\sigma)$ and $F>F_2^R(\sigma,\gamma)$.

Incorporating the constraints of (1) and (2), if and only if $\gamma>\max\{\gamma_1^R(\sigma),\gamma_2^R(\sigma)\}$ and $F>\max\{F_1^R(\sigma,\gamma),F_2^R(\sigma,\gamma)\}$, SN is the optimal strategy. Otherwise, the same as Lemma 3, strategy SS is the optimal strategy if $\gamma>\frac{1}{2}$ and NS is the optimal strategy if $\gamma<\frac{1}{2}$. □

Proof of Lemma 5.

(i) From Appendix B, in the marketplace model, the manufacturer can choose the leaking and non-leaking equilibrium through her wholesale prices. By comparing the manufacturer's profits under the two equilibria, we have $E\left[\pi_{ml}^{SN}\right]-E[\pi_{mn}^{SN}]=\frac{(\gamma(2+\gamma)(8+\gamma^2)\beta\sigma^2-a^2(2+\gamma^2)^2)(1-\phi)}{4(8-7\gamma^2-\gamma^4)}$. If and only if $\beta\sigma^2>\frac{a^2}{3}$, there exists a threshold $\gamma_l^M(\sigma)\in(0,1)$ such that $E\left[\pi_{ml}^{SN}\right]-E[\pi_{mn}^{SN}]>0$ if $\gamma>\gamma_l^M(\sigma)$, where $\gamma_l^M(\sigma)\in(0,1)$ is the solution of $\gamma(2+\gamma)(8+\gamma^2)\beta\sigma^2-(2+\gamma^2)^2=0$. Then, if and only if $\beta\sigma^2>\frac{a^2}{3}$ and $\gamma>\gamma_l^M(\sigma)$, the manufacturer will choose the leaking equilibrium. Otherwise, $E\left[\pi_{ml}^{SN}\right]-E[\pi_{mn}^{SN}]\le 0$ and the manufacturer will choose the non-leaking equilibrium.

(ii) From the equation $\gamma(2+\gamma)(8+\gamma^2)\beta\sigma^2-a^2(2+\gamma^2)^2=0$, we have $\gamma_l^M(\sigma)$ is independent of ϕ. Because $\frac{\partial\beta\sigma^2}{\partial\gamma}=-\frac{2(2+\gamma^2)\left(16+\gamma\left(16-\gamma(18+\gamma(4+\gamma))\right)\right)}{\gamma^2(2+\gamma)^2(8+\gamma^2)^2}<0$ always holds, $\frac{\partial\gamma_l^M(\sigma)}{\partial\sigma}=\frac{\frac{\partial\beta\sigma^2}{\partial\sigma}}{\frac{\partial\beta\sigma^2}{\partial\gamma_l^M(\sigma)}}<0$. □

Proof of Proposition 2.

From the results of Table B2 in Appendix B, in the marketplace model, the platform's profit difference between cases SS and NS is: $E[\pi_o^{SS}]-E[\pi_o^{NS}]=\frac{\beta\sigma^2(2+\gamma)\left(12+\gamma\left(14-\gamma(2-(4-\gamma)\gamma)\right)\right)}{2(1-\gamma)(8+\gamma^2)^2}>0$ and the platform's profit difference between cases SS and NN is: $E[\pi_o^{SS}]-E[\pi_o^{NN}]=\frac{\beta\sigma^2(112+16\gamma+36\gamma^2-4\gamma^3+5\gamma^4-3\gamma^5)}{4a^2(1-\gamma)(2+\gamma^2)^2}>0$. Then, strategy SS is better than NN and NS. This indicates that the platform will always share information with the manufacturer. Thus, we only need to compare cases SS and SN.

