

Horizontal mergers and successive oligopoly

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Abstract. This paper considers a successive oligopoly setting in which a set of upstream firms sell output non-exclusively to a group of downstream firms using a linear tariff. If the concavity of retail demand is constant then the profitability of horizontal merger at either the upstream or the downstream stage is shown to depend on the number of firms in the stage experiencing the merger and not on the number of firms in the other stage. Furthermore, the profitability of merger at either stage is the same as the profitability of merger amongst a set of vertically integrated firms in a setting in which all firms are vertically integrated. Finally, mergers at either stage are shown to reduce the sum of producer and consumer surplus. Moreover the negative effects of merger on surplus are unambiguously increased by increases in concentration in the merging stage and ambiguously affected by increases in concentration in the non-merging stage.

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1. Introduction

The purpose of this paper is to explore the profit and welfare consequences of horizontal mergers at either the downstream or upstream stage of production in a successive oligopoly setting in which the contract governing trade between the two stages of production is linear and thus gives rise to double-marginalization. This analysis is made relevant by recent consolidation at the retail level in both Europe and the US¹ and by ongoing theoretical and empirical debate about the ‘countervailing power’ benefits of retail consolidation.² The main conclusion of the paper is that if products and retailers are undifferentiated and the concavity of retail demand is constant then vertical separation has no effect on the profitability of horizontal merger at either the upstream or downstream stage of production. This result is obtained by using an ‘arms-length’ linear contracting model and contrasts with the existing results in the literature which show that vertical separation either ambiguously effects or increases the profitability of merger depending on whether upstream and downstream firms bargain over a linear tariff or use a two-part tariff³.

It should be noted that anti-competitive mergers are generally unprofitable in vertically *integrated* Cournot oligopoly models in which marginal cost is constant. In particular it has been shown⁴ that in the absence of cost efficiency gains any output-

¹ For detailed evidence of increased retail concentration see Dobson and Waterson (1997) for various product groups in the UK during the 1982 to 1992 period, Dobson and Waterson (1999) for retail grocery for various European countries in the 1988 to 1996 period and Wrigley (2001) for US supermarket retailing during the 1992 to 1999 period. The role of mergers in bringing about the increased concentration was more significant in the US (Wrigley 2001) than in the UK (Dobson and Waterson 1999).

² Theoretical results concerning countervailing power are contained in Horn and Wolinsky (1988), von-Ungern Sternberg (1996) and Dobson and Waterson (1997). For a review of some of the empirical literature and a general discussion of countervailing power see Scherer and Ross (1990, pp. 527-35) and Dobson and Waterson (1999).

³ Results concerning the profitability of merger in vertically separated settings are contained in Horn and Wolinsky (1988) and von-Ungern Sternberg (1996) for the linear bargaining case and in Ziss (2001) and González-Maestre and López-Cuñat (2001) for the case of two-part tariffs.

⁴ See Levin (1990), Gaudet and Salant (1991) or Cheung (1992). It should be pointed out that a 50 percent market share is a necessary but not sufficient condition for profitable merger. For example, if demand is linear then Salant, Switzer and Reynolds (1983) have shown that profitable merger requires

reducing merger is profitable only if it involves more than 50 percent of the firms in the industry. This result emerges because any internalisation of market power gains brought about by a contraction in output of the merging parties is more than offset by an expansion in output of the non-merging parties.⁵ My results show that horizontal mergers in Cournot oligopoly continue to be generally unprofitable when market structure goes from vertical integrated oligopoly to successive oligopoly.

The model developed in this paper assumes the products sold by upstream manufacturers as well as the selling services of downstream retailers to both are homogeneous. As a result horizontal merger brings about shutdown and is thus equivalent to negative entry. Secondly, I adopt the arms-length contracting model pioneered by Greenhut and Ohta (1976) and Waterson (1980) which assumes that the upstream firms choose output taking into account the impact on the equilibrium wholesale price, where the latter is determined by the derived demands of the downstream firms. The downstream retailers then take the wholesale price as given and choose output à la Cournot. My comparative static results indicate that horizontal mergers at either the upstream or downstream stages reduce industry output and thus reduce welfare. The upstream merger result generalises the well-known result derived by Seade (1980) for the case of Cournot oligopoly to the case of successive Cournot oligopoly. The downstream merger result has been the source of much debate as a result of the countervailing power hypothesis first put forward by Galbraith (1952). This argument states that buyer concentration may be pro-competitive because it may result in retailers gaining more bargaining power and thereby negotiating reductions in wholesale prices that are sufficiently large so as to overcome the increase in retail

the merging parties' market share to be at least 80 percent.

