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UPWARD PRICING PRESSURE IN TWO-SIDED MARKETS*

Pauline Affeldt, Lapo Filistrucchi and Tobias J. Klein

Measuring upward pricing pressure (UPP) has recently been proposed by Farrell and Shapiro (2010) as an alternative screening device for horizontal mergers. We extend the concept of UPP to two-sided markets. Examples of such markets are the newspaper market, where the demand for advertising is related to the number of readers and the market for online search, where advertising demand depends on the number of users. The formulae we derive depend on four sets of diversion ratios that can either be estimated using market-level demand data or elicited in surveys. In an application, we show that it is important to take the two-sidedness of the market into account when evaluating UPP.

Until recently, competition authorities have screened mergers based on the post-merger Herfindahl–Hirschman index (HHI) and the merger-related change in the HHI.[1] This requires the definition of the relevant market, which is usually done using a SSNIP test.[2] However, following this practice may be problematic in differentiated product markets because there substitutability is a matter of degree, while market definition involves a zero/one decision of whether to include a given product in the relevant market or not. Additionally, assuming the relevant market has been defined, the well-known positive relationship between HHI and market power (or allocative inefficiency) may not hold when products are differentiated or firms compete in prices.

As a response, pricing pressure indices have recently been proposed as alternative screening devices for horizontal mergers involving differentiated products. The upward pricing pressure (UPP) measure – initially proposed by Farrell and Shapiro (2010) – and the gross upward pricing pressure index (GUPPI) characterise the unilateral incentives to raise prices post-merger. These incentives arise because the merged entity will internalise externalities one of the merging parties exercises on the other when setting prices. This is because some of the lost sales of a product, following an increase of its price, will be recaptured by an increase in sales in the other, now merged firm. The level of recapture will depend on the competitive closeness of the products. For example, if all customers who stop buying a product that is initially sold by one firm will then buy a product that is sold by the other firm that merges with the first firm, then the merger generates a strong incentive to raise prices, while there is no incentive if those customers who stop buying from the first firm would buy from a different, third firm.

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[1] The HHI is the sum of the squared market shares of all firms in the relevant market.

[2] SSNIP stands for small but significant and non-transitory increase in price. A product is said to belong to the relevant market if a hypothetical monopolist owning all the other products in the relevant market has an incentive to charge significantly higher prices for all its products than the competitive ones.

In this article, we develop UPP measures for two-sided markets. Two-sided markets are markets in which a firm sells two different products or services to two distinct groups of customers. An example is newspapers, which cater both to readers and advertisers. A two-sided market is further characterised by indirect network externalities between the two groups of consumers.[3] These arise when the utility (or increase in profits) obtained by a consumer (a firm) of one group depends on the number of consumers (or firms) of the other group on the platform and the two groups of customers cannot internalise these externalities. In the case of newspapers, advertisers value advertising in a given newspaper more if it has more readers. It is not clear whether readers like, dislike or are indifferent towards advertising in a newspaper but, for the market to be two-sided already, the presence of one indirect network effect is sufficient.[4]

The incentive to increase prices post-merger unilaterally depends on the value of diverted sales that are recaptured by the merged entity. This value of diverted sales is different in a merger involving two-sided platforms, as compared to a merger in a one-sided market and, hence, the one-sided UPP formula needs to be changed for the case of horizontal mergers in two-sided markets. This is due to the presence of the indirect network externalities. To see this, consider a merger between two newspapers and assume for the moment that both indirect network externalities are positive, which means that advertisers like readers and readers like advertising. First, if one of the two newspapers increases the price it charges to advertisers, demand for advertising in this newspaper will decrease. Some of the advertisers who are no longer willing to purchase advertising space from the first newspaper will switch to the formerly competing, now merged, second newspaper. These advertisers are no longer lost to the merged entity post-merger, which generates incentives of the first newspaper to raise advertising prices post-merger. This part is similar to the logic underlying the one-sided UPP measure. Second, however, the fact that by increasing the advertising price, the first newspaper now attracts fewer advertisers in turn decreases its value also for readers. Consequently, fewer readers will purchase the first newspaper. But some of those readers, who no longer purchase the first newspaper following its increase of advertising rates, will switch to the second, now merged, newspaper and are no longer lost to the merged entity post-merger. This second effect is due to the indirect network externalities between the two consumer groups in a two-sided market and needs to be taken into account when calculating UPP. We show how this can be done.

The article is organised as follows: Section 1 reviews UPP in one-sided markets. In Section 2, we extend the one-sided UPP formula for two-sided markets and present an application using data on the Dutch newspaper market. Section 3 concludes.

1. UPP in One-sided Markets

Pricing pressure indices characterise the unilateral effects of horizontal mergers involving differentiated products by calculating the post-merger effects of marginal price increases above the pre-merger level on profits. Prior to the merger, if one of the

[3] See Caillaud and Jullien (2001, 2003), Rochet and Tirole (2002, 2003, 2006), Evans (2003), Parker and van Alstyne (2005) and Armstrong (2006).
[4] See Filistrucchi *et al.* (2013).

merging firms raises a price by a small amount above the observed equilibrium price, its profits remain unchanged. Post-merger, if the merged firm increases the price of one of its products, some of the lost sales will also be recaptured by increased sales of other products owned by the formerly competing firm. Therefore, this price increase is now profitable and thus likely to occur in the absence of efficiency gains.

1.1. *Upward Pricing Pressure (UPP)*

1.1.1. *Original formulation*

The concept of UPP has recently been advocated by Farrell and Shapiro (2010).[5] Here, we follow their line of argument and then formally derive the results in subsection 1.1.2. UPP is a measure of the unilateral incentives to increase prices post-merger in markets with differentiated products. Thus, it assesses the likely unilateral effects of the merger. It is calculated for one product at a time and holding all other prices fixed. Hence, there are as many UPPs as products involved in the merger. The underlying assumption is Bertrand competition with differentiated products where firms set prices independently pre-merger.

A merger changes the first order conditions in two ways. The first effect creates upward pressure on prices due to the loss of competition between the merging parties' products – Farrell and Shapiro (2010) call this 'cannibalisation', or 'gross upward pricing pressure' (GUPP). The second effect leads to downward pressure on prices caused by merger-related efficiencies (marginal cost decreases). The difference between these two effects is UPP.

Considering a merger between firm 1 and firm 2 selling differentiated products 1 and 2 respectively, Farrell and Shapiro (2010) define the UPP on product 1 as[6]

$$UPP_1 = D_{12}(P_2 - C_2) - E_1 C_1, \tag{1}$$

where D_{12} is the diversion ratio from product 1 to product 2, P_2 is the price for product 2, C_2 is the corresponding marginal cost, E_1 is the percentage efficiency gain that is due to the merger and C_1 is the marginal cost of producing one more unit of product 1. The diversion ratio is the fraction of customers who buy product 2 when they stop buying product 1. It measures the impact on the quantity sold of product 2 if the price of product 1 changes so much as to change the quantity sold of product 1 by one unit. It thereby reflects the degree of substitutability between product 1 and product 2.

