Countervailing Power and Price Transparency*

Morten Hviid[†]
University of Warwick

H. Peter Møllgaard[‡]
Copenhagen Business School

Both authors:
Centre for Industrial Economics
University of Copenhagen

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Abstract

We investigate whether increased transparency about prices may increase the countervailing power exercised by buyers of an intermediate good and whether this will lead to a decrease of intermediate goods prices. We show that, even in a non-cooperative, one-shot model, the most likely outcome of improved transparency is a price increase: Improved transparency will lead sellers to take tougher bargaining stands since more is at stake. The results are related to the experience of the Danish Competition Authority's practice in the 1990s.

Keywords: Negotiated intermediate prices, countervailing power, price transparency.

JEL: L20, L40

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[†]Department of Economics, University of Warwick, Coventry CV4 7AL. e-mail: m.hviid@warwick.ac.uk

[‡]Department of Economics, Copenhagen Business School, Solbjerg Plads 3, C5, DK-2000 Frederiksberg. e-mail: hpm.eco@cbs.dk

1 Introduction

Transparency regarding prices is often thought of as a means of improving competition and efficiency. In the UK, the Competition Commission in its recent inquiry of supermarkets stated that the first solution to problems of pricing behaviour would be to increase transparency of pricing. This could be done by improving price information on supermarket shelves and by making price comparisons easier through compulsory publishing of all current retail prices of different supermarkets on the internet.¹ The previous Danish competition act also relied heavily on market transparency as its main instrument to obtain more competition² and the Danish government in a recent report re-iterated its view that improved market information would often be a more powerful instrument than many of the Competition Authority's concrete interventions.³ The roots of transparency in competition policy may be traced back to the 1930 London Resolution of the Interparliamentary Union: The Resolution was favourable to cartels and dominant firms, considering these natural economic phenomena that could be controlled using publication of data regarding structure, conduct and performance.

Transparency means that market participants should have as much information about the market as possible, preferably all information. This may make sense in search markets where customers have imperfect information about prices and there is a significant search cost: a recent Danish investigation was concerned with *undertakers'* pricing of coffins where presumably the emotional cost of searching is high.⁴ Search markets are unconcentrated markets which makes the acquisition of information by individuals costly.

However, the Danish Competition Authority has also made public firm specific information about prices and discounts in much more concentrated markets where search costs are negligible. Recent examples include the market for ready-mixed concrete; the three largest whole-sellers of plumbing supplies for heating and sanitary purposes; producers of flat glass

¹See <http://www.competition-commission.gov.uk/10-00rem.htm>

²See Albæk, Møllgaard and Overgaard (1996, 1998) for an overview and discussion.

³Danish Ministry of Trade and Industry (1999).

⁴See Competition Council (1994a).

and double-glazed windows; and the three largest whole-sellers of electricians' supplies.⁵ Note that in these cases, intermediate goods prices are negotiated rather than set by the upstream firm, be they producers or whole-sellers. In the plumbing case, for example, it was the "individually negotiated discounts and bonuses" that were published.

In these concentrated markets improved information regarding sellers' prices, quantities or market shares *may* lead to improved coordination of sellers' strategies leading to higher prices as pointed out by Stigler (1964) and many authors since. That this is more than a theoretical possibility is demonstrated empirically by Albæk, Møllgaard and Overgaard (1997) on price data from the oligopolistic Danish ready-mixed concrete industry.

On the other hand, improved information among buyers about different prices at different sellers might lead them to shop around for better deals or to take tougher stands in negotiations about prices. This countervailing power⁶ would lower the price that the individual buyer obtains in the market place. This was undoubtedly one of the motivations for the emphasis on transparency in the previous Danish competition act and it may be the reason why consumer protection organizations insist on transparency. Advocates of transparency in competition policy are loath to accept that such publication could lead to the improved oligopolistic coordination and thus the substantial price increases of e.g. ready-mixed concrete that Albæk, Møllgaard, and Overgaard (1997) found. Instead they tend to emphasize the increased countervailing power brought about by increased transparency.

The aim of this paper is to establish whether, and if so, when, the transparency policy of improving buyers' information leads to lower prices and increased welfare in concentrated markets in a static setting. We thus explicitly do not consider the scope for improved seller coordination that the increase in transparency could also trigger⁷ but restrict ourselves to investigating the effect of improved transparency on negotiations of contracts in vertical transactions of e.g. ready-mixed concrete, plumbing widgets, glass or electricians' supplies.

⁵For details on these cases, consult Danish Competition Council (1994b;1995a,b;1996a,b).

⁶See Dobson & Waterson (1997) and von Ungern-Sternberg (1996) for recent models of countervailing power with upstream monopolies. These papers study the effects of increasing downstream concentration on end prices. Our focus is different: We wish to study the effect of improving price transparency.

⁷Thus our focus differs from that of Snyder (1996) who have upstream firms collude in a dynamic model of countervailing power. In an infinitely repeated procurement auction the sole buyer may accumulate a backlog of unfilled orders thus forcing sellers to collude on a low price in order to prevent undercutting. Nilsson (1999) and Møllgaard and Overgaard (2000) also model market transparency (regarding prices and qualities, respectively) in dynamic oligopoly models, but do not give customers power to negotiate prices.

The benefit of transparency may thus arise because of improved information in the bargaining of terms of the transaction between upstream and downstream firms regarding the intermediate goods. We model the effect of price transparency by assuming that the buyers in one market segment are better informed about the true (marginal) cost of production than the buyers in the other segment. If the ill-informed buyers observe the prices (or the discounts) that obtain in the other market segment, they improve the precision of their estimate and this may lead them to take a tougher stand in the bargaining.⁸ For this to make sense, it must be that the informed buyers negotiate their prices with producers before ill-informed buyers do the same, so we model the transparency policy as introducing sequentiality in an otherwise independent environment. Obviously, if the transparency policy is announced, producers will now know that the discounts that they give to informed customers will later be used by their previously ill informed customers. This, in turn, will lead the producers to take a different (tougher) bargaining stand with their informed customers since more is now at stake than before. It is thus not evident that (average) prices will decrease as a result of the transparency policy.

In the base model, which is set up in section 2, we assume for simplicity that there are two downstream firms, one of which is informed and one of which is not and that although these two firms purchase the same input, they are independent in their final goods market.⁹ With one upstream firm, we then have two sets of bilateral monopolies and we analyse the non-transparency case of independent markets in section 3 while section 4 analyses the transparency case in which markets are treated as sequential. Section 4 also compares the regimes and demonstrates that transparency may well lead to higher prices in both markets. The result arises exactly for the reason given in the previous paragraph: The information spill-over leads the upstream firm to be more aggressive. As the motivation for the transparency policy appears to arise at least partially from a wish to protect weaker economic agents, we assume in the

⁸Because of our stated aim, we assume that the negotiation of the intermediate goods price does not reveal all relevant information (in which case a policy of transparency would be redundant).

⁹We avoid competition between downstream firms because that would open up a separate set of issues relating to the upstream firm's price discrimination between trading partners leaving them on an unequal footing in competition. This would be illegal according to article 82 of the Treaty of Amsterdam (that prohibits 'applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage') and according to the Robinson-Patman Act. The modelling of downstream competition is taken up by McAfee and Schwartz (1994), Dobson and Waterson (1997) and von Ungern-Sternberg (1998), while O'Brien and Shaffer (1994) deal explicitly with the welfare effects of forbidding discriminatory pricing of intermediate goods in the context of Robinson-Patman.

analysis in sections 3 and 4 that the uninformed is relatively unsophisticated when it comes to updating its beliefs. To ensure that our results do not merely arise because of this, section 5 presents a full-blown signalling model of transparency in which all parties satisfy Bayesian rationality. Other extensions considered in section 5 are: bilateral oligopolies, competition among downstream firms and sequentiality of moves. Section 6 concludes.