⁵ The profitability of merger is improved if the loss of market share to non-merging parties is muted, as will be the case if marginal costs are increasing (Perry and Porter 1985); products are differentiated (Deneckere and Davidson 1983) or merger bestows upon the merged entity a first mover advantage

market power and reduce retail prices. My paper assumes that the retailers act as wholesale price takers both before and after the merger, which effectively means that the retailers have no bargaining power and that retail merger has no impact on bargaining power. The question addressed in this paper is thus whether an increase in retail bargaining power is actually a necessary condition for retail mergers to lower retail prices or whether the reduction in wholesale demand brought about by retail merger will be enough to induce manufacturers to lower prices even if retailer bargaining power remains at zero (i.e. they remain price takers). My results show that retail mergers have no impact on the wholesale price and thus result in higher retail prices. The conclusion is thus that an increase in retail bargaining power is a *necessary* condition for retail mergers to lower retail prices.

A final set of results deal with the impact of market structure on the welfare effects of merger. The motivation for this analysis is to determine how the market structure in both stages should be taken into account when assessing the welfare effects of a merger that brings about a fixed cost saving.⁶ The conventional wisdom⁷ is that mergers have more negative effects on the sum of producer and consumer surplus when markets are more concentrated. The implication of this wisdom is that mergers in concentrated markets require a greater fixed cost savings in order to increase welfare than mergers in less concentrated settings. My results indicate that the conventional wisdom holds even in markets that feature successive oligopoly but that this result does not apply to increases in concentration in the non-merging stage. In particular an increase in concentration in the non-merging stage will increase the

(Daughety 1990, d'Aspremont et al. 1983).

⁶ This issue is particularly relevant in retailing where many firms have merged in order to achieve the economics of scale needed to adopt new information technology (Wrigley 2001).

⁷ To my knowledge the conventional wisdom has not been formally proved. Previous papers that have examined the welfare effects of merger (Levin 1990, Farrell and Shapiro 1990, McAfee and Williams 1992) have focussed on models with heterogenous marginal cost and thus have not been able to derive

magnitude of the negative surplus effect of merger only if the non-merging stage is initially sufficiently unconcentrated. If the non-merging stage is already concentrated then a further increase in concentration may reduce the magnitude of the negative surplus effect of merger. This result is rather surprising as one would expect a priori that an increase in concentration which increases the extent of double marginalization would unambiguously worsen the negative surplus effect of any output reducing merger. The result is explained by the fact that an increase in the extent of double-marginalization brought about by an increase in concentration at the non-merging stage reduces the output contraction brought about by merger and that this effect can overcome the higher mark-up induced by the increase in concentration.

The paper is organized as follows. The model and the results regarding the comparative statics of entry are contained in Section 2. The profitability results are derived in Section 3. Section 4 contains results concerning the impact of market structure on the welfare effects of merger and Section 5 concludes.

2. The Model and the Comparative Statics of Entry

The model consists of r retailers and m manufacturers. Each manufacturer produces a homogeneous product at constant marginal cost c and zero fixed cost. The manufacturers sell homogeneous output non-exclusively to the retailers at the common wholesale price w . The non-differentiated retailers re-sell the output of the manufacturers at a common retail price $P(Q)$, where Q represents industry output. The inverted demand function $P(Q)$ is assumed to be strictly decreasing and twice continuously differentiable. Now define $\beta(Q)$ as the degree of concavity of retail demand and then assume that

the comparative results of an increase in the number of firms on the welfare effect of merger.

$$(1) \quad \beta(Q) \equiv P''(Q)Q/P'(Q) > -2$$

which implies $2P'(Q) + QP''(Q) < 0$ thereby ensuring that industry retail marginal revenue is downward sloping and that the second order conditions for the retail stage are satisfied for any market structure.⁸

If retailer i 's output is denoted x_i and manufacturer i 's output is denoted y_i then retailer pay-offs are given by

$$(2) \quad R_i = (P(Q) - w)x_i \quad i = 1, \dots, r$$

whereas manufacturer pay-offs are given by

$$(3) \quad M_i = (w - c)y_i \quad i = 1, \dots, m$$

The m manufacturers and r retailers play a two-stage game that involves simultaneous choice in each stage. In the first stage each manufacturer chooses their level of output x_i taking into account the impact of their choice on the equilibrium level of the wholesale price. In stage 2 the retailers take the wholesale price as given and choose output y_i in Cournot fashion. This game is solved using backward induction.