Because $E[\pi_{on}^{SN}]-E[\pi_o^{NS}]=0$ always holds in the non-leaking equilibrium, case SN with non-leaking equilibrium will not be an optimal choice for the platform. Incorporating Lemma 5, only when $\beta\sigma^2>\frac{a^2}{3}$ and $\gamma>\gamma_l^M(\sigma)$, the platform has the incentive to share information with the manufacturer only. If $\beta\sigma^2>\frac{a^2}{3}$ and $\gamma>\gamma_l^M(\sigma)$, the platform's profit difference between cases SN and SS is: $E\left[\pi_{ol}^{SN}\right]-E[\pi_o^{SS}]=\Pi^M(F)=\frac{(2+\gamma)(6-(1-\gamma)\gamma)(8+\gamma^2)F}{4(1-\gamma)(2+\gamma^2)^2}-\frac{3(a^2+\beta\sigma^2)(4-\gamma^2)(2+\gamma^2)^2}{4(1-\gamma^2)(8+\gamma^2)^2}$, which increases with F. Because $F\le\frac{a^2(2+\gamma^2)^2}{(8+\gamma^2)^2}$ in the marketplace model, $\Pi^M\left(F=\frac{a^2(2+\gamma^2)^2}{(8+\gamma^2)^2}\right)=\frac{a^2(2+\gamma)(6-(1-\gamma)\gamma)}{4(1-\gamma)(8+\gamma^2)}-\frac{3(a^2+\beta\sigma^2)(4-\gamma^2)(2+\gamma^2)^2}{4(1-\gamma^2)(8+\gamma^2)^2}$. If and only if $\beta\sigma^2<3a^2$, there exists a threshold $\gamma_r^M(\sigma)$ such that $\Pi^M\left(F=\frac{a^2(2+\gamma^2)^2}{(8+\gamma^2)^2}\right)>0$ if $\gamma>\gamma_r^M(\sigma)$, where $\gamma_r^M(\sigma)$ is the solution of $\frac{a^2(2+\gamma)(6-(1-\gamma)\gamma)}{4(1-\gamma)(8+\gamma^2)}-\frac{3(a^2+\beta\sigma^2)(4-\gamma^2)(2+\gamma^2)^2}{4(1-\gamma^2)(8+\gamma^2)^2}=0$. Then, if and only if $\frac{a^2}{3}<\beta\sigma^2<3a^2$ and $\gamma>\gamma_r^M(\sigma)$, there exists a threshold $F^M(\sigma,\gamma)$ such that $\Pi^M(F)>0$ if $F>F^M(\sigma,\gamma)$, where $F^M(\sigma,\gamma)=\frac{3(a^2+\beta\sigma^2)(2-\gamma)(2+\gamma^2)^4}{(8+\gamma^2)^3(6+5\gamma+\gamma^3)}$.

Then, we can conclude that if and only if $\frac{a^2}{3}<\beta\sigma^2<3a^2$, $\gamma>\max\{\gamma_l^M(\sigma),\gamma_r^M(\sigma)\}$ and $F>F^M(\sigma,\gamma)$, the platform will share information with the manufacturer only. Otherwise, the platform will also share information with the retailer. □

Proof of Proposition 3.

From the results of Tables C1 and C2 in Appendix C, in the reseller and marketplace models with TPT contract, the platform's profit in case SS is identical with case SN, representing that strategy SS is equivalent to SN in TPT contract. (1) In the reseller model, the platform's profit difference between cases SS and NN is: $E[\pi_o^{SS}]-$

$E[\pi_o^{NN}] = a^2\left(K_o^{TR}(\phi_h^{TR}) - K_o^{TR}(\phi_l^{TR})\right) + \frac{(4+4\gamma-\gamma^2)\beta\sigma^2}{4(2-\gamma)^2}$ and the platform's profit difference between cases SS and NS is: $E[\pi_o^{SS}] - E[\pi_o^{NS}] = a^2\left(K_o^{TR}(\phi_h^{TR}) - K_o^{TR}(\phi_{sl}^{TR})\right) + \frac{2\gamma\beta\sigma^2}{(2-\gamma)^2}$. Because K_o^{TR} increases with ϕ and $\phi_h^{TR} > \phi_l^{TR}$, we have $K_o^{TR}(\phi_h^{TR}) - K_o^{TR}(\phi_l^{TR}) > 0$. Then, $E[\pi_o^{SS}] - E[\pi_o^{NN}] > 0$ and $E[\pi_o^{SS}] - E[\pi_o^{NS}] > 0$. Then, both SS and SN are optimal strategies in the reseller model. (2) In the marketplace model, the platform's profit difference between cases SS and NN is: $E[\pi_o^{SS}] - E[\pi_o^{NN}] = a^2(K_o^{TM}(\phi_h^{TM}) - K_o^{TM}(\phi_l^{TM})) + \frac{\left(8+\gamma^2(9+\gamma)\right)\beta\sigma^2}{4(1-\gamma)(4+5\gamma^2)}$ and the platform's profit difference between cases SS and NS is: $E[\pi_o^{SS}] - E[\pi_o^{NS}] = a^2(K_o^{TM}(\phi_h^{TM}) - K_o^{TM}(\phi_l^{TM})) + \frac{(2+2\gamma+2\gamma^2+3\gamma^3)\beta\sigma^2}{2(1-\gamma)(4+5\gamma^2)}$. Because K_o^{TM} increases with ϕ and $\phi_h^{TM} > \phi_l^{TM}$, we have $K_o^{TM}(\phi_h^{TM}) - K_o^{TM}(\phi_l^{TM}) > 0$. Then, $E[\pi_o^{SS}] - E[\pi_o^{NN}] > 0$ and $E[\pi_o^{SS}] - E[\pi_o^{NS}] > 0$. Thus, both SS and SN are optimal strategies in the marketplace model.

