The Agency and Wholesale Models When a Platform Can Charge Entry Fees

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Introduction and literature

Introduction

- Entry fees are commonly charged by platforms (and supermarkets) acting as intermediaries for consumers.
  - LinkedIn charges recruiters \$1,680 annually for its "Recruiter Lite" service.
  - OpenTable charges restaurants a monthly fee ranging from \$149 to \$499 depending on the contract, plus a 2% commission.
  - Artsy, an online marketplace, charges galleries a monthly fee of \$425 and a 10% commission.
  - Doctolib, an intermediary connecting patients and doctors in France, charges general practitioners a monthly fee between €135 and €274, plus a 1% commission on teleconsultations.
- Although they are common, they are not universally charged (e.g. Expedia, Facebook Marketplace, Uber, Airbnb, etc. don't charge).
- Moreover, when they are charged, they seem to be affordable
  - e.g. the \$39.99/month Amazon charges to professional sellers, which includes benefits like access to advanced selling tools and reports.)
  - although Alibaba \$1,833 per month to maintain an online store.
- Admittedly, we often observe menus of fixed fees, suggesting they are used to screen sellers.

This paper

In this paper, we study (and compare in terms of prices, profits and entry probability) the most commonly used intermediation models in (online) markets,

- the *agency* and the *wholesale* models,
- in a bilateral monopoly setting
- when a platform can charge a seller an entry fee.

Literature:

Literature comparing platforms' choice of ad-valorem vs per-unit fees: Bishop (1968), Shy and Wang (2011), Johnson (2017), Gaudin and White (2014a, 2014b, 2021), Llobet and Padilla (2016), Wang and Wright (2017), De los Santos et al. (2024), Gu and Huang (2024), Wright and Hagiu (2024).

Model

Model

- Bilateral monopoly model: a seller (S) supplies a good to a platform (P) that sells to final consumers.
- P has a mc equal to $c_p \geq 0$;
- S has a mc equal to $c_s > 0$.
- Demand for the seller's product is $Q(p)$, with $Q'(p) < 0$.
- As in Johnson (2017), define measure of the price sensitivity of demand:

$$\lambda(p) \equiv -\frac{Q(p)}{Q'(p)} > 0,$$

- $\lambda'(p) = \sigma(p) - 1$ with $\sigma(p) \equiv \frac{Q(p)Q''(p)}{(Q'(p))^2}$ being the demand curvature.
- $\lambda''(p) > 0$: increasing demand curvature
- $\lambda(p) - p\lambda'(p) \geq 0$: decreasing elasticity $pQ'(p)/Q(p)$ (Marshall's Second Law of Demand)

- Differently from the literature, we allow the platform to charge the seller a positive entry fee, denoted $F \geq 0$.

- Hence:
  - In the *wholesale model* (WM): P first sets the entry fee F to be paid by S, who then sets a wholesale price w and finally P chooses the final consumer price p.
  - In *the agency model* (AM): P first sets the entry fee F and the (ad valorem) commission t it charges to S, and then S picks the final consumer price p.

- We distinguish among three settings:
  - benchmark: full-profit-extracting entry fees.
  - more realistic: partial-profit-extracting entry fees.
  - even more realistic: heterogeneous seller's willingness to pay for entry

Full-profit-extracting entry fees

The wholesale model

Timing:

1. P selects its entry fee $F \geq 0$
2. S chooses whether to enter or not and upon entry chooses its wholesale price ω
3. P picks the final consumer price p.

Proceeding backwards:

3. P chooses p to maximize $\pi^P(p) = (p - w - c_p)Q(p) \rightarrow p^*(w)$
2. S chooses ω to maximize $\pi^S(w) = (w - c_s)Q(p(w)) \rightarrow w^*$
1. P picks F to leave S indifferent between entering and not entering:

$$F^* = \lambda(p^*)(1 - \lambda'(p^*))Q(p^*).$$

The agency model

Timing:

1. P selects its entry fee $F \geq 0$ and the commission rate $t \geq 0$.
2. S chooses whether to enter or not and upon entry chooses the final consumer price p.

