Downstream market uncertainty and upstream maximizing tariffs in franchising

by

Christos Constantatos
University of Macedonia,
Department of Economics
e-mail:cconst@edu.uom.gr

and

Ioannis N. Pinopoulos
Athens University of Economics and Business,
Department of Business Administration
e-mail: ipinop@aueb,gr

1. INTRODUCTION

- While there are cases where contracts between an upstream and a downstream firm are negotiated, in other instances the upstream firm sets a fixed contract and attracts all the downstream firms willing to accept it.

  - Lafontaine (1992) reports that in the franchise business, 42% of surveyed franchisors set take-it-or-leave-it contracts, while Lafontaine and Shaw (1999) shows that 75% of franchisors out of a large dataset offer their franchisees identical contracts.
  - Also, in the plant-breeding industry, the patent owner of a genetically tailored basic plant cannot sell his product directly to consumers. He must attract specialized breeders who develop particular consumable products (plant varieties).

- ***In this paper we examine the form of a standard take-it-or-leave-it contract that an upstream firm (U) may offer to a set of potential downstream partners, when the success of the downstream operation is uncertain.***

  - Each downstream firm produces a separate product or operates on an exclusive territory
  - The contract can take the form of either ***linear*** (*l*) or ***two-part*** (*t*) tariff

❖ Related Literature

- Milliou and Petrakis (2024) shows that linear tariffs can be welfare-superior to two-part tariffs by inducing more entry in the downstream market.
  - No uncertainty.
  - Downstream products are imperfect substitutes competing on the same market and there is free entry

- Reisinger and Schnitzer (2012) obtains similar results but with upstream competition.
  - No uncertainty

- Constantatos and Pinopoulos (2023) shows that under uncertainty, the fixed transfer may be negative and that when it is the case, the linear contract is welfare superior to the two-part tariff one. The paper assumes does not address questions related to the number of downstream products.
  - Uncertainty
  - Single downstream firm

2. THE MODEL

- **Demand:** Each downstream market represents a single product (or location).
  - The downstream firm serving that market is a monopoly (no competition between downstream firms)
  - Standard non-convex demand function in each market: $p(q)$, with $p' < 0$, $p'' \leq 0$.
  - The demand in each market is positive with probability z (probability of zero demand: $1 - z$)
    - The risk in each market is independently distributed
- **Timing:**
  - U determines a take-it-or-leave-it contract, which can be either l or t, with specific terms
  - Each D accepts or rejects.
    - In case of acceptance, D pays all fixed costs.
  - Uncertainty is resolved.
  - Each D who faces a positive demand sets a price, sells the corresponding quantity and pays to U all the agreed variable proceeds.

❖ Cost

- No upstream production cost.
- Downstream cost:
  - No variable cost
  - A fixed start-up cost F, ***paid before demand is revealed***.
    - This cost may represent expenses for building a production unit, advertising in the local market, or developing a specific final product that can be directly sold to consumers.
    - In more general terms, F can be considered as the opportunity cost of D's outside option.
  - ***F* is *irrecoverable in case of failure***.
- *D*s differ according to the value of the necessary F (different outside options)
  - *D*s are uniformly distributed according to F in the $[0, \overline{F}]$ interval, with density $\frac{1}{\overline{F}}$
- Whether the tariff is l or t, D give U a variable that may take the form of either an input price (when there is physical input sold) or a royalty. Analytically both cases are the same.
- In case of t, D there is also a fixed transfer T paid before the uncertainty resolution and irrecoverable in case of failure

❖ Attitudes towards Risk

- U is risk-neutral

- *D*s are risk averse. Their utility function is of the *mean-variance* type (^ means expected):

$$v_i = \hat{\pi} - T - \lambda\sigma^2(w) - F_i$$

where

$$\hat{\pi}(w; z, \lambda) = (p(\hat{q}(w)) - w) \cdot \hat{q}(w)$$

and

$$\sigma_D^2(w) = z\pi_D^2(w) - z^2\pi_D^2(w) = z(1-z)[(p(w) - w)q(w)]^2.$$

- We assume that no increase in w can make D better-off, i.e.:

$$\lambda < \bar{\lambda} = \frac{1}{2(1-z)\pi_D(w)} \qquad (dPer \text{ condition})$$