Retail stage. Note that $Q = \sum_{i=1}^r x_i$ and then differentiate (2) with respect to x_i to obtain

$$(4) \quad P(Q) + x_i P'(Q) - w = 0 \quad i = 1, \dots, r$$

which implies that the derived inverted industry demand by the retailers for the output produced by the manufacturer's (denoted $w(Q, r)$) is the horizontal sum of the retail marginal revenue curves. Substitute $w = w(Q, r)$ and then apply symmetry by letting $x_i = Q/r$ to obtain that $w(Q, r)$ is given by

$$(5) \quad P(Q) + \frac{Q}{r} P'(Q) = w(Q, r)$$

⁸ In a symmetric model the condition which ensures that retail outputs are strategic substitutes is $\beta(Q) \geq -r$. If $r > 2$ then (1) implies, and is stronger than, the strategic substitutes condition. In the merger literature the strategic substitutes assumption has been used by Farrell and Shapiro (1990), Levin (1990) and Gaudet and Salant (1991), whereas the downward sloping industry marginal revenue assumption has been used by Kamien and Zang (1990), Cheung (1992) and Faulí-Oller (1997).

Differentiating (5) yields the following comparative statics

$$(6a) \quad w_Q(Q, r) = \frac{P'(Q)(r+1+\beta(Q))}{r} < 0$$

$$(6b) \quad w_r(Q, r) = -\frac{QP'(Q)}{r^2} > 0,$$

where subscripts denote partial derivatives. (6a) implies that the derived demand for manufacturer's output is downward sloping (i.e. the wholesale price must fall in order for manufacturers to sell more output to profit maximizing retailers). (6b) implies that an increase in demand for manufacturer's output brought about by an increase in the number of retailers will cause the wholesale price to rise.

Let me now derive some of the higher order derivatives of $w(Q, r)$ that will be required for subsequent analysis. Let $w_{QQ}(Q, r) \equiv \partial^2 w(Q, r) / \partial Q^2$ and

$w_{Qr}(Q, r) \equiv \partial^2 w(Q, r) / \partial Q \partial r$ and then differentiate (6a) with respect to Q and r to obtain (7a) and (7b) respectively

$$(7a) \quad w_{QQ}(Q, r) = \frac{P''(Q)(r+1+\beta(Q)) + P'(Q)\beta'(Q)}{r}$$

$$(7b) \quad w_{Qr}(Q, r) = -\frac{P'(Q)(1+\beta(Q))}{r^2}$$

Let $\alpha(Q, r)$ denote the degree of concavity of wholesale demand and then assume that

$$(7c) \quad \alpha(Q, r) \equiv w_{QQ}(Q, r) / w_Q(Q, r) > -2$$

which implies $2w_Q(Q, r) + Qw_{QQ}(Q, r) < 0$ thereby ensuring that industry wholesale marginal revenue is downward sloping and that the second order conditions for the wholesale stage are satisfied for any market structure.

LEMMA 1: If the concavity of the retail demand is constant and equal to β then the concavity of the wholesale demand is also constant and equal to β .

PROOF: Multiply (7a) by Q , divide the ensuing expression by (6a) and then substitute

$\beta(Q) \equiv P''(Q)Q/P'(Q)$ to obtain that the concavity of wholesale demand equals

$$(8) \quad \alpha(Q, r) = \beta(Q) + \frac{\beta'(Q)Q}{r+1+\beta(Q)},$$

If $\beta(Q) = \beta$ then $\beta'(Q) = 0$ and thus (8) implies that $\alpha(Q, r) = \beta$ as required. $\square$

Manufacturing stage. Substitute $w = w(Q, r)$ into (3). Note that $Q = \sum_{i=1}^m y_i$ and then

differentiate (3) with respect to y_i to obtain

$$(9) \quad w(Q, r) + y_i w_Q(Q, r) - c = 0 \quad i = 1, \dots, m$$

Denote the equilibrium solution for industry output as $Q(r, m)$.⁹ Now apply symmetry and substitute $y_i = Q(r, m)/m$ into (9) to obtain that $Q(r, m)$ must satisfy

$$(10) \quad w(Q(r, m), r) + \frac{Q(r, m)}{m} w_Q(Q(r, m), r) - c = 0$$

Differentiate (10) and then use (6) and (7) to get that the proportional increase in industry output is given by

$$(11a) \quad \frac{Q_r(r, m)}{Q} = \frac{1 + \frac{\beta(Q) - \alpha(Q, r)}{m+1+\alpha(Q, r)}}{r(r+1+\beta(Q))}$$

if there is an increase in the number of retailers and by

$$(11b) \quad \frac{Q_m(r, m)}{Q} = \frac{1}{m(m+1+\alpha(Q, r))}$$

if there is an increase in the number of manufacturers.