2 Bilateral Monopoly

The simplest example is that of an upstream monopolist (*Manufacturer*) who produces an intermediate product with constant marginal costs c . The monopolist sells to two downstream “retailers,” one who is informed about c (RI) and one who is not (RU). For simplicity, assume that the final demands of the two retailers are independent so that both are monopolists in their own market. Final goods demands are $D_i(P_i)$ where $i = I, U$ indicates whether the downstream firm is informed (I) or uninformed (U). One unit of the upstream good is transformed to one unit of the downstream good and downstream firms have no other variable costs.

Contracts are restricted to two-part tariffs¹⁰ so the payment from Ri to M takes the form $F_i + w_i D_i(P_i)$. M and Ri negotiate about contract terms, i.e. about (w_i, F_i) , knowing that their respective profits in market i depend on these terms as follows:

$$\Pi_{Mi} = (w_i - c)D_i(P_i) + F_i, \quad i = I, U$$

and

$$\Pi_{Ri} = (P_i - w_i)D_i(P_i) - F_i, \quad i = I, U.$$

Once an agreement has been reached in market i , Ri chooses its price optimally, i.e. it sets the price $P_i^*(w_i)$ that solves

$$\frac{d\Pi_{Ri}}{dP_i} = D_i(P_i) + (P_i - w_i)\frac{dD_i(P_i)}{dP_i} = 0. \quad (1)$$

We now turn to the regime without transparency where the two bargaining situations are independent. Section 4 then treats the transparency regime in which the negotiations take place sequentially and interdependently because RU may then observe the outcome of the negotiation between M and RI .

¹⁰In general, we just need efficient bargaining (given beliefs) but two-part tariffs are a simple way of achieving exactly this. Furthermore, the two-part tariff is one of the most basic pricing schemes (see McAfee and Schwartz (1994)).

3 The no-transparency regime

With no transparency the two bargaining situations may be treated independently since demands are independent and the (perceived) costs are independent. We assume that the bargaining outcome may be described as coming from split-the-surplus bargaining with $\gamma \in (0, 1)$ denoting the share of the surplus that accrues to the upstream firm (the downstream firm gets $1 - \gamma$ of the surplus). This bargaining model is very simple and robust. We could use generalized Nash bargaining or one of several non-cooperative bargaining models instead. However, Nash bargaining may be seen as the “limit” of e.g. alternating-offers bargaining (see Osborne and Rubinstein, 1990, ch. 4) and we do not add anything but complexity by choosing such bargaining models.

We analyse the simple case of the informed market first before we turn to the slightly more complicated case of the uninformed market.

3.1 The informed market

The total surplus in this market is

$$S_I(w_I) = \Pi_{MI} + \Pi_{RI} = (P_I^*(w_I) - c)D_I(P_I^*(w_I)). \quad (2)$$

Since the parties are to split S_I according to the $(\gamma, 1 - \gamma)$ -rule, they share a common interest in maximizing it. We thus immediately get the following result:

Lemma 1 *When the government does not pursue a policy of transparency, the contract terms agreed in the informed market are*

$$\begin{aligned} w_I^* &= c \\ F_I^* &= \gamma S_I(c) \end{aligned}$$

Proof: Maximizing $S_I(w_I)$ w.r.t. w_I yields a first-order condition

$$\frac{dS_I(w_I)}{dw_I} = \frac{dP_I^*}{dw_I} \left(D_I(P_I^*(w_I)) + (P_I^*(w_I) - c) \frac{dD_I(P_I^*(w_I))}{dP_i} \right) = 0 \quad (3)$$

Since $\frac{dP_I^*}{dw_I}$ is assumed different from (larger than) 0, this is only possible if $D_i(P_i^*) + (P_i^* - c) \frac{dD_i(P_i)}{dP_i} = 0$ which in turn can only be fulfilled simultaneously with (1) if $w_I = c$. In that case, $\Pi_{MI} = F_I$ and to split the surplus according to the γ -rule, $F_I = \gamma S_I(c)$. ■

3.2 The uninformed market

We assume that the uninformed downstream firm has a prior belief $\hat{c}$ about the true value of c . This belief is common knowledge. As long as the upstream firm does nothing that reveals the true cost, the bargaining proceeds by splitting the perceived surplus

$$S_U(w_U) = (P_U^*(w_U) - \hat{c})D_U(P_U^*(w_U)).$$

Thus, based on split-the-surplus bargaining RU will expect contract terms to be $w_U = \hat{c}$ and $F_U = \gamma S_U(\hat{c})$. If the upstream firm, M , tries to raise w_U above $\hat{c}$, RU will perceive this as cheap talk intended only to raise M 's share of the surplus. If, however, M suggests a lower-than-expected wholesale price, this will result in a downward revision of its cost expectation. RU 's belief about c is thus¹¹

$$E(c | w_U < \hat{c}) = w_U \tag{4}$$

$$E(c | w_U \geq \hat{c}) = \hat{c}$$

The perceived surplus may thus change only by downward revisions of w_U . In this market, M 's true profit is

$$\Pi_{MU}(w_U) = (w_U - c)D_U(P_U^*(w_U)) + \gamma(P_U^*(w_U) - \min\{\hat{c}, w_U\})D_U(P_U^*(w_U)). \tag{5}$$

M may now choose to set w_U somewhere between the true cost c and the perceived cost $\hat{c}$:

Lemma 2 *When the government does not pursue a policy of transparency, the contract terms agreed in the uninformed market are*

$$w_U^* = \min\{\hat{c}, v_U\} \in [c, \hat{c}]$$

$$F_U^* = \gamma S_U(w_U^*)$$

where v_U solves $(1 - \gamma)D_U(P_U^*(w_U)) + (w_U - c)\frac{dD_U}{dP}\frac{dP_U^*}{dw_U} = 0$.

Proof: Assume that $w_U < \hat{c}$. Maximizing Π_{MU} w.r.t. w_U yields a first-order condition

$$\frac{d\Pi_{MU}}{dw_U} = (1 - \gamma)D_U(P_U^*(w_U)) + (w_U - c)\frac{dD_U}{dP}\frac{dP_U^*}{dw_U} = 0 \tag{6}$$

¹¹ Note that RU is naive in the sense that if $w_U < \hat{c}$, it assumes that the upstream firm sets w_U such that total revenue is maximised. The extension in section 5.1 below assumes full Bayesian rationality of all players.

since (1) holds. Let v_U solve this condition. If $v_U > \hat{c}$, M is constrained by the expectations formation (4) to set $w_U^* = \hat{c}$. If $v_U < \hat{c}$, M 's global maximum is to set $w_U^* = v_U$.

Clearly, at $w_U = c$, $\frac{d\Pi_{MU}}{dw_U} > 0$. The second-order condition then implies that $v_U > c$. ■

It is important here to realise that the upstream firm may voluntarily choose a lower price than the one expected by the downstream firm. It is equally true, that the upstream firm would like to correct the beliefs of the downstream firm when these are very low, i.e. if $\hat{c} < c$, but it has no credible way of doing so.

Figure 1: Negotiating the wholesale price in the uninformed market.

The situation is illustrated in Figure 1: If the RU has belief $v_U = c$, then the perceived surplus is the square above v_U and the wholesale price is $w_U^* = v_U$ while F_U^* is half of the square. The true profit to M however includes the square between v_U and c . If RU has a belief $\hat{c}$ that exceeds v_U then M will want to reduce these beliefs down to v_U and may do this: The decrease in the profits that are collected via F_U is offset by the increase in the profits that – unknown to RU – are collected below the line. If on the other hand RU has a belief $\hat{c}$ that falls short of v_U , then M will have to just live with these beliefs, since she has no means of raising the beliefs.

