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Stéphane Caprice, Vanessa von Schlippenbach
And Christian Wey

Toulouse School of Economics

# Supplier Fixed Costs and Retail Market Monopolization*

Stéphane Caprice[†] Vanessa von Schlippenbach[‡] Christian Wey[§]

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**Abstract**

Considering a vertical structure with perfectly competitive upstream firms that deliver a homogenous good to a differentiated retail duopoly, we show that upstream fixed costs may help to monopolize the downstream market. We find that downstream prices increase in upstream firms' fixed costs when both intra- and interbrand competition exist. Our findings contradict the common wisdom that fixed costs do not affect market outcomes.

JEL-Classific*ation: L13, L14, L42*

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[†]Corresponding Author: Toulouse School of Economics (TSE, GREMAQ-INRA); 21 allée de Brienne, 31000 Toulouse, e-mail: <caprice@toulouse.inra.fr>.

[‡]DIW Berlin, Mohrenstr. 58, 10117 Berlin, Germany, and Heinrich-Heine-Universität Düsseldorf, DICE, e-mail: <vschlippenbach@diw.de>.

[§]Heinrich-Heine-Universität Düsseldorf, DICE, e-mail: <Christian.Wey@dice.uni-duesseldorf.de>.

# 1 Introduction

The economic consequences of fixed production costs have been largely neglected in the literature, analyzing input market transactions. In the respective literature, input prices are typically determined at the margin, i.e., by the interaction of upstream firms' supply functions and downstream firms' derived demand functions. Even when bargaining between vertically related firms is considered, contractual outcomes rely on the firms' "marginal contribution" to the bilateral surpluses (Inderst and Shaffer 2009). These approaches remain silent about how fixed production costs are shared across the vertically related firms and how they affect the terms of contracts and the market outcome.[1]

The consideration of fixed production costs, however, has become increasingly relevant as public regulations have imposed considerable additional fixed costs on many manufacturing firms. This is particularly true for the food industry, where food scares—such as the periodical outbreaks of foodborne illness caused by pathogens[2]—have fueled public concern about food safety.[3] As a consequence, public regulations have been tightened to ensure the quality of products and services. In addition, the number of ISO certifications (either publicly required or voluntarily implemented) in many industries has grown exponentially in recent years (see ISO 2012). Compliance with these standards induce significant additional costs for producers, tracing back to the need for (supplementary) quality control technologies such as product inspection and testing, process controls and various audits. In particular, extra labor has to be employed

[1] This may trace back to the fact that in many vertical structures, upstream fixed cost do not affect market outcomes. Consider an upstream monopolist, which delivers to an oligopolistic retail sector, upstream fixed costs do not affect the market outcome as long as profit sharing allows to cover the upstream fixed costs. The same holds for fixed costs borne by an oligopolistic upstream sector, which supplies a common retailer.

[2] Every year, approximately 42,000 cases of salmonellosis are reported in the United States (see Centers for Disease Control & Prevention, http://www.cdc.gov/salmonella/general/, November 19th, 2013). In May 2011, a major outbreak of Shiga toxin-producing Escherichia coli occurred in Germany, which resulted in about 4,000 ill people and in the death of more than 56 people (see EFSA Journal 2013, 11(1), 3025).

[3] For example, to foster the integrated management of foodborne hazards from farm-to-fork, the U.S. enacted the mandated use of the Hazard Analysis and Critical Control Points (HACCP). The HACCP system identifies specific hazards and measures for their control to ensure the safety of food along the entire production process (for a detailed description, see the Codex Alimentarius of the FAO/WHO). In the European Union, the implementation of the HACCP system became mandatory for food industries in 1995 (EU Directive 93/43).

to manage the daily tasks of documentation (Bain and Busch 2004).[4] Note that these additional production costs are only incurred if production actually takes place, without depending on the total quantity produced (Antle 2000). In other words, producers bear substantial *inframarginal* or *fixed operating costs* when complying with the more and more demanding public or private (quality) standards.

We consider a vertical structure with perfectly competitive upstream firms ("suppliers") that compete to deliver a homogenous good to a differentiated downstream duopoly ("retailers").[5] The upstream firms make take-it-or-leave-it offers to the retailers—either in the form of simple linear or two-part tariff contracts[6]—and incur a fixed cost if production actually takes place. Within this framework, we show that fixed costs affect both input market contracting and final goods prices. Most importantly, we find that fixed costs may help to monopolize an imperfectly competitive downstream market and, thus translate into higher consumer prices.

Our results depend on the nature of contracts. Perfect competition among upstream producers implies two equilibrium properties: first, any upstream producer makes zero profit and second, both retailers select a common supplier even though they are differentiated. In the case of linear contracts, the equilibrium wholesale prices are increasing in the amount of the fixed cost, because the upstream firm's margins need to cover that fixed cost. Under two-part tariff contracts, however, a sufficiently high fixed cost enables the retailers to monopolize the market. As the retailers select a common supplier that internalizes all externalities, the industry profit

[4] The food safety related expenditures, in particular for implementing HACCP systems, amount to approximately 1% to 7% of the production value (cf. Ragasa et al. 2011).

[5] This corresponds to the observed structure in many markets. Food industries, for example, are characterized by a large bunge of upstream firms producing almost homogeneous goods, which they deliver to more and more concentrated processors or retailers (OECD 1998; EU 1999; FTC 2001).

[6] This mirrors the observation that in some industries simple linear contracts are used, while in others trade is based on more complex contracts. The assumption of non-linear tariffs accounts for the fact that vertical relations in intermediate goods markets are often based on more complex contracts than simple linear pricing rules (Rey and Vergé, 2008). Analyzing the yoghurt market in the U.S., Villas-Boas (2007) provides evidence for the existence of non-linear pricing schemes in retailing. In particular, she states that "[t]he manufacturer extracts revenue from retailers via a fixed fee or by selling the non-marginal units at higher wholesale prices" (Villas-Boas, 2007, p. 646). Furthermore, Bonnet and Dubois (2010, p. 141) find for the French bottled water market that "manufacturers and retailers use nonlinear pricing contracts and in particular two-part tariff contracts with resale price maintenance."

is maximized. In contrast to the general presumption that two-part tariff contracts are more efficient than linear contracts,[7] we find that two-part tariff contracts may well lead to higher consumer prices than linear contracts.

The identified anticompetitive effects of two-part tariff contracts are in line with the findings of Shaffer (1991). In a similar industry structure but without considering any fixed costs at the upstream level, he shows that the competing upstream firms charge a wholesale price above marginal cost to soften downstream competition. The rents are redistributed to the retailers via negative fixed fees (slotting allowances). However, in Shaffer (1991) the monopoly solution can never be sustained as an equilibrium outcome. We show instead that monopolization in fact becomes possible when considering fixed costs at the upstream level. Upstream fixed costs imply that the retailers necessarily buy from a common supplier, which maximizes the industry surplus.