Now let $\tilde{w}(r, m)$ denote the equilibrium solution for the wholesale price (the $\sim$ is used to distinguish the solution for the wholesale price from the wholesale demand function faced by the manufacturers). Since $\tilde{w}(r, m) = w(Q(r, m), r)$ then

$$(12a) \quad \tilde{w}_r(r, m) = w_Q(Q, r)Q_r(r, m) + w_r(Q, r)$$

⁹ Industry output will also depend on c but I have chosen to hide this fact to avoid clutter.

$$(12b) \quad \tilde{w}_m(r, m) = w_Q(Q, r)Q_m(r, m)$$

Substituting (6a), (6b) and (11a) into (12a) yields

$$(13a) \quad \tilde{w}_r(r, m) = \frac{P'(Q)Q(\beta(Q) - \alpha(Q, r))}{r^2(m + 1 + \alpha(Q, r))}$$

Substituting (6a) and (11b) into (12b) yields

$$(13b) \quad \tilde{w}_m(r, m) = \frac{P'(Q)Q(r + 1 + \beta(Q))}{rm(m + 1 + \alpha(Q, r))}$$

The following Proposition now follows from the comparative static results given in (11) and (13), the concavity assumptions in (1) and (7c) and the relationship between the concavity of retail and wholesale demand given in (8).

PROPOSITION 1: (i) An increase in the number of manufacturers causes industry output to rise and wholesale and retail prices to fall. (ii) An increase in the number of retailers causes industry output to rise and the retail price to fall. (iii) An increase in the number of retailers causes the wholesale price to rise, remain constant or fall depending on whether the concavity of retail demand rises ($\beta'(Q) > 0$), remains constant ($\beta'(Q) = 0$) or falls ($\beta'(Q) < 0$), respectively.

Part (i) of Proposition 1 extends the ‘entry increases industry output’ result derived by Seade (1980) for Cournot oligopoly to the case of successive Cournot oligopoly. The only difference between the two results is that the former depends on the concavity of the retail demand whereas the latter depends on the concavity of the derived wholesale demand. Part (ii) of Proposition 1 shows that the countervailing hypothesis does not hold for the case of successive oligopoly. In particular part (ii) implies that increases in retail concentration result in higher not lower retail prices.

Finally part (iii) of Proposition 2 generalises the result obtained by Greenhut and Ohta (1976) to consider general demand functions and upstream oligopoly. In particular Greenhut and Ohta consider upstream monopoly and a particular retail demand specification which features constant concavity to show that downstream market structure does not affect the wholesale price. Part (iii) shows that this invariance result continues to hold even if the upstream market structure is oligopoly and the concavity of retail demand is constant but does not for either monopoly or oligopoly if the concavity of retail demand varies with output.

3. The profitability of merger

At both the retail and manufacturing stages, it has been assumed that marginal cost is constant and that firms sell undifferentiated output. A merger involving $k + 1$ firms at either stage will thus result in the merged entity operating only one of the firms involved in the merger and shutting down the remaining k firms. Consequently if there are $N \geq 2$ firms in a particular stage prior to merger then a merger of $k + 1$ firms in that stage will reduce the number of firms in that stage from N to $N - k$. At either stage, it is profitable for firms to merge provided the post-merger profit of the single merged entity exceeds the collective pre-merger pay-offs of the merging firms. The pre and post merger payoffs of the merging firms are given by $(k + 1)R(N, m)$ and $R(N - k, m)$ respectively for a retail merger and by $(k + 1)M(r, N)$ and $M(r, N - k)$ respectively for a manufacturing merger. Comparing the pre and post merger profits of the merging firms yields that a retail merger is profitable if

$$(14a) \quad \frac{R(N - k, m)}{R(N, m)} > k + 1$$

whereas a manufacturing merger is profitable if

$$(14b) \quad \frac{M(r, N-k)}{M(r, N)} > k + 1$$

Retail mergers: An expression for the left-hand side of (14a) can be found by

analysing the symmetric equilibrium retail profit given by

$$(15) \quad R(r, m) = (P(Q(r, m)) - \tilde{w}(r, m)) \frac{Q(r, m)}{r}$$

Differentiating (15) with respect to r and then dividing the ensuing expression by

$R(r, m) = (P - w) \frac{Q}{r}$ yields that the proportional change in retailer profit resulting from

an increase in the number of retailers is given by

$$(16) \quad \frac{R_r(r, m)}{R(r, m)} = \frac{Q_r}{Q} + \frac{(P'Q_r - \tilde{w}_r)}{P - w} - \frac{1}{r}$$

Now substitute $P - w = -\frac{QP'}{r}$, which follows from (5), and then substitute (11a) and

(13a) to obtain

$$(16)' \quad -\frac{R_r(r, m)}{R(r, m)} = \frac{2r + \beta(Q) - (2 + \beta(Q)) \frac{\beta(Q) - \alpha(Q, r)}{m+1+\alpha(Q, r)}}{r(r+1+\beta(Q))}$$