4 The transparency regime

When the government pursues a policy of transparency, the uninformed downstream firm, RU , can observe the contractual terms of the informed market. Based on this, RU forms beliefs¹²

$$E(c \mid w_I) = w_I \quad (7)$$

which is simpler than (4) since M may now convince the uninformed downstream firm that marginal costs are indeed w_I , by “putting its money where its mouth is”. The profit of the upstream firm from the uninformed segment is thus

$$\Pi_{MU}(w_I) = (w_I - c)D_U(P_U^*(w_I)) + \gamma(P_U^*(w_I) - w_I)D_U(P_U^*(w_I))$$

unless negotiations between M and RI break down in which case there are no contract terms to observe and so RU must make do with the old prior. In this case, the profit to the upstream firm is given by (5), thus the threatpoint in negotiations is $\Pi_{MU}(w_U^*)$. The surplus to be split between the parties in the informed segment is then

$$S_I^T(w_I) = \Pi_{MI} + \Pi_{RI} + [\Pi_{MU}(w_I) - \Pi_{MU}(w_U^*)].$$

Now the regulator will set the same wholesale price in both markets – and it will be above the true marginal cost:

Lemma 3 *When the government pursues a policy of transparency, the terms agreed in the two uninformed market are given by*

$$\begin{aligned} w_U^{**} &= w_I^{**} > c \\ F_U^* &= \gamma S_U(w_U^{**}) \\ F_I^* &= \gamma S_I^T(w_I^{**}) \end{aligned}$$

Proof: To see that $w_I^{**} > c$, maximize $S_I^T(w_I)$ w.r.t. w_I to get the first-order condition

$$\begin{aligned} \frac{dS_I^T(w_I)}{dw_I} &= \frac{dS_I(w_I)}{dw_I} + \frac{d[\Pi_{MU}(w_I) - \Pi_{MU}(w_U^*)]}{dw_I} \\ &= \frac{dS_I(w_I)}{dw_I} + \frac{d\Pi_{MU}(w_I)}{dw_I} = 0 \end{aligned} \quad (8)$$

¹²As in equation (4) this assumes a degree of naivety on behalf of RU . A more sophisticated player would realise that M and RI have an incentive to affect the inference that it is making and would make the appropriate adjustments. The extension in section 5.1 below allows for this signalling aspect of the model.

since $\frac{d\Pi_{MU}(w_U^*)}{dw_I} = 0$. The last term, $\frac{d\Pi_{MU}(w_I)}{dw_I}$, is clearly positive when evaluated at $w_I = c$ for reasons explored in Lemma 2, but Lemma 1 told us that at $w_I = c$, $\frac{dS_I(w_I)}{dw_I} = 0$. Thus at the optimal w_I , $\frac{dS_I(w_I)}{dw_I}$ must be negative, i.e. $w_I > c$ while $\frac{d\Pi_{MU}(w_I)}{dw_I}$ must be positive. It then follows immediately, that $w_U^{**} = w_I^{**}$: If anything, M would subsequently want to raise w_U^{**} since $\frac{d\Pi_{MU}(w_I)}{dw_I} > 0$, but given the expectation formation, this is not possible. ■

4.1 Comparison of regimes

Transparency always raises the wholesale price in the informed segment thus reducing the surplus in this segment and harming the final customers of the informed downstream firm, RI . On the other hand, transparency may increase or reduce the wholesale price in the uninformed segment which will in turn affect the surplus and the final customers of the uninformed downstream firm, RU . This will depend on the uninformed prior belief about c , $\hat{c}$. We may summarise the effect of transparency in the following proposition:

Proposition 1: *If the uninformed prior is high, i.e. $w_I^{**} < \hat{c}$, then transparency has the effect of increasing the informed price, w_I , and reducing the uninformed price, w_U : $w_I^* < w_I^{**} = w_U^{**} < w_U^*$. If, however the uninformed prior is low, $\hat{c} < w_I^{**}$, then transparency will increase both intermediate goods prices: $w_I^{**} = w_U^{**} > \max(w_I^*, w_U^*)$*

Proof: Follows immediately from Lemma 1-3. ■

Note that transparency changes the outcome from one in which there is some welfare reducing double marginalisation in just the uninformed market to one where there is a welfare loss from double marginalisation in both, but where the loss is reduced in the uninformed segment. Thus in general, welfare conclusions are ambiguous. However, if one assumes that it is typically large downstream firms that are better informed and if those firms are large because they serve disproportionately large downstream markets, then the damage from transparency is likely greater than the benefit. If, on the other hand, uninformed downstream firms are relatively important **and** have a high prior belief then transparency may be beneficial.

4.1.1 The linear example

To make the comparison of welfare and profits across regimes precise, consider the following special, linear example:¹³ Let there be a continuum of identical consumers on $[0, 1]$ each with

¹³The fully worked out example is found in the Appendix.

a demand for the final good that may be described by $d(p) = a - bp$. A fraction μ belongs to the informed segment, while the rest belongs to the uninformed segment. Varying μ allows us to discuss the relative importance of the two segments. Total demand in segment i may be written $D_i(P_i) = a_i - b_i P_i$ with $a_I \equiv \mu a$, $b_I \equiv \mu b$, $a_U \equiv (1 - \mu) a$ and $b_U \equiv (1 - \mu) b$. Assume that $a > bc$, where c are the actual marginal costs of the upstream firm.

Figure 2 illustrates Proposition 1: w_U^* depends on $\hat{c}$ as indicated by the fat line. If $\hat{c} < w_U^{**} = w_I^{**}$, then transparency will have the effect of increasing both prices. On the other hand, if $\hat{c} > w_U^{**}$ then transparency will reduce w_U but increase w_I . Transparency will be beneficial to the uninformed only if their beliefs about c are wildly exaggerated.

Figure 2: The effect of transparency depends on the uninformed prior.

In the linear example, it is easily shown that

$$\frac{dw_I^{**}}{d\mu} < 0$$

so that the price with transparency is decreasing in the size of the informed segment relative to that of the uninformed segment as one would expect. In fact, in the limit as $\mu \rightarrow 1$, $w_I^{**} = c$, while at the other extreme, as $\mu \rightarrow 0$, we get $w_I^{**} = w_U^*$. Thus the more important is the

informed segment, the lower will the wholesale price with transparency be. However it will always lie between c and w_U^* so if μ is large, transparency hurts many a little and may benefit a few a lot if their beliefs are very wrong.

We may summarise the comparison of the two regimes in the following way. Table 1 shows when transparency will be preferred to no transparency by the different parties involved: The up- and downstream firms, consumers and society at large. The table is divided into two cases depending on whether $\hat{c}$ is above or below v_U . The precise conditions on $\hat{c}$ and μ may be found in the appendix

Table 1: Comparison of regimes:

When is transparency preferred by a party?

Party	Case when $\hat{c} > v_U$	Case when $\hat{c} < v_U$
M	Never	Only if $\hat{c}$ and μ are small
R_I	Never	Never
R_U	Always	If $\hat{c} > c + \frac{1-\mu}{3-\mu}(\frac{a}{b} - c)$
CS (Consumers)	Never	Never
W (Society)	Never	If $\hat{c}$ and μ are high

The results for this linear case offer very little support for transparency. The case where the uninformed has a very high prior estimate of c is particularly stark. Without transparency, the manufacturer is able to exploit the uninformed retailer without engaging in double marginalisation in the informed market. Once transparency is introduced, this is no longer the case with double marginalisation spilling over to the informed market, leading to profit and welfare losses for all but the uninformed firm. The gain of the latter is never enough to increase welfare. When the uninformed has a very low prior expectation and this market is important, μ small, the manufacturer gains from being able to adjust the beliefs of the uninformed and this gain offsets the loss from double marginalisation.

Finally, when $\hat{c} = c$, transparency hurts everybody. So if the uninformed is correct without knowing so, transparency hurts all the involved players.