The second term in the formula for UPP_1 measures merger-related efficiencies, where E_1 is the efficiency parameter applied to pre-merger marginal costs of product 1,

[5] The idea of measuring the upward pressure on prices post-merger due to unilateral effects goes at least back to Werden (1996). Werden (1996) develops a formula to calculate the level of merger-specific efficiencies needed in order for post-merger prices not to increase, assuming Bertrand competition and merging firms with differentiated products. These efficiencies depend on pre-merger margins of the two products of the merging firms, the two diversion ratios and pre-merger prices. Werden (1996) finds that large (if not implausible) cost reductions are necessary to restore pre-merger prices in cases where the products are highly differentiated (and thus margins are high) and the merging firms compete intensely prior to the merger. Another predecessor to Farrell and Shapiro's (2010) UPP concept is Shapiro (1996). He relates gross margins and diversion ratios to incentives to increase prices post-merger, assuming Bertrand competition and independent price setting by firms pre-merger.

[6] Both the UPP and GUPPI formulae (presented below) can be adapted to account for Cournot competition or bidding competition (Moresi, 2009). Jaffe and Weyl (2012) generalise the idea to generalised pricing pressure (GePP), which allows for different types of non-Bertrand conduct.

for example, 10%. In the absence of efficiency gains, every horizontal merger between firms selling differentiated products, which are substitutes, creates an incentive to raise prices. A merger can however lead to efficiency gains that decrease marginal costs. This creates a countervailing incentive to lower prices that can potentially offset UPP created by the loss of competition between merging firms. Farrell and Shapiro (2010) propose to credit every merger with some default level of efficiencies in order to avoid flagging every merger between firms offering differentiated products for further investigation. For illustrative purposes, they use a 10% efficiency credit. Nevertheless, the authors note that this default credit must not be narrowly interpreted as marginal cost reductions but could also represent, for example, an increase in product quality.

Whenever the UPP measure is positive, the merger is likely to lead to price increases and should be further investigated according to Farrell and Shapiro (2010). The higher the diversion ratio (that is the closer substitutes product 1 and 2 are) and the higher the profit margin of product 2, the higher UPP_1 will be. The higher the merger-related efficiencies for product 1, the lower UPP_1 will be. Nevertheless, the test only gives a clear answer when the indices for both product 1 and product 2, UPP_1 and UPP_2, respectively, are positive. Farrell and Shapiro suggest to further investigate mergers where there is UPP for at least one of the merging firms' products.

1.1.2. *Formal derivation*

We now relate the UPP measure to profit maximisation. Assume that each firm owns only one product. Before the merger, firm 1 earns profits

$$\pi_1 = (P_1 - C_1)Q_1$$

and the optimal, observed price solves the first order condition

$$Q_1 + (P_1 - C_1)\frac{\partial Q_1}{\partial P_1} = 0. \tag{2}$$

After the merger, prices are set as to maximise joint profits

$$\pi_1 + \pi_2 = [P_1 - (1 - E_1)C_1]Q_1 + (P_2 - C_2)Q_2,$$

where E_1 is the efficiency credit in firm 1. The derivative of joint profits with respect to P_1 is

$$Q_1 + [P_1 - (1 - E_1)C_1]\frac{\partial Q_1}{\partial P_1} + (P_2 - C_2)\frac{\partial Q_2}{\partial P_1}.$$

This is the effect of a marginal price increase. We can re-express this in relative terms, relative to the magnitude of the effect this change has on the quantity sold in firm 1 by dividing by $-\partial Q_1/\partial P_1$ (we multiply by -1 because the sign of the own-price effect is negative). This gives

$$\left[Q_1 + (P_1 - C_1)\frac{\partial Q_1}{\partial P_1}\right] \Big/ \left(-\frac{\partial Q_1}{\partial P_1}\right) + \left(E_1 C_1 \frac{\partial Q_1}{\partial P_1}\right) \Big/ \left(-\frac{\partial Q_1}{\partial P_1}\right) + (P_2 - C_2)\frac{\partial Q_2}{\partial P_1} \Big/ \left(-\frac{\partial Q_1}{\partial P_1}\right).$$

At the pre-merger prices the first term is zero because of the first-order condition (2). Recognising that

$$-\frac{\partial Q_2}{\partial P_1} \Big/ \frac{\partial Q_1}{\partial P_1}$$

is the diversion ratio D_{12} gives the UPP formula presented above.

1.1.3. *Efficiency gains in the other firm*

So far, only efficiency gains in firm 1 have been incorporated. One way to incorporate efficiency gains E_2 in firm 2 is to adjust the price cost margin in that firm, so that

$$UPP_1^* = D_{12}[P_2 - (1 - E_2)C_2] - E_1 C_1.$$

This generally increases the incentive for firm 1 to increase prices.[7]

1.1.4. *Gross upward pricing pressure index (GUPPI)*

In their comment on updating the US merger guidelines, Salop and Moresi (2009) propose to use GUPPI to measure the upward pressure on post-merger prices. Differently from UPP, GUPPI does not grant an efficiency credit. Rather, it expresses UPP in terms of percentage margins.[8]

Salop and Moresi (2009) define GUPPI for product 1 as

$$GUPPI_1 = D_{12} \times m_2,$$

where again D_{12} is the diversion ratio from product 1 to product 2 and m_2 is the percentage pre-merger price-cost margin of firm 2's product 2. The thought experiment here is that firm 1 is initially indifferent between raising the price marginally or not, or equivalently between losing one unit of sales or not. Post-merger, if it loses one unit of sales, then it will gain the GUPPI times that unit in the other firm. The difference to UPP is that the GUPPI formula measures the value of diversion of sales from product 1 to product 2 in percentage terms instead of currency units. Specifically, it gives the percentage gain in firm 2 that is associated with losing sales in firm 1. Like UPP, GUPPI is the higher, the higher the diversion ratio between the merging firms' products, and the higher the pre-merger margin on product 2.

The GUPPI formula used in the US merger guidelines, is slightly different (CRA, 2010). It is given by

$$GUPPI_1^+ = D_{12} \times m_2 \times \frac{P_2}{P_1}$$

and generalises Salop and Moresi's (2009) formula because it allows for price differences pre-merger.