Integrate the LHS of (16)' to obtain

$$(17) \quad \int_{N-k}^N -\frac{R_r(r, m)}{R(r, m)} dr = \ln \left[\frac{R(N-k, m)}{R(N, m)} \right]$$

Now take the exponential of both sides of (17) to get

$$(18) \quad \frac{R(N-k, m)}{R(N, m)} = \exp \int_{N-k}^N -\frac{R_r(r, m)}{R(r, m)} dr$$

From (16)', (18) and (14a) it then follows that a retail merger is profitable if

$$(19) \quad \exp \int_{N-k}^N \frac{2r + \beta(Q) - (2 + \beta(Q)) \frac{\beta(Q) - \alpha(Q, r)}{m+1+\alpha(Q, r)}}{r(r+1+\beta(Q))} dr > k + 1$$

Manufacturing mergers: A solution to the left-hand side of (14b) is found by applying

the above analysis to the symmetric equilibrium manufacturer profit given by

$$(20) \quad M(r, m) = (w(Q(r, m), r) - c) \frac{Q(r, m)}{m}$$

Differentiating (20) with respect to m and then dividing the ensuing expression by

$B = (w - c) \frac{Q}{m}$ yields that the proportional change in manufacturing profit resulting

from an increase in the number of manufacturers is given by

$$(21) \quad \frac{M_m(r, m)}{M(r, m)} = \frac{Q_m}{Q} + \frac{w_Q Q_m}{w - c} - \frac{1}{m}$$

Substitute $w - c = -\frac{Q w_Q}{m}$, which follows from (10), and then substitute (11b) to obtain

$$(21)' \quad -\frac{M_m(r, m)}{M(r, m)} = \frac{2m + \alpha(Q, r)}{m(m + 1 + \alpha(Q, r))}$$

Now follow the procedure indicated in the text between (16)' and (19) and then use

(14b) to obtain that a merger among $k + 1$ manufacturers is profitable provided

$$(22) \quad \exp \int_{N-k}^N \frac{2m + \alpha(Q, r)}{m(m + 1 + \alpha(Q, r))} dm > k + 1$$

Mergers under vertical integration: For the sake of comparison with existing results

in the literature let me now present the merger analysis for the case in which all n

firms in an industry are vertically integrated. If the symmetric Cournot equilibrium

level of industry output is denoted $Q(n)$ then the symmetric equilibrium profit for

each firm in a vertically integrated industry is given by

$$(23) \quad \pi(n) = (P(Q(n)) - c) \frac{Q(n)}{n}$$

If there are N vertically integrated firms prior to merger then a merger of $k + 1$

vertically integrated firm is profitable provided

$$(24) \quad \frac{\pi(N - k)}{\pi(N)} > k + 1$$

which becomes

$$(24)' \quad \exp \int_{M-k}^M \frac{2n + \beta(Q)}{n(n + 1 + \beta(Q))} dn > k + 1$$

after the solution for $\pi(N - k)/\pi(N)$ is substituted (see Faulí-Oller (1997) for details).

PROPOSITION 2: If upstream marginal cost and the degree of concavity of retail demand are both constant then (a) the profitability of a horizontal merger involving $k + 1$ firms is the same in both the upstream and downstream stages provided there are the same number of firms in the merging stage prior to merger. (b) Furthermore a merger of $k + 1$ firms at either stage (i) is the same as a merger involving $k + 1$ firms in an industry in which all firms are vertically integrated, (ii) does not depend on the number of firms in the other stage and (iii) does not depend on the level of manufacturing marginal cost.

PROOF: If the concavity of retail demand is constant and equal to β then from Lemma 1 it follows that the concavity of wholesale demand is also constant and equal to β . Substituting $\alpha(Q, r) = \beta(Q) = \beta$ into (19) and (22) yields that a merger of $k + 1$ retailers is profitable if

$$(19)' \quad \exp \int_{N-k}^N \frac{2r + \beta}{r(r + 1 + \beta)} dr > k + 1$$

and that a merger of $k + 1$ manufacturers is profitable if

$$(22)' \quad \exp \int_{N-k}^N \frac{2m + \beta}{m(m + 1 + \beta)} dm > k + 1$$

Both (19)' and (22)' are equivalent to (24)' if $\beta(Q) = \beta$, thereby implying part (i) of the result, and are independent of c , thereby implying part (iii) of the result.