Thereby, a retailer's incentive to deviate to an alternative supplier in order to free-ride on the contract of its rival retailer remains an issue. However, the existence of upstream fixed costs reduces each retailer's incentive to deviate since the deviating retailer has to bear the entire fixed costs of the alternative supplier. As a consequence, monopolization of the downstream industry can be an equilibrium for sufficiently high fixed costs. Our results do not depend on the nature of downstream competition. In contrast to Shaffer (1991), where the anticompetitive effect of two-part tariffs relies on Bertrand competition among differentiated retailers, our insights also hold under Cournot competition in the downstream market, where the output decisions are strategic substitutes.

There is a wide literature on how vertical contracting affects market outcomes.[8] In a recent

[7] In vertical structures with either an upstream monopoly and a downstream oligopoly or an upstream oligopoly and a downstream monopoly, the vertically related firms do not internalize the impact of their individual decisions on the overall industry profit when supply is based on linear contracts. This problem of double marginalization results in too high consumer prices which do not maxmize overall industry profit. As is well-known, it can be overcome by two-part tariff contracts.

[8] See Bonanno and Vickers (1988) as well Rey and Stiglitz (1988) as seminal references. More recently, Miklós-Thal et al. (2011) show that monopolization of the industry is an equilibrium when the retailers' offers can be contingent on the relationship being exclusive or not. Studying a model where a dominant supplier distributes its product through retailers that also sell substitute products from a competitive fringe, Inderst and Shaffer (2010) find as well that the industry profit can be maximized when the contracts used are market-share contracts, i.e.,

paper, Rey and Whinston (2013), study a model of vertical contracting between a manufacturer and two retailers. They show that when retailers can offer a menu of three-part tariffs, there is always an equilibrium in which no exclusion occurs and industry profits are maximized. In contrast, we pursue a different approach. We do not examine the monopolizing effects resulting from different contracting arrangements, but we explain industry monopolization by exogenous fixed costs. We also contribute to the small literature that deals with food safety standards in food supply chains. This literature deals mainly with the question of how those private standards are chosen.[9] We, instead, take the existence as well as the adoption of either public or private standards as given in order to consider the implications in vertically related markets of the associated compliance costs for the contracting and, finally, consumer prices.

The remainder of the paper is organized as follows. In Section 2, we present our theoretical framework and characterize the monopoly outcome to provide an appropriate benchmark. Section 3 contains the equilibrium analysis if linear contracts are used. In Section 4, we study the case of non-linear contracts. In Section 5, we illustrate our results using a linear example. Finally, we discuss our results and conclude (sections 5 and 6).

## 2 The Model

Consider a perfectly competitive upstream industry, which produces a homogeneous good, and two differentiated retailers $i = 1, 2$, which sell to final consumers.[10] The upstream firms produce at constant marginal cost, $c \geq 0$. In addition, each upstream manufacturer bears a fixed cost $K \geq 0$ if production actually takes place.[11] The fixed cost $K$ is neither scale-dependant nor

a retailer receives discounts according to its total purchases.

[9] See, for example, Bazoche et al. (2005), Giraud-Héraud et al. (2006). More recently, von Schlippenbach and Teichmann (2012) show that the observed difference in private quality standards could be a result of retailers' strategy to increase their bargaining position vis-à-vis suppliers.

[10] Note that the upstream firms may represent primary producers, while the downstream firms may also characterize processors or retailers whose businesses depend on the input of the upstream firm. The differentiation of downstream firms represents the brand or store preferences of consumers.

[11] This may correspond to costs induced by compliance with public or private regulations. Under certified production, for example, fixed operating costs include costs for regular audits, administration costs and training of employees.

retailer-specific. The costs of the retailers (except procurement costs) are normalized to zero. We further assume that the upstream firms have prohibitively high costs to sell directly to consumers.

We consider a three-stage game. First, the manufacturers make simultaneous contract offers to the retailers, where they are allowed to discriminate between the retailers. Second, the retailers observe all contract offers and decide from which manufacturer they will exclusively buy. Finally, the retailers compete noncooperatively in prices. The game is solved by backward induction where our equilibrium concept refers to subgame perfection.

We consider two different types of vertical contracts: *i)* a contract only consisting of a linear wholesale price $w_i$ and *ii)* a two-part tariff contract $(w_i, F_i)$, entailing a linear wholesale price $w_i$ and a fixed fee $F_i$. The fixed payment can be positive, zero or negative, whereas a negative fixed fee indicates a slotting fee paid by the manufacturer to the retailer. We do not allow for contracts that are contingent on the rival retailer-supplier pair's contract. Furthermore, we assume that each retailer-supplier pair may agree on an exclusivity clause in order to avoid a retailer accepting the payment of slotting allowances without stocking the manufacturer's product.

Each retailer $i$ faces a demand function $D_i(P)$, where $P = (P_1, P_2)$ indicates the vector of retail prices. Demand is twice differentiable and downward-sloping with $\partial_{P_i} D_i(P) < 0 < \partial_{P_j} D_i(P)$. Let $R_i(P) = (P_i - w_i)\, D_i\,(P)$ denote the retailer $i$'s flow profit when it sells at a price $P_i$ and the rival retailer $j \neq i$ sells at $P_j$. The retailer $i$'s total profit is given by $\pi_i(P) = R_i(P) - F_i$. The following assumptions ensure a well-behaved price competition problem which brings about a unique Nash equilibrium (see Shaffer 1991): *i)* $\partial^2_{P_i} R_i(P) < 0$ is a necessary condition for profit maximization; *ii)* $\partial^2_{P_i P_j} R_i(P) > 0$ ensures that each retailer $i$'s reaction function is upward sloping; *iii)* $\Delta := \partial^2_{P_i} R_i(P) \partial^2_{P_j} R_j(P) - \partial^2_{P_i P_j} R_i(P) \partial^2_{P_j P_i} R_j(P) > \partial_{P_j} D_i(P) \partial^2_{P_i P_j} R_i(P)$ guarantees both uniqueness of the Nash equilibrium and also ensures that each retailer $i$'s equilibrium marginal return decreases in its marginal cost $w_i$.