Since GUPPI only captures the internalisation of cannibalisation between the merging parties' products post-merger, it will always be positive if the merging parties' products are substitutes. Hence, if GUPPI is to be used as a horizontal merger screening device, some threshold GUPPI level needs to be specified below which the merger is considered not to give rise to substantial unilateral effects.[9]

[7] For this to hold, we need that the products are substitutes so that D_{12} is positive, which we assume throughout.

[8] The use of GUPPI, even if not specifically named that way, is also proposed in the revised US horizontal merger guidelines. See the US Department of Justice and the Federal Trade Commission's horizontal merger guidelines, issued 19 August, 2010. Available at http://www.ftc.gov/os/2010/08/100819hmg.pdf (last accessed: June 2012).

[9] The revised US horizontal merger guidelines state in this respect that a merger is unlikely to have significant unilateral effects if the GUPPI is proportionally small. They do not define however what is meant by 'small'. Nevertheless, following what has usually been considered a small but significant non-transitory increase in price, this 'small' could be interpreted as meaning 5% (CRA, 2010) or 10%. For a discussion of the relationship between GUPPI and market definition see Moresi (2010).

1.2. *Measuring Diversion Ratios in One-sided Markets*

The diversion ratio is the fraction of customers that buy product 2 when they stop buying product 1 due to a small price increase. It can be measured directly by conducting a survey among customers of firm 1, asking them whether they would stop buying if firm 1 would raise the price by 1% and, if so, to which product they would switch to.

Equivalently, it is the effect of a marginal price increase of product 1 on demand for product 2, divided by the marginal effect of this price change on demand for product 1, that is,

$$D_{12} = -\frac{\partial Q_2/\partial P_1}{\partial Q_1/\partial P_1}.$$

See for example, Epstein and Rubinfeld (2010). Here, we multiply by -1 to obtain a positive number – merely a matter of notation. These marginal effects can be calculated from demand estimates that can in principle be obtained from market level data. In practice, however, this is by no means straightforward as it requires exogenous variation in prices.[10]

The diversion ratio is in a similar manner related to own and cross-price elasticities with respect to a change in the price of product 1,

$$\eta_{11} = \frac{\partial Q_1/\partial P_1}{Q_1/P_1}$$

and

$$\eta_{21} = \frac{\partial Q_2/\partial P_1}{Q_2/P_1},$$

so that

$$D_{12} = -\frac{\eta_{21} Q_2}{\eta_{11} Q_1}.$$

This formula may be useful if a policy maker has strong priors in terms of (cross) price elasticities, as data on Q_1 and Q_2 are usually readily available. See also Werden (1998).

2. UPP in Two-sided Markets

In this Section, we develop UPP measures maintaining the original assumption of Farrell and Shapiro (2010) that firms compete in prices. As compared to one-sided markets, a firm now sets two prices and each of these affect sales of firm 2 on both market sides.[11]

[10] For multi-product firms it is sometimes convenient to express diversion ratios in terms of matrices. Here, we show how this can be done based on estimates of marginal effect. Denote by $\boldsymbol{Q}_1$ and $\boldsymbol{P}_1$ the K_1-vectors of quantities and prices of firm 1, respectively, and following Magnus (2010), by $\partial \boldsymbol{Q}_1/\partial \boldsymbol{P}_1'$ the $K_1 \times K_1$ matrix of derivatives of components of $\boldsymbol{Q}_1$ (in the rows) with respect to components of $\boldsymbol{P}_1$ (in the columns). Likewise for the $K_2 \times K_1$ matrix of derivatives of $\boldsymbol{Q}_2$ with respect to $\boldsymbol{P}_1$, which we denote by $\partial \boldsymbol{Q}_2/\partial \boldsymbol{P}_1'$. Then, denoting by dg$A$ the matrix which is the same size as $\mathbf{A}$ but contains only the diagonal elements of $\mathbf{A}$ on its own diagonal, the $K_1 \times K_2$ matrix of diversion ratios is

$$\boldsymbol{D}_{12} = -\left(\mathrm{dg}\frac{\partial \boldsymbol{Q}_1}{\partial \boldsymbol{P}_1'}\right)^{-1}\left(\frac{\partial \boldsymbol{Q}_2}{\partial \boldsymbol{P}_1'}\right)'.$$

[11] White and Weyl (2012) present UPP formulae for two-sided markets assuming instead that firms charge insulating tariffs, that is, price schedules conditional on quantities on the other side of the market. This, however, amounts in practice to assuming that firms choose quantities and then support those quantities by the corresponding insulating tariffs.

2.1. *Upward Pricing Pressure (UPP)*

2.1.1. *Formal derivation*

Our empirical example below is for the daily newspaper market, so we say that the firm sets P_1^A on the advertising market and P_1^R on the readership market. To see that evaluating a merger in a two-sided market is more complex, suppose firm 1 increases P_1^A so that Q_1^A decreases by one unit. Then, this decrease of Q_1^A also decreases Q_1^R (if the indirect network externality is positive, so more generally, it changes Q_1^R). The additional profits of firm 2 are then the recaptured units of advertising times the advertising margin. In addition to the recaptured advertisers, firm 1 now also internalises the recaptured readers in firm 2 times the margin on readers. A similar reasoning applies to the effect of an increase in P_1^R. On top of this, there are feedbacks between the two market sides. These arise because, for given prices, the amount of advertising demanded depends on the number of readers, which depends on the amount of advertising, which again depends on the number of readers and so on.

In two-sided markets, quantities on one market side are functions of prices on that same market side and quantities on the other market side. In the context of the newspaper industry, this means that the amount of advertising demanded is a function of the advertising price and the number of readers. In the following, as first order conditions involve derivatives of quantities with respect to prices, it will be useful to work with the reduced form quantities as functions of prices on both market sides, i.e., to work with the implied advertising demand, say, as a function of all advertising prices and all readership prices. For developing an intuition, it is instructive to imagine an iterative procedure in which one starts with known demands as functions of prices and quantities and then updates advertising and subscription demand, holding prices constant throughout and using last iteration's quantities on the respective other market side.[12] In the following, we denote these reduced forms for quantities as functions of prices with hats. We show in subsection 2.2 below how derivatives of those quantities with respect to prices can be obtained by applying the implicit function theorem.