3. Linear Tariff

❖ The critical value of F for which $\hat{v}_D^L(w) = 0$ is

$$\tilde{F}(w) \equiv \hat{\pi}_D(w) - \lambda\sigma_D^2(w)$$

❖ Note that

$$\frac{d\tilde{F}(w)}{dw} \equiv \tilde{F}' = \frac{d\hat{v}_D(w)}{dw} < 0$$

❖ Let also the expected variable proceeds for U be

$$\hat{R}(w) \equiv zwq(w)$$

❖ With Linear tariff, the upstream supplier's target is:

$$\max_{w} \hat{\pi}_U^L(w) = \hat{R}(w) \cdot F^L(w) \cdot \frac{1}{\overline{\overline{F}}}$$

subject to:

$$F^L = \tilde{F}(w)$$

❖ Linear tariff FOC:

$$\frac{\hat{R}'(w)}{\hat{R}(w)} = -\frac{\tilde{F}'(w)}{\tilde{F}(w)}$$

❖ **Proposition 1:** The *l* upstream monopolist choses *w* by equalizing the rates of return at the two margins, intensive (per market profit) and extensive (market coverage)

- ***Intuition:***

  - Write the FOC as

$$\tilde{F}(w)\hat{R}'(w) = -\hat{R}(w)\tilde{F}'(w)$$

  - Since we have assumed that the lowest value of F is 0, $\tilde{F}(w)$ represents the expected number of markets, therefore $\tilde{F}'(w) < 0$ is the change in the number of products due to a small change in *w*.

  - Since $\tilde{F}'(w) < 0$, it must be that $\hat{R}'(w) > 0$, therefore *U* chooses a point on the inelastic part of the derived demand (revenue is not maximized, since *w* is chosen by the last participant's constraint) :

    - An increase in *w* ***increases*** $\hat{R}(w)$ and *reduces* $\tilde{F}(w)$.

      - The monopolist choses *w* by equalizing the proceeds at the intensive margin multiplied by the number of markets to the proceeds from the extensive margin multiplied by the profit per market.

4. Two-part Tariff

❖ The critical value of F for which $\hat{v}_D^T(w) = 0$ is

$$F^t \equiv \hat{\pi}_D(w) - \lambda\sigma_D^2(w) - T = \tilde{F}(w) - T.$$

❖ The upstream supplier's target is:

$$\max_{w,T} \hat{\pi}_U^t(w) = \left[\hat{R}(w) + T\right] \cdot F^t \cdot \frac{1}{\overline{\overline{F}}}.$$

subject to:

$$F^t = \tilde{F}(w) - T$$

By incorporating the constraint into the profit function we obtain:

$$\max_{w,T} \hat{\pi}_U^t(w) = \frac{\left[\hat{R}(w) + T\right]\left[\tilde{F}(w) - T\right]}{\overline{\overline{F}}}$$

❖ After manipulation, the FOC wrt *w* and *T* become:

$$\hat{R}'(w) = -\tilde{F}'(w)$$

$$\left(\tilde{F} - T\right) = \left(\hat{R} + T\right).$$

Manipulating further the 2nd FOC we obtain

$$T = \frac{1}{2}\left[\tilde{F} - \hat{R}\right],$$

therefore

$$F^t = \frac{\left(\tilde{F} + \hat{R}\right)}{2}$$

❖ **Proposition 2:** The *t* upstream monopolist choses *w* by equalizing the ***marginal proceeds*** at the two margins and sets *T* in such a way that the marginal retailer has fixed cost equal to $\frac{(\tilde{F}+\hat{R})}{2}$.