We now characterize the equilibrium retail prices. In the last stage of the game, both retailers set their prices so as to maximize their profits. The corresponding first-order conditions are given by:

$$\partial_{P_i} \pi_i(P) = (P_i - w_i)\, \partial_{P_i} D_i(P) + D_i(P) = 0, \tag{1}$$

whose solution yields the equilibrium prices $P^*(w_1, w_2) = (P_1^*(w_1, w_2), P_2^*(w_1, w_2))$. For ease of exposition, we use the simplified notation $P_i^* := P_i^*(w_1, w_2)$ and $P^* := P^*(w_1, w_2)$. Comparative statics reveal that an increase of the retailer $i$'s wholesale price $w_i$ results in an increase of both retail prices:

$$\frac{\partial P_i^*}{\partial w_i} = \frac{\partial^2_{Pj} R_j(P^*) \partial_{P_i} D_i(P^*)}{\Delta} > 0 \tag{2}$$

and,

$$\frac{\partial P_j^*}{\partial w_i} = -\frac{\partial^2_{P_j P_i} R_j(P^*) \partial_{P_i} D_i(P^*)}{\Delta} > 0. \tag{3}$$

Using the equilibrium retail prices $P^*(w_1, w_2)$, we derive the wholesale prices that maximize the industry profit. The reduced form of the overall gross industry profit is given by:

$$\Pi(w_1, w_2) = (P_1^* - c) D_1(P^*) + (P_2^* - c) D_2(P^*). \tag{4}$$

Maximizing (4) with respect to $w_i$, we obtain:

$$\begin{aligned} \frac{\partial \Pi(w_1, w_2)}{\partial w_i} &= \left[(P_i^* - c)\partial_{P_i} D_i(P^*) + D_i(P^*) + (P_j^* - c)\partial_{P_i} D_j(P^*)\right] \partial_{w_i} P_i^* \\ &+ \left[(P_i^* - c)\partial_{P_j} D_i(P^*) + (P_j^* - c)\partial_{P_j} D_j(P^*) + D_j(P^*)\right] \partial_{w_i} P_j^* = 0, \end{aligned} \tag{5}$$

which simplifies to:

$$\begin{aligned} \frac{\partial \Pi(w_1, w_2)}{\partial w_i} &= (w_i - c)\, \partial_{P_i} D_i(P^*) \partial_{w_i} P_i^* + (P_i^* - c)\partial_{P_j} D_i(P^*) \partial_{w_i} P_j^* \\ &+ (w_j - c)\, \partial_{P_j} D_j(P^*) \partial_{w_i} P_j^* + \left(P_j^* - c\right) \partial_{P_j} D_j(P^*) \partial_{w_i} P_i^* = 0. \end{aligned} \tag{6}$$

Solving the respective equation system for $w_1$ and $w_2$, we get the equilibrium wholesale prices $w^M = (w_1^M, w_2^M)$, which maximize the overall industry profit. The optimal wholesale prices are such that the final product prices $P^*(w_1, w_2)$ are raised to the level a fully integrated monopolist would choose.[12] In the following, the equilibrium wholesale prices $w^M$ will be used as a benchmark.

[12] A monopolist sets the prices $P_1$ and $P_2$ as to maximize $\sum_i (P_i - c) D_i(P)$, which leads to the first-order conditions $(P_i - c)\partial_{P_i} D_i(P) + D_i(P) + (P_j - c)\partial_{P_i} D_j(P) = 0$ for $i, j = 1, 2$ and $j \neq i$. Inspecting the expressions in the rectangular brackets on the right-hand side of (5), we find that the optimal wholesale prices $w^M$ also fulfill the first-order conditions of an integrated monopolist.

## 3 Linear Contracts

We start with the analysis of linear contracts. In the second stage of the game, retailers observe all contract offers and select the most profitable offers. At the same time, manufacturers will not offer contracts that earn them negative profits. As suppliers incur fixed costs $K$ and perfectly compete for exclusively supplying the retailers, the latter will decide to purchase from a common supplier in equilibrium. The common supplier sets wholesale prices to solve the following maximization problem:

$$\max_{w_1,w_2} \sum_{i=1}^{2}(P_i^*(w_1,w_2)-w_i)D_i(P^*(w_1,w_2)) \text{ s. t. } \sum_{i=1}^{2}(w_i-c)D_i(P^*(w_1,w_2))-K\geq 0.$$

As retail profits decrease in wholesale prices, the constraint of the common supplier to earn non-negative profits is binding. Using symmetric retailers, the symmetric equilibrium wholesale prices are, thus, implicitly given by:[13]

$$w_1^L=w_2^L=w^L=c+\frac{K}{D_1(P^*(w^L,w^L))+D_2(P^*(w^L,w^L))}. \tag{7}$$

The equilibrium wholesale price is equal to the marginal cost of production plus a margin which increases linearly with the level of the fixed cost $K$. The margin corresponds to the fixed cost $K$ devided by the total sales. An increase of the fixed cost $K$ leads to raising wholesale prices for fulfilling the manufacturer's zero-profit condition. In the absence of any fixed costs, the wholesale prices are set equal to marginal cost (see Proposition 1 in: Shaffer 1991).

There exists an upper bound of the fixed cost, $\overline{K}$, which can be afforded by the upstream manufacturer. Using symmetry, the maximum value corresponds to the maximized profit of a single supplier which serves both retailers; i.e., $\overline{K}:=\sum_{i=1}^{2}(w^{\max}-c)D_i(P^*(w^{\max},w^{\max}))$ with:

$$w^{\max}:=\arg\max_{w_1,w_2}\sum_{i=1}^{2}(w_i-c)D_i(P^*(w_1,w_2)).$$

It is obvious that $w^L$ can never exceed $w^{\max}$ and, thus, there exists no equilibrium when $K>\overline{K}$.

**Proposition 1** *In the case of linear contracts, both retailers can receive the same equilibrium wholesale price $w^L$ which is given by (7). $w^L$ is monotonically increasing in $K$ in the interval $K\in(0,\overline{K}]$, with $w^L=0$ at $K=0$ and $w^L=w^{\max}$ at $K=\overline{K}$. Moreover, there exists a*

[13] As other couples of wholesale prices fulfill the manufacturer's zero-profit condition, there also exists asymmetric equilibria with $w_1^L\neq w_2^L$.

*unique threshold value* $\widehat{K} := \sum_{i=1}^{2}(w_i^M - c)D_i(P^*(w_1^M, w_2^M))$ *such that* $w^L > w^M$ $(w^L \leq w^M)$ *for* $K > \widehat{K}$ $(K \leq \widehat{K})$.

**Proof.** To prove the last part of Proposition 1, we evaluate (6) for $w_i = w_i^{\max}$, which gives the requirement:

$$\left.\frac{\partial \Pi(w_1, w_2)}{\partial w_i}\right|_{w_i = w_i^{\max}} = (P_i^* - w_i)\partial_{P_j} D_i(P^*)\partial_{w_i} P_j^* + (P_j^* - w_j)\partial_{P_i} D_j(P^*)\partial_{w_i} P_i^* - D_i(P^*) < 0.$$

Using $D_i(P^*) = -(P_i^* - w_i)\,\partial_{P_i} D_i(P^*)$, we get:

$$\left.\frac{\partial \Pi(w_1, w_2)}{\partial w_i}\right|_{w_i = w_i^{\max}}$$
$$= (P_i^* - w_i)\left(\partial_{P_j} D_i(P^*)\partial_{w_i} P_j^* + \partial_{P_i} D_i(P^*)\right) + (P_j^* - w_j)\partial_{P_i} D_j(P^*)\partial_{w_i} P_i^* < 0.$$