Before the merger firm 1 earns profits

$$\pi_1 = (P_1^A - C_1^A)\hat{Q}_1^A + (P_1^R - C_1^R)\hat{Q}_1^R$$

and the optimal, observed prices solve the first order conditions

$$\hat{Q}_1^A + (P_1^A - C_1^A)\frac{\partial \hat{Q}_1^A}{\partial P_1^A} + (P_1^R - C_1^R)\frac{\partial \hat{Q}_1^R}{\partial P_1^A} = 0, \tag{3}$$

[12] In practice, one can start with some initial guess for the quantities, for example, the observed quantities and iterate until convergence. A sufficient condition for the set of quantities for given prices to be unique is that the mapping that is defined by the updated quantities in iteration $i + 2$ relative to iteration i possesses the properties of the mapping used in the appendix of Berry *et al.* (1995), namely that the derivative with respect to the own quantity is positive and that the sum of the derivatives on the same market side is less than one. Then, this is a contraction mapping with modulus less than one and hence the quantities are unique provided that some boundary conditions hold. It is straightforward to verify numerically that these conditions hold. They do in our application.

$$\hat{Q}_1^R + \left(P_1^A - C_1^A\right)\frac{\partial \hat{Q}_1^A}{\partial P_1^R} + \left(P_1^R - C_1^R\right)\frac{\partial \hat{Q}_1^R}{\partial P_1^R} = 0, \tag{4}$$

provided that the optimal prices are positive. After the merger, these prices are set as to maximise joint profits

$$\pi_1 + \pi_2 = [P_1^A - (1 - E_1^A)C_1^A]\hat{Q}_1^A + [P_1^R - (1 - E_1^R)C_1^R]\hat{Q}_1^R + (P_2^A - C_2^A)\hat{Q}_2^A + (P_2^R - C_2^R)\hat{Q}_2^R, \tag{5}$$

incorporating efficiency gains E_1^A and E_1^R in firm 1. The derivatives of those with respect to P_1^A and P_1^R are

$$\hat{Q}_1^A + [P_1^A - (1 - E_1^A)C_1^A]\frac{\partial \hat{Q}_1^A}{\partial P_1^A} + [P_1^R - (1 - E_1^R)C_1^R]\frac{\partial \hat{Q}_1^R}{\partial P_1^A} + (P_2^A - C_2^A)\frac{\partial \hat{Q}_2^A}{\partial P_1^A} + (P_2^R - C_2^R)\frac{\partial \hat{Q}_2^R}{\partial P_1^A},$$

$$\hat{Q}_1^R + [P_1^A - (1 - E_1^A)C_1^A]\frac{\partial \hat{Q}_1^A}{\partial P_1^R} + [P_1^R - (1 - E_1^R)C_1^R]\frac{\partial \hat{Q}_1^R}{\partial P_1^R} + (P_2^A - C_2^A)\frac{\partial \hat{Q}_2^A}{\partial P_1^R} + (P_2^R - C_2^R)\frac{\partial \hat{Q}_2^R}{\partial P_1^R}.$$

Dividing by the negative of the own-price effect, as before, gives

$$\begin{aligned}&\left\{\hat{Q}_1^A + [P_1^A - (1 - E_1^A)C_1^A]\frac{\partial \hat{Q}_1^A}{\partial P_1^A} + [P_1^R - (1 - E_1^R)C_1^R]\frac{\partial \hat{Q}_1^R}{\partial P_1^A}\right\} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right) \\ &+ (P_2^A - C_2^A)\frac{\partial \hat{Q}_2^A}{\partial P_1^A} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right) + (P_2^R - C_2^R)\frac{\partial \hat{Q}_2^R}{\partial P_1^A} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right)\end{aligned} \tag{6}$$

and

$$\begin{aligned}&\left\{\hat{Q}_1^R + [P_1^A - (1 - E_1^A)C_1^A]\frac{\partial \hat{Q}_1^A}{\partial P_1^R} + [P_1^R - (1 - E_1^R)C_1^R]\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right\} \Big/ \left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right) \\ &+ (P_2^A - C_2^A)\frac{\partial \hat{Q}_2^A}{\partial P_1^R} \Big/ \left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right) + (P_2^R - C_2^R)\frac{\partial \hat{Q}_2^R}{\partial P_1^R} \Big/ \left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right).\end{aligned} \tag{7}$$

Evaluating these expressions at the pre-merger prices amounts to substituting (3) and (4) in (6) and (7), respectively. This gives

$$UPP_1^A = D_{12}^{AA}(P_2^A - C_2^A) + D_{12}^{AR}(P_2^R - C_2^R) - E_1^A C_1^A + D_{11}^{AR} E_1^R C_1^R, \tag{8}$$

$$UPP_1^R = D_{12}^{RA}(P_2^A - C_2^A) + D_{12}^{RR}(P_2^R - C_2^R) + D_{11}^{RA} E_1^A C_1^A - E_1^R C_1^R, \tag{9}$$

where

$$D_{12}^{AA} = \frac{\partial \hat{Q}_2^A}{\partial P_1^A} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right),$$

$$D_{12}^{AR} = \frac{\partial \hat{Q}_2^R/\partial P_1^A}{\partial \hat{Q}_1^R/\partial P_1^A}\frac{\partial \hat{Q}_1^R/\partial P_1^A}{-(\partial \hat{Q}_1^A/\partial P_1^A)} = \frac{\partial \hat{Q}_2^R}{\partial P_1^A}\Big/\left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right),$$

$$D_{12}^{RA} = \frac{\partial \hat{Q}_2^A/\partial P_1^R}{\partial \hat{Q}_1^A/\partial P_1^R}\frac{\partial \hat{Q}_1^A/\partial P_1^R}{-(\partial \hat{Q}_1^R/\partial P_1^R)} = \frac{\partial \hat{Q}_2^A}{\partial P_1^R}\Big/\left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right),$$

$$D_{12}^{RR} = \frac{\partial \hat{Q}_2^R}{\partial P_1^R}\Big/\left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right),$$

$$D_{11}^{AR} = \frac{\partial \hat{Q}_1^R}{\partial P_1^A}\Big/\left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right),$$

$$D_{11}^{RA} = \frac{\partial \hat{Q}_1^A}{\partial P_1^R}\Big/\left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right).$$

These are diversion rations within and across market sides, within and across firms, respectively. The terms $(\partial \hat{Q}_1^R/\partial P_1^A)/(\partial \hat{Q}_1^A/\partial P_1^A)$ and $(\partial \hat{Q}_1^A/\partial P_1^R)/(\partial \hat{Q}_1^R/\partial P_1^R)$ in the formula of the second and third diversion ratio above 'translate' the effect of the price increase on one side into one on the other side. They respectively represent the change in readers of firm 1 as a result of the change of one unit in advertisers of firm 1 and the change in advertisers of firm 1 as a result of the change of one unit in readers of firm 1.[13]