Since the retailer channel is coordinated in the two-part tariff, the manufacturer can capture the information value from the fixed fee f_r. Therefore, the manufacture will always choose to leak the information to the retailer.

From the results in case SS of Appendix C, the optimal side payment the platform charges the retailer $I_r^{SS} = 0$. This indicate that the platform will share information with the retailer for free in strategy SS. □

Proof of Proposition 4.

From the results of Table D1 in Appendix D, in case SN with hybrid model: $E[\pi_{on}^{SN}] < E[\pi_o^{NN}]$ always holds in the non-leaking equilibrium. Then, the non-leaking equilibrium is not beneficial for the platform. In the leaking equilibrium, the platform will choose the optimal commission fee rate $\phi^{SN*} = 1$. Given this commission fee rate, we have $E\left[\pi_{ml}^{SN}\right] - E[\pi_{mn}^{SN}] = \frac{2(a^2+B)(2+\gamma)^2(8-\gamma^2)^2}{\left(64-7\gamma^2(4+\gamma)\right)^2} - \frac{a^2(8-\gamma^2)^2}{8\left(8-\gamma(3+2\gamma)\right)^2} - \frac{\beta\sigma^2}{16} > 0$ always holds. Thus, if the platform chooses to share information with the manufacturer only, the manufacturer will always leak the information to the retailer. We only need to consider the leaking equilibrium of case SN when comparing the strategies.

The platform's profit difference between cases SS and NN is: $E[\pi_o^{SS}] - E[\pi_o^{NN}] = \frac{(1+\gamma)(3+\gamma)(8-\gamma^2)\beta\sigma^2}{\left(8-\gamma(3+2\gamma)\right)^2} > 0$ and the platform's profit difference between cases SS and NS is: $E[\pi_o^{SS}] - E[\pi_o^{NS}] = \frac{(512+1536\gamma+208\gamma^2-344\gamma^3-99\gamma^4-4\gamma^5)\beta\sigma^2}{4(4-\gamma)^2\left(8-\gamma(3+2\gamma)\right)^2} > 0$. Then, strategy SS is better than NN and NS. This indicates that the platform will always share information with the manufacturer. Thus, the optimal information sharing strategy is between strategies SS and SN.

The platform's profit difference between cases SS and SN is: $E[\pi_o^{SS}] - E\left[\pi_{ol}^{SN}\right] = \Pi^H(F) = \frac{(a^2+\beta\sigma^2)(8-\gamma^2)G^H(\gamma)}{4(64-7\gamma^2(4+\gamma))^2\left(8-\gamma(3+2\gamma)\right)^2} - \frac{F(4+\gamma)\left(112+\gamma\left(52-\gamma(4+3\gamma)\right)\right)}{(8-\gamma^2)^2}$, where $G^H(\gamma) = 24576 - 6144\gamma - 30592\gamma^2 - 7168\gamma^3 + 8408\gamma^4 + 5064\gamma^5 + 1011\gamma^6 + 68\gamma^7$ and decreases with γ. If and only if $G^H(\gamma) > 0$, which is equivalent to $\gamma < \hat{\gamma}^H$, there exists a positive threshold $F^H(\gamma,\sigma)$ such that $\Pi^H(F) > 0$ if $F < F^H(\gamma,\sigma)$, where $\hat{\gamma}^H \in (0,1)$ is the solution of $G^{WH}(\gamma) = 0$ and $F^H(\gamma,\sigma)$ is the solution of $\Pi^H(F) = 0$. Incorporating the constraint $F < \bar{F}^H(\gamma) = \frac{a^2(8-\gamma^2)^2}{16\left(8-\gamma(3+2\gamma)\right)^2}$ in the hybrid model, we can conclude that if and only if $< \hat{\gamma}^H$ and $F < \min\{F^H(\gamma,\sigma), \bar{F}^H(\gamma)\}$, SS is the optimal strategy; otherwise, SN is the optimal strategy. □

Proof of Proposition 5.