Proceeding backwards:

2. S chooses p to maximize $\pi^S(p) = (p(1-t) - c_s)Q(p) \rightarrow p^a(t)$
1. P picks F and t to solve:

$$\max_{F,t} (tp(t) - c_p)\, Q\,(p(t)) + F$$

subject to

$$F \leq (p(t)(1-t) - c_s)\, Q(p(t)),$$

For a given t, the choice of F must leave the constraint binding. Hence, plugging the constraint, the platform's problem is:

$$\max_{t} (p(t) - c_p - c_s)\, Q(p(t)),$$

which equals the industry profit.

Proposition 1

Assume the platform can charge full-profit-extracting entry fees. Then,

- $p^* > p^a = p^m$, *so consumer surplus is higher in the agency model,*
- *the platform prefers the agency model to the wholesale model, while the seller is indifferent.*

As a consequence, a shift from the wholesale model to the agency model results in a Pareto improvement.

Contrast result without entry fees that if $c_p = 0$, AM leads to a lower price if and only if demand satisfies Marshall's 2 law (see e.g., Bishop (1968), Gaudin and White (2014a), Johnson (2017) and Llobet and Padilla (2016)).

- Double-marginalization fully eliminated in the AM, not in the WM.
- Main difference: in the WM, entry fee is sunk when the firms make their pricing decisions.

Also in contrast to Johnson (2017) that P prefers AM to WM when demand is log-concave, log-linear or constant elasticity (see his Prop. 3).

Disentangling the effects

Comparison of WM and AM involves a change in the order of moves, and a change in the type of instrument (per-unit vs ad valorem).

- Here, the result is fundamentally linked to the timing of pricing decisions.

Consider AM with per-unit commissions instead. Proceeding backwards:

2. S chooses p to maximize $\pi^S(p) = (p - t - c_s)Q(p) \rightarrow p^a(t)$
1. P picks F and t to solve:

$$\max_{F,t} (t - c_p)Q(p(t)) + F$$

subject to

$$F \leq (p(t) - t - c_s)Q(p(t)),$$

Again, the constraint will be binding and the P's problem becomes:

$$\max_{t} \left(p(t) - c_p - c_s\right) Q(p(t)),$$

which again equals the industry profit.

Similarly, the inefficiency of WM does not depend on the per-unit nature of the wholesale price.

Consider WM with ad valorem commission τ.

Proceeding backwards:

3. P chooses p to maximize $\pi^P = (p(1-\tau) - c_p)Q(p) \to p^*(\tau)$
2. S chooses τ to maximize $\pi^S(\tau) = (\tau p(\tau) - c_s)Q(p(\tau)) \to \tau^*$
1. P picks F to leave S indifferent between entering and not entering

$$F^* = (\tau^* p(\tau^*) - c_s)Q(p(\tau^*))$$

P's FOC is: $p - \frac{c_p}{1-\tau} - \lambda(p) = 0$.

Using it to rewrite S's problem:

$$\max_p \left\{ \pi^S(p) = \left(p - c_p - c_s - \frac{\lambda c_p}{p-\lambda} \right) Q(p) \right\}$$

This payoff differs from the joint profit $(p - c_p - c_s)\, Q(p) \to p^* \neq p^m$.

In conclusion, when intermediaries can charge full-profit-extracting fees:

- the superiority of the WM over the AM when demand is superconvex is destroyed, or what is equivalent the superiority of ad valorem commissions over per-unit ones (see e.g. Shy and Wang (2011), Johnson (2017)).
- moreover, the equivalence between AM with per-unit commissions and WM is destroyed

What if, more realistically, P cannot employ full-profit-extracting entry fees, but partial-profit-extracting entry fees?

Partial-profit-extracting entry fees

Model

Following Calzolari et al. (2021) assume that S has to incur a cost $(1+\kappa)F$ to be able to pay the entry fee F, where κ represents a dead-weight loss.

$\Rightarrow$ The seller will enter if and only if $\beta\pi^S \geq F$, with $\beta \equiv \frac{1}{1+\kappa}$.

β: S's willingness to pay for entry (as fraction of profit).

- Alternative interpretation: S must keep a proportion $\beta \in [0,1]$ of its profits because it has to settle corporate taxes, shares profits with investors, or with workers as end-of-year bonuses.

Proposition 2: comparing WM and AM

WM: p^* solves the FOC $p - c_p - c_s - \lambda(p)(2 - \lambda'(p)) = 0$.