[13] For multi-product firms they are, in matrix notation,

$$\boldsymbol{D}_{12}^{AA} = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{A\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_2^A}{\partial \boldsymbol{P}_1^{A\prime}}\right)'$$

$$\boldsymbol{D}_{12}^{AR} = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{A\prime}}\right)^{-1}\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{A\prime}}\right)\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{A\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_2^R}{\partial \boldsymbol{P}_1^{A\prime}}\right)' = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{A\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_2^R}{\partial \boldsymbol{P}_1^{A\prime}}\right)',$$

$$\boldsymbol{D}_{12}^{RA} = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{R\prime}}\right)^{-1}\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{R\prime}}\right)\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{R\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_2^A}{\partial \boldsymbol{P}_1^{R\prime}}\right)' = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{R\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_2^A}{\partial \boldsymbol{P}_1^{R\prime}}\right)',$$

$$\boldsymbol{D}_{12}^{RR} = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{R\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_2^R}{\partial \boldsymbol{P}_1^{R\prime}}\right)',$$

$$\boldsymbol{D}_{11}^{AR} = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{A\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{A\prime}}\right)',$$

$$\boldsymbol{D}_{11}^{RA} = -\left(\mathrm{dg}\frac{\partial \hat{\boldsymbol{Q}}_1^R}{\partial \boldsymbol{P}_1^{R\prime}}\right)^{-1}\left(\frac{\partial \hat{\boldsymbol{Q}}_1^A}{\partial \boldsymbol{P}_1^{R\prime}}\right)'.$$

Comparing the two-sided UPP formulae in (8) and (9) with the one-sided formula in (1), three differences should be noted. First, there are two relevant UPP formulae in two-sided markets, one for each side. Second, each two-sided UPP formula has more terms than the one-sided UPP one. This is due to the fact that, as explained above, pricing decisions on one side also affect profits earned on the other side of the market. Third, the diversion ratios used in the two-sided UPP formulae also account for feedbacks between the two sides of the market. We explain this in more detail in subsection 2.2.

The UPP formulae developed above can also be used when – as is often the case in two-sided markets – one side does not pay, for example, in the case of a merger involving a free newspaper. In that case, the first order condition of the free newspaper with respect to the readership price will not hold in the pre-merger equilibrium and, therefore, UPP for that newspaper on the readership side cannot be measured using the formulae that have been developed above. However, for all remaining prices the formulae are still valid. In other words, UPP formulae do not allow us to make inference on whether a merger would provide an incentive to start charging a positive price for newspapers that were free pre-merger.

2.1.2. *Efficiency gains in the other firm*

As before, efficiency gains in firm 2 can be incorporated by adjusting the margins on both sides of the market. Then,

$$UPP_1^{A*} = D_{12}^{AA}[P_2^A - C_2^A(1 - E_2^A)] + D_{12}^{AR}[P_2^R - C_2^R(1 - E_2^R)] - E_1^A C_1^A + D_{11}^{AR} E_1^R C_1^R,$$

$$UPP_1^{R*} = D_{12}^{RA}[P_2^A - C_2^A(1 - E_2^A)] + D_{12}^{RR}[P_2^R - C_2^R(1 - E_2^R)] + D_{11}^{RA} E_1^A C_1^A - E_1^R C_1^R.$$

2.1.3 *Gross upward pricing pressure index (GUPPI)*

For GUPPI, instead of granting efficiency credits, we express everything in terms of margins

$$m_2^A = \frac{(P_2^A - C_2^A)}{P_2^A},$$

$$m_2^R = \frac{(P_2^R - C_2^R)}{P_2^R}.$$

This gives

$$GUPPI_1^{A+} = D_{12}^{AA} m_2^A \times \frac{P_2^A}{P_1^A} + D_{12}^{AR} m_2^R \times \frac{P_2^R}{P_1^A},$$

$$GUPPI_1^{R+} = D_{12}^{RA} m_2^A \times \frac{P_2^A}{P_1^R} + D_{12}^{RR} m_2^R \times \frac{P_2^R}{P_1^R}.$$

2.2. *Measuring Diversion Ratios in Two-sided Markets*

In two-sided markets, a price change in, say, P_1^A affects all demands. This is because there are feedback effects so that the demand for advertising in firm 2 depends on all advertising quantities and circulation, which again depends on amounts of advertising

and thereby on advertising prices. For the UPP formula developed above, the relevant sales in firm 2 are $Q_2^A = Q_2^A(P^A, Q^R)$ and $Q_2^R = Q_2^R(P^R, Q^A)$ and the reduced form quantities as functions of prices are $Q_2^A = \hat{Q}_2^A(P^A, P^R)$ and $Q_2 = \hat{Q}_2^R(P^A, P^R)$. In principle, when market level or scanner data are available, one can choose whether to estimate the original demand equations (the ones without the hat) or the reduced form equations (the ones with the hat).[14] However, when a survey is conducted instead, it is only possible to ask questions which provide information on the direct demand equations.[15]

We now show how one can calculate the derivatives of the reduced form demands with respect to prices in firm 1 that are needed to calculate the diversion ratios that appear in the two-sided UPP formulae.[16] For this, if there are K products owned by the merging parties, stack all quantities and prices into the K-vectors $\boldsymbol{Q}^A$, $\boldsymbol{Q}^R$, $\boldsymbol{P}^A$ and $\boldsymbol{P}^R$, respectively. Then, applying the implicit function theorem gives

$$\begin{pmatrix} \partial\hat{\boldsymbol{Q}}^A/\partial\boldsymbol{P}^{A'} & \partial\hat{\boldsymbol{Q}}^A/\partial\boldsymbol{P}^{R'} \\ \partial\hat{\boldsymbol{Q}}^R/\partial\boldsymbol{P}^{A'} & \partial\hat{\boldsymbol{Q}}^R/\partial\boldsymbol{P}^{R'} \end{pmatrix} = -\begin{pmatrix} -\boldsymbol{I} & \partial\boldsymbol{Q}^A/\partial\boldsymbol{Q}^{R'} \\ \partial\boldsymbol{Q}^R/\partial\boldsymbol{Q}^{A'} & -\boldsymbol{I} \end{pmatrix}^{-1} \begin{pmatrix} \partial\boldsymbol{Q}^A/\partial\boldsymbol{P}^{A'} & \boldsymbol{0} \\ \boldsymbol{0} & \partial\boldsymbol{Q}^R/\partial\boldsymbol{P}^{R'} \end{pmatrix}, \tag{10}$$

where the matrices above are all block matrices, in which each block has dimensions $K \times K$. Calculating the marginal effects in this way fully accounts for the feedbacks from one side of the market to the other, which is the more important the higher the indirect network effects.[17]

The quantities on the right-hand side of (10) are marginal effects that one can obtain from the original demand estimates. Except possibly for the need to pay attention to the structure of the matrices above, we believe that implementing this is straightforward, provided that the relevant estimates of marginal effects on the right-hand side of the equation above are available.[18]

2.3. *Assessing a Hypothetical Merger between Dutch Daily Newspaper Publishers*

We now apply these concepts to a hypothetical merger in the Dutch daily newspaper market. We focus on whether conclusions change when the correct two-sided UPP formulae, rather than the one-sided ones, are used to assess the merger.