5 Extensions

A number of possible extensions are considered: To demonstrate that the qualitative results do not depend on the assumed naivety of the uninformed firm, we analyse the effects of

transparency in a simple signalling model with full Bayesian rationality. Since most real world cases involve bilateral oligopolies in each segment we consider the case of increasing downstream competition *within* each segment in subsection 5.2 followed by a discussion of what happens if there is competition between segments in subsection 5.3. Finally to counter criticism of the assumption that the negotiation between the manufacturer and the informed segment is concluded first, in subsection 5.4 we discuss what would happen if we instead considered a two period model in which period 2 beliefs could be conditioned on the outcomes in period one. Our overall conclusion is robust to each of these extensions.

5.1 Signalling game

We have assumed that the uninformed react very naively to the announced price in the informed segment. This would not be the case if we considered a proper signalling game. In this section we extend the linear example introduced above with a signalling game in order to study the effects of assuming full Bayesian rationality. In the separating equilibrium of this game, the uninformed is able to infer the cost correctly with transparency, but will have to make a qualified guess without transparency. The implication would be that with transparency $w_I > c$ and $w_U = c$. In this case, the only clear winner is the uninformed firm. As double marginalisation is switched from the uninformed segment to the informed segment, consumers may loose overall.

5.1.1 The setup without transparency

The upstream firm, M , knows her own marginal cost c and the demand curves of the two retailers $D_i(P_i)$ where $i = I, U$. The informed downstream retailer, R_I , also knows c for sure. The uninformed retailer, R_U , however only knows the distribution of c : We assume that this distribution is commonly known to be uniformly distributed on $[\underline{c}, \bar{c}]$.

In this particular example, we assume that in each bargaining situation, M gets to propose a take-it-or-leave-it offer with probability γ and R_i gets to propose an ultimatum with probability $1 - \gamma$. This “bargaining model” shares the distributive characteristics of the model used in the previous sections, and allows us to treat the bargaining as a signalling game: at each decision node there is only one player who may move.

The informed segment Without transparency, when the bargaining situations are independent, we know that whoever gets to propose will keep the other part at her reservation contract. If M is the one to propose, she will set $w_I^* = c$ to maximize the surplus and set $F_I^* = S_I(c)$, so R_I has normal profits of 0. If R_I is the one to propose, she will set $w_I^* = c$ and set $F_I^* = 0$ and now M is the one with zero profits (from this deal). In expected terms, we thus have $w_I^* = c$ and $F_I^* = \gamma S_I(c)$ as in Lemma 1.

The uninformed segment Without transparency, in the uninformed segment, M will propose $w_U^* = c$ to maximize the surplus and set $F_U^* = S_U(c)$ so R_U has normal profits of 0. However, if R_U is the one to propose, she does not possess the knowledge of c but only of its distribution and so will have to maximize expected profits. We here assume that c is cannot be made observable to R_U and that she is risk neutral.

M will only accept the offer if her profit is non-negative, i.e. if

$$(w_U - c)D_U(P_U^*(w_U) + F_U) > 0$$

or if

$$c \leq w_U + \frac{F_U}{D_U(P_U^*(w_U))}$$

Seen from R_U 's perspective, the probability of this is

$$\Pr \left[c \leq w_U + \frac{F_U}{D_U(P_U^*(w_U))} \right] = \frac{w_U + \frac{F_U}{D_U(P_U^*(w_U))} - \underline{c}}{\bar{c} - \underline{c}} \equiv \varphi(w_U)$$

R_U now maximizes her expected profit

$$\max_{w_U, F_U} [(P_U^*(w_U) - w_U)D_U(P_U^*(w_U)) - F_U] \varphi(w_U) + 0(1 - \varphi(w_U))$$

From the first order condition w.r.t. F_U we find (using the first order condition of R_U 's subsequent maximization) that

$$F_U = \left(\frac{P_U^*(w_U) + \underline{c}}{2} - w_U \right) D_U(P_U^*(w_U))$$

and from the first order condition w.r.t. w_U we similarly find that $F_U^* = 0$ such that

$$w_U^* = \underline{c} + \frac{1}{2}(P_U^*(w_U^*) - \underline{c}) > \underline{c}$$

In the linear case, $P_U^*(w_U^*) = \frac{a_U + b_U w_U^*}{2b_U}$ so

$$w_U^* = \min\{\underline{c} + \frac{a_U - b_U \underline{c}}{3b_U}, \bar{c}\} > \underline{c}$$

In that case the probability of the deal going through is

$$\varphi(w_U^*) = \min\{\frac{1}{3} \frac{\frac{a_U}{b_U} - \underline{c}}{\bar{c} - \underline{c}}, 1\}$$

which is positive if the market exists ($a_U > b_U \underline{c}$) but smaller than 1.

The expected contract will thus have

$$w_U^* = \gamma \frac{1}{2}(\bar{c} + \underline{c}) + (1 - \gamma) \min\{\frac{1}{3} \frac{\frac{a_U}{b_U} - \underline{c}}{\bar{c} - \underline{c}}(\underline{c} + \frac{a_U - b_U \underline{c}}{3b_U}), \bar{c}\} > \frac{1}{2}(\bar{c} + \underline{c})$$

and $EF_U^* = \gamma S_U(c)$. The expected fee is thus as in Lemma 2 while the expected wholesale price is larger than the expected cost, which is also the case in Lemma 2 (in a sense).

5.1.2 Transparency in a signalling model

Transparency introduces sequentiality: In a separating signalling equilibrium, M or R_I (depending on who is chosen to make the first-period offer) will observe the type (i.e. the true c) and then propose a $w_I = \tau(c)$ knowing that R_U will observe w_I and infer that the true type is $\tau^{-1}(w_I)$. We thus have a signalling model of the kind treated by Mailath (1987): The set of possible types is $[\underline{c}, \bar{c}] \subset \mathfrak{R}$, the informed agent's (M 's or R_I 's) set of possible actions affecting beliefs is $\mathfrak{R}$, the informed agent chooses a strategy $w_I = \tau([\underline{c}, \bar{c}])$ as a mapping from the set of possible types to the set of real numbers. In order to find the informed agent's payoff function, let us solve the game backwards, starting with the uninformed segment.

The uninformed segment If M , who is informed, is chosen to propose, she will suggest the full-information solution

$$(w_U^{**}, F_U^{**}) = (c, S_U(c))$$

which will maximize her profits.

If R_U , who now believes that the cost is $\hat{c} = \tau^{-1}(w_I)$ is chosen to propose, she will suggest a contract, that she believes will keep M at her reservation value ($= 0$):

$$(w_U^{**}, F_U^{**}) = (\tau^{-1}(w_I), 0)$$

so M 's expected profit in this segment is

$$\begin{aligned} E\pi_M^U(w_I) &= \frac{1}{2}S_U(c) + \frac{1}{2}(\tau^{-1}(w_I) - c)D_U(P_U^*(\tau^{-1}(w_I))) \\ &= \frac{1}{2}\frac{(a_U - b_U c)^2}{4b_U} + \frac{1}{4}(\tau^{-1}(w_I) - c)(a_U - b_U \tau^{-1}(w_I)) \end{aligned}$$

where the last equality assumes the linear demand. Note that in this case

$$\frac{dE\pi_M^U(w_I)}{dw_I} = \frac{1}{4}\frac{1}{\tau'(c)}\{a_U - 2b_U \tau^{-1}(w_I) + b_U c\}$$