AM: p^a solves the FOC:

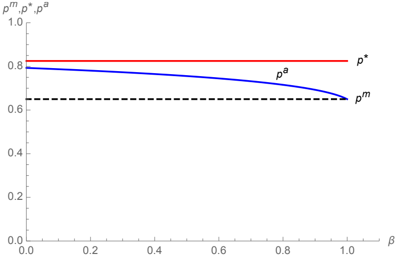
$$p - c_p - c_s - \lambda(p) - c_s(1-\beta)\frac{p\lambda(p)(1-\lambda'(p))}{(p-\lambda(p))^2} = 0.$$

Proposition 2

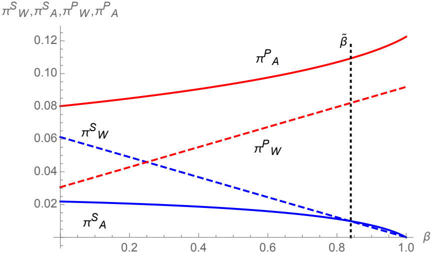
Assume $\beta \in [0,1)$ so that the platform can only extract a fraction of the profit of the seller. Then:

1. *Both p^* and p^a are higher than p^m.*
2. *$p^a < p^*$ if and only if $\beta > \hat{\beta} \equiv \max\left\{0, 1 - \frac{(p^*-\lambda(p^*))^2}{c_s p^*}\right\}$. Hence:*
   - *$p^a < p^*$ for any demand if β is sufficiently large*
   - *$p^a < p^*$ for any demand that satisfies Marshall's 2 law, regardless of β.*
3. *Regarding the preference across business models:*
   - *P prefers AM if $c_p + \lambda(p^a) - p^a\lambda'(p^a) > 0$; hence, for any demand that satisfies Marshall's 2 law.*
   - *If demand satisfies Marshall's 2 law, $\exists\tilde{\beta} \in (0,1)$ that solves $\beta - \frac{\lambda(p^a)-p^a\lambda'(p^a)}{p^a(1-\lambda'(p^a))} = 0$ such that S surely prefers WM $\forall\beta < \tilde{\beta}$.*

Ex.: Linear demand $Q(p) = 1 - p$, $c_p = 0$, $c_s = 0.3$

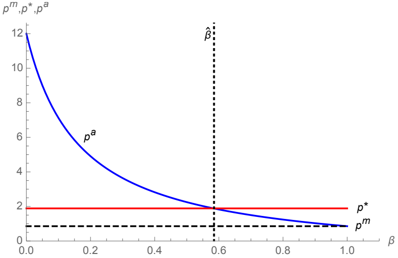


Equilibrium prices

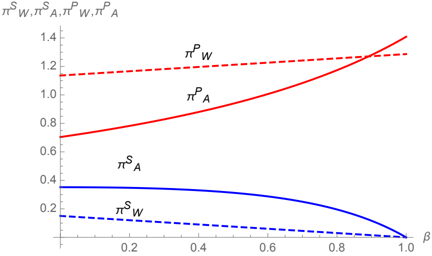


Equilibrium profits

Ex.: Non-Marshall demand: $Q(p) = \frac{1}{p} + \frac{1}{p^2}$, $c_p = 0$, $c_s = 0.3$



Equilibrium prices



Equilibrium profits

disentangling the effects ...

The consignment model

Consider the agency model with per-unit commissions, rather than ad valorem.

Proceeding backwards:

2. S chooses p to maximize $\pi^S(p) = (p - t - c_s)Q(p) \rightarrow p^a(t)$
1. P picks F and t to solve:

$$\max_{F,t}(t - c_p)Q(p(t)) + F$$

subject to

$$F \leq \beta(p(t) - t - c_s)Q(p(t)),$$

Again, the constraint will be binding and the P's problem can be written as choosing p to maximize:

$$\max_t \left(p - c_p - c_s - (1 - \beta)\lambda(p)\right) Q(p).$$

The FOC is:

$$p - c_s - c_p - \lambda(p) - (1 - \beta)\lambda(p)(1 - \lambda'(p)) = 0.$$

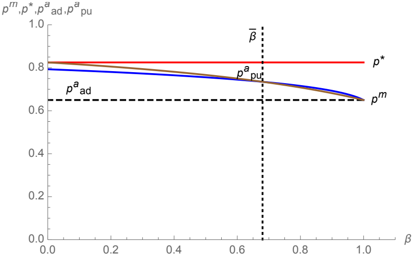
Proposition 3: AM with per-unit vs. AM with ad-valorem commissions