Furthermore (19)' is independent of m and (22)' is independent of r thereby implying part (ii) of the result. $\square$

A priori one would expect that the effect of vertical separation and double-marginalization on the profitability of merger to be ambiguous for the following reason. On the one hand double-marginalization enhances the profitability of merger because part of lost profit from the output contraction are borne by firms at the other stage of production. On the other hand double-marginalization reduces the equilibrium level of output in the post-merger stage which then reduces the profitability of merger because the price increase brought about by merger applies over fewer units of output¹⁰. Proposition 2 points out that under fairly general conditions the two effects cancel each other out and leave the profitability of merger unaffected by the extent of double-marginalization. Since the number of firms at the non-merging stage determines the extent of double-marginalization then it follows that the latter does not affect the profitability of merger. Furthermore since a regime in which all firms are vertically integrated is a special case in which double-marginalization is zero then the profitability of merger under a vertically integrated regime is the same as a merger in a vertically separated regime.

Finally the reason that upstream mergers and downstream mergers are equally profitable follows from Lemma 1, Proposition 1 and from a previous result in the literature. In particular Faulí-Oller (1997) has shown that in symmetric Cournot oligopoly the profitability of merger depends neither on the positioning of the demand curve nor on the unchanging level of constant marginal cost, but rather depends only on the concavity of the demand curve faced by the merging firms, the pre-merger market structure and the number of firms involved in the merger. The implication of

¹⁰ Vertical separation can also affect the response of the non-merging firms to the merger which then affects the extent of the price increase that the merging firms can achieve for any given output contraction. This effect is ignored in the above discussion because there is no clear intuition as to how vertical separation will affect the response of the non-merging firms. For downstream mergers there is also the possibility that mergers will bring about a reduction in marginal cost by resulting in a lower wholesale price. Proposition 1 rules out this possibility if the concavity of retail demand is constant.

this result is that the profitability of upstream and downstream mergers of equal size and identical pre-merger market structure in the merging stage can only differ if the merging stage marginal cost curves were to shift as a result of merger, or if the concavity of the retail and wholesale demand differed from one another. The assumptions of the model and previous results derived in this paper rule out both of these possibilities. In particular a change in manufacturing marginal cost brought about by a manufacturing merger is ruled out by assumption whereas a change in retail marginal cost brought about by a retail merger is ruled out by Proposition 1 if the concavity of retail demand is constant. Secondly Lemma 1 establishes that the concavity of retail and wholesale demand do not differ from one another if the former is constant.

4. The effect of market structure on the welfare effects of mergers

Proposition 1 establishes that a horizontal merger at either the upstream or downstream stage reduces output and therefore lowers the sum of consumer and producer surplus (hereafter referred to as surplus). The purpose of this section is to determine the effect of pre-merger market structure, in both the merging and non-merging stages, on the negative surplus effects of mergers. The motivation behind this analysis is to determine the effect of market structure on the size of the fixed cost efficiency gain required for a surplus reducing merger to increase welfare (surplus net of fixed costs). More specifically the issue of interest is whether or not mergers in concentrated setting require a greater fixed cost efficiency gain in order to raise welfare than mergers in less concentrated settings.

Let me begin by denoting the number of firms in the merging and non-merging stage by n and $\tilde{n}$ respectively. Now let $S(n, \tilde{n})$ and $Q(n, \tilde{n})$ denote the equilibrium level of surplus and industry output respectively. If $\Delta S = S(N-k, \tilde{n}) - S(N, \tilde{n})$ denotes the change in surplus resulting from a merger then from the First Fundamental Theorem of Calculus and the definition of surplus it follows that

$$(25a) \quad \Delta S = - \int_{N-k}^N \frac{\partial S(n, \tilde{n})}{\partial n} dn < 0$$

$$(25b) \quad \text{where } \frac{\partial S(n, \tilde{n})}{\partial n} = (P(Q(n, \tilde{n}) - c) \frac{\partial Q(n, \tilde{n})}{\partial n} > 0$$

The effect of an increase in the number of firms on the surplus effects of a merger is thus given by

$$(26a) \quad \frac{\partial \Delta S}{\partial N} = - \int_{N-k}^N \frac{\partial S(n, \tilde{n})}{\partial n^2} dn$$

$$(26b) \quad \text{where } \frac{\partial^2 S(n, \tilde{n})}{\partial n^2} = (P - c) \frac{\partial^2 Q}{\partial n^2} + P' \left(\frac{\partial Q}{\partial n} \right)^2$$

if the rise in the number of firms occurs in the merging stage (prior to merger) and by

$$(27a) \quad \frac{\partial \Delta S}{\partial \tilde{n}} = - \int_{N-k}^N \frac{\partial^2 S(n, \tilde{n})}{\partial n \partial \tilde{n}} dn$$

$$(27b) \quad \text{where } \frac{\partial^2 S(n, \tilde{n})}{\partial n \partial \tilde{n}} = (P - c) \frac{\partial^2 Q}{\partial n \partial \tilde{n}} + P' \frac{\partial Q}{\partial n} \frac{\partial Q}{\partial \tilde{n}}$$

if the increase in the number of firms occurs in the non-merging stage.¹¹ If we now assume that the concavity of retail demand is constant then from (11a,b) we obtain that the comparative statics related to the merging stage are given by

$$(28a) \quad \frac{\partial Q}{\partial n} > 0$$

¹¹ (26a) is obtained by using the second and then the first fundamental theorem of calculus whereas (27a) is obtained by simply differentiating the integrand.