Using (2) and (3) and rearranging terms, we can re-write the last equation as:

$$\left.\frac{\partial \Pi(w_1, w_2)}{\partial w_i}\right|_{w_i = w_i^{\max}} =$$
$$(P_i^* - w_i)\left(\Delta - \partial_{P_j} D_i(P^*)\partial^2_{P_j P_i} R_j(P^*)\right) + (P_j^* - w_j)\underbrace{\partial_{P_i} D_j(P^*)}_{>0}\underbrace{\partial^2_{P_j} R_j(P^*)}_{<0} < 0.$$

Applying symmetry, we obtain:

$$\Delta - \partial_{P_j} D_i(P^*)\partial^2_{P_j P_i} R_j(P^*) + \partial_{P_i} D_j(P^*)\partial^2_{P_j} R_j(P^*) < 0$$

because of

$$\left(\partial^2_{P_j} R_j(P^*) - \partial^2_{P_j P_i} R_j(P^*)\right)\left(\partial^2_{P_j} R_j(P^*) + \partial^2_{P_j P_i} R_j(P^*)\right) < -(\partial^2_{P_j} R_j(P^*) - \partial^2_{P_j P_i} R_j(P^*))\partial_{P_j} D_i(P^*)$$

which reduces to $\partial^2_{P_j} R_j(P^*) + \partial^2_{P_j P_i} R_j(P^*) < -\partial_{P_j} D_i(P^*)$. ■

If the equilibrium wholesale price equals $w^M$, the industry profit is maximized. As rents can only be transferred via the linear wholesale price, parts of the overall industry profit cannot be shifted to the supplier. This implies that the maximum fixed costs the supplier can cover are necessarily lower than the monopoly industry outcome, i.e., $\overline{K} < \Pi\left(w_1^M, w_2^M\right)$. Our results further reveal that for all $K > \widehat{K} := \sum_{i=1}^{2}(w_i^M - c)D_i(P^*(w_1^M, w_2^M))$ the equilibrium wholesale price exceeds the wholesale price that ensures the monopoly outcome, i.e., $w^L > w^M$.

# 4 Non-linear Contracts

We now assume that the upstream manufacturers offer non-linear contracts in the form of two-part tariff contracts $(w_i, F_i)$ to the retailers. Each retailer purchases from the supplier it earns the highest profit with. In equilibrium, both retailers buy from the same supplier due to the existence of upstream fixed costs. The manufacturers offer contracts $(w_i, F_i)$ to both retailers which maximize the industry surplus subject to earning non-negative profit. Equilibrium contracts have to be immune against bilateral deviation of one of the retailers with an alternative supplier.

We show the existence of an equilibrium, where the common supplier proposes a wholesale price $w_i^M$ which maximizes the industry profit, and uses the fixed fee to redistribute the joint surplus to the respective retailer. Suppose that the corresponding fixed fee is given by:

$$F_i^M = R_i\left(P^*\left(w_1^M, w_2^M\right)\right) - \alpha_i\left(\Pi\left(w_1^M, w_2^M\right) - K\right),$$

where $\alpha_i \in [0,1]$ (with $\alpha_i + \alpha_j = 1, \forall i = 1,2, j \neq i$) indicates how the industry profit is shared among the retailers. Such a two-part tariff $(w_i^M, F_i^M)$ constitutes an equilibrium contract if an alternative supplier cannot propose a better offer to any retailer $j \neq i$ leading to a unilateral deviation by that retailer. We denote by

$$\pi_j^D\left(w_i^M, w_j^{BR}(w_i^M)\right) = \left(P_j^*\left(w_i^M, w_j^{BR}(w_i^M)\right) - c\right) D_j\left(P^*\left(w_i^M, w_j^{BR}(w_i^M)\right)\right)$$

the joint profit of a retailer $j \neq i$ and an alternative supplier without considering the fixed costs, where $w_j^{BR}(w_i^M)$ denotes the best-response to the wholesale price $w_i^M$, i.e.:

$$w_j^{BR}(w_i^M) := \arg\max_{w_j}\left\{\left(P_j^*\left(w_i^M, w_j\right) - c\right) D_j\left(P^*\left(w_i^M, w_j\right)\right)\right\}.$$

Hence, $(w_i^M, F_i^M)$ is an equilibrium contract if:

$$R_j\left(P^*\left(w_1^M, w_2^M\right)\right) - F_j^* = (1-\alpha_i)\left[\Pi\left(w_1^M, w_2^M\right) - K\right] \geq \pi_j^D\left(w_i^M, w_j^{BR}(w_i^M)\right) - K, \tag{8}$$

which simplifies to the condition:

$$K \geq \frac{\pi_j^D\left(w_i^M, w_j^{BR}(w_i^M)\right) - (1-\alpha_i)\Pi\left(w_1^M, w_2^M\right)}{\alpha_i}. \tag{9}$$

Note that $\pi_j^D\left(w_i^M, w_j^{BR}(w_i^M)\right) < \Pi\left(w_1^M, w_2^M\right)$. A larger value of $K$ makes a unilateral deviation less attractive as the deviating retailer must cover the entire fixed costs of the alternative supplier.

The monopoly industry outcome is, therefore, more likely to be an equilibrium the higher the fixed costs of the upstream industry. In detail, for any $K \geq \widetilde{K} := 2\pi_j^D\left(w_i^M, w_j^{BR}(w_i^M)\right) - \Pi\left(w_1^M, w_2^M\right)$, there exists a symmetric equilibrium, where both retailers earn an equal share of the overall industry profit, i.e. $\left(\Pi\left(w_1^M, w_2^M\right) - K\right)/2$ and, thus, the monopoly outcome in the downstream market can always be sustained.[14] This equilibrium is unique for $K = \widetilde{K}$.[15] We get multiplicity of equilibria for $K > \widetilde{K}$, and the range of feasible sharing rules in equilibrium is increasing in $K$. Note, for $K \geq \pi_j^D\left(w_i^M, w_j^{BR}(w_i^M)\right)$, all sharing possibilities among retailers, i.e. $\alpha_i \in [0,1]$, constitute an equilibrium. This implies that it is even possible that one retailer gets the full industry profit, while its upstream competitor ends up with zero profit.

Under two-part tariff contracts, the vertically related firms can make use of two instruments. For $K \geq \widetilde{K}$, the supplier charges a wholesale price $w^M$ that ensures the monopoly industry outcome. The fixed fee is used to transfer rents to the downstream firms up to the level where the supplier's profit cover the fixed costs. For $\widetilde{K} \leq K < \widehat{K}$, the fixed fees are negative as the upstream flow profit exceeds $K$, i.e. $\sum_{i=1}^{2}(w_i^M - c)D_i(P^*(w_1^M, w_2^M)) \geq K$. For $K > \widehat{K}$, however, the supplier's flow profit does not cover the fixed cost. To ensure the supplier's participation constraint, the retailers have to pay fixed fees in order to shift at least part of their rents to the supplier in order to ensure its zero-profit constraint.

