Vertical Restraints under Asymmetric Information: On the Role of Participation Constraints*

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Abstract

We investigate the impact on optimal contracting of a type-dependent reservation utility within a sequential monopolies environment with adverse selection and moral hazard. The welfare and private properties of contracts controlling both the retail price and the sales level are compared with those restricting only sales. When contracts are chosen non-cooperatively and the retailer's reservation utility severely affects the agency conflict between an upstream supplier and a downstream retailer, retail price restrictions are shown to be optimal from the supplier viewpoint but detrimental to consumers. When contracts are chosen cooperatively, retail price restrictions fail to maximize joint-profit whenever the reservation utility has a negligible impact on the design of optimal contracts. In constrast to the Chicago view, a *laissez faire* policy turns out not to be optimal in many realistic circumstances.

Keywords: asymmetric information, countervailing incentives, double marginalization, resale price maintenance, vertical restraints, welfare.

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I. INTRODUCTION

THIS PAPER STUDIES THE SOCIAL AND PRIVATE INCENTIVES to exert vertical control within a sequential monopolies model with asymmetric information. In a framework where the retailer is privately

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informed about local market conditions, we illustrate the effects of external factors, such as the intensity of upstream competition and the multimarket nature of retailing activities, on the agency relationship between vertical related firms.[1] We show that these external factors drive a countervailing incentives issue giving rise to an *overproduction* effect which mitigates the standard double marginalization phenomenon induced by rent extraction. More precisely, depending upon the strength of such effect, novel welfare implications on the social desirability of vertical price fixing arise. Our results confirm that no simple conclusions can be drawn on whether any particular type of restraint is *per se* pro- or anti-competitive.[2]

Vertical contracts are likely to be affected by other factors than those arising within an isolated principal-agent relationship in many interesting circumstances. First, when a downstream firm has limited production and retailing resources, serving a particular brand or product on a larger market might have negative spillovers on his other market activities. This creates an implicit retailing cost that must be taken into account at the time contracts are designed. Second, when upstream suppliers compete for signing an exclusive dealing with the downstream firm, exclusivity clauses prevent the retailer from exploiting valuable trading opportunities. This effect weakens suppliers bargaining power in so far as the offer made by one supplier determines the retailer's reservation utility in the negotiation process with other suppliers (see for instance Jullien [1996, 2000]). Third, a retailer's type-contingent reservation utility may well capture entry or trading fixed costs incurred by the retailer when he has to specialize some assets before contracting with the upstream supplier. In our analysis these external factors are modeled by introducing a retailer's outside option in the form of a type-dependent participation constraint. In this context our main objective is to compare two alternative contracts that may regulate the terms of trade between an upstream supplier and a privately informed downstream retailer. Under the first type of contract the supplier controls both the retail price and the sales level, while under the second only sales are contractible. These features capture some of the most significant real-life aspects of vertical contracting, and are intended to illustrate how retailers' outside options contribute to determine organization design in sequential monopolies when contractual choices are endogenous. Moreover, understanding this link allows us also to investigate important normative questions concerning the welfare effects of vertical price control. In fact, introducing a type-contingent reservation utility in our sequential monopolies model alters the basic trade-off determining the upstream supply and, in turn, generates non-trivial effects on the welfare properties of alternative contractual rules.[3] More specifically, we show that when firms choose contracts non-cooperatively, although being optimal from the supplier viewpoint, retail price restrictions might be detrimental to consumers. When the type-dependent reservation utility has a strong impact on the agency conflict, retail price restrictions are detrimental to consumers relative to contracts based only upon sales. The converse is true when the type-dependent reservation utility has a low impact on optimal contracting. This result confirms that the Chicago view (Spengler [1950] and Telser [1960] among many others), advocating for the lawfulness of retail price restrictions, no longer holds when upstream competitive pressure and/or resource constraints at the retail level influence the design of arrangements governing vertical transactions.

When contracts are chosen cooperatively, instead, we show that vertical price control does not necessarily maximize (constrained) joint-profit. More precisely, contracts based on retail price restrictions hamper vertical coordination whenever they significantly distort the retailers' service levels. In this case, the beneficial value of vertical control on productive efficiency is offset by its negative effect on retailer's promotional activities which significantly reduces consumers' willingness to pay relative to contracts based only on the sales level. In contrast to a standard double marginalization framework, in our set-up the objective of the integrated structure, i.e., the supplier-retailer coalition, is not always aligned with that of consumers, and the *laissez faire* regime supported by the Chicago view turns out to be inappropriate.[4]

The rest of the paper is organized as follows. Section II sets up the model while Section III briefly examines the complete information benchmark. Section IV introduces asymmetric information and Section V develops our welfare analysis. Finally, Section VI concludes. All proofs are relegated to the Appendix.

II. THE MODEL

Environment and assumptions: Consider an upstream monopolist selling a raw input to a downstream monopolistic retailer who exploits a one-to-one technology to recover a final good, whose (inverse) demand is linear, $p(q, \theta, e) = \max\{0, \theta + e - q\}$.[5] Marginal costs are normalized to zero for both the upstream and downstream production technologies and, as usual, we assume that both firms are risk neutral. Consumers' demand is decreasing in the final price, p, depends on an unverifiable activity (effort), e, performed by the retailer and on the realization of the random variable θ.

The variable e captures specific investment in advertising or supply of indivisible services jointly consumed with the final good.[6] Providing effort is costly and $\psi(e)$ denotes an increasing, strictly convex, and three times differentiable disutility function. In particular, to disentangle the effects of type-dependent participation constraints on the welfare properties of both contractual modes, we consider the standard quadratic specification $\psi(e) = e^2/2$. In such a *cutting-edge* case Martimort and Piccolo [2006a] show that both types of contracts imply the same level of consumers' surplus when the reservation utility is non type-dependent.[7] Therefore, the welfare results obtained in the present paper will be only driven by the presence and the relative magnitude of the retailer's reservation utility. The term θ captures the consumers' willingness to pay or the market size; its realization is observed only by the retailer.[8] We assume that θ distributes uniformly on the compact support $\Theta \equiv [\theta_l, \theta_h]$, with $\Delta\theta \equiv \theta_h - \theta_l > 0$. Moreover, we normalize $\theta_l = 1$ and assume $\theta_h \leq 3/2$ in order to guarantee interior solutions. Finally, we denote with $F(\theta) = (\theta - 1)/\Delta\theta$ the cumulative distribution function and with $f(\theta) = 1/\Delta\theta$ its density.[9]

The retailer's outside option is captured by introducing an increasing and weakly convex reservation utility, $v(\theta)$.[10] These assumptions appear to be fairly realistic in our environment. For instance, in the case of a multimarket retailer subject to limited production and retailing resources, a linear $v(\theta)$ captures the idea that distributing one product on a larger market forces the retailer to reduce his activity on other sides.[11] Alternatively, if the reservation utility is interpreted as the outside option given up by a retailer signing an exclusive contract with a supplier, assuming a quadratic $v(\theta)$ turns out to be appropriate. In fact, in this case retailers serving larger markets are assumed to have better job opportunities as some competing suppliers may want to offer more profitable contractual terms in order to convince them to distribute their own brands (Jullien [1996, 2000]). Furthermore, when the retailer prefers one of the competing suppliers, perhaps because of localization and transportation factors, then a competing supplier would be willing to leave to the retailer the entire complete information surplus, which would be quadratic in θ under the above assumptions.[12]

For the sake of simplicity, in the following we assume $v(\theta) = \alpha\theta$. However, the same qualitative results obtain in the case of a quadratic reservation utility.[13]

Mechanisms: We invoke the *Revelation Principle* to describe the set of incentive feasible allocations.[14] As standard, a communication stage between the upstream supplier (principal) and the downstream firm (agent) is played before production occurs. At this stage the informed agent delivers to the uninformed principal a message, $\widehat{\theta} \in \Theta$, about the realized state of demand. Given this message, the supplier proposes a contract specifying, for any $\widehat{\theta}$, both a quantity, a fixed fee and, possibly, a retail price restriction in the form of a price *target*.