From the results of Table D2 in Appendix D, in cases SS and SN, there exists two equilibria: the leaking and non-leaking equilibrium. Because $E[\pi_{on}^{SN}] - E[\pi_o^{NS}] = \left(\frac{8}{(4-\gamma)^2} - \frac{3}{16}\right)\beta\sigma^2 < 0$ always holds, the non-leaking equilibrium of strategy SN cannot be an optimal equilibrium for the platform. In the leaking equilibrium of strategy SN, the optimal commission fee rate is $\phi^{SN*} = 1$. If and only if $E\left[\pi_{ml}^{SN}\right] - E[\pi_{mn}^{SN}] = \frac{2(a^2+\beta\sigma^2)(2+\gamma)^2}{\left(8-\gamma(4+3\gamma)\right)^2} - \frac{\beta\sigma^2}{8} - \frac{4a^2}{(4-3\gamma)^2} > 0$, which is equivalent to $\gamma > \gamma_{l2}^{OR}(\sigma)$, the platform has the incentive to share information with the manufacturer only and the platform's optimal profit in strategy SN is $E\left[\pi_{ol}^{SN}(\phi = 1)\right]$. The optimal commission fee rate in strategy SS is $\phi^{SS*} = \min\{\phi_r^{OR}, \phi_{l1}^{OR}\}$ in the leaking equilibrium and $\phi^{SS*} = \phi_r^{OR}$ in the non-leaking equilibrium. Because both $E[\pi_{ol}^{SS}]$ and $E[\pi_{on}^{SS}]$ strictly increases with ϕ, the platform's optimal profit in strategy SS is $\max\{E[\pi_{on}^{SS}(\phi_r^{OR})], \min\{E\left[\pi_{ol}^{SS}(\phi_r^{OR})\right], E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]\}\}$. The platform's optimal profit in strategy NS is $E[\pi_o^{NS}(\phi_r^{OR})]$.

The platform's profit difference between cases NS and NN is: $E[\pi_o^{NS}] - E[\pi_o^{NN}] = \frac{(16+8\gamma-\gamma^2)\beta\sigma^2}{4(4-\gamma)^2} > 0$ always holds, then the platform will always share information with at least one party.

Given $\beta\sigma^2 \geq a^2/3$, if and only if $\gamma > \gamma_{l2}^{OR}(\sigma)$, $E\left[\pi_{ol}^{SN}(1)\right] > \max\left\{E[\pi_{on}^{SS}(\phi_r^{OR})], \min\left\{E\left[\pi_{ol}^{SS}(\phi_r^{OR})\right], E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]\right\}\right\}$ and $E\left[\pi_{ol}^{SN}(1)\right] > E[\pi_o^{NS}(\phi_r^{OR})]$, which is equivalent to $\gamma > \gamma^{OR}(\sigma)$ and $F > \max\{0, F^{OR}(\sigma,\gamma)\}$, the platform's optimal strategy is SN, where $\gamma^{OR}(\sigma)$ is the solution of $F^{OR}(\sigma,\gamma) = \bar{F}^{OR}(\gamma) = \frac{a^2}{(4-3\gamma)^2}$ and $F^{OR}(\sigma,\gamma)$ is the solution of $E\left[\pi_{ol}^{SN}(1)\right] = E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]$. Otherwise, the platform's optimal strategy is NS or SS. If and only if $E[\pi_o^{NS}(\phi_r^{OR})] > \max\left\{E[\pi_{on}^{SS}(\phi_r^{OR})], \min\left\{E\left[\pi_{ol}^{SS}(\phi_r^{OR})\right], E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]\right\}\right\}$, which is equivalent to $\gamma < \hat{\gamma}^O(\sigma,F) = \min\{\gamma_1^{OR}, \max\{\gamma_2^{OR}(\sigma), \gamma_3^{OR}(\sigma,F)\}\}$, the platform's optimal strategy is NS, where $\gamma_1^{OR} = \frac{1}{3}(6-2\sqrt{3})$ is the solution of $E[\pi_o^{NS}(\phi_r^{OR})] = E[\pi_{on}^{SS}(\phi_r^{OR})]$, $\gamma_2^{OR}(\sigma)$ is the solution of $E[\pi_o^{NS}(\phi_r^{OR})] = E\left[\pi_{ol}^{SS}(\phi_r^{OR})\right]$ and $\gamma_3^{OR}(\sigma,F)$ is the solution of $E[\pi_o^{NS}(\phi_r^{OR})] = E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]$. If $\gamma > \hat{\gamma}^O(\sigma,F)$, the platform's optimal strategy is SS.