For relatively low values of the fixed cost, i.e., $K < \widetilde{K}$, the monopoly industry outcome under two-part tariffs is not an equilibrium. As the incentive constraint given in (8) is binding, the equilibrium wholesale prices $w_1^T(K) = w_2^T(K) = w^T(K)$ are, thus, implicitly given in case of symmetric retailers by the highest wholesale prices satisfying:

$$\frac{\Pi\left(w_1^T(K), w_2^T(K)\right) - K}{2} = \pi_j^D\left(w_i^T(K), w_j^{BR}(w_i^T(K))\right) - K.$$

Note that this symmetric equilibrium implying an equal distribution of the industry profit among the retailers is unique for all $K < \widetilde{K}$. An asymmetric equilibrium is not possible because an

[14] Schutz (2012) questions the existence of an equilibrium in Shaffer (1991) for the case of non-linear contracts. To the contrary, the equilibrium we highlight for $K \geq \widetilde{K}$ is immune to multilateral deviations as considered by Schutz. This is due to the fact that the equilibrium contract implies the monopolization of the industry for $K \geq \widetilde{K}$.

[15] An asymmetric distribution of the overall profit among retailers would require a lower equilibrium wholesale price to ensure non-deviation of the retailer that gets the lower share. Correspondingly, the symmetric equilibrium is payoff-dominant and, thus, the unique equilibrium.

unequal distribution of profits among retailers would lead to stronger deviation incentives of the low-profit retailer resulting in lower wholesale prices and, thus, a lower overall industry profit.[16]

The equilibrium contracts are, thus, given by $w_1^T(K) = w_2^T(K) = w^T(K)$ and $F^T(K) = R_i\left(P^*\left(w_1^T(K), w_2^T(K)\right)\right) - \frac{1}{2}\left(\Pi\left(w_1^T(K), w_2^T(K)\right) - K\right)$. The existence of such an equilibrium requires that the realized industry profits, $\Pi\left(w_1^T(K), w_2^T(K)\right)$, are larger than $K$. Note further that the wholesale price $w_i^T(K)$ is monotonically increasing in $K$ as:

$$\frac{\partial}{\partial K}\left\{\Pi\left(w_1^T(K), w_2^T(K)\right) - 2\pi_j^D\left(w_i^T(K), w_j^{BR}(w_i^T(K))\right) + K\right\} > 0$$

holds everywhere. The equilibrium gross industry surplus is, thus, increasing in $K$.

Obviously, slotting allowances emerge in equilibrium when the wholesale prices lead to upstream flow profits exceeding $K$. Then, the common supplier has to transfer rents to the retailers by lump-sum payments inducing a negative fixed fee. This allows wholesale prices to be higher under two-part tariff contracts than under linear contracts. Under linear tariffs, the upstream firm charges the lowest possible wholesale price to its buyers as there is no second instrument to transfer rents between the vertically related firms. This finding contradicts the general presumption that non-linear contracts are more efficient than linear contracts in vertical relations.

However, if slotting allowances are banned, the common supplier cannot transfer rents to the retailers by lump-sum payments. In this case, if the ban is binding, the wholesale prices are the same under both contracting regimes. If the ban is not binding, wholesale prices under two-part tariffs undercut the wholesale prices under linear tariffs as the upstream gross profit plus the fixed fees are used to cover the fixed cost. Our results can be summarized as follows:

**Proposition 2** *Industry monopolization arises as an equilibrium outcome whenever $K \geq \widetilde{K}$. For $K = \widetilde{K}$, there exists a unique equilibrium; while for $K > \widetilde{K}$, there exist multiple equilibria with alternative sharing rules. For lower values of $K$, i.e., $K < \widetilde{K}$, industry monopolization is not an equilibrium outcome. The equilibrium wholesale price $w^T(K)$ satisfies:*

$$2\pi^D\left(w^T(K), w^{BR}(w^T(K))\right) - \Pi\left(w^T(K), w^T(K)\right) = K$$

*to avoid unilateral deviation. Existence of such an equilibrium requires $K \leq \Pi\left(w^T(K), w^T(K)\right)$.*

[16] We can define other potential equilibria based on different sharing rules of the industry profits where non-deviation of retailers is ensured. However, these potential equilibria are strictly pareto-dominated by the presented equilibrium, in which the fixed costs are equally shared between retailers.

## 5 Example: Linear demand

To illustrate our results, we apply linear demand functions and set the supplier's marginal cost of production to zero, i.e., $c = 0$. Consistent with our assumptions, the inverse demand functions $P_i(q_1, q_2)$ are given by:

$$P_i(q_1, q_2) = 1 - q_i - \beta q_j,\ i = 1, 2,\ j \neq i, \tag{10}$$

where $\beta \in (0, 1)$ indicates how substitutable the retailers are from a consumer perspective. The higher $\beta$ the higher the degree of substitutability. Solving the system of inverse demand functions (see (10)), we get the following demand functions:

$$D_i(p_1, p_2) = \frac{1}{1+\beta} - \frac{1}{1-\beta^2}p_i + \frac{\beta}{1-\beta^2}p_j.$$

The retailers set their prices so as to maximize their profits, which yields:

$$P_i^*(w_1, w_2) = \frac{2(1+w_i) + \beta w_j - \beta(1+\beta)}{4-\beta^2}.$$

In the following, we derive the wholesale prices under the two different contracting regimes. Note as a benchmark that the monopoly industry outcome is sustained for $w^M = \beta/2$ implying a monopoly industry profit of:

$$\Pi(w_1^M, w_2^M) = \Pi^M = \frac{1}{2(1+\beta)}.$$

**Linear contracts.** Note first that the equilibrium wholesale price equals marginal cost if the fixed cost equals zero, i.e., $w^L = 0$ for $K = 0$. Using our assumptions and applying condition (7), the equilibrium wholesale price for linear contracts is given by:

$$w^L(K) = \frac{1}{2}\left(1 - \sqrt{1 - 2K\left(2 + \beta - \beta^2\right)}\right) \lesseqqgtr w^M.$$

That is, the common supplier that delivers to the two retailers always makes zero profit. Correspondingly, the wholesale price $w^L$ exceeds the wholesale price $w^M$ that ensures the monopoly outcome for:

$$K > \widehat{K} := \textstyle\sum_{i=1}^2 (w_i^M - c) D_i(P^*(w_1^M, w_2^M)) = \frac{\beta}{2+2\beta}.$$

Note that the maximum cost that can be afforded is given by:

$$\overline{K} := \max_{w_i, w_j} \textstyle\sum_{i=1}^2 (w_i - c) D_i(P) = \frac{1}{4+2\beta-2\beta^2}.$$

That is, in the interval $K \in (\overline{K}, \Pi^M]$, the supplier's flow profit never covers the fixed cost, so that trade can never occur. Because of the double marginalization problem, a fixed cost larger than $\overline{K}$ can never be covered.

