Retailers' Cost Uncertainty and Consumer Search with Product Differentiation

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- Do the same issues arise if consumers search for both prices and product characteristics?

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- Once we understand beliefs, we can study cost uncertainty/vertical relations that change how beliefs are formed.

Literature

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- Related strand of literature studies cost uncertainty and learning (Benabou and Gertner (1993) and Fishman (1996))
- Much less is known about vertical relations and search. Janssen and Shelegia (2012) and Lubensky (2011) are first attempts at understanding these issues.

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- Moreover, prices jump in the search cost, and may even jump twice for very different reasons.
- First jump happens because for some search costs retail prices are independent of manufacturer's price.
- Second jump happens because once retail prices go above the reservation utility total demand drops discretely.

The model

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- Consumers visit one retailer at random for free. Visiting the second one costs s.
- The common marginal cost for retailers is c. The cost may or may not be known to consumers (to be specified later)

Beliefs and demand

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- For $p_i^e \leq w^*$, expected demand of retailer 1 is:

$$Q_1(p_1) = (1 - G(w^* - p_2^e + p_1)) + G(w^* - p_1^e + p_2)(1 - G(w^* - p_1^e + p_1))$$
$$+ \int_{p_1}^{w^* - p_2^e + p_1} G(p_2 - p_1 + v) g(v) dv + \int_{p_1}^{w^* - p_1^e + p_1} G(p_2 - p_1 + v) g(v) dv.$$

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- Given the demand, retailer 1 will charge the price that solves

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- The key is to understand $Q_1'(p_1)$ and how it depends on beliefs.
- For example, if beliefs are "Passive" as in Wolinsky, i.e. p_2^e is independent of p_1, then price will be very different than when beliefs are Coordinated, i.e. $p_2^e = p_1$.

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- Wolinsky uses unilateral deviations’ idea but solutions concepts such as PBE do not require this.
- This is a crucial (and little understood) assumption that is very natural in his model, but might not be in other models
- As for consumers who arrive at retailer 2, since they observe retailer 2 charge p^* they believe that retailer 1 also charges p^*, so $p_1^e = p^*$ and $p_2 = p^*$.

Wolinsky benchmark

- Once we plug $p_2 = p_1^e = p_2^e = p^*$ into $Q_1(p_1)$, we get the FOC

$$p^*(c) = c + \frac{1 - G(p^*)^2}{2\int_{p^*}^{w^*} g(v)^2\, dv + 2G(p^*)g(p^*) + (1 - G(w^*))g(w^*)}.$$

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- This depends on s, and the condition binds when $p^* = w^*$, or

$$w^* = c + \frac{1 - G(w^*)}{g(w^*)}.$$

  This is the condition for the single-good monopoly price $p^m(c)$, so the threshold $\bar{s}$ solves

$$w^*(s) = p^m(c).$$

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- For larger search cost, retailers switch to charging p^m and consumers do not search the second retailer.
- This leads to a drop in demand per retailer from $1 - G(p)^2$ to $1 - G(p)$.
- Why don't retailers try to avoid this by not going above w^*?
- If firm 2 does this, its consumers search retailer 1, and firm 1 wants to price above w^*, so the equilibrium prices for $s > \bar{s}$ have to be equal to p^m

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Coordinated beliefs

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- What if p_2^e changes with p_1 for some reason (to be discussed extensively later)
- E.g. "Coordinated" beliefs where $p_2^e = p_1$.
- Coordinated beliefs are very favorable for retailers - when a retailer deviates up, consumers who visit it think that the other retailer has done the same.

Coordinated beliefs

- Once we plug $p_2 = p_1^e = \tilde{p}$ and $p_2^e = p_1$ into $Q_1(p_1)$, we get

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- and it's clear that for a given c prices are higher with Coordinated beliefs.

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- What about $s > \underline{s}$?

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- Since w^* is decreasing in s, eventually s will become so large that both retailers would prefer to go above w^*.
- This happens at $s = \bar{s}$, or when w^* falls all the way down to p^m. From $s > \bar{s}$ onwards prices stop at p^m and consumers do not search the second firm.