When $\beta\sigma^2 \leq a^2/9$, if $\gamma < \gamma_{l2}^{OR}(\sigma)$, strategy SN is not optimal for the platform, we only need to compare cases SS and NS. Because $\max\left\{E[\pi_{on}^{SS}(\phi_r^{OR})], \min\left\{E\left[\pi_{ol}^{SS}(\phi_r^{OR})\right], E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]\right\}\right\} < E[\pi_o^{NS}(\phi_r^{OR})]$ always holds for any $\gamma < \gamma_{l2}^{OR}(\sigma)$, strategy NS is better than strategy SS, and the platform will not choose strategy SS when $\gamma < \gamma_{l2}^{OR}(\sigma)$. If $\gamma > \gamma_{l2}^{OR}(\sigma)$, the platform has the incentive to share information with the manufacturer only. Because $\max\left\{E[\pi_{on}^{SS}(\phi_r^{OR})], \min\left\{E\left[\pi_{ol}^{SS}(\phi_r^{OR})\right], E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OR}\right)\right]\right\}\right\} < E\left[\pi_{ol}^{SN}(\phi = 1)\right]$ always holds for any $\gamma > \gamma_{l2}^{OR}(\sigma)$, strategy SN is better than strategy SS, and the platform will not choose strategy SS when $\gamma > \gamma_{l2}^{OR}(\sigma)$. Therefore, the platform will not share information with both parties when $\beta\sigma^2 \leq a^2/9$. □

Proof of Proposition 6.

From the results of Table D3 in Appendix D, we have $E[\pi_o^{NS}] = E[\pi_{on}^{SN}] = a^2 L_o^M + \frac{\beta\sigma^2}{4}$. The platform's profit difference between cases NS and NN $E[\pi_o^{NS}] - E[\pi_o^{NN}] = \frac{\beta\sigma^2}{4} > 0$ always holds. Then strategy NN is not an optimal strategy.