$$(28b) \quad \frac{\partial^2 Q}{\partial n^2} = -\frac{\partial Q}{\partial n} \frac{2n + \beta}{n(n+1 + \beta)} < 0$$

and those related to the non-merging stage are given by

$$(28c) \quad \frac{\partial Q}{\partial \tilde{n}} > 0$$

$$(28d) \quad \frac{\partial^2 Q}{\partial n \partial \tilde{n}} = \frac{1}{Q} \frac{\partial Q}{\partial n} \frac{\partial Q}{\partial \tilde{n}} > 0$$

From (26a,b) and (28a,b) we obtain that

$$(29) \quad \frac{\partial \Delta S}{\partial N} > 0$$

In order to sign $\partial \Delta S / \partial \tilde{n}$ we substitute (28d) into (27b) and then factor to obtain

$$(30) \quad \frac{\partial^2 S}{\partial n \partial \tilde{n}} = P' \frac{\partial Q}{\partial n} \frac{\partial Q}{\partial \tilde{n}} \left(\frac{P-c}{P'Q} + 1 \right)$$

From (5), (6a) and (9) it follows that

$$(31) \quad \frac{P-c}{P'Q} = \frac{-(n + \tilde{n} + 1 + \beta)}{n\tilde{n}}$$

which then implies that (30) becomes

$$(30)' \quad \frac{\partial^2 S}{\partial n \partial \tilde{n}} = \frac{P'}{n\tilde{n}} \frac{\partial Q}{\partial n} \frac{\partial Q}{\partial \tilde{n}} (-(n + \tilde{n} + 1 + \beta) + n\tilde{n})$$

PROPOSITION 3: If the concavity of retail demand is constant then (i) an increase in the number of firms in the merging stage (prior to merger) unambiguously reduces the negative surplus effects of merger (ii) an increase in the number of firms in the non-merging stage *reduces* the negative surplus effect of a merger if

$$(32) \quad \tilde{n} > \frac{N-k+1+\beta}{N-k-1}$$

(iii) an increase in the number of firms in the non-merging stage *increases* the negative surplus effect of a merger if

$$(33) \quad \tilde{n} < \frac{N+1+\beta}{N-1}$$

PROOF: (i) Follows from (29). (ii) Let $x = -(n + \tilde{n} + 1 + \beta) + n\tilde{n}$. From (27a,b) and (28a,c) and (30)' we obtain that $\partial\Delta S/\partial\tilde{n}$ is positive if $x > 0$ for all values of n between N and $N - k$. Since x is increasing in n (i.e. $\tilde{n} > 1$) then the latter is true if $x > 0$ at $n = N - k$ which yields (32). (iii) Conversely it follows that $\partial\Delta W/\partial\tilde{n}$ is negative if $x < 0$ for all values of n between N and $N - k$. Since x is increasing in n then the latter is true if $x < 0$ at $n = N$ which yields (33). $\square$

The conventional wisdom is that mergers have more negative effects on consumer and producer surplus when markets are more concentrated. Proposition 2 points out that the conventional wisdom is true even if markets are characterized by double-marginalization (part i) but that this presumption does not carry over to increases in concentration in the non-merging stage (parts ii and iii). The intuition behind the differing impacts of merging and non-merging stage concentration on the surplus effects of merger is as follows. There are two factors which determine the surplus loss associated with an output-reducing merger: the size of the output contraction and the total mark-up (i.e. the sum of the retail and wholesale mark-up). An increase in concentration at the merging stage increases both the total mark-up and the size of the output contraction and thus unambiguously increases the magnitude of the surplus loss brought about by merger. On the other hand an increase in concentration in the non-merging stage increases the mark-up but reduces the output contraction and thus has an ambiguous effect on the surplus loss associated with merger.

The reason that increases in concentration at either stage increase the total mark-up is straightforward: less competition yields higher mark-ups. The reason that increases in concentration have qualitatively different effects on the size of the output contraction is as follows. The size of the output contraction brought about by merger depends on two factors: the response of the non-merging firms in the merging stage and the size of the market (i.e. the gap between demand and marginal cost). An increase in concentration at the merging stage implies that there are fewer non-merging firms which then implies that the latter are collectively less responsive to the output contraction of the merging firms. As a result the contraction of industry output will be larger when the merging stage is more concentrated. On the other hand an increase in concentration in the non-merging stage serves to reduce the size of the market in the merging stage by either increasing the marginal cost in the merging stage, or by resulting in an inward rotation of the derived market demand in the merging stage, depending on whether the increase in non-merging stage concentration occurs at the upstream or the downstream stage. Since the size of the market determines the responsiveness of industry output to changes in market structure then it follows that an increase in non-merging stage concentration will reduce the size of the output contraction brought about by merger.