Let $\mathcal{M} \equiv \{QF, RPM\}$ define the space of deterministic and piecewise differentiable direct truthful revelation mechanisms. The supplier can commit to a *restricted mechanism*, $QF \equiv \left\{q(\widehat{\theta}), t(\widehat{\theta})\right\}_{\widehat{\theta}\in\Theta}$, where $q(\widehat{\theta})$ and $t(\widehat{\theta})$ define a quantity and an up-front transfer, respectively. Alternatively, she might propose an *unrestricted mechanism*, $RPM \equiv \left\{p(\widehat{\theta}), q(\widehat{\theta}), t(\widehat{\theta})\right\}_{\widehat{\theta}\in\Theta}$, which specifies also a retail price target besides a quantity and a transfer.[15] With a little abuse of language we shall label the former mechanism as *"quantity fixing"*, whereas the latter one will be referred to as *"resale price maintenance"*.

Noteworthy, a QF arrangement is equivalent to a *vertically decentralized* organizational structure. The supplier does not have enough instruments to monitor the promotional activity exerted by the retailer so that the vertical externality created by the effort choice cannot be fully internalized. On the other side, RPM replicates the constrained *vertical integration* outcome, since, by dictating the retail price and the quantity sold to the retailer, the supplier is able to *control directly* the retailer's effort level.

Timing: Once a contracting mode is chosen, the game unfolds as follows,

- $\mathbf{t = 1}$: the uncertainty about demand realizes and only the retailer observes the realization of θ;
- $\mathbf{t = 2}$: the supplier makes a take-it or leave-it offer to the retailer according to the chosen contracting mode;
- $\mathbf{t = 3}$: the retailer accepts or refuses this offer. If he accepts the trading terms, then effort is exerted, production occurs and, finally, payments are made according to the chosen contractual regime. If

trading terms are rejected, each party receives his outside option which is normalized to zero for the supplier and set to $v(\theta)$ for a generic type θ retailer.

III. THE COMPLETE INFORMATION BENCHMARK

When the supplier observes the realization of the demand uncertainty both mechanisms leave the retailer with no surplus, they achieve the integrated monopoly profit and deliver the same level of social welfare. As a consequence, antitrust policy banning retail price restrictions should not have effects on welfare provided that contracts involving up-front fixed fees are enforceable. The underlying intuition is that risk neutrality and complete information altogether allow the upstream producer to achieve full surplus extraction simply by means of a type-contingent lump sum transfer, regardless of the type of instruments used to design the optimal contract. In fact, one can immediately verify that the two types of contracts entail the same levels of output, retail price, and effort.[16]

Proposition 1 *The allocation* $p^*(\theta) = q^*(\theta) = e^*(\theta) = \theta$ *is achieved under both contractual regimes.*

The welfare equivalence between contracts based on retail price control and those that do not impose this type of restriction thus holds with complete information (Tirole [1988], chapter 4). In the next section we shall prove that this result drastically changes under asymmetric information and type dependent participation constraints.

IV. ASYMMETRIC INFORMATION

When the supplier does not observe the realization of the uncertainty about demand, the agency problem may not satisfy the usual monotonicity property of the information rent, i.e., a standard requirement of the implementability theorems. More specifically, within the present framework, any direct truthful revelation mechanism must take into account that low-demand types may want to mimic high-demand ones as this would signal a higher reservation utility and thus command more favorable contractual terms. The retailer's incentive to misrepresent his type at the revelation stage is thus determined by two conflicting effects:

- When the reservation utility has a negligible impact on the revelation constraints, a retailer has an incentive to *understate* his type in so far as it is profitable, when demand is high, to claim that large sales are due to high effort: *a standard mimicking effect.*
- By *overstating* his type, a retailer may however persuade the supplier to give up more information rent simply because his reservation utility is an increasing function of θ: *an outside option effect.*

In order to minimize the information rent given up to the agent, the principal must internalize the tension between these effects in designing the optimal contract. As a result, depending on the steepness of $v(\theta)$ several cases of interest will occur.[17] In general, participation constraints bind for some but not all types under both contractual regimes. Moreover, the information rent granted to the retailer and the measure of the subset of types whose participation constraints bind crucially depend on the chosen contractual mode. More importantly, besides displaying a no-rent region, the optimal contract exhibits overproduction for certain demand realizations in order to make low-demand types unwilling to mimic high-demand ones. This result will be crucial for our welfare analysis; indeed, such an overproduction effect mitigates the double marginalization phenomenon obtained in the region of types whose information rent is increasing in θ.

IV(i). *Resale Price Maintenance*

Under an RPM regime the upstream supplier controls both the retail price and the sales level, hence effort is the main screening device. In particular, when the retailer is privately informed about θ, vertical price control allows a supplier to internalize the vertical externality created by the effort component in the retail demand. In this case, the retailer cannot exploit his informative advantage at the revelation stage and the moral hazard problem is neutralized.[18] However, since the hidden information problem allows high-demand types to mimic low-demand ones, the principal is still forced to give up some rents to foster separation of types.

Since we focus on truthful direct revelation mechanisms, by definition of incentive compatibility the retailer's utility will be given by:

$$u(\theta) = \max_{\widehat{\theta}\in\Theta} \left\{ -t(\widehat{\theta}) - v(\theta) + p(\widehat{\theta})q(\widehat{\theta}) - (p(\widehat{\theta}) + q(\widehat{\theta}) - \theta)^2/2 \right\}.$$

Formally, the principal's problem, $\mathcal{P}^R$, is to design a menu of contracts $\{p(\theta), q(\theta), t(\theta)\}_{\theta\in\Theta}$ so to maximize the expected transfer, $\int_{\theta_l}^{\theta_h} t(\theta)dF(\theta)$, subject to the following constraints defining the incentive feasible allocations for each retailer with type θ:[19]

$$\text{(PC)} \quad u(\theta) \geq 0,$$

$$(\text{IC}_1) \quad \dot{u}\,(\theta) = -\dot{v}(\theta) + p(\theta) + q(\theta) - \theta,$$

$$(\text{IC}_2) \quad \dot{p}(\theta) + \dot{q}(\theta) \geq 0,$$

$$e(\theta) \geq 0,\ q(\theta) \geq 0,\ p(\theta) \geq 0,$$

where PC defines a participation constraint accounting for the reservation utility, while IC_1 and IC_2 denote the first-order and second-order local incentive compatibility constraints, respectively.

Within this setting, the agent's mimicking strategy at the revelation stage is determined by the rate at which the information rent varies across types, that is by $\dot{u}(\theta)$. More precisely, whenever the outside option effect is relatively weaker than the standard mimicking effect, that is for all θ such that $\dot{u}(\theta) > 0$, the retailer prefers to understate his type. In this case, the principal is forced to give up positive information rents to high-demand types, the sales level and the effort are thus distorted *downward*, and a double marginalization result holds. Differently, if the outside option effect is strong enough, that is for all θ such that $\dot{u}(\theta) < 0$, the retailer has an incentive to overstate his type. Now, the rent-extraction efficiency trade-off entails an *upward* distortion of both sales and effort levels, and positive rents are distributed to low-demand types. In this case, the optimal contract yields an overproduction result which mitigates the double marginalization effect emerging for those types who under-report the realized demand intercept. Of course, when these effects balance out, that is when the realizations of θ are such that $\dot{u}(\theta) = 0$, the participation constraint binds and all such types get exactly their outside option.