- **Intuition:**

  - Again, $\hat{R}'(w) > 0$ which implies that U does not maximize revenue per market.

  - U now choses w by equating the marginal change in per market revenue to the marginal change in revenue from the marginal consumer.

  - Compared to the l supplier who sets $\tilde{F}(w)\hat{R}'(w) = -\hat{R}(w)\tilde{F}'(w)$, the t supplier does not weight the margins, because he has two instruments, w,T.

5. Comparison

- ❖ Which tariff scheme yields the higher w?
  - ➢ Let $\xi = \lambda(1 - z)$ represent a measure of the subjective cost of risk for given expected profit.

❖ **Proposition 3:** There exists a value of ξ,

$$\xi_0 = -\frac{1}{(5p' + 2qp'')q^2}$$

such that

(i) For any $\xi \in (0, \xi_0]$, it holds that $w^L \geq w^T and\ T \geq 0$; then, $F^l \geq F^t$.

(ii) For any $\xi \in \left(\xi_0, \bar{\xi}\right)$, it holds that $w^L < w^T\ and\ T < 0$; then, $F^l < F^t$.

❖ The above proposition implies that

- when the subjective cost of risk is high, the optimal *t* contract dictates that *U* takes up part of the start up cost, in order to induce more market coverage;
- in such a case, *U* charges a higher input price under *t* than under linear tariff and attracts more retailers.
- It can also be shown that *U* never takes charge of the entire *F* of the marginal consumer but only of a part of it.

❖ In case of linear demand:

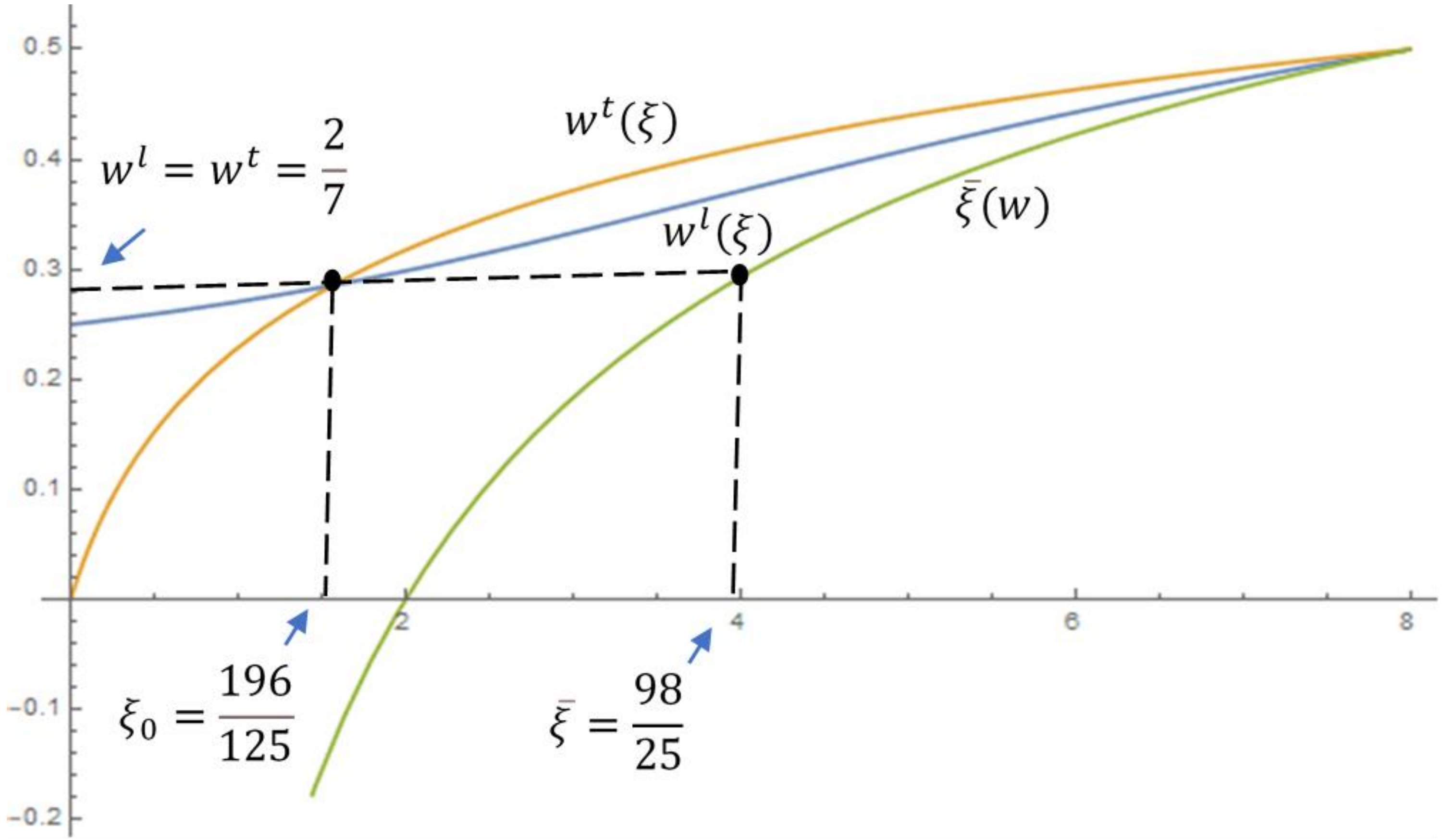


Figure 1

6. Welfare

❖ For each tariff $i = l, t,$ total welfare is

$$W = \int_0^{F^i} \int_0^{q^i(w^i)} [zp(q; w^i) - \lambda\sigma^2(q) - F] dq \, dF \,, \quad i = l, t.$$

➢ Letting $V(q) \equiv v(q) - \lambda\sigma^2(q)$ represent the expected per market value, gross of fixed cost and manipulating:

$$W = F^i \int_0^{q^i(w^i)} V(q) dq - \frac{{F^i}^2}{2}, \quad i = l, t.$$

- The 1st term on the RHS of the above is expected market value gross of the fixed cost multiplied by the number of products, since the latter is $\int_0^{F^i} dF = F^i$.
- The second term shows the total start-up cost.

- The total welfare change due to small changes in input price and market coverage is:

$$dW = \frac{\partial W}{\partial w}dw + \frac{\partial W}{\partial F}dF = FV(q)\frac{\partial q}{\partial w}dw + \left[-F + \int_0^q V(x)dx\right]dF.$$

  - The coefficient of dw is negative, due to $\frac{\partial q}{\partial w} < 0$, and represents the welfare change due to a change at the intensive margin (benefit per market).

  - The coefficient of dF is positive, and represents the welfare change due to an increase in the extensive margin (market coverage).

- Let us ignore the cost of risk. Then, unless $\xi = \xi_0$,

  - ***the tariff scheme that one type of tariff produces higher expected welfare per market margin but attracts fewer downstream firms, therefore fewer expected products.***

    - Hence, when ξ is small and $T > 0$, the t produces higher surplus per market (the well known effect) but induces smaller number of expected products

- One might think that for very low values of ξ one tariff scheme is welfare superior to the other and that the ranking is reversed when ξ is very large. However, the weights of the two margins change as well with ξ.

- Assume first that $\xi < \xi_0$ and the tariff scheme is *l*. A small reduction in *w* coupled with a small increase in *T* as to leave profits unchanged would produce higher surplus per market, but fewer markets. However, due to the low value of ξ, there are already many products in the market, therefore a small increase in the per market value is more important than the reduction in the number of products.

  - ♦ Unless the equilibrium (w, T) pair pushes the reduction in the number of markets relative to *l* too far, ***t* is welfare superior than *l*.**

- Assume now that $\xi > \xi_0$ and the tariff scheme is *l*. A small reduction in *w* coupled with a small increase in *T* as to leave profits unchanged would produce lower surplus per market, but larger number of markets. However, due to the high value of ξ, there is already a small number of products, therefore a small increase in the per market value is not so important relative to attracting more downstream firms.