Coordinated vs Passive beliefs ($G(\cdot) \sim N(100, 15)$)

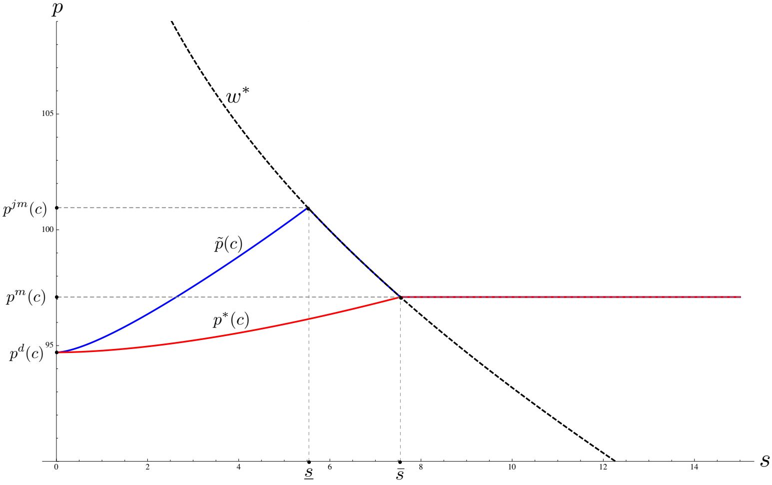

Figure : Prices with Passive (red) and Coordinated (blue) beliefs for $c = 75$.

Coordinated vs Passive" beliefs

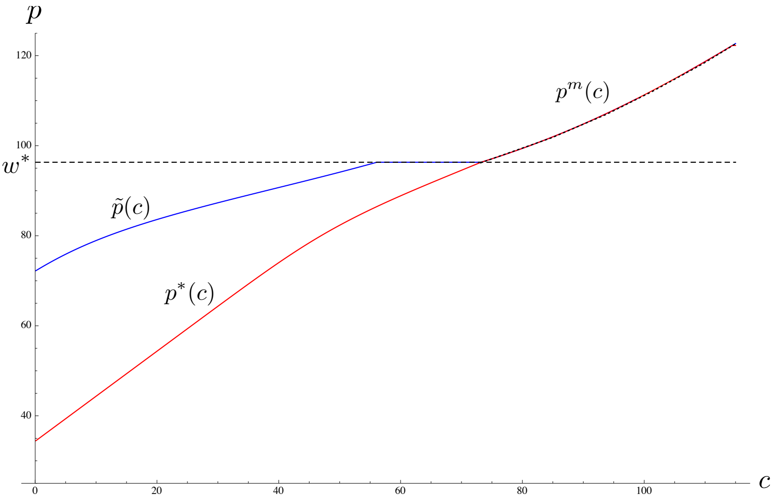

Figure : Prices with Passive (red) and Coordinated (blue) beliefs for $s = 8$.

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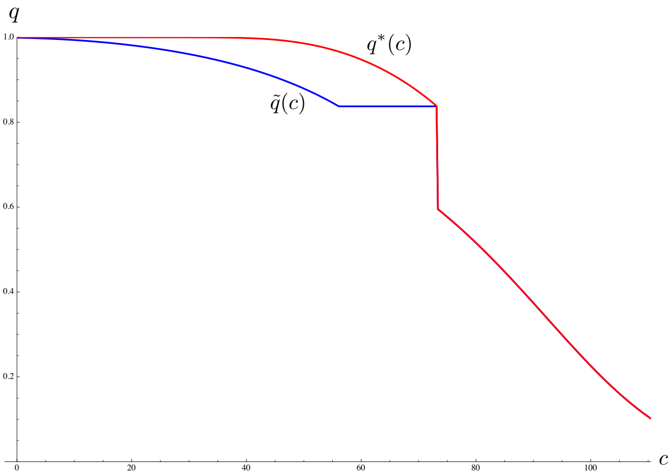

Figure : Quantities with Passive (red) and Coordinated (blue) beliefs for $c = 75$.

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- For out of equilibrium prices one is free to set beliefs, but to make things simpler we set $p_2^e = p_1$ also for out of equilibrium p_1.

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- There may be other pooling equilibria with other beliefs.

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- This makes the biggest difference between observed and unobserved marginal cost models.

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- After this, if upstream firm increases c, demand drops as consumers stop searching.

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- Since w^* is decreasing in s, so will be the retail and upstream price.

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- This is the classic double-marginalization model.