Figure 1 illustrates the equilibrium outcomes under linear contracts depending on the value of $K$ and the product differentiation parameter $\beta$. In the interval $[0, \overline{K}]$, a trade-equilibrium exists: while in the interval $[\widehat{K}, \overline{K}]$, the fixed cost is so high that the equilibrium wholesale price exceeds the industry maximizing wholesale price, for $K < \widehat{K}$, however, the wholesale price is below the industry maximizing level.

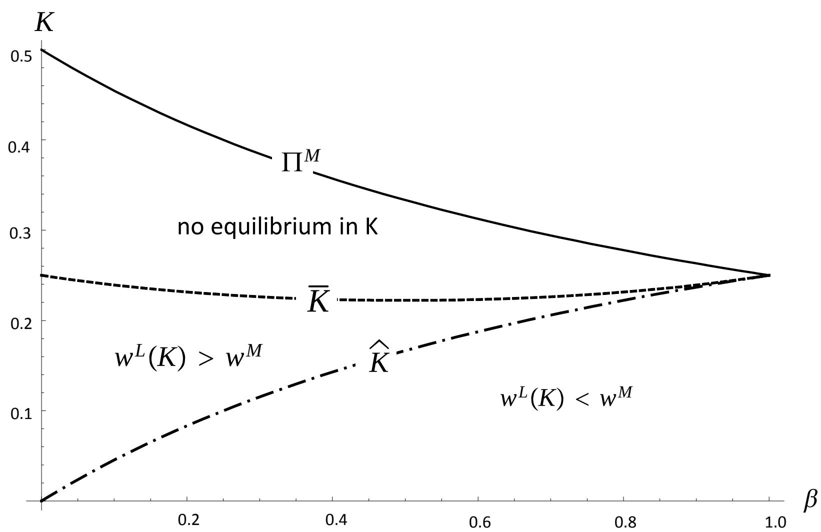


Figure 1: Equilibria under Linear Tariffs

As illustrated in Figure 2,[17] the retail prices are increasing in $K$. A sufficiently high fixed cost causes a price increase of more than one-half compared to a case where no fixed costs are incurred by the upstream firm. Interestingly, a higher degree of downstream competition tends to raise the final product price for a given value of the upstream firm's fixed costs $K$.

[17]We restrict attention to values of $K$, which are lower than the equilibrium industry surplus for $K = 0$, i.e., $\Pi(0, 0)$.

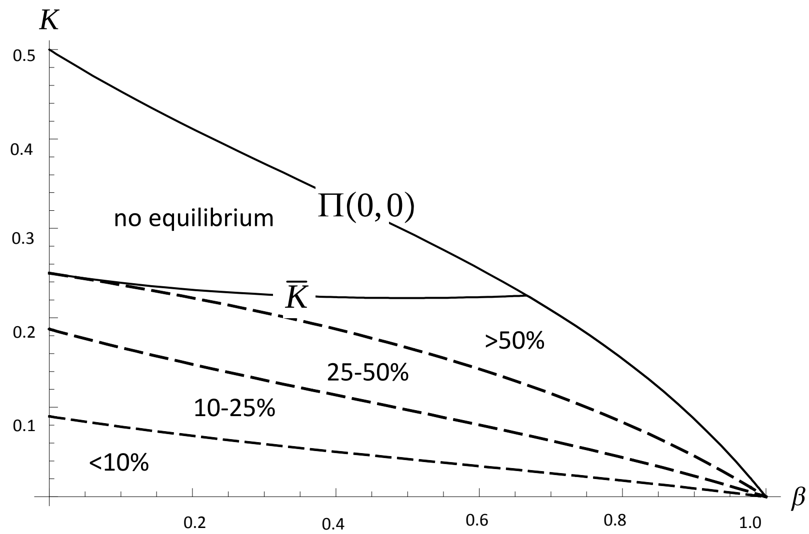


Figure 2: Comparison of Retail Prices for $K > 0$ and $K = 0$

under Linear Tariffs

**Two-part tariff contracts.** We first determine the deviation profit of a retailer when it purchases from another supplier. The best alternative offer of a rival supplier maximizes the deviating retailer's profit, taking the wholesale price of the other supplier-retailer pair as given. Let us define the wholesale price of the deviating supplier-retailer pair as:

$$w_j^{BR}(w_i^M) := \arg\max_{w_j} \left\{ \left(P^*\left(w_i^M, w_j\right) - c\right) D_j \left(P^*\left(w_i^M, w_j\right)\right) \right\}.$$

The solution to this maximization problem is given by:

$$w_j^{BR}(w_i^M) = \frac{\beta^2\left(4 - 2\beta - \beta^2\right)}{8\left(2 - \beta^2\right)}.$$

The corresponding retailer profit is given by:

$$\pi_j^D(w_i^M, w_j^{BR}(w_i^M)) = \frac{\left(4 - 2\beta - \beta^2\right)^2}{32\left(2 - 3\beta^2 + \beta^4\right)}.$$

Thus, we get monopolization of the industry profit if:

$$K \geq \widetilde{K} := 2\pi_j^D(w^M, w_j^{BR}(w_i^M)) - \Pi\left(w^M, w^M\right) = \frac{\left(4 - 2\beta - \beta^2\right)^2}{16\left(2 - 3\beta^2 + \beta^4\right)} - \frac{1}{2\left(1 + \beta\right)}.$$

The more substitutable the products are, the more profitable is the deviation strategy; thus, to prevent unilateral deviation $K$ has to be sufficiently large. In other words, $\widetilde{K}$ is increasing in

$\beta$ (see Figure 3). Note that for $K > \widehat{K}$, the retailers have to pay a transfer to the supplier to fulfill its participation constraint.

If the monopoly industry outcome cannot be sustained because of unilateral deviation, i.e. $K < \widetilde{K}$, the equilibrium wholesale prices are implicitly given by:

$$\pi^D\left(w^T(K), w^{BR}(w^T(K))\right) - K = \frac{1}{2}\left(\Pi\left(w^T(K), w^T(K)\right) - K\right),$$

which implies the following equilibrium wholesale prices:

$$w^T(K) = \frac{4\beta^2 - 6\beta^3 + \beta^4 + \beta^5 + 2\sqrt{K(8 - 8\beta + \beta^3)^2(2 - 3\beta^2 + \beta^4)}}{(4 - 2\beta - \beta^2)^2}.$$

We get slotting allowances if:

$$K > \widehat{K}' := 2(w^T(K) - c)D_i(P^*(w^T(K), w^T(K))).$$

This is an equilibrium as long as the respective industry profit exceeds $K$, which holds for all $K < \overline{K}'$. The critical value $\overline{K}'$ is given by $\Pi\left(w\left(\overline{K}'\right), w\left(\overline{K}'\right)\right) = \overline{K}'$.