The informed segment If M is chosen to propose, she will keep R_I at her reservation value of 0 by setting

$$\begin{aligned} F_I &= (P_I^*(w_I) - w_I)D_I(P_I^*(w_I)) \\ &= \frac{(a_I - b_I w_I)^2}{4b_I} \end{aligned}$$

and then solve the following maximization problem

$$\begin{aligned} \max_{w_I} U(c, \hat{c}, w_I) &= \max_{w_I} (w_I - c)D_I(P_I^*(w_I)) + F_I + E\pi_M^U(w_I) \\ &= \max_{w_I} \frac{1}{2}(w_I - c)(a_I - b_I w_I) + F_I + E\pi_M^U(w_I) \end{aligned}$$

by finding the solution to the following first order condition (strict incentive compatibility):

$$(a_I - 2b_I w_I + b_I c) - (a_I - b_I w_I) + \frac{1}{2}\frac{1}{\tau'(c)}\{a_U - 2b_U \tau^{-1}(w_I) + b_U c\} = 0 \quad (9)$$

leading to the following condition:

$$\tau'(c) = \frac{\frac{1}{2}\{a_U - 2b_U \tau^{-1}(w_I) + b_U c\}}{b_I(w_I - c)}$$

which when evaluated at $\tau^{-1}(w_I) = c$ gives us Mailath's (1987) differential equation (DE):

$$\tau'(c) = \frac{\frac{1}{2}\{a_U - b_U c\}}{b_I(\tau(c) - c)} = \frac{dU/d\hat{c}}{-dU/dw_I} \quad (10)$$

Since $U_3 \equiv dU/dw_I = \frac{1}{2}b_I(c - w_I) = 0$ has a unique solution in $w_I = c$ that maximizes $U(c, c, w_I)$ and $U_2 = dU/d\hat{c} = (a_I - 2b_I w_I + b_I c)/4 > 0$, the initial value condition is $\tau(\underline{c}) = \underline{c}$. Furthermore the single crossing condition $d(U_3/U_2)/dc > 0$ is fulfilled so we know from Mailath (1987) that there is a unique, monotonically increasing, continuous solution to the signalling game which is described by (10).

Clearly $\tau'(c) > 0$ if and only if $w_I = \tau(c) > c$, so only at $w_I = \underline{c}$ will M not mark up the true cost. Otherwise she has to because R_U will discount whatever other w_I she observes.

If R_I is chosen to propose, she will keep M at her reservation value of 0 by setting

$$(w_I - c)D_I(P_I^*(w_I)) + F_I + E\pi_M^U(w_I) = 0$$

and then solve the following maximization problem

$$\begin{aligned} \max_{w_I} U(c, \hat{c}, w_I) &= \max_{w_I} (P_I^*(w_I) - w_I)D_I(P_I^*(w_I)) - F_I \\ &= \max_{w_I} (P_I^*(w_I) - c)D_I(P_I^*(w_I)) + E\pi_M^U(w_I) \\ &= \max_{w_I} \frac{(a_I + b_I w_I - 2b_I c)(a_I - b_I w_I)}{4b_I} + E\pi_M^U(w_I) \end{aligned}$$

by finding the solution to the following first order condition (strict incentive compatibility):

$$-b_I(w_I - c) + \frac{1}{2} \frac{1}{\tau'(c)} \{a_U - 2b_U \tau^{-1}(w_I) + b_U c\} = 0$$

which is identical to (9). So the analysis leading to (10) being the unique, monotonic, continuous solution to the signalling game with initial condition $\tau(\underline{c}) = \underline{c}$ is unchanged.

To summarise: Without transparency, $w_I^* = c$ and $E(w_U^*) > E(c)$. With transparency $w_I^{**} > c$ for $c > \underline{c}$ and $w_U^{**} = c$. The effect of introducing transparency in the signalling model is thus to increase w_I and increase or decrease w_U , just as in section 4. The welfare effects remain qualitatively unchanged, depending on where the double marginalisation does the greater damage.

5.2 Bilateral oligopolies

In a closely related model of bilateral oligopolies, we have shown that transparency has the same effect as in the bilateral monopolies, see Hviid and Møllgaard (1999): A duopoly produces an intermediate good and sells this to two customer segments with independent demand curves. To keep it simple, in each market segment there are only two buyers who bargain with the producers. We show that, due to intermediate product differentiation, the buyer never buys from more than one seller.¹⁴ The solution to this bargaining problem is found using Nash

¹⁴This is in contrast to Dobson and Waterson (1996), who analyse the effects of resale price maintenance. In their model, each downstream retailer wants to carry the product of both upstream manufacturers and thus bargaining occur between upstream firm i and downstream firm j . If the costs of the manufacturers are in any way correlated, negotiating with both manufacturers gives each retailer an additional source of information and inferring the costs may thus be relatively speaking be easier. We believe that our formulation offers a better chance to support the argument for transparency put forward by the Danish Competition Council.

bargaining with endogenous threatpoints: If negotiations between a producer and a customer break down, the latter may approach the other producer to obtain supplies there. The two market segments operate entirely independently as long as prices and discounts are secret. The results of this more complicated model are qualitatively not any different from those obtained above.

5.3 Competition between the segments

If the two retailers are competing, the incentive to bias the inference of the uninformed still exist. It will clearly be tempered by the losses in the total revenue from the change in the way the firms compete, but the upstream firm will prefer to bias the prices because although it leads to a lower overall profit, the upstream firm will get a larger slice of this.

The results of McAfee and Schwartz (1994) and O'Brien and Shaffer (1994) may also be interpreted in terms of transparency. They focus on the effect of transparency on strengthening the commitment of firms not to renegotiate contracts between upstream and downstream firms.

McAfee and Schwartz (1994) study bilateral contracting between an input supplier and (contrary to our model) competing downstream firms without commitment regarding other contracts' terms. Each downstream firm then fears renegotiation between the upstream firm and its rival(s). They show that nondiscrimination clauses generally are not sufficient to assuage such fears and that crude forms of commitment may be adopted to reassure the downstream firms. In particular, contract terms may be made transparent and uniform across firms in order to reduce the scope for camouflaging selective discounting.

O'Brien and Shaffer (1994) analyse the effect of the Robinson-Patman act which made it unlawful for an upstream firm to discriminate in price between two different downstream firms. Their model is a three stage game between one manufacturer and two retailers in which the manufacturer first publicly announce the supply terms for each retailer. Subsequently, private renegotiation between retailer(s) and manufacturer may take place. Finally the retailers compete. The effect of the Robinson-Patman act in the model is either to rule out any renegotiation at all or to limit the renegotiation to a fixed fee, thus fixing the transfer price at the initial announcement by the manufacturer, thereby making it transparent. This implies that in their model, we can equate Robinson-Patman with transparency of transfer prices. Their result is

that the Robinson-Patman act lead to higher transfer prices and retail prices and hence by implication to the conclusion that transparency is detrimental for welfare. The class of models considered by O'Brien and Shaffer (1994) thus offers no support for the use of transparency in competition policy.

5.4 Two-period model: Sequential moves.

The results so far depend on the bargaining between the manufacturer and the informed retailer is concluded first. This may seem unduly restrictive. Assume as an alternative that there are two periods and in each period, the two negotiations occur simultaneously. Transparency in this set up amounts to assuming that period one prices are known to all before period two bargains are concluded. Transparency has no effect on the uninformed firm in period one because it has no useful information about the marginal costs of the upstream firm yet. Thus the first-period wholesale price is w_U^* in both regimes. Similarly, there is no effect in the informed segment in the second period as there is no future to affect: $w_I^* = c$. The only effect is thus on the informed segment in period one and the uninformed segment in period two. In the regime without transparency, $W_1^I = w_I^*$ and $W_2^U = w_U^*$ while in the regime with transparency, these become $W_1^I = w_I^{**} = W_2^U = w_U^{**}$ as in section 4.

6 Conclusion

From the analysis in this paper it is clear that the main effect of the transparency policy in markets with countervailing power is the shifting of most or all of the double marginalisation problem from the uninformed segment to the informed segment. Thus we have demonstrated that it may be the case that increased transparency leads to lower prices on average. However, for this to be the case, it must be true that the uninformed segment is much more important in terms of demand than is the informed segment and in addition that the uninformed downstream firms have very wrong beliefs about the costs of the upstream firm, see Fig. 2. Empirically, one might expect the opposite to be true in most industries and thus it would appear more likely that the average price goes up rather than down.