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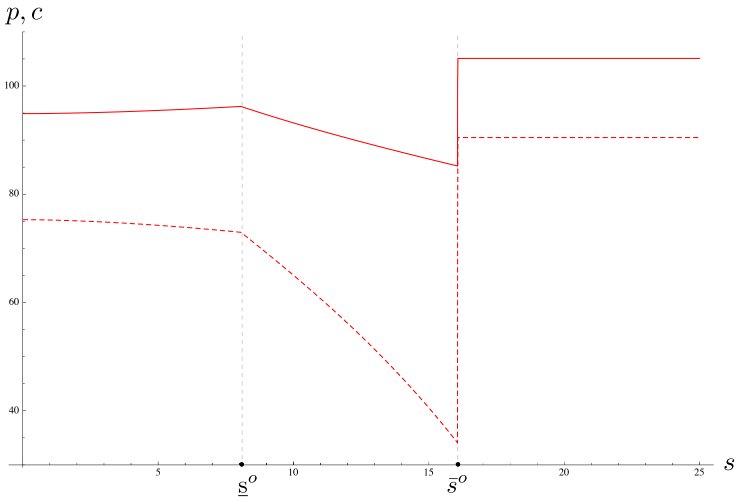

Figure : Upstream (dashed) and downstream (solid) prices.

Vertical model: observed c

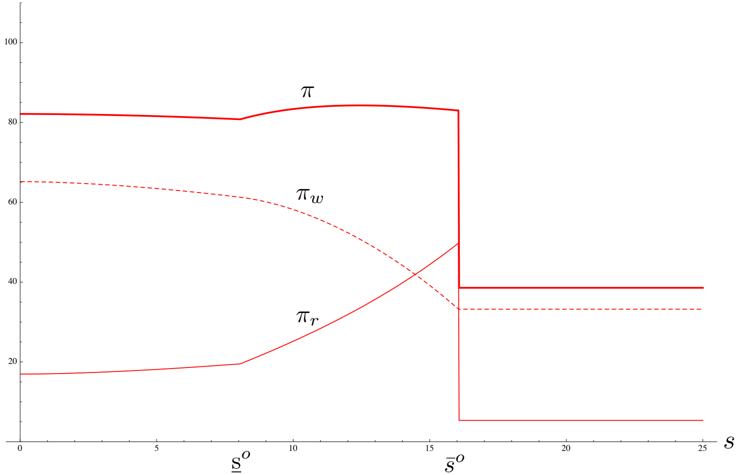

Figure : Upstream (dashed), downstream (solid), and total (thick) profits.

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- Note: with Coordinated beliefs we shut down the driving force in Janssen and Shelegia (2012) and look purely at how beliefs change equilibrium.

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- The threshold for the second jump is the same as in the observed case.

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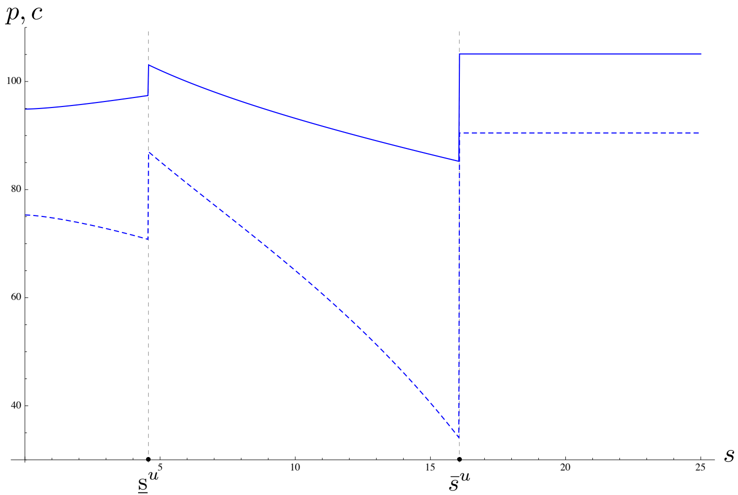
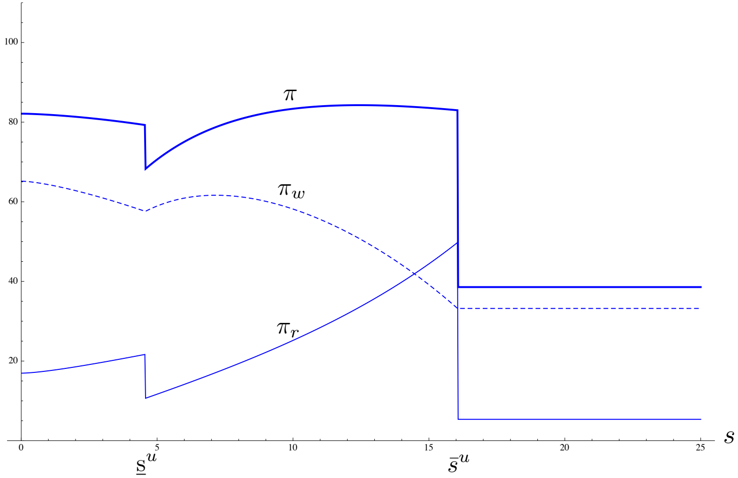