We next prove that strategy NS and the non-leaking equilibrium in strategy SN is also not an optimal strategy. Given the commission fee rate, if and only if $E\left[\pi_{ml}^{SN}\right] > E[\pi_{on}^{SN}]$, which is equivalent to $\gamma > \gamma_{l2}^{OM}$ and $\phi < \phi_{l2}^{OM}$, the manufacturer will leak the information in strategy SN and otherwise will not leak. If and only if $E\left[\pi_{ml}^{SS}\right] > E[\pi_{on}^{SS}]$, which is equivalent to $\gamma > \gamma_{l1}^{OM}$ and $\phi < \phi_{l1}^{OM}$, the manufacturer will leak the information in strategy SS and otherwise will not leak, where γ_{l1}^{OM} is the solution of $E\left[\pi_{ml}^{SS}\right] = E[\pi_{on}^{SS}]$ when $\phi = 0$, ϕ_{l1}^{OM} is the solution of $E\left[\pi_{ml}^{SS}\right] = E[\pi_{on}^{SS}]$, γ_{l2}^{OM} is the solution of $1024a^2 + \gamma(-8+\gamma^2)\left(16-3\gamma(2+\gamma)\right)^2\beta\sigma^2 + 16a^2\gamma(4+\gamma)\left(-20+\gamma\left(-3+\gamma(7+\gamma)\right)\right) = 0$, and ϕ_{l2}^{OM} is the solution of $E\left[\pi_{ml}^{SN}\right] = E[\pi_{on}^{SN}]$. We have $0 < \gamma_{l1}^{OM} < \gamma_{l2}^{OM} < 1$. (i) If $0 < \gamma < \gamma_{l1}^{OM}$, the manufacturer will not leak the demand information in strategies SN and SS. The platform's profit difference between cases SS and NS is: $E[\pi_{on}^{SS}(\phi_r^{OM})] - E[\pi_o^{NS}(\phi_r^{OM})] = \frac{768+1152\gamma+384\gamma^2-9\gamma^4}{4(32-3\gamma^2)^2}\beta\sigma^2 > 0$ always holds. (ii) If $\gamma > \gamma_{l1}^{OM}$ and $\phi_{l1}^{OM} < \phi_r^{OM}$, the platform has a feasible solution to charge the commission fee rate $\phi = \phi_r^{OM}$, and the manufacturer will not leak the demand information. Then, the platform's profit difference between cases SS and NS is: $[\pi_{on}^{SS}(\phi_r^{OM})] - E[\pi_o^{NS}(\phi_r^{OM})] = \frac{768+1152\gamma+384\gamma^2-9\gamma^4}{4(32-3\gamma^2)^2}\beta\sigma^2 > 0$. (iii) If $\gamma > \gamma_{l1}^{OM}$ and $\phi_{l1}^{OM} > \phi_r^{OM}$, the platform's optimal commission fee rate is $\phi = \phi_r^{OM}$. We have $E\left[\pi_{ol}^{SS}(\phi_r^{OM})\right] > E[\pi_o^{NS}(\phi_r^{OM})]$ and $E[\pi_{on}^{SS}(\phi_r^{OM})] > E[\pi_o^{NS}(\phi_r^{OM})]$, regardless of whether the manufacturer leaks the information to outside retailer. Because the platform's profit in the non-leaking equilibrium of strategy SN equals to $E[\pi_o^{NS}(\phi_r^{OM})]$, the non-leaking equilibrium in strategy SN is also not an optimal strategy. Therefore, if and only if $\gamma > \gamma_{l2}^{OM}$, the platform has the incentive to share information with the manufacturer only and the platform's optimal profit in strategy SN is $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right]$. □

Because strategies NN, NS and SN with the non-leaking equilibrium are not optimal for the platform, we only need to compare strategy SN with the leaking equilibrium and SS. Given $\beta\sigma^2 \geq a^2/3$ and $\gamma > \gamma_{l2}^{OM}$, (i) if $\phi_r^{OM} < \phi_{l2}^{OM}$, the platform's optimal profit in strategy SS is $\max\left\{E\left[\pi_{ol}^{SS}(\phi_r^{OM})\right], E[\pi_{on}^{SS}(\phi_r^{OM})]\right\}$. If and only if $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] > \max\left\{E\left[\pi_{ol}^{SS}(\phi_r^{OM})\right], E[\pi_{on}^{SS}(\phi_r^{OM})]\right\}$, which is equivalent to $\gamma > \gamma_2^{OM}(\sigma)$ and $F > F^{OM}(\sigma,\gamma)$, the platform's optimal strategy is SN; (ii) if $\phi_r^{OM} > \phi_{l2}^{OM}$, the platform's optimal profit in strategy SS is $\max\left\{E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OM}\right)\right], E[\pi_{on}^{SS}(\phi_r^{OM})]\right\}$. If and only if $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] > \max\left\{E\left[\pi_{ol}^{SS}\left(\phi_{l1}^{OM}\right)\right], E[\pi_{on}^{SS}(\phi_r^{OM})]\right\}$, which is equivalent to $\gamma > \gamma_1^{OM}(\sigma)$, the platform's optimal strategy is SN, where $\gamma_1^{OM}(\sigma)$ is the solution of $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] - E\left[\pi_{ol}^{SS}(\phi_{l1}^{OM})\right] = 0$, $\gamma_2^{OM}(\sigma)$ is the solution of $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] - E\left[\pi_{ol}^{SS}(\phi_{r}^{OM})\right] = 0$ when $F = \bar{F}^{OM}(\gamma) = \frac{a^2(4+\gamma)^2}{\left(16-3\gamma(2+\gamma)\right)^2}$ and $F^{OM}(\sigma,\gamma)$ is the solution of $E\left[\pi_{ol}^{SN}(\phi_{l2}^{OM})\right] - E\left[\pi_{ol}^{SS}(\phi_{r}^{OM})\right] = 0$.