- Unless the equilibrium (w,T) pair pushes the reduction in the per-market surplus relative to *l* too far, ***t* is again welfare superior than *l*.**
  - The "unless" condition in both cases implies that we may a ranking reversal for intermediate case.

- Hereafter, we assume that demand is linear and derive numerically some welfare measures for all values of ξ that do not violate stochastic dominance (the *dPer* condition)

  - In all figures:

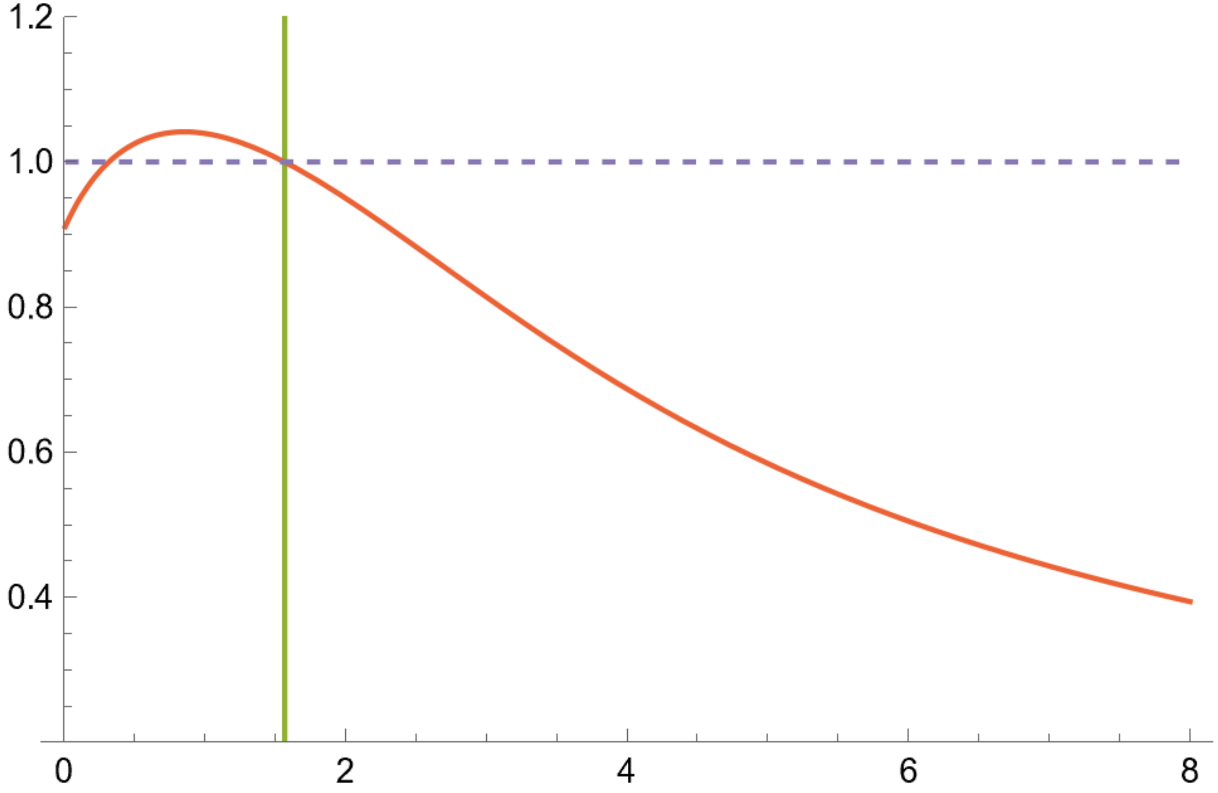
    - The horizontal axis measures ξ.