Note that our model predict price movements following a shift to transparency which are similar to the theories based on transparency improving firms ability to collude, such as Albæk

et al (1997) or Nilsson (1999). To distinguish between these theories, note that, while both would predict that the price charged to informed firms would be increased, the countervailing power model predicts that the price to the uninformed will fall. Thus if all prices rise after the shift to transparency, the collusion model is more credible, whereas if prices fall to some customers, in particular to smaller customers, the countervailing power model is more credible.

Although in deriving the results, we have made a number of strong assumptions, in each case, the aim has been to make it more likely that prices fall unambiguously as a consequence of the increased transparency. Even so, it has turned out to be hard to obtain such a result. In addition, the intuition provided by the model, that transparency affects the degree of double marginalisation in submarkets, suggests to us that our qualitative results are very robust. This adds to the doubt about the appropriateness of transparency as an instrument for competition policy and consumer protection policy in concentrated markets.

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A Appendix: A Linear Example

In order to analyse the effects of transparency in more detail, we consider a simple linear example. This example enables a discussion of effects on both welfare and the profitability of the firms involved.

Let there be a continuum of identical consumers on $[0, 1]$ each with a demand for the final good that may be described by $d(p) = a - bp$. A fraction μ belongs to the informed segment, while the rest belongs to the uninformed segment. Total demand in segment i may be written $D_i(P_i) = a_i - b_i P_i$ with $a_I \equiv \mu a$, $b_I \equiv \mu b$, $a_U \equiv (1 - \mu) a$ and $b_U \equiv (1 - \mu) b$. Assume that $a > bc$, where c are the actual marginal costs of the upstream firm.

In each segment, the retailer and manufacturer negotiate a price for the intermediate good. Given this, the retailer sets the retail price P_i . We assume that a two part tariff is used in each segment so that the total payment from Retailer i to the Manufacturer is $w_i q_i + F_i$ when the retailer purchases q_i units. Retailer i 's profit can thus be written $\Pi_{Ri}(P_i) = (P_i - w_i) D_i(P_i) - F_i$. The price which maximizes profits is the found to be

$$P_i^*(w_i) = \frac{a_i + b_i w_i}{2b_i} = \frac{a + b w_i}{2b}$$

so that equilibrium demand becomes

$$D_i(P_i^*(w_i)) = \frac{1}{2} (a_i - b_i w_i)$$

Thus, given that the retail price is set optimally, profits of retailer i are

$$\Pi_{Ri}(w_i) = \frac{(a_i - b_i w_i)^2}{4b_i} - F_i$$

whereas the profits of the upstream manufacturer in market segment i are

$$\Pi_{Mi}(w_i) = (w_i - c) \frac{1}{2} (a_i - b_i w_i) + F_i$$

Finally, consumer surplus in market segment i is given by

$$CS_i(P_i^*) = \frac{(a_i - b_i P_i^*)^2}{2b_i} = \frac{(a_i - b_i w_i)^2}{8b_i}$$

A.1 No transparency

A.1.1 The informed segment

Consider the negotiation *without* transparency. In the informed segment total profits to the two parties is, in case of reaching an agreement, $\Pi_{Mi}(w_i) + \Pi_{Ri}(w_i) + \Pi_{MU}(\hat{c})$, while if they do not agree, their total profit becomes $\Pi_{MU}(\hat{c})$ so that their surplus, $S_I(w_I)$, becomes $S_I(w_I) = \Pi_{Mi}(w_i) + \Pi_{Ri}(w_i)$ which can be written as

$$S_I(w_I) = \frac{(a_I - b_I w_I)^2}{4b_I} + \frac{1}{2} (w_I - c) (a_I - b_I w_I) \quad (11)$$

Total surplus is maximized at

$$w_I^* = c \quad (12)$$

so that the surplus of the no-transparency regime becomes

$$S_I(w_I^*) = \frac{(a_I - b_I c)^2}{4b_I}$$

and the fixed fee is half of that:

$$F_I^* = \frac{1}{2} S_I(c) = \mu \frac{(a - bc)^2}{8b} \quad (13)$$

Thus profits are

$$\Pi_{MI}(w_I^*) = \Pi_{RI}(w_I^*) = \mu \frac{(a - bc)^2}{8b} \quad (14)$$

and consumer surplus is given by

$$CS_I(w_I^*) = \frac{(a - bc)^2}{2b} \frac{1}{4} \mu$$

A.1.2 The uninformed segment

In this case, the retailer has a prior belief about c , given by $\hat{c}$ and is unwilling to accept a w_U higher than $\hat{c}$. It may still be in the interest of the manufacturer to offer a transfer price below $\hat{c}$ because this may lead to far too high a price. Let v_U be the transfer price which the Manufacturer would charge if this lead the retailer to believe that the costs of the manufacturer is v_U and the associated fixed element is

$$F_U = (1 - \mu) \frac{(a - bv_U)^2}{8b}$$

We first determine v_U which is the unrestricted wholesale price that maximizes

$$\Pi_{MU}(w) = \frac{1}{2} (w - c) (1 - \mu) (a - bw) + (1 - \mu) \frac{(a - bw)^2}{8b}$$

with respect to w . Solving the corresponding first-order condition, we get

$$v_U \equiv \frac{1}{3} \frac{a_U}{b_U} + \frac{2}{3} c = c + \frac{1}{3} \frac{a - bc}{b} > c \quad (15)$$

We have thus determined the contract:

$$w_U^* = \min(\hat{c}, c + \frac{1}{3} \frac{a - bc}{b}) \quad (16)$$

The corresponding fixed element, F_U^* , is given by

$$F_U^*(\hat{c}) = \begin{cases} \frac{1}{8} (1 - \mu) \frac{(a - b\hat{c})^2}{b} & \text{if } \hat{c} < v_U \\ \frac{1}{18} (1 - \mu) \frac{(a - bc)^2}{b} & \text{if } \hat{c} > v_U \end{cases}$$

The profits are given by

$$\Pi_{MU}(\hat{c}) = \begin{cases} \frac{1}{2} (1 - \mu) \left((\hat{c} - c) (a - b\hat{c}) + \frac{1}{4} \frac{(a - b\hat{c})^2}{b} \right) & \text{if } \hat{c} < v_U \\ \frac{1}{6} (1 - \mu) b \left(\frac{a - bc}{b} \right)^2 & \text{if } \hat{c} > v_U \end{cases} \quad (17)$$

and

$$\Pi_{RU}(\hat{c}) = \begin{cases} \frac{1}{8}(1-\mu)b\left(\frac{a-b\hat{c}}{b}\right)^2 & \text{if } \hat{c} < v_U \\ \frac{1}{18}(1-\mu)b\left(\frac{a-bc}{b}\right)^2 & \text{if } \hat{c} > v_U \end{cases} \quad (18)$$

and consumer surplus is

$$CS_{RU} = \begin{cases} \frac{1}{4}(1-\mu)\frac{(a-b\hat{c})^2}{2b} & \text{if } \hat{c} < v_U \\ \frac{1}{9}(1-\mu)\frac{(a-bc)^2}{2b} & \text{if } \hat{c} > v_U \end{cases}$$

A.2 Transparency

In the case of transparency, we need to solve the game in the uninformed segment first as the outcome of this segment depends on any agreement reached in the informed segment.