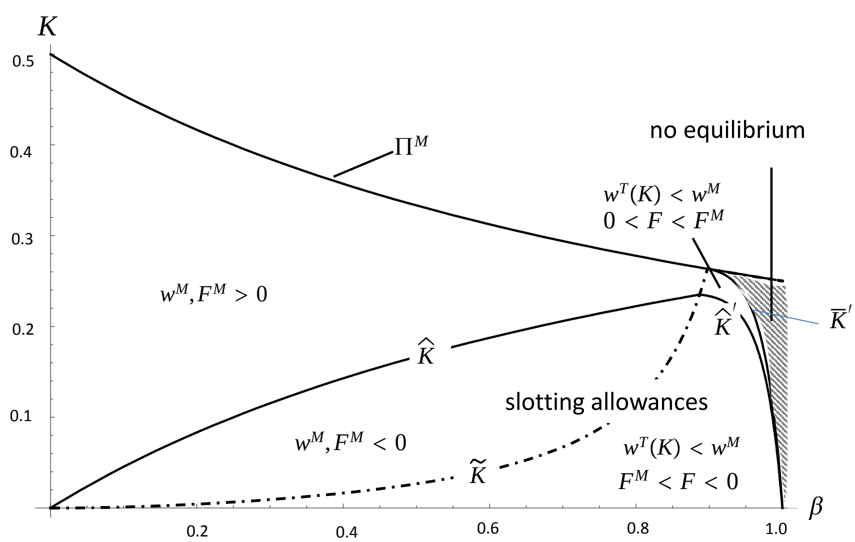


Figure 3: Equilibria under Non-linear Tariffs

Based on our results, we assess the impact of the fixed costs on retail prices (see Figure 4). We find that the implications of $K$ are less severe the more differentiated the products are whenever downstream monopolization is feasible. Otherwise, we obtain similar results as under linear contracts.

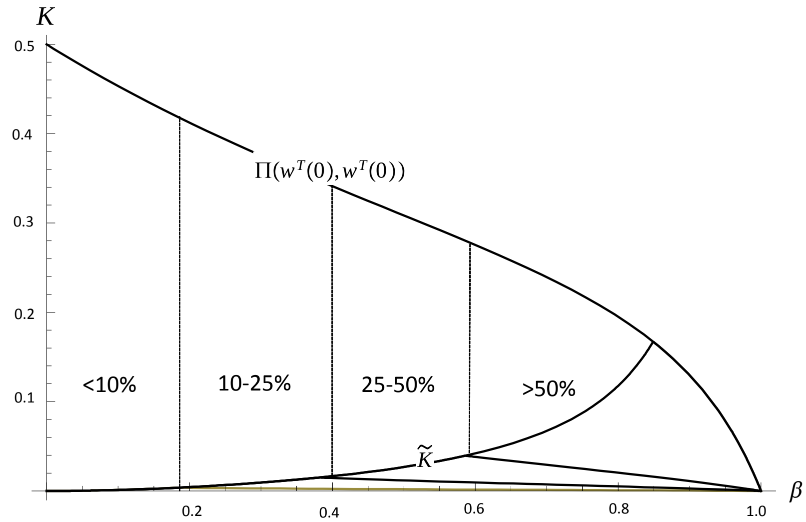


Figure 4: Comparison of Retail Prices for $K > 0$ and $K = 0$ under Non-linear Tariffs

## 6 Discussion

Our results are derived under various assumptions, which we discuss in the following.

**Public vs. Secret Contracts.** The previous analysis relies critically on the ability of a given retailer to observe the details of its rival retailer's contract. Otherwise, suppliers had an incentive to behave opportunistically to the detriment of downstream retailers. Under secret contracts, wholesale prices, therefore, equal marginal cost of production and fixed fees are used to cover the fixed cost. The existence of an equilibrium is only guaranteed for $K < \Pi(c, c)$. It follows that fixed costs have no impact on retail prices with secret two-part tariffs. In the linear tariffs' case, the analysis is unchanged because opportunistic behavior of the common upstream firm is not an issue.

**Cournot Competition.** So far, we have assumed that the downstream firms compete in prices. Thereby, the best response to an increasing price of the rival is to charge a higher price in equilibrium, i.e., prices are strategic complements.[18] Previous literature on vertical delegation

[18] See Vives (1999) for a characterization of the conditions under which firms' decisions are strategic complements

is based on this strategic complementarity (Bonanno and Vickers 1988, Rey and Stiglitz 1988, Shaffer 1991 and Caillaud and Rey 1995 for a review of this literature). In contrast to their findings, our results with regard to the anti-competitive effects are robust to the nature of downstream competition. Particularly, we can show that they also hold when downstream decisions are strategic substitutes.

Consider the same industry structure as above and a simple linear demand for perfect substitutes with $P(Q) = 1 - Q$, where $Q = q_1 + q_2$ indicates the sum of quantities offered in the downstream market. As previously, we assume $c = 0$. Both retailers maximize their profits by setting a quantity $q_i = (1 - 2w_i + w_j)/3$, for $i = 1, 2$, $j \neq i$. The equilibrium wholesale prices under linear contracts are given by $w^L(K) = \frac{1}{2}(1 - \sqrt{1 - 6K})$. We get that $w^L(K)$ is larger than the monopoly wholesale price which is $w^M = 1/4$ for $K > \widehat{K} := 1/8$. The existence of equilibria is guaranteed for $K < \overline{K} := 2/9$.

In the case of two-part tariff contracts, we get monopolization of the industry profit for $K \geq \widetilde{K} := 7/72$. For $K < \widetilde{K}$, we obtain:[19]

$$w^T(K) = -1 + \frac{3}{2}\sqrt{\frac{1}{2} + 2K}.$$

Furthermore, the comparison of wholesale prices shows that the selected supplier pays slotting allowances for all $K < \widehat{K} := 1/8$. Figure 5 depicts the equilibrium wholesale prices under

or substitutes for both Bertrand and Cournot competition.

[19] We get $w_j^{BR}(w_i) = 0$ for any $w_i$.

Cournot competition for linear contracts and two-part tariff contracts.

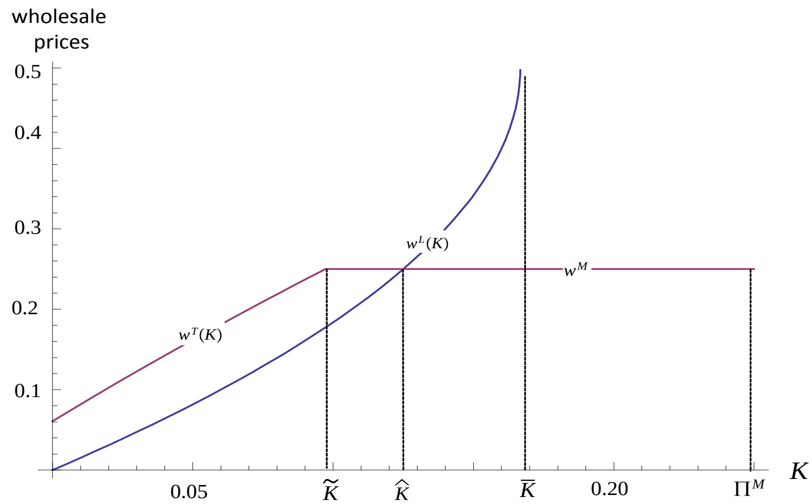


Figure 5: Equilibrium Wholesale Prices under Cournot Competition

# 7 Conclusion

The literature on vertical contracting suggests that upstream fixed costs do not affect the market outcome. This is true for the case of an upstream monopolist that contracts with two competing (differentiated) downstream firms under complete information. The supplier can specify two-part tariffs with fixed fees that are set so as to extract all the downstream surplus, while wholesale prices are used to maximize industry profits. Hence, the contracting outcome is independent of the supplier's fixed costs. A similar reasoning applies to linear tariffs. As the supplier aims at maximizing its profit, upstream fixed costs do not affect the market outcome as long as the upstream profits are large enough to cover the fixed costs.[20] In contrast to the existing literature, this article offers an alternative view. Upstream fixed costs may help to dampen downstream competition and as a result consumer surplus may decrease.