The market for daily newspapers in the Netherlands is described in Abbring and Van Ours (1994) and Filistrucchi *et al.* (2012). The hypothetical merger we investigate is

[14] In general, this is likely to depend on the type, quality and quantity of available data, including instruments.

[15] One could ask the readers of a newspaper how they would react to a change in the cover price of the newspaper or the amount of advertising in the newspaper, but would not be able to ask them how they would react to a change in the price of an advertising slot.

[16] This has first been suggested by Filistrucchi *et al.* (2010).

[17] Note that what matters is in practice the product of the two estimated network effects, for example, in our newspaper example below, what matters is the product of the effect of an additional reader on advertisers' demand times the effect of an additional ad on readers' demand. This is the 'module' which is repeated in a sort of multiplier effect due to the two-sidedness of the market that is 'applied' to the direct elasticities.

[18] Whereas the application of the implicit function theorem is straightforward, it requires that the reduced form demand functions above exist. For this, one can test whether sufficient conditions for existence similar to the ones for uniqueness hold. See also footnote 12.

between publisher 1, De Persgroep, owning the *Algemeen Dagblad* (AD1), NRC *Handelsblad* (NRC), *nrc.next* (NRN), *Het Parool* (PAR), *Trouw* (TRO) and *de Volkskant* (VOL) and publisher 2, the Telegraaf group, owning *De Gooi- en Eemlander* (GOO), *Haarlems Dagblad* (HAR), *Leidsch Dagblad* (LEI), *Noordhollands Dagblad* (NOR) and *De Telegraaf* (TEL). AD1 is a national level newspaper with regional editions, NRC is a business-oriented national level newspaper, NRN is the corresponding morning edition and PAR, TRO and VOL are other national level newspapers. The other group of newspapers consists of the regional level newspapers GOO, HAR, LEI and NOR and the tabloid TEL. *A priori*, it is not clear whether these newspapers all operate in the same market because the newspapers owned by publisher 1 are mainly higher quality national level newspapers, while the newspapers owned by publisher 2 are regional level newspapers and one tabloid national level newspaper.

Table 1 summarises the demand elasticities, prices and marginal costs that we use. We report averages within groups of newspapers owned by the two publishers. The underlying model for readership demand is a logit model that is estimated at the municipality level (Berry, 1994). The parameter values are taken from Filistrucchi *et al.* (2012). For advertising demand, we use a constant elasticity specification in which advertising demand depends only on the (own) advertising price and (own) circulation and calibrate it so that the implied margins match the pattern documented in Nederlands Uitgeversverbond (2009). We proceed under the assumption that these demand elasticities and marginal costs are correct. The main challenge in practice is often to obtain robust estimates that the competition authorities and the merging parties more or less agree on (van Damme *et al.*, 2010). Here, we ignore this issue, as our objective is to show how, starting from a set of estimates that are taken as given, conclusions may change when the two-sided nature of the market is correctly taken into account.

Table 1

Market Characteristics

	Firm 1	Firm 2
Average elasticities for advertising demand		
Advertising price $(\partial Q_j^A/\partial P_j^A)/(Q_j^A/P_j^A)$	−1.02	−1.02
Circulation $(\partial Q_j^A/\partial Q_j^R)/(Q_j^A/Q_j^R)$	0.30	0.30
Average elasticities for advertising demand incorporating feedback		
Advertising price $(\partial \hat{Q}_j^A/\partial P_j^A)/(Q_j^A/P_j^A)$	−1.04	−1.05
Subscription price $(\partial \hat{Q}_j^A/\partial P_j^R)/(Q_j^A/Q_j^R)$	−0.60	−0.51
Average elasticities for subscription demand		
Subscription price $(\partial Q_j^R/\partial P_j^R)/(Q_j^R/P_j^R)$	−1.96	−1.65
Amount advertising $(\partial Q_j^R/\partial Q_j^A)/(Q_j^R/Q_j^A)$	0.04	0.07
Average elasticities for subscription demand incorporating feedback		
Advertising price $(\partial \hat{Q}_j^R/\partial P_j^R)/(Q_j^R/P_j^R)$	−0.38	−0.57
Subscription price $(\partial \hat{Q}_j^R/\partial P_j^A)/(Q_j^R/P_j^A)$	−1.98	−1.69
Prices and marginal costs		
Advertising price per column millimetre P_j^A	7.10	3.95
Marginal cost advertising C_j^A	0.40	0.30
Subscription price per year P_j^R	263.82	241.84
Marginal cost subscription C_j^R	164.49	163.02

The first part of the top panel of Table 1 shows elasticities of advertising demand with respect to the advertising price, holding the number of readers constant and with respect to the number of readers, holding the advertising prices constant. The second part of the top panel shows elasticities of advertising demand with respect to the advertising price and the subscription price, holding the respective other price fixed. They are obtained as described in subsection 2.2. The elasticity of advertising demand with respect to the price is −1.02 and 0.30 with respect to the circulation of the newspaper.

On the subscription side the own-price elasticity is about −1.8 on average. Advertising is estimated to have a small but positive effect on circulation, with an elasticity of about 0.05 on average, so that the market is found to be characterised by two indirect positive network effects between the demand for advertising and the demand for readership.

The bottom panel of Table 1 shows prices and marginal costs. Advertising prices are per column millimetre and reflect the acquisition and typesetting costs for an additional column millimetre of advertising. For simplicity, we assume that there are no additional printing costs. All prices are in year-2002 euro. The initial situation is the one at the end of 2009.

In Table 2, we present summary statistics of the implied diversion ratios. Each row is for a particular product and we present the sum of the diversion ratios across competing products. Table 2 contains estimates that do not and do, respectively, take indirect network effects into account. The entries in the top part of the first of the three columns are zero because the advertising demand model assumes that direct cross-effects are zero on the advertising market.[19] Then, one-sided diversion ratios on that side of the market are automatically zero once the quantity of readers is held constant. However, two-sided diversion ratios are positive. This is due to the fact that a drop in advertising demand negatively affects the subscription sales of that newspaper and increases the subscription sales of the other newspapers and thereby positively affects also their sales of advertisements. This is summarised in the top part of the second and third columns. But, since readers value advertising only very little, two-sided diversion ratios are still small and hardly different from the one-sided ones. A similar effect is at play in the lower part of Table 2 and also here the difference in the diversion ratios between columns 1 and 3 is small because one of the two network effects is small.[20]

Table 3 shows measures of one-sided UPP measures, ignoring the presence of indirect network effects. *GUPP* is zero on the advertising side, as diversion ratios are zero when the two-sidedness of the market is ignored, since direct cross-price elasticities are zero. Therefore, once we grant a 5% efficiency credit (denoted by *EC*), *UPP* is negative, suggesting downward pricing pressure. Adjusting for efficiency gains in the other firm does not change *UPP* because diversion ratios are zero. For the same reason, *GUPPI* is zero and the efficiency credit that is necessary to achieve UPP equal to

[19] This is an assumption that is commonly made in this context, see for example, Rysman (2004), Van Cayseele and Vanormelingen (2009) and Fan (forthcoming). It means that, holding the number of subscribers constant, advertising demand in newspaper i depends only on the price of advertising in that newspaper and not in others. Rysman (2004) argues that this is a reasonable assumption if readers take a single paper.