In the following we solve an auxiliary program neglecting both the IC_2 and the non-negativity constraints, that is $\max_{\{p(.),q(.),u(.)\}} \int_{\theta_l}^{\theta_h} t(\theta)dF(\theta)$ s.t., PC-IC_1, and then check that the solution of this program also optimizes $\mathcal{P}^R$.

Let $\mathcal{H}(\theta, p(\theta), q(\theta), \mu(\theta), u(\theta))$ denote the Hamiltonian below:

$$\mathcal{H}(.) \equiv (p(\theta)q(\theta) - e(\theta)^2/2 - v(\theta) - u(\theta))f(\theta) + \mu(\theta)(p(\theta) + q(\theta) - \theta - \dot{v}(\theta)).$$

Since $\mathcal{P}^R$ includes a pure state constraint, the solution of the auxiliary program must maximize the Lagrangian $\mathcal{L} \equiv \mathcal{H}(.) + \tau(\theta)u(\theta)$, where $\tau(\theta)$ denotes the shadow value of the participation constraint, that is the multiplier associated to $u(\theta) \geq 0$. The first-order necessary conditions with respect to $p(\theta), q(\theta)$ and $u(\theta)$ are, respectively:

(1) $$(\theta - p(\theta))f(\theta) + \mu(\theta) = 0,$$

(2) $$(\theta - q(\theta))f(\theta) + \mu(\theta) = 0,$$

(3) $$\dot{\mu}(\theta) = f(\theta) - \tau(\theta).$$

In addition to equations (1)-(3), few more technical requirements (i.e., slackness and transversality conditions) discussed in the appendix must be satisfied at the optimum.

Equations (1) and (2) above imply that, at the optimum, marginal (virtual) revenue is equated to the marginal cost of production, the latter being normalized to zero. The multiplier $\mu(\theta)$ is the shadow value of the rate at which the information rent varies with respect to θ; thus it captures the extra marginal cost introduced by information revelation. More precisely, when $\mu(\theta) < 0$ the retailer has an incentive to understate his type and the supplier distorts downward the output. However, when the outside option effect is strong enough and the retailer overstates his type, then output must be upward distorted in order to make the allocation offered to high-types less attractive to low-types. In this case $\mu(\theta) > 0$ and an *overproduction* result pushes up the output schedule relative to the complete information level. It is important to observe that under an RPM regime the only screening instrument is effort, whereas output is chosen according to the monopoly condition $p(\theta) = q(\theta)$ for all θ as under complete information: a dichotomy result.[20]

Following standard techniques one can check that the optimal output schedule, $q^R(\theta)$, displays the following features:

$$q^R(\theta) = \begin{cases} 2\theta - 1 & \text{if} \quad \theta < \theta_1^R \equiv (2+\alpha)/3 \\ (\theta+\alpha)/2 & \text{if} \quad \theta \in \Theta_P^R \equiv [\theta_1^R, \theta_2^R] \\ 2\theta - \theta_h & \text{if} \quad \theta > \theta_2^R \equiv (2\theta_h + \alpha)/3 \end{cases}, \tag{4}$$

where it is immediate to show that the subset Θ_P^R is non-empty given that $\theta_h > 1$.[21] Figure 1 provides a graphical representation of the output schedule implemented in this case.

Place Figure 1 approximately here

It can be observed that when α lies within the interior of the types' support, the output schedule displays both types of distortions. Low-demand retailers, $\theta \leq \theta_1^R$, have an incentive to overstate their types, thereby output displays an upward distortion relative to the complete information level. This (information-based) overproduction result washes out the standard double marginalization effect. At the same time, high-demand retailers, $\theta \geq \theta_2^R$, have an incentive to understate their types, so they are forced to produce below the complete information level thus driving a double marginalization result. For moderate-demand types, $\theta \in \Theta_P^R$, the participation constraint binds due to low convexity of the utility profile. Interestingly, the optimal retail price schedule, $p^R(\theta)$, fits the evidence provided in Chevalier, Kashyap, and Rossi [2003] showing that retail prices fall on average when demand is large, i.e., high realizations of θ.[22] Finally, when the outside option effect is negligible, that is $\alpha \leq 1$, the optimal allocation exhibits downward distortion in the whole types' support since the standard incentive to understate the type dominates the effect of the reservation utility.[23]

IV(ii). *Quantity Fixing*

Under a QF regime the upstream supplier *does not observe* the (ex post) realization of the retail price. As a consequence, the output level represents the only screening device available to the supplier in order to induce types' separation. Differently from the RPM case, under this mechanism the supplier is unable to internalize the effect of the retailer's effort choice on the information rent.

As before, by definition of incentive compatibility the retailer's utility is given by:

$$u(\theta) = \max_{\widehat{\theta}\in\Theta} \left\{ -t(\widehat{\theta}) - v(\theta) + \max_{e\in\Re_+} \left\{ \left(\theta + e - q(\widehat{\theta})\right) q(\widehat{\theta}) - (e^2/2) \right\} \right\}.$$

Formally, the supplier's optimization problem, $\mathcal{P}^Q$, is to design a contract, $\{q(\theta), t(\theta)\}_{\theta\in\Theta}$, so to maximize the expected transfer, $\int_{\theta_l}^{\theta_h} t(\theta)dF(\theta)$, subject to participation, incentive compatibility and non-negativity constraints for each retailer with type θ:

$$\text{(PC)} \quad u(\theta) \geq 0,$$

$$(\text{IC}_1) \quad \dot{u}(\theta) = -\dot{v}(\theta) + q(\theta),$$

$$(\text{IC}_2) \quad \dot{q}(\theta) \geq 0,$$

$$q(\theta) \geq 0.$$

As in the case of RPM, any deviation by the agent at the revelation stage is determined by the rate at which the information rent varies across types, i.e., $\dot{u}(\theta)$. More precisely, for all θ such that $\dot{u}(\theta) > 0$, the outside option effect is sufficiently small relative to the standard mimicking effect, hence the retailer has an incentive to understate his type at the revelation stage. In this case, the output is downward distorted and high-demand types enjoy positive rents. Differently, when the outside option effect outweighs the standard mimicking effect, that is for all θ such that $\dot{u}(\theta) < 0$, the information rent is decreasing with respect to θ, and the retailer has an incentive to overstate his type. The rent-extraction efficiency trade-off then leads the supplier to distort upward the output, and low-demand types enjoy positive rents. Finally, for all θ such that $\dot{u}(\theta) = 0$, the participation constraint binds, the retailer gets his outside option and, under certain circumstances, a pooling solution emerges.