    - Red line: ratio of l value over t value or the corresponding variable

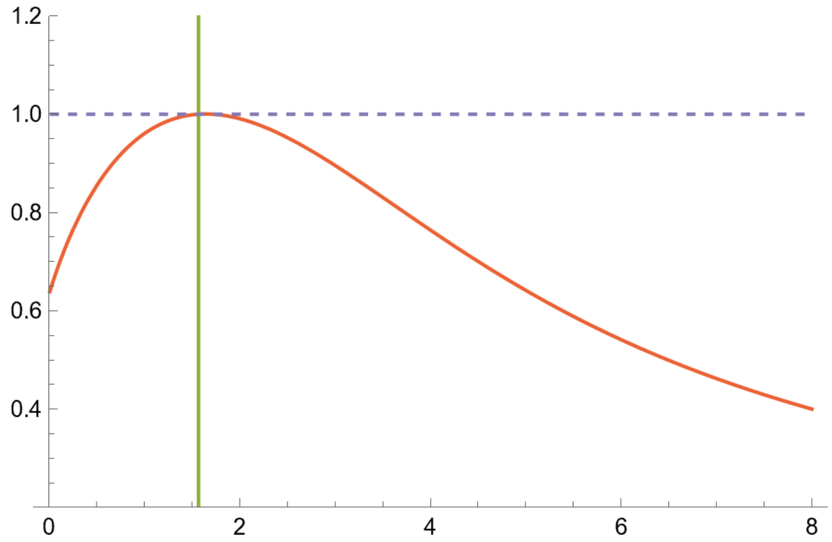
    - Dashed purple line: 1

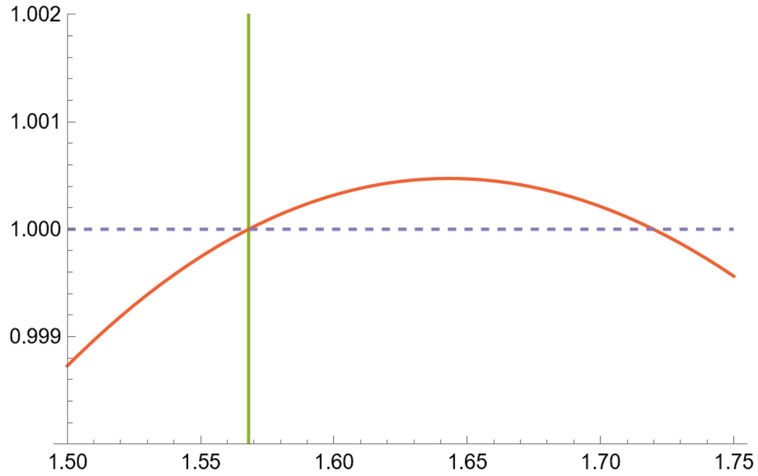
    - Green vertical line: the value of ξ_0

❖ **Total welfare ratio**



❖ Consumer Surplus Ratio





7. Conclusions

- We considered an upstream monopolist offering a common take-it-or-leave-it contract to a population of potential downstream firms distributed according to their start-up cost, and each downstream firm:
  - Produces a different product (each is a monopolist in her own market)
  - Faces uncertainty and is risk-averse

- We showed that
  - when the subjective cost of risk is low, the linear contract implies a higher input price that the two-part tariff contract, but attracts more downstream participants;
    - due to uncertainty, the input price is always above marginal cost in any scheme;
  - when the subjective cost of risk is high, the optimal transfer payment of the *t* scheme is negative, meaning that *U* participates in the start-up cost of each *D*;
    - in such a case the input price is lower under *t* than under *l* (but still above marginal cost)
  - in terms of welfare,
    - the tariff scheme that yields lower price produces higher welfare per market, but induces a smaller number of expected products;
    - *t* is more likely to be welfare superior, at least when the subjective cost of risk is very low or very high

- for intermediate cases of the cost of risk, *l* may produce higher total welfare or consumer surplus, but not both at the same time.

THANKS FOR YOUR ATTENTION