A.2.1 The uninformed segment

If no agreement is reached in the informed segment, the uninformed cannot make any inference and hence the outcome will be the same as under no transparency, with the profits of the two firms given in (17) and (18). If an agreement is reached, the uninformed retailer observes the transfer price w_I and, as under no transparency $w_I = c$, infers that the true value of c , $E(c|w_I) = w_I$. Given this inference, the uninformed firm accepts a price of $w_U^{**} = w_I$ with corresponding fixed element

$$F_U^{**} = \frac{1}{8}(1-\mu)\frac{(a-bw_I)^2}{b}$$

The profit in the uninformed segment as a function of w_I is found to be:

$$\Pi_{MU}(w_I) = \frac{1}{2}(1-\mu)(w_I - c)(a - bw_I) + \frac{1}{8}(1-\mu)\frac{(a - bw_I)^2}{b} \quad (19)$$

and

$$\Pi_{RU}(w_I) = \frac{1}{8}(1-\mu)\frac{(a - bw_I)^2}{b} \quad (20)$$

A.2.2 The informed segment

The important difference between the transparency and the no-transparency case is that if an agreement is reached, this is observed by the uninformed firm and used in the bargaining in that segment. To see the potential impact of this, note that, at no-transparency transfer price $w_I^* = c$, the upstream firm would profit from increasing w_i as

$$\left. \frac{d\Pi_{MU}(w_I)}{dw_I} \right|_{w_I=c} = \frac{1}{4}(1-\mu)(a - bc) > 0$$

To find the total surplus in the informed segment, note that, if the two parties reach an agreement, their total profits are $\Pi_{Mi}(w_i) + \Pi_{Ri}(w_i) + \Pi_{MU}(w_I) = S_I(w_I) + \Pi_{MU}(w_I)$,

while their total profit in case no agreement is reached is $\Pi_{MU}(\hat{c})$ because, although there is transparency, there is no transfer price to observe. Thus total surplus can be expressed as

$$S_I^T(w_I) = S_I(w_I) + \Pi_{MU}(w_I) - \Pi_{MU}(\hat{c})$$

The three terms are given in (11), (19) and (17) respectively so that total surplus in the informed segment can be expressed as

$$\begin{aligned} S_I^T(w_I) &= \mu \frac{(a - bw_I)^2}{4b} + \frac{1}{2} \mu (w_I - c)(a - bw_I) \\ &\quad + (1 - \mu) \frac{1}{2} (w_I - c)(a - bw_I) + \frac{1}{8} (1 - \mu) \frac{(a - bw_I)^2}{b} - \Pi_{MU}(\hat{c}) \end{aligned} \quad (21)$$

The corresponding first-order condition from maximising $S_I^T(w_I)$ with respect to w_I can be written as

$$-b_I(w_I - c) + \left(\frac{1}{2} a_U - \frac{3}{2} b_U w_I + b_U c \right) = 0$$

so that

$$w_I^{**} = c + \frac{(1 - \mu) a - bc}{(3 - \mu) b} \quad (22)$$

Comparing (22) with (12) and (16) it is obvious that $w_I^* = c < w_I^{**} < w_U^*$. It is also easily seen that

$$\frac{dw_I^{**}}{d\mu} = -\frac{2}{(3 - \mu)^2} \frac{a - bc}{b} < 0$$

so that the price with transparency is decreasing in the size of the informed segment relative to that of the uninformed segment as one would expect. In fact in the limit as $\mu \rightarrow 1$, $w_I^{**} = c$, while at the other extreme, as $\mu \rightarrow 0$, we get $w_I^{**} = w_U^*$.

Using (16) and (22) in (21) we get:

$$S_I^T(w_I^{**}) = \begin{cases} \frac{(a - bc)^2}{2(3 - \mu)b} - \frac{1}{2} (1 - \mu) \left((\hat{c} - c)(a - b\hat{c}) + \frac{1}{4} \frac{(a - b\hat{c})^2}{b} \right) & \text{if } \hat{c} < v_U \\ \frac{\mu(4 - \mu)}{6(3 - \mu)} \frac{(a - bc)^2}{b} & \text{if } \hat{c} > v_U \end{cases}$$

From this we get that

$$\Pi_{MI}(w_I^{**}) = \Pi_{RI}(w_I^{**}) = \frac{1}{2} S_I^T(w_I^{**}) \quad (23)$$

For the case when $\hat{c} > v_U$, can recover F_I^{**} by solving.

$$\frac{1}{2} S_I^T(w_I^{**}) = \frac{\mu}{(3 - \mu)^2} \frac{(a - bc)^2}{b} - F_i$$

from which we get:

$$F_I^{**} = \frac{(7 - \mu) \mu^2}{12(3 - \mu)^2} \frac{(a - bc)^2}{b}$$

Consumer surplus is

$$CS_I(w_I^{**}) = \frac{\mu}{(3 - \mu)^2} \frac{(a - bc)^2}{2b}$$

A.2.3 Profits in the uninformed segment

Having determined w_I^{**} we can find the profits of the uninformed segment in order to compare profits across regimes:

$$\Pi_{MU}(w_I^{**}) = \frac{(1-\mu)(\frac{3}{2}-\mu)}{(3-\mu)^2} \frac{(a-bc)^2}{b}$$

which is a decreasing function of μ :

$$\frac{d\Pi_{MU}(w_I^{**})}{d\mu} = \frac{-9+7\mu}{(3-\mu)^3} \frac{(a-bc)^2}{2b} < 0 \text{ if } \mu \in [0, 1]$$

The uninformed retailer's profit is

$$\Pi_{RU}(w_I^{**}) = \frac{1}{2} \frac{(1-\mu)}{(3-\mu)^2} \frac{(a-bc)^2}{b}$$

which is an decreasing function of μ as one should expect:

$$\frac{d\Pi_{RU}(w_I^{**})}{d\mu} = -\frac{1}{2} \frac{1+\mu}{(3-\mu)^3} \frac{(a-bc)^2}{b}$$

Consumer surplus is

$$CS_U(w_I^{**}) = \frac{1-\mu}{(3-\mu)^2} \frac{(a-bc)^2}{2b}$$

A.3 Comparison of profits and welfare across regimes

We first assume that $w_U^* = v_U$, the unrestricted case, and then treat the more involved restricted case ($w_U^* = \hat{c}$) afterwards.

A.3.1 The unrestricted case

Using (17) and (14), the manufacturer's total profit without transparency may be expressed as

$$\Pi_M = \Pi_{MI}(w_I^*) + \Pi_{MU}(w_U^*) = \frac{4-\mu}{24} \frac{(a-bc)^2}{b} \quad (24)$$

Note that this is a decreasing function of μ : The manufacturer would indeed prefer to have a very small informed segment if he is free to set prices in the uninformed segment, which will be the case if the uninformed prior is very high ($\hat{c} > v_U$). With transparency, the manufacturer's profit becomes

$$\Pi_M^T = \Pi_{MI}(w_I^{**}) + \Pi_{MU}(w_I^{**}) = \frac{2(18-25\mu+12\mu^2+\mu^3)}{(3-\mu)^2} \frac{(a-bc)^2}{b} \quad (25)$$

Profits are higher with transparency if

$$\frac{2(18-25\mu+12\mu^2+\mu^3)}{(3-\mu)^2} > 4-\mu$$

but this would require that $-17+14\mu-6\mu^2 > 0$, which can never be the case. Thus manufacturer profits are higher without transparency than with transparency.

The informed retailer's profit is larger without transparency:

$$\Pi_{RI}(w_I^*) = \mu \frac{(a - bc)^2}{8b} \geq \Pi_{RI}(w_I^{**}) = \frac{\mu(12 - 7\mu + \mu^2)}{(3 - \mu)^2} \frac{(a - bc)^2}{12b}$$

which holds with inequality for all $\mu < 1$ and with equality when $\mu = 1$. (This is independent of $\widehat{c}$).

The uninformed retailer's profit is higher with transparency than without:

$$\Pi_{RU}(v_U) = \frac{(1 - \mu)}{9} \frac{(a - bc)^2}{2b} \leq \Pi_{RU}(w_I^{**}) = \frac{(1 - \mu)}{(3 - \mu)^2} \frac{(a - bc)^2}{2b}$$

except when $\mu = 0$ (in which case there is equality).

Total consumer surplus without transparency is

$$CS = \frac{4 + 5\mu}{36} \frac{(a - bc)^2}{2b}$$

In the case of transparency, the similar expression is

$$CS^T = \frac{1}{(3 - \mu)^2} \frac{(a - bc)^2}{2b}$$

and it is easily checked that consumer surplus is never higher with transparency unless $\mu = 1$ in which case it does not matter.