Differently from the RPM case, the effort distortion is now only indirectly induced by output through the optimality condition $\psi'(e(\theta)) = q(\theta)$. We solve an auxiliary program neglecting both IC_2 and the non-negativity constraints, that is $\max_{\{q(.),u(.)\}} \int_{\theta_l}^{\theta_h} t(\theta)dF(\theta)$ s.t., PC-IC_1. Let $\mathcal{H}(\theta, q(\theta), \mu(\theta), u(\theta))$ define the following Hamiltonian:

$$\mathcal{H}(.) \equiv (\theta q(\theta) - q(\theta)^2/2 - v(\theta) - u(\theta))f(\theta) + \mu(\theta)(q(\theta) - \dot{v}(\theta)).$$

The optimal allocation under QF must then be a maximizer of the Lagrangian $\mathcal{L} \equiv \mathcal{H}(.) + \tau(\theta) u(\theta)$, where $\tau(\theta)$ is the multiplier associated to the participation constraint. The first-order necessary and sufficient conditions, with respect to $q(\theta)$ and $u(\theta)$, are:[24]

$$(\theta - q(\theta))f(\theta) + \mu(\theta) = 0, \tag{5}$$

$$\dot{\mu}(\theta) = f(\theta) - \tau(\theta). \tag{6}$$

Notice that equation (5) equalizes (virtual) marginal revenue to marginal cost. When $\mu(\theta) > 0$ the retailer has an incentive to overstate his true type and overproduction obtains, the standard mimicking effect prevails otherwise. Importantly, since under a QF contract output is the only screening device, the dichotomy result no longer holds. Indeed, the level of output must be distorted away from the monopoly condition, $p(\theta) = q(\theta)$, for rent-extraction reason. In the case at hand one can easily check that the *rules* according to which output is chosen under QF and RPM boil down to the same equation. However, the two contracts turn out to be different because of the interplay between the dichotomy result (holding only under RPM) and the rate at which information rent varies when price control is given up.

The optimal allocation, $q^Q(\theta)$, exhibits the following features:

$$q^Q(\theta) = \begin{cases} 2\theta - 1 & \text{if} \quad \theta < \theta_1^Q \equiv (1+\alpha)/2 \\ \alpha & \text{if} \quad \theta \in \Theta_P^Q \equiv [\theta_1^Q, \theta_2^Q] \\ 2\theta - \theta_h & \text{if} \quad \theta > \theta_2^Q \equiv (\theta_h + \alpha)/2 \end{cases}, \tag{7}$$

where it is easy to check that the subset Θ_P^Q is non-empty. For α within the interior of the types' support, the rent-extraction efficiency trade-off entails downward distortion for high-demand types and upward distortion for low-demand types. In contrast to the RPM case, however, a pooling solution emerges since now moderate types, whose participation constraint binds, $\theta \in \Theta_P^Q$, produce the same output in the optimum.[25] As argued by Lewis and Sappington [1989a], this property captures some features of several contracting practices displaying *rules* rather than *discretion*.[26] Figure 2 provides a graphical representation of $q^Q(\theta)$.

Place Figure 2 approximately here

The presence of countervailing incentives mitigates the information-driven double marginalization effect. A natural question arises then as to whether, and to what extent the welfare results characterized in the previous literature are affected by the possibility of market and/or technological forces leading suppliers to design contracts involving forms of countervailing incentives. These issues will be addressed in the next section.

V. Welfare Analysis

This section illustrates two main welfare results. First, we show that retail price restrictions are detrimental to consumers when the impact of the reservation utility on optimal contracts is strong enough. Second, we demonstrate that these restrictions might fail to be optimal relative to simpler contracts whenever firms maximize their (constrained) joint-profit. This result is somewhat novel in the literature and challenges the conventional view according to which several vertical restraints allow producers and distributors to achieve joint-profit maximization in sequential monopolies.

To begin with, we show that the supplier always prefers RPM to QF.[27]

Proposition 2 *The supplier weakly prefers RPM to QF.*

Intuitively, since the allocation enforced under QF can always be replicated with an RPM mechanism, the supplier's profit is (weakly) increasing in the number of instruments used in the mechanism proposed to the retailer. Hence, RPM is weakly preferred to QF by the supplier.[28]

The next proposition states a result which is key for the rest of the analysis.

Proposition 3 *Under RPM the subset of types enjoying a positive rent is smaller than under QF.*

Under RPM the retailer is subject to a *stricter* monitoring regime relative to QF since under the former mechanism the supplier monitors all the available screening instruments. This implies that when one moves from an RPM to a QF regime, the agent's incentive to mimic weakens. Then, as no information rent is left to the agent within the region of types where the participation constraint binds, the optimal allocation implemented under RPM must distribute rents to a smaller subset of types relative to QF.[29]

We can now determine the welfare effects of both vertical arrangements characterized above. Let us start by illustrating their effects on consumers.[30] Since the schedules $q^Q(\theta)$ and $q^R(\theta)$ cross only at $\theta = \alpha$, so that $q^Q(\theta) \leq q^R(\theta)$ (resp. $\geq$) for all $\theta \geq \alpha$ (resp. $\leq$), and consumers' surplus is positively related to the output level, it follows that in some demand states consumers prefer RPM whereas in others they prefer QF. Clearly, an interim analysis of the impact on consumers' well being of the two contractual regimes delivers ambiguous predictions.[31] Therefore, in order to derive unambiguous predictions, the problem must be approached from an ex ante perspective, that is by studying the sign of the difference (ΔCS) between the expected consumers' surpluses under RPM and QF, respectively. The next proposition summarizes our results.

Proposition 4 *RPM is detrimental to consumers relative to QF when the reservation utility is steep enough and the converse is true otherwise. Formally, there exists a unique α^* such that if $\alpha \leq \alpha^*$ (resp. $\geq$) then $\Delta CS \geq 0$ (resp. $\leq$).*

For any given demand state, consumers' surplus is positively affected by the sales level. Therefore, as the measure of the subset of types where $q^Q(\theta) \geq q^R(\theta)$ increases in α (see Figure 3), the double marginalization effect obtained under QF for large demand realizations is sensibly mitigated relative to RPM whenever the retailer's incentive to over-report his type is strong enough.[32] This result shades new light on the sources of social inefficiencies created by vertical price fixing. In fact, aspects which are not directly intrinsic to the agency problem — such as upstream competition and the degree of horizontal integration of downstream retailers — can play a crucial role in determining whether retail price restrictions are likely to harm consumers.

Place Figure 3 approximately here

On a normative ground, Proposition 4 confirms the recent view according to which *per se* rules are in general inappropriate to evaluate vertical restraints (Rey and Vergé [2005]). When a supplier contracts with an horizontally integrated retailer subject to resource constraints, the effects on consumers' well being of different contractual arrangements depend upon the level of profitability of the other markets served by the retailer.[33] Similarly, when α is thought of as a measure of the intensity of upstream competition for exclusive contracts, tougher upstream competition may drive detrimental forms of vertical price fixing, while the converse holds otherwise.[34]

The previous analysis was based on the implicit assumption that the supplier offers a take-it or leave-it contract to the retailer. However, recent empirical contributions have provided strong evidence that vertical restraints are often chosen in order to maximize the supplier-retailer joint-profit (see Bonnet, Dubuois, and Simioni [2005] among others). In addition, the widespread use of "slotting allowances" also strengthens this view (Marx and Shaffer [2004]). Thus, in order to take into account such a possibility, we devote the rest of the section to investigate the welfare implications of joint-profit maximization behavior. More precisely, before uncertainty about demand resolves, we assume that the supplier and the retailer commit to a contract in a way such to maximize their joint-profit. Once this choice is made, the game unfolds exactly as before and the two agents share ex ante joint-profit through a lump-sum fixed-fee, which yields a (non type-dependent) reservation value to the retailer.[35] Let then $\Delta\Pi$ be the difference between the expected joint-profits under RPM and QF, respectively. The next proposition summarizes our results.