Proposition 3

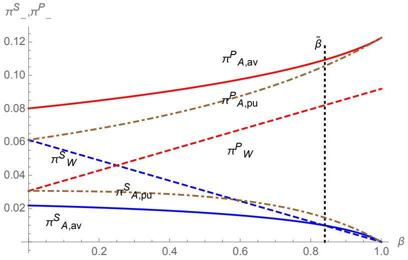
Assume $\beta \in [0,1)$ so that the platform can only extract part of the profit of the seller. Then:

1. $\tilde{p} < p^* \; \forall \beta \in (0,1)$ *and* $\tilde{p} = p^*$ *for* $\beta = 0$.
2. $p^a < \tilde{p}$ *if and only if* $\beta - \frac{c_p \tilde{p} + \lambda(\tilde{p})[\lambda(\tilde{p}) - \tilde{p}\lambda'(\tilde{p}))]}{\tilde{p}\lambda(\tilde{p})(1-\lambda'(\tilde{p}))} < 0$. *As a result:*
   - *if* $c_p = 0$ *and demand satisfies Marshall 2 law,* $\exists \bar{\beta} \in (0,1)$ *s.t.* $p^a < \tilde{p}$ $\forall \beta < \bar{\beta}$. *(If* $c_p > 0$*, maybe* $p^a < \tilde{p} \; \forall \beta$*.)*
   - *for* $c_p = 0$ *and non-Marshall demands,* $p^a > \tilde{p} \; \forall \beta$*, thereby generalizing the result known for* $\beta = 0$. *(If* $c_p > 0$*, maybe* $p^a < \tilde{p} \; \forall \beta$*.)*
3. *P prefers ad valorem commissions* $\forall \beta \in (0,1)$. *If demand is log-linear or log-convex and satisfies Marshall 2 Law, then S prefers per unit commissions* $\forall \beta < \tilde{\beta}$.

Ex.: Linear demand $Q(p) = 1 - p$, $c_p = 0$, $c_s = 0.3$

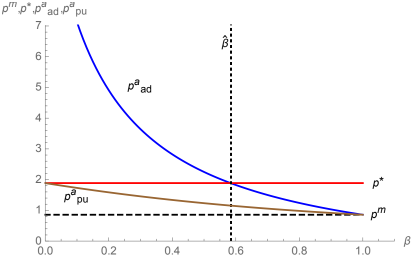


Equilibrium prices

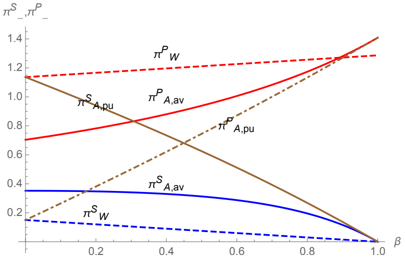


Equilibrium profits

Ex.: Non-Marshall demand: $Q(p) = \frac{1}{p} + \frac{1}{p^2}$, $c_p = 0$, $c_s = 0.3$



Equilibrium prices



Equilibrium profits

Seller heterogeneity

Model

Suppose the share of profits S can pay as entry fee β is distributed on $[0, 1]$, with cdf G and pdf g.

- Can be interpreted as P uncertain about S's willingness to pay for entry.

Define the inverse hazard rate by $\mu(\beta) \equiv \frac{1-G(\beta)}{g(\beta)}$.

Assume g is finite and, for the SOCs to hold, increasing (so $\mu(\beta)$ is decreasing).

Entry fees are not chosen anymore to leave S's indifferent, but to deal with the trade-off: a higher F increases the probability that the seller refuses to enter, while it increases the platform's payoff in case of entry.

- The amount of rent-extraction becomes endogenous (interior).

The (technical) innovation here is that we can reformulate the problems of P as choosing S's share of profits to extract rather than choosing entry fees.