Welfare may be written $W = CS + \Pi_M + \Pi_{RI} + \Pi_{RU}$. In the no-transparency regime, we get

$$W = \frac{20 + 7\mu}{36} \frac{(a - bc)^2}{2b}$$

while the transparency regime yields

$$W^T = \frac{30 - 19\mu + 5\mu^2 + 2\mu^3}{6(3 - \mu)^2} \frac{(a - bc)^2}{2b}$$

$W > W^T$ for all $\mu \in [0, 1)$ and $W = W^T$ when $\mu = 1$.

A.4 The restricted case

We now assume that $c < w_U^* = \widehat{c} < \frac{1}{3}\frac{a}{b} + \frac{2}{3}c$. The manufacturer's profit without transparency may be expressed as

$$\Pi_M = \mu 6 \frac{(a - bc)^2}{48b} + \frac{(1 - \mu)(\widehat{c} - c)(a - b\widehat{c})}{2} + \frac{(1 - \mu)(a - b\widehat{c})^2}{8b}$$

while the manufacturer's profit with transparency is expressed in (25). $\Pi_M > \Pi_M^T$ iff

$$\mu \frac{(a - bc)^2}{8b} + (1 - \mu) \left(\frac{(\widehat{c} - c)(a - b\widehat{c})}{2} + \frac{(a - b\widehat{c})^2}{8b} \right) > \frac{(18 - 25\mu + 12\mu^2 + \mu^3)}{(3 - \mu)^2} \frac{(a - bc)^2}{12b} \quad (26)$$

or if

$$12b \frac{x}{y^2} + 3y^{-2} > f(\mu) \quad (27)$$

where $x \equiv \frac{\hat{c}-c}{a-b\hat{c}} \in (0, \frac{1}{2b})$, $y \equiv \frac{a-bc}{a-b\hat{c}} \in (1, \frac{3}{2})$, and

$$f(\mu) = \frac{36 - 77\mu + 6\mu^2 - 2\mu^3}{(3 - \mu)^2(1 - \mu)}$$

The denominator is always positive. The numerator $36 - 77\mu + 6\mu^2 - 2\mu^3 > 0$ when $\mu < 0.48277$ and negative when $\mu > 0.48277$. Thus, given our assumptions, (26) is always fulfilled when $\mu > 0.48277$.

The left-hand side of (27) takes a minimum of 3 with respect to $\hat{c}$ when $\hat{c} = c$ and a maximum of 8 when $\hat{c} = v_U$. The right hand side takes a maximum of 4 when $\mu = 0$. Thus for small μ **and** small $\hat{c}$ it is possible that the condition is violated, so the manufacturer would prefer transparency, otherwise the no-transparency regime is preferred. To be precise, the manufacturer prefers no-transparency if

$$\begin{aligned} \hat{c} &> v_U - \frac{a-bc}{3b} \sqrt[2]{4-f(\mu)} \\ &= c + \frac{a-bc}{3b} (1 - \sqrt[2]{4-f(\mu)}) \end{aligned} \quad (28)$$

which is decreasing in μ , taking a maximum of $\hat{c} = v_U$ at $\mu = 0$, in which case M is indifferent between the two regimes. If $1 - \sqrt[2]{4-f(\mu)} \leq 0$, or if $\mu \geq 0.257$ then this requirement just amounts to $\hat{c} > c$. In this example then, M will only prefer transparency if

$$\hat{c} < v_U - \frac{a-bc}{3b} \sqrt[2]{4-f(\mu)}$$

If $\hat{c}$ is sufficiently high, the uninformed retailer's profit is higher with transparency than without:

$$\frac{1}{8}(1-\mu)b \left(\frac{a-b\hat{c}}{b} \right)^2 = \Pi_{RU}(\hat{c}) \leq \Pi_{RU}(w_I^{**}) = \frac{(1-\mu)}{(3-\mu)^2} \frac{(a-bc)^2}{2b}$$

if

$$\left(\frac{3-\mu}{2} \right)^2 \leq \left(\frac{a-bc}{a-b\hat{c}} \right)^2$$

or

$$\hat{c} \geq \frac{1}{3-\mu} [3v_U - \frac{a}{b}\mu] = c + \frac{1-\mu}{3-\mu} \left(\frac{a}{b} - c \right)$$

which is a decreasing function of μ . If μ and $\hat{c}$ are both low, the manufacturer will use the small informed market to raise the wholesale price in the uninformed segment.

Total consumer surplus without transparency is

$$CS = \frac{1}{8b} [\mu(a-bc)^2 + (1-\mu)(a-b\hat{c})^2]$$

In the case of transparency, we know from before that

$$CS^T = \frac{1}{(3-\mu)^2} \frac{(a-bc)^2}{2b}$$

so it is easily checked that consumer surplus is higher with transparency only if

$$\widehat{c} > \frac{a}{b} - \frac{1}{b} \frac{a-bc}{3-\mu} \sqrt{\frac{4-(3-\mu)^2\mu}{1-\mu}}$$

On the other hand we need $\widehat{c} < v_U$, so we need to check that

$$\frac{a}{b} - \frac{1}{b} \frac{a-bc}{3-\mu} \sqrt{\frac{4-(3-\mu)^2\mu}{1-\mu}} < \frac{1}{3} \frac{a}{b} + \frac{2}{3} c$$

or,

$$\frac{9}{4} \frac{4-(3-\mu)^2\mu}{(3-\mu)^2(1-\mu)} > 1$$

and the last inequality is never true, so consumer surplus is lower with transparency than without.

Thus prospects for positive welfare effects of transparency are weak: Welfare may be written $W = CS + \Pi_M + \Pi_{RI} + \Pi_{RU}$. In the no-transparency regime, we get

$$W = 3\mu \frac{(a-bc)^2}{8b} + 3(1-\mu) \frac{(a-b\widehat{c})^2}{8b} + \frac{(1-\mu)(\widehat{c}-c)(a-b\widehat{c})}{2}$$

while the transparency regime yields

$$W^T = \frac{30-19\mu+5\mu^2+2\mu^3}{6(3-\mu)^2} \frac{(a-bc)^2}{2b}$$

Welfare without transparency, W , exceeds welfare with transparency, W^T , if

$$p \left(\frac{a-b\widehat{c}}{a-bc} \right)^2 + b \frac{\widehat{c}-c}{a-bc} \frac{a-b\widehat{c}}{a-bc} > \frac{60-119\mu+64\mu^2-5\mu^3}{9-15\mu+7\mu^2-\mu^3}$$

The left-hand side decreases from 9 to $\frac{11}{9}$ as $\widehat{c}$ goes from c to v_U . The right-hand side is decreasing in μ from $6\frac{2}{3}$:

Thus for small $\widehat{c}$ and μ , transparency is likely to be welfare decreasing. As $\widehat{c}$ and/or μ increase, it is more likely that transparency has a positive welfare effect. Thus with a very large uninformed market segment with high beliefs ($\widehat{c} < v_U$), transparency will reduce $w_U^{**} < w_U^*$ and the effect of this is more important than the increase in the wholesale price at the informed market segment.

A.5 Summary of the results

The results from the preceding analysis on when transparency will be preferred to no transparency are summarised in the table below:

Table 1: Summary

Party	$\widehat{c} > v_U$	$\widehat{c} < v_U$
M	Never	Only if $\widehat{c}$ and μ are small (see eqn. (28))
R_I	Never	Never
R_U	Always	If $\widehat{c} > c + \frac{1-\mu}{3-\mu}(\frac{a}{b} - c)$
CS (Consumers)	Never	Never
W (Society)	Never	If $\widehat{c}$ and μ are high

Finally, note that when $\widehat{c} = c$, transparency hurts everybody. So if the uninformed is correct without knowing so, transparency hurts all the involved players.