Proposition 5 *RPM (resp. QF) maximizes joint-profit if the reservation utility is steep enough (resp. flat). Formally, there exists a unique $\hat{\alpha}$, with $\hat{\alpha} \in (0,1)$, such that for all $\alpha \geq \hat{\alpha}$ (resp. $\leq$) then $\Delta\Pi \geq 0$ (resp. $\leq$).*

The economic intuition for this result is related to the way the reservation utility shapes the optimal allocations under the two mechanisms. Depending on the level of α, the trade off between having consumers with a higher willingness to pay and the gain in productive efficiency associated to retail price restrictions drives the coalition to prefer one or the other contractual regime. In particular, when α is small enough, the model converges to the cutting-edge case illustrated in Martimort and Piccolo [2006a], that is $q^R(\theta) \approx q^Q(\theta)$ and $e^Q(\theta) \geq e^R(\theta)$ for all θ.[36] In this case, it is not optimal to control the retail price since a QF contract allows the coalition to extract more surplus from consumers. When α is large enough, though, the subset of types where the output schedules do not coincide enlarges. The advantage in terms of productive efficiency provided by RPM then overcomes the cost of facing consumers with a lower willingness to pay.

The result shows that in the presence of countervailing incentives, the standard view that more sophisticated vertical restraints allow to harmonize in the best way the agency conflict between suppliers and retailers no longer holds. A natural question then arises as to whether the coalition's best choice is also in the consumers' interest. Next corollary provides some guidance on this issue.

Corollary 6 *Assume that firms maximize joint-profit, then a policy intervention concerned with consumers' well being involves a laissez faire regime for moderate values of* α. *For extreme values of* α, *instead, the joint-profit maximizing contract is detrimental to consumers; there exists then a conflict between the firms coalition's preferences and the consumers' ones.*

Place Table I approximately here

Summarizing, our results suggest that understanding the effects of outside options in vertical contracting is a crucial step towards a case-by-case approach to the evaluation of social and private incentives to vertical restraints. A priori it would be very difficult for competition agencies to establish whether observed contracts are detrimental to consumers. In fact, as shown in Table I, an unregulated market does not always achieve the (constrained) Pareto optimal allocation. This implies that advocating for the lawfulness of RPM is correct only to a limited extent. More precisely, arguments in favour of a *laissez faire* regime must be qualified in terms of the impact of the external forces leading contracts to display countervailing incentives. Our conclusions imply that the effectiveness of antitrust and competition laws can be substantially strengthen by developing empirical methods aimed at identifying and evaluating the sources and the impact of outside options on vertical contracts. This approach would certainly broaden the range of circumstances where a case-by-case analysis turns out to be appropriate.

VI. CONCLUDING REMARKS

This paper illustrates the private and social incentives to exert vertical price control in a sequential monopolies model where, besides retailers' information superiority, other external factors shape optimal contracts. We have studied a simple supplier-retailer relationship where, in addition to adverse selection and moral hazard, the retailer's type-dependent outside option, capturing such external factors, plays a key role. The paper has the following policy implications. First, we argued that the Chicago school view, advocating for the lawfulness of retail price restrictions, holds only to a limited extent. More precisely, when the type-dependent reservation utility has a strong impact on the agency conflict between vertical related firms, forbidding price restrictions determines a beneficial effect on consumers' welfare. Second, when the outside option has negligible impact on optimal contracting, arrangements controlling only the level of sales may be spontaneously chosen by firms maximizing joint-profit. Since however in this case consumers would prefer the outcome based on retailer's price restriction, competition agencies should forbid joint-profit maximization behavior, or act to remove those features which might induce firms to sign joint-profit maximizing contracts. Finally, when the type-dependent reservation utility has mild impact on vertical contracting, competition agencies may let firms free to design contracts as they wish: a *laissez faire* policy is optimal.

The paper has two main merits. On a normative ground, it illustrates the effects that external factors, such as the intensity of upstream competition and the multimarket nature of retailing activities, have on sequential monopolies with asymmetric information, and permits to obtain a sharp characterization of the welfare impact of retail price restrictions. On a positive ground, it delivers simple testable implications making a step forward towards a careful classification of the circumstances under which certain kinds of vertical restraints are socially undesirable relative to others.

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APPENDIX

A. *Incentive Feasible Allocations under RPM*

In this section we characterize the solution of program $\mathcal{P}^R$ under linear reservation utility. To begin with, let us state the two first-order conditions omitted in the text:

Complementary slackness conditions

$$\tau(\theta)u(\theta) = 0,\ \tau(\theta) \geq 0,\ u(\theta) = 0, \tag{8}$$

Transversality conditions

$$\mu(1)u(1) = 0,\ \mu(1) \leq 0,\ \mu(\theta_h)u(\theta_h) = 0,\ \mu(\theta_h) \geq 0. \tag{9}$$

Let $\mu_P(\theta)$ denote the costate variable when the retailer's profit is constant with respect to θ, i.e., such that $e(\mu_P(\theta), \theta) = \dot{v}(\theta)$. By using (1) and (2), since $e(\theta) = p(\theta) + q(\theta) - \theta$ for all θ, we get $p_P(\theta) = q_P(\theta) = (\theta + \alpha)/2$ for all $\theta \in \Theta_P^R$ and $\mu_P(\theta) = (\alpha - \theta)/2\Delta\theta$. If the participation constraint, PC, has to bind on a non-degenerate subset of types, say $\Theta_P^R \subseteq \Theta$, then $\mu(\theta)$ must be equal to $\mu_P(\theta)$ on this subset. Following Maggi and Rodriguez (1995), in order to derive the (unique) maximum of the auxiliary program we first conjecture a solution for $\mu^R(\theta)$. Then, by using the first-order conditions (1)-(3) and (8)-(9), the allocation optimizing $\mathcal{L} \equiv \mathcal{H}(\theta, p(\theta), q(\theta), \mu(\theta), u(\theta)) + \tau(\theta)u(\theta)$ obtains. To this end, consider the following candidate solution for $\mu(.)$:

$$\mu^R(\theta) = \begin{cases} F(\theta) & \text{if} \quad \mu_P(\theta) > F(\theta) \\ \mu_P(\theta) & \text{if} \quad \mu_P(\theta) \in [F(\theta) - 1, F(\theta)] \\ F(\theta) - 1 & \text{if} \quad \mu_P(\theta) < F(\theta) - 1 \end{cases}.$$

By substituting $\mu^R(\theta)$ into equation (1) it is immediate to obtain the schedule $q^R(\theta)$ in (4). Moreover, note that the pair $\{\mu^R(\theta), q^R(\theta)\}_{\theta \in \Theta}$ satisfies both the slackness condition, $\tau(\theta) > 0$ for all $\theta \in \Theta_P^R$, and the transversality conditions. As for the former condition, first note that since $\theta_h > 1$ it follows $\Theta_P^R \equiv \{\theta : q_P(\theta) = (\theta + \alpha)/2\} \neq \varnothing$; similarly as $\dot{\mu}_P(\theta) = -1/2\Delta\theta$ one has $\tau(\theta) = 3/2\Delta\theta > 0$ for all $\theta \in \Theta_P^R$. Transversality conditions are satisfied by construction. Finally, to complete the proof we must show that the solution of the auxiliary program also optimizes $\mathcal{P}^R$. First, observe that IC_2 is satisfied as $q^R(\theta)$ is weakly increasing in θ (Figure 1) and that $\theta_h \leq 3/2$ guarantees interior solutions. Second, we refer the reader to Maggi and Rodriguez (1995) in order to prove that the global incentive compatibility constraint is satisfied at the solution of $\mathcal{P}^R$. *QED*