Considering a vertical setting with a perfectly competitive upstream market and assuming that vertical contracting is based on two-part tariffs, upstream fixed costs may enable competing

[20] In the case of two upstream firms contracting with a downstream monopolist, market outcomes are also independent of upstream fixed costs in both vertical contracting forms (i.e. two-part tariffs or linear tariffs).

(differentiated) downstream firms to monopolize the market. The reason is that upstream fixed costs induce the retailers to buy from a common supplier. This enables each of them to avoid bearing the entire fixed cost, which would be the case when contracting with an alternative supplier. Even if the retailer's incentive to deviate with an alternative supplier in order to free-ride on the contract of its competing retailer still remains an issue, we show that a sufficiently high fixed cost do not allow for such a deviation. As a consequence, monopolization of the industry is an equilibrium for a high enough fixed cost in two-part tariff contracting. For a lower fixed cost, retail prices are still larger than in the absence of fixed costs because contracting with an alternative supplier is always more costly than contracting with the same supplier.

In the case of linear tariffs, retail prices are also increasing in the upstream fixed cost. The reason is that wholesale prices have to increase in the fixed upstream cost in order to enable the upstream firm of covering its cost since there are no fixed fees allowing to redistribute rents between the downstream and the upstream firms. In sum, upstream fixed costs raise retail prices when there is both intra- and interbrand competition.

Our results imply that upstream fixed costs which may result from various regulations such as consumer protection policies, are neither neutral for retail pricing nor less worrisome than other changes in marginal costs. To the contrary, the predicted outcome can be even more detrimental to final consumers than changes in marginal costs. In our setting, rising marginal costs lead to higher retail prices without changing the intensity of downstream competition. The existence of upstream fixed costs, instead, may enable the monopolization of the downstream market. Accordingly, the potential benefits of various regulations implying fixed upstream costs are less clear than expected from a consumer perspective. Our analysis provides a framework which can be used to test empirically these impacts.

## References


Antle, J. A. (2000). No Such Thing as a Free Safe Lunch: The Cost of Food Safety Regulation in the Meat Industry. *American Journal of Agricultural Economics* 82: 310-322.

Bain, L. and Busch, C. (2004). New! Improved? The Transformation of the Global Agrifood System. *Rural Sociology* 69 (3): 321-346.

Bazoche, P., Giraud-Héraud, E., Soler, L.G. (2005). Premium Private Labels, Supply Contracts, Market Segmentation, and Spot Prices. *Journal of Agricultural & Food Industrial Organization* vol.3: n°1: Article 7.

Bonanno, G. and Vickers, J. (1988). Vertical Separation. *Journal of Industrial Economics* 36: 257-265.

Bonnet, C. and Dubois, P. (2010). Inference on Vertical Contracts between Manufacturers and Retailers Allowing for Nonlinear Pricing and Resale Price Maintenance. *RAND Journal of Economics* 41(1): 139-164.

Caillaud, B. and Rey, P. (1995). Strategic Aspects of Vertical Delegation. *European Economic Review* 39: 421-431.

Giraud-Héraud, E., Rouached, L., and Soler, L.-G (2006). Private Labels and Public Quality Standards: How Can Consumer Trust be Restored After the Mad Cow Crisis? *Quantitative Marketing and Economics* 4(1): 31-55.

Hoffmann, S. (2010). Food Safety Policy and Economics. A Literature Review. Resources of the Future Discussion Paper RFF DP 10-36. Available at: www.rff.org/documents/ RFF-DP-10-36.pdf.

Inderst, R. and Shaffer, G. (2010). Market-share Contracts as Facilitating Practices. *RAND Journal of Economics* 41(4): 709-729.

Inderst, R. and Shaffer, G. (2009). The Role of Buyer Power in Merger Control. In: ABA Section of Antitrust Law (ed.). Issues in Competition Law and Policy, 2009: 1611-1635.

ISO (2012). The ISO Survey of Management System Standard Certifications – 2012. Available at: http://www.iso.org/iso/iso_survey_executive-summary.pdf (April 4, 2014).

Kariuki, I. M., Loy, J.-P. and Herzfeld, T. (2012). Farmgate Private Standards and Price Premium: Evidence from the GlobalGAP Scheme in Kenya's French Beans Marketing. *Agribusiness* 28: 42-53.

Lee, D. R. (2005). Agricultural Sustainability and Technology Adoption: Issues and Policies for Developing Countries. *American Journal of Agricultural Economics* 87: 1325-1334.

Miklós-Thal, J., Rey, P. and Vergé, T. (2011). Buyer Power and Intrabrand Coordination. *Journal of the European Economic Association* 9(4): 721-741.

Ragasa, C. Thornsbury, S. and Joshi, S. (2011). Are Food Certification Costs Misestimated? Exporter-Perspective on the European Standard. *Journal of Agricultural Economics* 62(3): 669-689.

Rey, P., and Stiglitz, J. E. (1988). Vertical Restraints and Producers' Competition. *European Economic Review* 32(2-3): 561-568.

Rey, P., and Vergé, T. (2008). Economics of Vertical Restraints. In: Buccirossi, P. (ed.). *Handbook of Antitrust Economics*. The MIT Press: 353-390.

Rey, P. and Whinston, M. (2013). Does Retailer Power Lead to Exclusion? *RAND Journal of Economics* 44(1): 75-81.

Schutz, N. (2012). Competition with Exclusive Contracts in Vertically Related Markets: An Equilibrium Non-Existence Result, mimeo.

Shaffer, G. (1991). Slotting Allowances and Resale Price Maintenance: A Comparison of Facilitating Practices. *RAND Journal of Economics* 22(1): 120-135.

Villas-Boas, S. (2007). Vertical Relationships between Manufacturers and Retailers: Inference with Limited Data. *Review of Economic Studies* 74(2): 625-652.

Vives, X. (1999). Oligopoly Pricing. MIT Press.

von Schlippenbach, V., and Teichmann, I. (2012). The Strategic Use of Private Quality Standards in Food Supply Chains. *American Journal of Agriculture Economics* 94(5): 1189-1201.