Figure : Upstream (dashed) and retail (solid) prices for $G(\cdot) \sim N(100, 15)$.

Vertical model: unobserved c



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- So for $s \leq \underline{\mathsf{s}}^u$ retail prices are higher, and wholesale price lower in the unobserved case
- At $s = \underline{\mathsf{s}}^u$ prices jump up in the unobserved case, so they are even higher.
- After this the retail prices starts declining in the unobserved model, until the two models coincide at $s = \underline{\mathsf{s}}^o$.

Vertical model: comparison

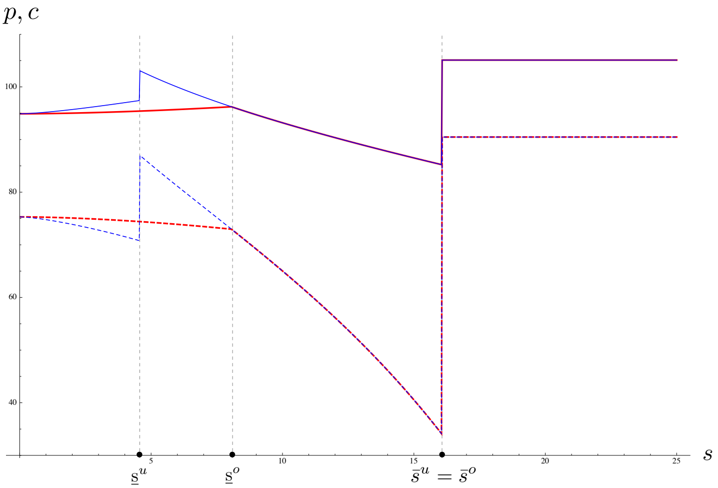

Figure : Upstream (dashed) and retail (solid) prices for observed (red) and unobserved (blue) c.

Vertical model: comparison

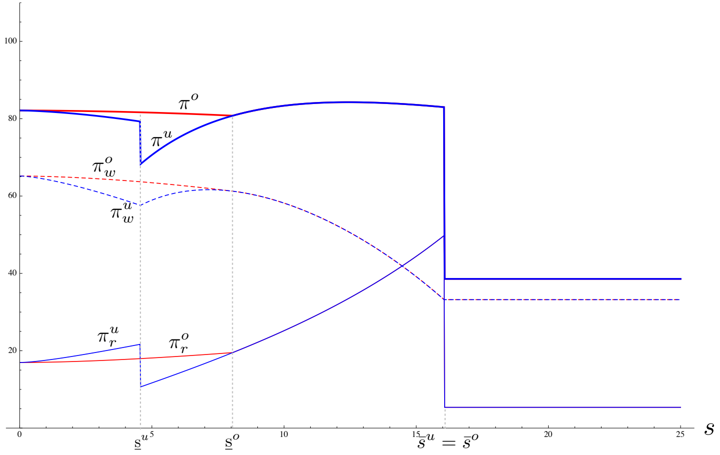

Figure : Upstream (dashed), retail (solid) and total (thick) profits for observed (red) and unobserved (blue) c.

Conclusions

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- When cost is random, retail prices increase and then decrease in search cost, and in the decreasing range retail prices are independent of marginal cost.
- In vertical relations model with observed or unobserved marginal cost, prices are increasing and then decreasing in search cost, and may jump up.
- Industry and upstream profits are higher in the observed marginal cost case, but retail profits may be higher in the unobserved case, thus retailers may hide their costs.