B. *Incentive Feasible Allocations under QF*

In this section we characterize the solution of program $\mathcal{P}^Q$. For completeness, let us first state the two first-order conditions previously omitted:

Complementary slackness condition

$$\tau(\theta)\, u(\theta) = 0,\ \tau(\theta) \geq 0,\ u(\theta) \geq 0, \tag{10}$$

Transversality conditions

$$\mu(1)\,u(1)=0 \;\; \mu(1)\leq 0, \;\; \mu(\theta_h)\,u(\theta_h)=0 \;\; \mu(\theta_h)\geq 0. \tag{11}$$

Let $\mu_p(\theta)$ denote the costate when the retailer's profit is constant with respect to θ, i.e., such that $q^Q\left(\mu_p(\theta),\theta\right)=\dot{v}(\theta)$. By equation (5) one gets $\mu_p(\theta)=(\alpha-\theta)/\Delta\theta$. If the participation constraint, PC, has to bind on a non-degenerate subset of types, say $\Theta_P^Q\subseteq\Theta$, then $\mu(\theta)$ must be equal to $\mu_p(\theta)$ on this subset. As before, we first conjecture a solution for $\mu^Q(\theta)$ and then, by using the first-order conditions (5)-(6) and (10)-(11), the allocation maximizing $\mathcal{L}\equiv\mathcal{H}(\theta,q(\theta),\mu(\theta),u(\theta))+\tau(\theta)\,u(\theta)$ is derived. Consider the following candidate solution for $\mu(.)$:

$$\mu^Q(\theta)=\begin{cases} F(\theta) & \text{if} \;\; \mu_p(\theta)>F(\theta) \\ \mu_p(\theta) & \text{if} \;\; \mu_p(\theta)\in[F(\theta)-1,F(\theta)] \\ F(\theta)-1 & \text{if} \;\; \mu_p(\theta)<F(\theta)-1 \end{cases}.$$

By substituting $\mu^Q(\theta)$ into (5), it is immediate to verify that $q^Q(\theta)$ satisfies (7). Moreover, since $q^Q(\theta)=e^Q(\theta)$ for all θ, the effort schedule is readily obtained. Now we need to verify that the pair $\left\{\mu^Q(\theta),q^Q(\theta)\right\}_{\theta\in\Theta}$ satisfies both the slackness condition, $\tau(\theta)>0$ for all $\theta\in\Theta_P^Q$, and the transversality conditions. The transversality conditions are satisfied by construction. As for the former condition, first note that $\Theta_P^Q\equiv\left\{\theta:q^Q(\theta)=\alpha\right\}\neq\varnothing$ since $1<\theta_h$; moreover, as $\dot{\mu}_p(\theta)=-1/\Delta\theta$, one can easily show that $\tau(\theta)=2/\Delta\theta>0$ for all $\theta\in\Theta_P^Q$. Finally, we show that the solution of the auxiliary program also optimizes $\mathcal{P}^Q$. Observe that IC_2 is satisfied as $q^Q(\theta)$ is weakly increasing in θ (Figure 2) and that $\theta_h\leq 3/2$ guarantees interior solutions. As above, we refer the reader to Maggi and Rodriguez (1995) in order to prove that the global incentive compatibility constraint is satisfied at the solution of $\mathcal{P}^Q$. *QED*

C. *Proof of Proposition* 3

In order to prove the result it is sufficient to show that the subset of types whose PC binds under QF is larger than that under RPM, that is $\Theta_P^Q\subseteq\Theta_P^R$. The claim follows immediately because $(2+\alpha)/3-(1+\alpha)/2=(1-\alpha)/6<0$ and $(2\theta_h+\alpha)/3-(\theta_h+\alpha)/2=(\theta_h-\alpha)/6>0$. *QED*

D. *Proof of Proposition* 4

The proof will be developed in two steps.

Step 1. Let $\Delta CS(\theta)\equiv CS^R(\theta)-CS^Q(\theta)$ and assume $0\leq\alpha\leq 1$; it is then straightforward to show that $\Delta CS\equiv E_{\theta\in\Theta}[\Delta CS(\theta)]\geq 0$ for all α since $q^R(\theta)\geq q^Q(\theta)$ for all $\theta\in\Theta$.

Step 2. Assume $\alpha\in\text{int}\Theta$, by using the functional forms obtained for $q^Q(\theta)$ and $q^R(\theta)$ and integrating one gets:

$$\Delta CS=\frac{1+(1+\theta_h)\theta_h+6\alpha(1+\theta_h)-15\alpha^2}{54\Delta\theta}. \tag{12}$$

We first show that the sign of ΔCS must necessarily change within the types' support Θ. Indeed, it can be easily verified that $\lim_{\alpha\to 1}\Delta CS > 0$ and $\lim_{\alpha\to\theta_h}\Delta CS < 0$. To conclude the step we then need only to prove that ΔCS is strictly decreasing with respect to α. Straightforward algebraic manipulations yield:

$$\frac{\partial \Delta CS}{\partial \alpha} = \frac{1+\theta_h-5\alpha}{9\Delta\theta}.$$

As we assumed $\theta_h \leq 3/2$, one can show that $(\partial\Delta CS/\partial\alpha) < 0$. By the Mean-Value Theorem there exists a unique $\alpha^* \in \text{int}\Theta$ such that for all $\alpha \geq \alpha^*$ (resp. $\leq$) then $\Delta CS \leq 0$ (resp. $\geq$).

Steps 1 and 2 together conclude the proof. *QED*

E. *Proof of Proposition* 5

To begin with, we show that at the interim stage, i.e., after θ has realized, the coalition formed by the supplier and the retailer may prefer either RPM or QF depending on the realized demand state. To this end, let us define the function $\Gamma(x) \equiv x^2 - (2x-\theta)^2/2$ which is concave and has a maximum at $x = \theta$. Notice that, from the first-order conditions associated to programs $\mathcal{P}^R$ and $\mathcal{P}^Q$, one can easily verify that $\Pi^R(\theta) = \Gamma(q^R(\theta))$ and

$$\Pi^Q(\theta) = \Gamma(q^Q(\theta)) + \frac{1}{2}\left[\frac{\mu^Q(\theta)}{f(\theta)}\right]^2.$$

It then follows immediately that $\Delta\Pi(\theta) \equiv \Pi^R(\theta) - \Pi^Q(\theta) < 0$ for all θ such that $q^Q(\theta) = q^R(\theta)$. Instead, for any generic θ such that $q^Q(\theta) \neq q^R(\theta)$, the concavity of $\Gamma(.)$ implies that $\Gamma(q^R(\theta)) > \Gamma(q^Q(\theta))$. Thus, in general the sign of $\Delta\Pi(\theta)$ is ambiguous, thereby requiring an ex ante comparison. The proof will be developed in three steps.

Step 1. To begin with assume $\alpha \in \text{int}\Theta$. Simple expectations on $\Pi^R(\theta)$ and $\Pi^Q(\theta)$ allow to get:

$$\Delta\Pi \equiv E_{\theta\in\Theta}[\Delta\Pi\,(\theta)] = \frac{1+\theta_h(1+\theta_h) - 3\alpha(1+\theta_h) + 3\alpha^2}{216\Delta\theta}.$$

Observe that $\Delta\Pi$ is strictly convex in α, so it displays a minimum at $\alpha^m = (\theta_h+1)/2$. Since $\Delta\Pi|_{\alpha=\alpha^m} = \Delta\theta/864 > 0$, one can conclude that $\Delta\Pi > 0$ for all $\alpha \in \text{int}\Theta$.