[20] See also footnote 17.

Table 2

Diversion Ratios

	Without network effects	With network effects	
	Same side	Advertising	Subscriptions
Advertising: first firm with newspapers …			
AD1	0.0000	0.0022	0.0054
NRC	0.0000	0.0030	0.0031
NRN	0.0000	0.0010	0.0016
PAR	0.0000	0.0010	0.0004
TRO	0.0000	0.0012	0.0010
VOL	0.0000	0.0035	0.0039
… merging with the second firm with newspapers …			
GOO	0.0000	0.0003	0.0000
HAR	0.0000	0.0003	0.0000
LEI	0.0000	0.0002	0.0000
NOR	0.0000	0.0006	0.0002
TEL	0.0000	0.0044	0.0039
Subscriptions: first firm with newspapers …			
AD1	0.1292	0.1305	0.1305
NRC	0.1129	0.1140	0.1140
NRN	0.1091	0.1103	0.1103
PAR	0.0659	0.0664	0.0664
TRO	0.0998	0.1009	0.1009
VOL	0.0546	0.0227	0.0561
… merging with the second firm with newspapers …			
GOO	0.0769	0.0780	0.0789
HAR	0.0674	0.0441	0.0692
LEI	0.0964	0.2402	0.0991
NOR	0.0744	0.0870	0.0764
TEL	0.0805	0.0732	0.0826

Notes. Each row i shows the sum of the diversion ratios, over products j of the other firm, on the advertising side of firms 1 and 2, respectively, in the top panel and on the readership side in the bottom panel. The columns correspond to the effect on either advertising or readership demand. That is, the cells contain values of $\sum_j D_{ij}^{AA}$, $\sum_j D_{ij}^{AA}$ and $\sum_j D_{ij}^{AR}$ in the top panel and values of $\sum_j D_{ij}^{RR}$, $\sum_j D_{ij}^{RA}$ and $\sum_j D_{ij}^{RR}$ in the bottom panel.

zero (*NEC*) is zero. On the subscription side, looking at *UPP**, the numbers suggest that there is UPP for NRN and PAR in firm 1 and all newspapers in firm 2. This is confirmed by looking at *NEC*, which is above 5% for those newspapers.[21]

Table 4 shows the same measures but now adjusted for the presence of indirect network effects. While the earlier finding of UPP on the readership side that was obtained using the one-sided formulae is confirmed, we find in addition, for example, by looking at *NEC*, that there is UPP on the advertising side. For all papers, *NEC* exceeds 5%.[22] The reason for this is that advertisers care more about readers than

[21] These are the efficiency credits necessary on the same market side as the UPP measure is calculated, respectively, assuming that there is no efficiency credit on the other market side.

[22] We have also conducted a full merger simulation. Advertising prices charged by the merging parties increase by 7.5% on average and subscription prices by 2.7%, thus confirming the existence of UPP on both sides of the market.

Table 3

One-sided Upward Pricing Pressure (UPP) Measures

	GUPP	*EC*	*UPP*	*UPP**	*GUPPI*$^{+}$	*GUPPI*$^{*+}$	*NEC*
Advertising: first firm with newspapers …							
AD1	0.00	−0.05	−0.05	−0.05	0.00	0.00	0.00
NRC	0.00	−0.02	−0.02	−0.02	0.00	0.00	0.00
NRN	0.00	−0.01	−0.01	−0.01	0.00	0.00	0.00
PAR	0.00	−0.01	−0.01	−0.01	0.00	0.00	0.00
TRO	0.00	−0.01	−0.01	−0.01	0.00	0.00	0.00
VOL	0.00	−0.02	−0.02	−0.02	0.00	0.00	0.00
… merging with the second firm with newspapers …							
GOO	0.00	−0.00	−0.00	−0.00	0.00	0.00	0.00
HAR	0.00	−0.00	−0.00	−0.00	0.00	0.00	0.00
LEI	0.00	−0.00	−0.00	−0.00	0.00	0.00	0.00
NOR	0.00	−0.01	−0.01	−0.01	0.00	0.00	0.00
TEL	0.00	−0.05	−0.05	−0.05	0.00	0.00	0.00
Subscriptions: first firm with newspapers …							
AD1	3.92	−8.38	−4.46	−4.00	0.02	0.02	0.02
NRC	5.80	−11.61	−5.81	−5.18	0.02	0.02	0.02
NRN	5.06	−3.88	1.18	1.74	0.03	0.03	0.07
PAR	7.50	−7.65	−0.14	0.64	0.03	0.03	0.05
TRO	5.63	−8.98	−3.35	−2.74	0.02	0.02	0.03
VOL	6.27	−8.85	−2.58	−1.93	0.02	0.03	0.04
… merging with the second firm with newspapers …							
GOO	12.31	−6.89	5.42	6.60	0.05	0.05	0.09
HAR	10.85	−8.87	1.98	3.00	0.04	0.05	0.06
LEI	10.24	−10.20	0.04	1.02	0.04	0.05	0.05
NOR	6.35	−6.40	−0.05	0.53	0.03	0.03	0.05
TEL	9.33	−8.39	0.94	1.82	0.04	0.04	0.06

Notes. Each row i in this Table corresponds to a newspaper belonging to one of the two merging parties. The columns in this Table show *GUPP*, which is the sum of the diversion ratios from such a newspaper i over newspapers j in the other firm, multiplied by the markups in the other firms, $\sum_j D_{ij}(P_j - C_j)$; *EC*, which is a corresponding 5% efficiency credit for newspaper i, $0.05 \cdot C_i$; *UPP*, which is the UPP measure for newspaper i that is given by the difference between the two; *UPP**, which is the same, only that now also efficiency gains in j are taken into account, so $UPP^*_{ij} = \sum_j D_{ij}(P_j - 0.95 \cdot C_j) - 0.05 \cdot C_i$; $GUPPI^{+} = \sum_j D_{ij}(P_j - C_j)/P_i$; $GUPPI^{*+}$ that takes efficiency gains in i in a similar fashion into account as *UPP**, so $GUPPI^{*+} = \sum_j D_{ij}(P_j - 0.95 \cdot C_j)/P_i$; and *NEC*, the efficiency credit for newspaper i on the same side that is necessary to completely offset the UPP, $\sum_j D_{ij}(P_j - C_j)/C_i$. *GUPP*, gross upward pricing pressure index; *EC*, efficiency credit; *UPP*, upward pricing pressure.

readers care about advertising and for that reason firms would be inclined to increase advertising prices.