To summarize, suppose $\beta\sigma^2 \geq a^2/3$ in the marketplace model with competition outside of the platform, we conclude this proposition. □

Proof of Proposition G1.

We first prove that $\pi_{o1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) \geq \pi_{o2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$, that is, for the platform, S2 is not better than S1. As compared to S1, the platform's decision of commission fee rate in S2 moves backward, which weakens its first-mover advantage. Then, in an arbitrary information sharing strategy, we have,

$$\pi_{o1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) \geq \pi_{o2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right). \quad (1)$$

Next, we prove that $\pi_{o1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) \leq \pi_{o2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$. At Time 0A and Time 0B, the decision variables are ϕ^{i*} and side payments I_m^{i*}, I_r^{i*}, which are determined by the platform. If $\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right)$ is a feasible solution in S2, then

$$\pi_{j1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{j2}^{i}\left(I_{m1}^{i*}, I_{r1}^{i*}; \phi_1^{i*}\right), \qquad j = \{o, m, r\}. \quad (2)$$

Then, proving that $\pi_{o1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) \leq \pi_{o2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$ is equivalent to proving that the optimal solution $\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right)$ in S1 is a feasible solution in S2. In S1, our result have demonstrated that by adjusting the side payments, the platform's information sharing makes $\pi_{m1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{m1}^{NN*}(\phi_1^{NN*}; I_{m1}^{NN*}, I_{r1}^{NN*})$ or $\pi_{r1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{r1}^{NN*}(\phi_1^{NN*}; I_{m1}^{NN*}, I_{r1}^{NN*})$ in information sharing contract i. In S2, given the platform's information sharing contract and side payments $\left(I_{m1}^{i*}, I_{r1}^{i*}\right)$, the platform's optimal commission fee rate is $\phi = \phi_1^{i*}\left(I_{m1}^{i*}, I_{r1}^{i*}\right)$. By anticipating the platform's optimal commission fee rate $\phi = \phi_1^{i*}\left(I_{m1}^{i*}, I_{r1}^{i*}\right)$, the shared parties can infer that

$$\pi_{m2}^{i*}\left(\left(I_{m1}^{i*}, I_{r1}^{i*}\right); \phi_1^{i*}\left(I_{m1}^{i*}, I_{r1}^{i*}\right)\right) = \pi_{m1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{m1}^{NN*}(\phi_1^{NN*}; I_{m1}^{NN*}, I_{r1}^{NN*}) = \pi_{m2}^{NN*}(I_{m1}^{NN*}, I_{r1}^{NN*}; \phi_1^{NN*})$$

or

$$\pi_{r2}^{i*}\left(\left(I_{m1}^{i*}, I_{r1}^{i*}\right); \phi_1^{i*}\left(I_{m1}^{i*}, I_{r1}^{i*}\right)\right) = \pi_{r1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{r1}^{NN*}(\phi_1^{NN*}; I_{m1}^{NN*}, I_{r1}^{NN*}) = \pi_{r2}^{NN*}(I_{m1}^{NN*}, I_{r1}^{NN*}; \phi_1^{NN*}),$$

where $i \neq NN$. Obviously, $i = NN$ also satisfies the above two equations. It indicates that if the platform charges side payments $\left(I_{m1}^{i*}, I_{r1}^{i*}\right)$ for the involved parties in S2, the involved parties will accept the platform's information sharing strategy i. Then, $\left(I_{m1}^{i*}, I_{r1}^{i*}; \phi_1^{i*}\right)$ is a feasible solution in S2. Thus,

$$\pi_{o1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{o2}^{i*}\left(I_{m1}^{i*}, I_{r1}^{i*}; \phi_1^{i*}\right) \leq \pi_{o2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right). \quad (3)$$

Combining (1), (2) and (3), we obtain that $\pi_{j1}^{i*}\left(\phi_1^{i*}; I_{m1}^{i*}, I_{r1}^{i*}\right) = \pi_{j2}^{i*}\left(I_{m2}^{i*}, I_{r2}^{i*}; \phi_2^{i*}\right)$, where $i = \{NN, NS, SN, SS\}$ and $j = \{o, m, r\}$. We conclude that S1 is equivalent to S2. □

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