Step 2. Assume now $2-\theta_h \leq \alpha \leq 1$. In this case we can show that $(2+\alpha)/3 \leq (1+\alpha)/2 \leq \alpha \leq 1$ and that $(2\theta_h+\alpha)/3 \geq (\theta_h+\alpha)/2 \geq 1$, with:

$$q^R(\theta) = \begin{cases} (\theta+\alpha)/2 & \text{if} \quad \theta \in [1, (2\theta_h+\alpha)/3] \\ 2\theta - \theta_h & \text{if} \quad \theta \geq (2\theta_h+\alpha)/3 \end{cases},$$

and

$$q^Q(\theta) = \begin{cases} \alpha & \text{if} \quad \theta \in [1, (\theta_h+\alpha)/2] \\ 2\theta - \theta_h & \text{if} \quad \theta \geq (\theta_h+\alpha)/2 \end{cases}.$$

Again, by taking expectations of $\Delta\Pi(\theta)$ with respect to θ we have:

$$\Delta\Pi = \frac{\upsilon_1(\theta_h) + (\alpha-1)\,\upsilon_2(\theta_h) + 3\,(\alpha-1)^2\,\upsilon_3(\theta_h) + 17\,(\alpha-1)^3}{216\Delta\theta},$$

where $\upsilon_1(\theta_h) = \theta_h^3 - 3\theta_h^2 + 3\theta_h - 1$, $\upsilon_2(\theta_h) = -3(\theta_h^2 - 2\theta_h + 1)$ and $\upsilon_3(\theta_h) = \Delta\theta$. One can then check that $\lim_{\alpha\to 1}\Delta\Pi = \Delta\theta^2/216 > 0$ and $\lim_{\alpha\to 2-\theta_h}\Delta\Pi = -5\Delta\theta^2/108 < 0$. Moreover, since

$$\frac{\partial\Delta\Pi}{\partial\alpha} = \frac{18 - \theta_h^2 + 2\alpha(\theta_h - 18) + 17\alpha^2}{72\Delta\theta}, \tag{13}$$

it follows that $\lim_{\alpha\to 1}(\partial\Delta\Pi/\partial\alpha) = -\Delta\theta/72 < 0$ and $\lim_{\alpha\to 2-\theta_h}(\partial\Delta\Pi/\partial\alpha) = 7\Delta\theta/36 > 0$. It can then be immediately proved that $\Delta\Pi$ has a unique flex-point at $\alpha^F = (18-\theta_h)/17$, with $\alpha^F \in (2-\theta_h, 1)$. Finally, a simple continuity argument allows to show that there exists a value $\hat{\alpha} \in (2-\theta_h, 1)$ such that $\Delta\Pi \geq 0$ (resp. $\leq$) for all $\alpha \geq \hat{\alpha}$ (resp. $\leq$).

Step 3. Assume $3-2\theta_h \leq \alpha \leq 2-\theta_h$; in this case it can be shown that $(2+\alpha)/3 \leq (1+\alpha)/2 \leq \alpha \leq 1$ and $(\theta_h+\alpha)/2 \leq 1 \leq (2\theta_h+\alpha)/3$, with:

$$q^R(\theta) = \begin{cases} (\theta+\alpha)/2 & \text{if} \quad \theta \in [1, (2\theta_h+\alpha)/3] \\ 2\theta - \theta_h & \text{if} \quad \theta \geq (2\theta_h+\alpha)/3 \end{cases} \qquad \text{and} \quad q^Q(\theta) = 2\theta - \theta_h \quad \forall\, \theta \in \Theta.$$

By taking the expectation of $\Delta\Pi(\theta)$ with respect to θ we have:

$$\Delta\Pi = \frac{\varkappa + 3\alpha(4\theta_h^2 - 9) + \alpha^2(27 - 12\theta_h) - 5\alpha^3}{108\Delta\theta},$$

where $\varkappa = -9 + 2\theta_h(27 + \theta_h(7\theta_h - 27))$. Moreover, since

$$\frac{\partial\Delta\Pi}{\partial\alpha} = \frac{(3 - 5\alpha + 2\theta_h)(-3 + \alpha + 2\theta_h)}{86\Delta\theta},$$

it follows that $sign(\partial\Delta\Pi/\partial\alpha) = sign(3 - 5\alpha + 2\theta_h)$ because $\alpha \geq 3 - 2\theta_h$. As $\alpha \leq 2 - \theta_h$ it follows $(3-5\alpha+2\theta_h) \geq 7\Delta\theta > 0$, hence $\partial\Delta\Pi/\partial\alpha > 0$. Since $\lim_{\alpha\to 3-2\theta_h}\Delta\Pi = -\Delta\theta^2/6 < 0$ and $\lim_{\alpha\to 2-\theta_h}\Delta\Pi = -5\Delta\theta^2/108 < 0$, a simple continuity argument implies that $\Delta\Pi < 0$ for $3-2\theta_h \leq \alpha \leq 2-\theta_h$. Furthermore, note that for $0 \leq \alpha \leq 3 - 2\theta_h$ we have $e^Q(\theta) = q^Q(\theta) = q^R(\theta) = 2\theta - \theta_h$ and $e^R(\theta) = 3\theta - 2\theta_h$, for all $\theta \in \Theta$. In this case $e^Q(\theta) - e^R(\theta) = \theta_h - \theta \geq 0$ for all $\theta \in \Theta$; it follows then $\Pi^R(\theta) - \Pi^Q(\theta) \equiv -\int_{e^R(\theta)}^{e^Q(\theta)}(e^Q(\theta) - e)de \leq 0$ for all θ with equality holding only at $\theta = \theta_h$. Finally, by taking the expectation of the previous expression we obtain $\Delta\Pi < 0$ for all $\alpha \in [0, 3 - 2\theta_h]$.

Steps 1, 2 and 3 together complete the proof. *QED*

F. *Proof of Corollary* 6

The claim follows immediately by the proof of Propositions 4 and 5 together. Focusing on cases where participation constraints bind at least in some non-empty subset of Θ, that is $\alpha > 3 - 2\theta_h$, it can be readily showed that $\hat{\alpha} < 1 < \alpha^* \Rightarrow \hat{\alpha} < \alpha^*$. This implies that for all $\alpha \leq \hat{\alpha}$ consumers prefer RPM to QF while the coalition prefers QF; for $\alpha \in (\hat{\alpha}, \alpha^*)$ the preferences of consumers and firms are aligned since they both prefer RPM. Finally, for $\alpha \geq \alpha^*$ consumers prefer QF whereas the firms coalition prefers RPM. *QED*

Notes

[1]Previous contributions on this ground are Gal-Or [1991], Blair and Lewis [1994], De Fraja and Piga [2000], and Martimort and Piccolo [2006a] among others.

[2]Since 1911, when the Supreme Court of the US declared resale price mainteanace to constitute a *per se* violation of the Sherman Act, the view of the Court about the legacy of resale price mainteanace has changed several times. At the same time, the European Union legislation simply provides a set of general guidelines and analytical criteria to help in assessing if a given restraint should be considered either legal or illegal under Article 81 EC. Moreover, the guidelines are not strictly binding and are subject to approval by the European courts on a case-by-case basis. See Comanor [1985], Neven, Papandropoulos, and Seabright [1998], and Rey and Vergé [2005].