Part (ii) and (iii) of Proposition 3 resolve the indeterminate effect of concentration in the non-merging stage on the surplus effect of merger as follows. Increases in concentration in the non-merging stage will magnify the negative surplus effect of merger if the non-merging stage concentration is initially low (part ii). On the other hand if the non-merging stage concentration is already high then a further increase in concentration may reduce rather than magnify the negative surplus effect of merger (part iii). Moreover the point at which further increases in concentration

start to reduce rather than magnify the surplus effects of merger depend on the concavity of retail demand. For example, if demand is linear (i.e. $\beta = 0$) then a merger from triopoly to duopoly (i.e. $N = 3, k = 1$) will have a *more* negative surplus effect if the number of firms in the non-merging stage falls from some $\tilde{n} > 2$ to $\tilde{n}$ equal to 3 but will have a *less* negative surplus effect if $\tilde{n}$ falls from 2 to 1. On the other hand if the concavity of demand is given by $\beta = 10$ then the same merger will have more negative surplus effect if the number of firms in the non-merging stage falls from $\tilde{n} > 13$ to $\tilde{n} = 13$ and will have a less negative surplus effect if $\tilde{n}$ falls from 6 to some $\tilde{n}$ which is less than 6.

5. Conclusions

This paper has explored the profit and welfare consequences of horizontal merger in markets which feature vertical separation. My model differs from previous papers in that it employs an arms-length linear contracting approach as opposed to a bargaining or a two-part tariff approach. One of the merits of my approach is that unlike the aforementioned alternative approaches it does not assume that downstream firms deal exclusively with an upstream firm. A consequence of assuming non-exclusive dealing is that I can allow for an arguably more realistic setting in which both upstream and downstream firms make strategic capacity choices whereas the other approaches assume that only the downstream firm makes the capacity choice.

A comparison of my results to those in the literature indicates that the nature of the contracting relationship qualitatively affects the profitability of horizontal merger but does not qualitatively impact on the welfare effects of horizontal merger. In particular my welfare results are qualitatively similar to the bargaining and two-part

tariff results in that they imply that horizontal mergers reduce welfare. On the other hand I have shown that if the concavity of retail demand is constant then vertical separation does not affect the profitability of merger. This result contrasts both with the linear tariff bargaining results of Horn and Wolinsky (1988) and von-Ungern Sternberg (1996) which suggest that vertical separation can either enhance or reduce the profitability of merger depending on whether or not products are differentiated¹², and with the two-part tariff results of Ziss (2001) and González-Maestre and López-Cuñat (2001) who show that vertical separation unambiguously enhances the profitability of horizontal merger.

A second contribution of this paper is to show that the reduction in wholesale demand brought about by retail merger does not induce manufacturers to alter wholesale prices in the absence of any change in retail bargaining power. As a result retail mergers raise retail prices and are anti-competitive. The implication of this result is that an increase in retail bargaining power is a necessary condition for retail mergers to lower retail prices and enhance welfare in the absence of cost efficiency gains. This result is particular relevant given the relatively lax antitrust treatment that retail mergers appear to receive in both the UK (Dobson and Waterson 1997) and the vacillating degree of antitrust enforcement of retail mergers in the US (Wrigley 2001).

A final contribution of this paper is to derive comparative static results regarding the impact of market structure on the welfare effects of mergers. A standard presumption in the literature is that increases in concentration serve to worsen the welfare effect of horizontal merger. My results confirm that the conventional wisdom

¹² In particular Horn and Wolinsky (1988) show that if products are differentiated substitutes and the upstream stage is monopoly then downstream merger for monopoly is never profitable under vertical separation whereas such a merger is always profitable under vertical integration. On the other hand von-Ungern Sternberg (1996) show that if products are homogeneous and the upstream stage is monopoly then a reduction in the number of retailers lowers wholesale prices. Since Cournot profits rise with a uniform reduction in the marginal cost and since merger results in shutdown when products

is true even in the presence of double-marginalization but shows that this result only applies if the increase in concentration occurs in the merging stage. If the increase in concentration occurs in the non-merging stage then the negative welfare effect of merger may rise or fall with increases in non-merging stage concentration depending on the initial level of concentration in the non-merging stage and on the concavity of retail demand.

are homogeneous then these results imply that retail merger is always profitable.

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