Comparing Table 3 to Table 4 shows that one cannot, in general, use one-sided UPP measures in two-sided markets. Looking for instance at the top part of Table 4 one can see that UPP on the advertising market is detected only when the two-sided nature of the market is taken into account.

3. Conclusion

The main advantage of using pricing pressure indices in the analysis of horizontal mergers in differentiated product industries is that they focus the analysis on the most

Table 4

Two-sided Upward Pricing Pressure (UPP) Measures

	GUPP	*EC*	*UPP*	*UPP**	*GUPPI*$^{+}$	*GUPPI*$^{*+}$	*NEC*
Advertising: first firm with newspapers …							
AD1	0.38	−0.31	0.07	0.12	0.02	0.02	0.41
NRC	0.24	−0.20	0.04	0.07	0.03	0.04	0.58
NRN	0.12	−0.03	0.09	0.10	0.03	0.03	0.64
PAR	0.04	−0.05	−0.01	−0.01	0.01	0.02	0.24
TRO	0.08	−0.08	0.01	0.02	0.02	0.03	0.41
VOL	0.32	−0.16	0.16	0.19	0.04	0.05	0.66
… merging with the second firm with newspapers …							
GOO	0.00	−0.01	−0.01	−0.01	0.01	0.01	0.07
HAR	0.01	−0.03	−0.02	−0.02	0.00	0.00	0.07
LEI	0.01	−0.04	−0.04	−0.04	0.00	0.00	0.07
NOR	0.02	−0.04	−0.02	−0.02	0.01	0.01	0.08
TEL	0.40	−0.24	0.17	0.20	0.03	0.03	0.37
Subscriptions: first firm with newspapers …							
AD1	4.27	−8.40	−4.12	−3.65	0.02	0.02	0.03
NRC	6.64	−11.63	−4.98	−4.33	0.02	0.02	0.03
NRN	5.59	−3.89	1.71	2.28	0.03	0.03	0.07
PAR	10.07	−7.66	2.41	3.23	0.04	0.04	0.07
TRO	6.61	−8.99	−2.38	−1.75	0.02	0.02	0.04
VOL	7.08	−8.87	−1.79	−1.12	0.03	0.03	0.04
… merging with the second firm with newspapers …							
GOO	13.33	−6.84	6.49	7.69	0.05	0.06	0.10
HAR	11.70	−8.86	2.84	3.88	0.05	0.05	0.07
LEI	11.32	−10.20	1.12	2.11	0.05	0.05	0.06
NOR	6.86	−6.43	0.43	1.02	0.03	0.03	0.05
TEL	10.36	−8.45	1.90	2.79	0.04	0.05	0.06

Notes. See notes to previous Table. All measures are adjusted for indirect network effects as described in the main text.

important aspects that determine unilateral effects, namely diversion ratios, profit margins and merger-specific efficiencies. Furthermore, they allow the analyst to avoid the market definition exercise, which is often problematic in differentiated product markets. Another advantage of these indices is that they do not require any assumption on the shape of the demand functions.

In this article, we extend the concept of pricing pressure indices to two-sided markets. Additional complications arise due to the presence of the two market sides and the indirect network effects. We show how these can be overcome so that UPP can be used as a screening device in two-sided markets.

Nevertheless, the general critique that applies to using pricing pressure indices in one-sided markets remains valid. In particular, the fact that no assumption on demand systems are needed (which determines pass-through) is because both UPP and GUPPI only calculate the incentive to increase prices unilaterally post-merger but not the actual price increase. However, what one is ultimately interested in is the change in total welfare and consumer surplus due to the merger, which is determined by the merger-induced price change.[23]

[23] The point is raised for instance by Schmalensee (2009). Jaffe and Weyl (2012) discuss how to convert pricing pressure into quantitative estimates of price changes.

Furthermore, one of the main questions is whether UPP and GUPPI are feasible initial horizontal merger screening devices. In order to calculate UPP and GUPPI, data on diversion ratios between merging parties' products as well as on margins are needed. Diversion ratios can best be obtained via customer surveys. Sometimes conducting such a survey may not be feasible because it takes too much time or is too expensive to implement in an initial screening period. In a two-sided market, the survey would need to be more comprehensive, as one would need to survey participants on both sides and ask them not only how they would react to a price increase but also how they would react to a change in participation on the other side. This has already been done in practice, for instance in the Bloemenveiling Aalsmeer/FloraHolland flower auction house merger and also in the merger between the Dutch yellow page directories.[24] However, the results were not used to calculate UPP at the time. A further complication is that survey results are sensitive to the design of the survey. Finally, calculating margins requires not only price data but also information on marginal (or at least average variable) costs, which is often difficult to obtain at the initial screening stage (Schmalensee, 2009; Bailey *et al.*, 2010; Werden and Froeb, 2011).

Another shortcoming of UPP and GUPPI is that both indices ignore responses by competitors. If the merging parties increase their prices post-merger, competitors have an incentive to also increase their prices in response. This is turn gives the merging parties the incentive to raise prices further. Hence, UPP and GUPPI tend to underestimate the incentive to increase prices post-merger in a one-sided market. In a two-sided market, depending on the sign and size of the indirect network effects, prices on one side might be strategic complements (as in one side markets) and strategic substitutes (Fahri and Hagiu, 2008). Therefore, UPP and GUPPI may either underestimate or overestimate the incentives to increase prices.

Overall, it seems that all advantages and disadvantages of using UPP measures which have been discussed for one-sided markets also apply to two-sided markets, with some of them being potentially amplified. Still, using UPP measures has many advantages over conducting a full merger analysis, which involves collecting even more data and making additional assumptions. Therefore, we conclude that in two-sided markets as well, UPP – when calculated using formulae that take the two-sidedness of the market into account – is an especially useful device in the initial screening phase that may be complemented by a full merger simulation at a later stage. Nonetheless, if one were to use UPP to evaluate a merger, using one-sided formulae and disregarding the two-sided nature of the market might lead to biased conclusions. In this article, we have shown how one could overcome this by accounting for the two-sidedness of the market.

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[24] See NMa Case No. 5901/184 Bloemenveiling Aalsmeer/FloraHolland [2007] and NMa Case No. 6246 European Directories/Truvo Nederland [2008], respectively.

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Additional Supporting Information may be found in the online version of this article:

Appendix S1. Data and Matlab Code.

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