[3]Actual contracts stipulated between vertically related firms often exhibit features that might be driven by countervailing incentives. As observed by Lewis and Sappington [1989a], in these practices inflexible rules are often preferred to arrangements based on discretion. Furthermore, recent empirical contributions have provided evidence of the relevance of countervailing incentives. For instance, in their analysis of the investment-cash flow sensitivity, Degryse and de Jong [2006] find a positive correlation between these two variables, for publicly listed firms in The Netherlands. This correlation can be explained in terms of the agency conflict between informed managers and uninformed shareholders inducing both downward and upward distortions in the investment level, depending upon asymmetric information and managerial discretion. This evidence might in fact well be captured by type-dependent outside options since the degree of sensitivity between investment and cash flow depends on the size of investment opportunities. Similar results are provided by Chevalier, Kashyap, and Rossi [2003] in their analysis based on supermarket data.

[4]On the welfare effects of information asymmetries between vertical related firms see Rey and Tirole [1986], Jullien and Rey [2000], Rey and Vergé [2005], and Martimort and Piccolo [2006b], among others.

[5]Up to a simple normalization, our model can be generalized to allow inverse demand functions of the form $p(q, \theta, e) = \theta + e - \phi(q)$ for some $\phi(\cdot)$ increasing and convex.

[6]Distributors can indeed provide a wide range of services that affect the demand for products being offered. Services such as free delivery, pre sales advice to potential buyers, show rooms, and after sales

services can play a key role in enhancing demand. Looking at supermarket data relative to the Chicago area, the importance of the retailer activity in price determination and the role of the retailer advertising as a way of competing for customers are empirically documented by Chevalier, Kashyap, and Rossi [2003].

[7]They show that two effects are at play in general when the principal moves away from RPM to QF: (i) a demand-enhancing effect, such that the agent will exert more effort under QF relative to RPM since he is residual claimant of the full impact of his effort on enhancing demand; (ii) a rent-extraction effect, such that as the output is the only screening device under QF, the principal needs to distort it downward for rent-extraction reasons. In the cutting-edge case at hand, i.e., $\psi'''(e) = 0$, these effects exactly compensate so that both types of contracts entail the same output and thus the same consumers' surplus.

[8]This variable might represent local market conditions which are observed only by the closest firm to final consumers.

[9]These assumptions guarantee that the usual hazard-rate monotonicity requirements hold.

[10]See Lewis and Sappington [1989a, 1989b], Maggi and Rodriguez [1995], Brainard and Martimort [1997] and Jullien [1996, 2000], among others.

[11]This seems to fit well a framework where the retailer has a private label, or distributes some other product that is available on some competitive market, with limited sales force or shelf space. We thank an anonymous referee for suggesting us this interpretation.

[12]Alternatively, if one thinks of θ as being an (inverse) measure of marginal costs, $v(\theta)$ can be then interpreted as being fixed cost, possibly due to the necessity of specializing some assets before contracting with the upstream suppliers or to R&D investments. In this case, it is natural to imagine that low marginal cost, that is high level of θ, is likely to be associated with high overhead cost.

[13]Details of the quadratic case are available from the authors on request.

[14]See Laffont and Martimort [2002] among others.

[15]This mechanism is based on the assumption that both retail price and sales level are observable by the supplier. Such an assumption is unrestrictive in the present framework since, as shown by Martimort and Piccolo [2006a], the optimal allocation under RPM, when only the retail price is verifiable, is the same as that obtained under a mechanism where both instruments are verifiable.

[16]The proof is provided in Martimort and Piccolo [2006a], thus it will be omitted.

[17]For the quadratic case it is the degree of convexity of $v(\theta)$ that matters.

[18]Note that this clearly resembles the regulation model by Laffont and Tirole [1986]. Here, however, the variable $y(\theta) = p(\theta) + q(\theta)$ plays the role of the observable cost in their framework.

[19]Throughout we shall also impose full-participation, that is the supplier contracts with all retailer's types. Besides being simplifying, this assumption seems a natural one under several circumstances. First, competition agencies might enforce a full-participation regime by law if non-participation is severely detrimental for consumers' well being. Second, full-participation might be a useful instrument to prevent entry of competing firms at the upstream level so to relax future competition. Third, if the promotional activities exerted by retailers require the specialization of some assets, the risk of loosing future worthwhile exclusive trading opportunities may refrain suppliers from exploiting non-participation rules. In fact, one can think of several circumstances where effort is quite specific and so not easily redeployable toward different uses. In this scenario, our static set-up may capture a framework where, after an exclusive contract has been signed and effort has been exerted, the two firms are linked for a certain amount of time whose length increases with the degree of effort specificity. We refer the reader to Jullien [2000] who offers an elegant treatment of non-participation policy when participation constraints are type-dependent.

[20]This result follows immediately from the first-order conditions and it is in the spirit of Laffont and Tirole [1993, Chapter 3].

[21]In addition, note that when $\theta_h \leq 3/2$ program $\mathcal{P}^R$ displays interior solutions.

[22]Although they interpret this finding as due to retailers' competition for customers, one could revisit their results as being due to a grocery-retailing story where vertical contracts are set in the same fashion as illustrated in Figure 1.

[23]If the outside option effect completely overcomes the standard mimicking effect (i.e., $\alpha \geq \theta_h$) each agent has an incentive to overstate his type, and output exhibits upward distortion for all types. However, since when $\alpha \geq \theta_h$ the supplier's complete information profit is negative for all θ, we rule out this uninteresting case.

[24]As before, complementary slackness and transversality conditions are discussed in the Appendix.

[25]The same pattern would obtain with a concave reservation utility. For extreme values of α, that is

$\alpha < 1$ and $\alpha > \theta_h$, the same qualitatively outcomes as in the RPM case apply.

[26]Several contractual schemes between suppliers and retailers appear indeed to display much less flexibility than mechanisms with full-separation.

[27]The proof is straightforward and thus it is omitted.

[28]The proof of this claim is based on a simple revealed preference argument, thus it is omitted.

[29]One can prove that this result does not rely on the uniform specification for $F(\theta)$, but it holds for all distribution functions which satisfy standard regularity requirements on the hazard rate.

[30]Many scholars have indeed advocated that the sole role of competition policies should be to enlarge consumers' surplus (see, for instance, Bork [1978], chapter 2).

[31]Interim welfare analysis is meant to compare type-dependent consumers' surpluses obtained under both contracts. Notice also that the same qualitative results would obtain with a concave reservation utility (Maggi and Rodriguez [1995] and Jullien [2000]) but not with a constant reservation utility which would give results in line with those discussed in Martimort and Piccolo [2006a].

[32]Observe that, for any function $F(\theta)$ which satisfies standard requirements on the hazard rate one can find sufficient conditions under which the claim in Proposition 4 holds.

[33]In particular, it could be argued that when competition on the related markets becomes less intense, which results in higher profits (i.e., larger levels of α), it is more likely that QF is welfare enhancing relative to RPM.

[34]For more details, see the quadratic example worked out in the working paper version.

[35]Actually, this shift in bargaining power is rather standard in the incomplete contract literature which assumes that parties have equal bargaining powers ex post, once some non-verifiable variables become publicly observable, but ex ante organizational choices are made according to an efficiency criterion. See Laffont and Martimort [2002, Chapter 6] for some remarks on this. The same perspective can be taken here by assuming that before the retailer learns about the demand parameter, the supplier and the retailer keep a more equal bargaining power than after private information will be revealed.

[36]In this case one can check that $e^Q(\theta) = q^Q(\theta) = q^R(\theta) = 2\theta - \theta_h$ and $e^R(\theta) = 3\theta - 2\theta_h$, for all θ.