Equilibrium

Proposition 4

In the wholesale model, the final price p^* charged to consumers solves the equation

$$p - c_p - c_s = \lambda(p)(2 - \lambda'(p)),$$

while the wholesale price is

$$w^* = p^* - c_p - \lambda(p^*).$$

The platform charges a positive entry fee F^* if and only if $g(0) < 1 - \lambda'(p^*)$, in which case F^* is equal to a share z^* of the seller's profits $\pi^S(p^*)$, where z^* solves the equation

$$\mu(z) = z + \frac{\lambda(p^*)}{p^* - c_s - c_p - \lambda(p^*)}$$

Otherwise, $F^* = 0$.

Proposition 5

In the agency model:

(A) *If* $g(0) < \frac{c_s \lambda(p^a)}{p^a(p^a - c_s - \lambda(p^a)) - c_p(p^a - \lambda(p^a))}$*, the platform charges a commission*

$$t^a = 1 - \frac{c_s}{p^a - \lambda(p^a)}$$

and an entry fee equal to:

$$F^a = Q(p^a)\left(\frac{c_s \lambda(p^a)}{p^a - \lambda(p^a)} - \frac{(p^a - \lambda(p^a))(p^a - c_p - c_s - \lambda(p^a))}{p^a\,(1 - \lambda'(p^a))}\right), \quad (1)$$

where p^a *is the final consumer price and is given by the solution to:*

$$\mu\left(1 - \frac{(p - \lambda(p))^2 (p - c_p - c_s - \lambda(p))}{c_s p \lambda(p)\,(1 - \lambda'(p))}\right) - \frac{(p - \lambda(p))\left[(p - c_p - c_s)\left(\lambda(p) - p\lambda'(p)\right) + \lambda(p)(p - \lambda(p))\right]}{c_s p \lambda(p)\,(1 - \lambda'(p))} = 0. \quad (2)$$

(B) *Otherwise,* $F^a = 0$ *and the final price* p^a*, as in Johnson (2017), is given by the solution to:*

$$p - c_p - c_s = \lambda(p)\left[1 + \frac{c_s p(1 - \lambda'(p))}{(p - \lambda(p))^2}\right].$$

Comparison of final consumer prices with one another

Corollary of Proposition 2 *In the model with seller heterogeneity, assume that entry fees are strictly positive in both intermediation settings, for which* $g(0) = 0$ *suffices. Then, the final price under the agency model* p^a *is lower than under the wholesale model* p^* *if and only if*

$$y^a > 1 - \frac{(p^* - \lambda(p^*))^2}{c_s p^*}.$$

As a result, $p^a < p^*$ *for any demand function that satisfies Marshall's second law of demand.*

Entry probability

To compare welfare, it is not enough to compare final consumer prices because entry probability is also important.

Proposition 6

In the model with seller heterogeneity, assume that entry fees are strictly positive in both models of intermediation, for which $g(0) = 0$ *suffices. Assume also that the demand function satisfies Marshall's 2 law so that* $p^a < p^*$. *Then, the seller's entry probability under the agency model is higher than under the wholesale model if:*

$$p^a - c_p - \frac{p^a c_s}{p - \lambda(p^a)} > \lambda(p^a), \tag{3}$$

or equivalently,

$$y^a < \frac{\lambda(p^a) - p^a \lambda'(p^a)}{p^a(1 - \lambda'(p^a))}. \tag{4}$$

As a result, if these conditions hold, the agency model results in a higher consumer surplus, higher platform profits but lower seller's profits. On aggregate, welfare under the agency model is higher than under the wholesale model.

Conclusions

Concluding remarks

- We study AM and WM of intermediation in a bilateral monopoly setting where a platform can charge an entry fee to a seller.
- With full-profit-extracting entry fees, AM is superior to WM for any demand (AM efficient, eliminates DM altogether, while WM not).
  - Moreover, AM with per-unit commissions equivalent to AM with ad-valorem commissions, hence no longer equivalent to WM.
- Results generalize to partial-profit-extracting entry fees, if P must leave a fixed (independent of price) amount of profits to S (not shown today).
- When P must leave an amount of profits to S that depends on price, then results generalize if profit-extraction is large enough.
- With Marshall demands, P prefers AM while S prefers WM over AM for low β.
- With seller heterogeneity, P not always charges entry fee (risk of S exit).
  - When it does, $p^a < p^*$ for Marshall demands, entry probability is also higher under AM than WM provided rent-extraction is sufficiently low.

Thanks much for your attention!