Upward Pricing Pressure in Two-Sided Markets

Affeldt, P.; Filistrucchi, L.; Klein, T.J.

Publication date:
2012

Link to publication

Citation for published version (APA):
Affeldt, P., Filistrucchi, L., & Klein, T. J. (2012). *Upward Pricing Pressure in Two-Sided Markets*. (CentER Discussion Paper; Vol. 2012-069). Economics.

Discussion paper

f

3

UPWARD PRICING PRESSURE IN TWO-SIDED MARKETS

By

Pauline Affeldt, Lapo Filistrucchi, Tobias J. Klein

July 2012

TILEC Discussion Paper No. 2012-029

CentER Discussion Paper No. 2012-069

ISSN 0924-7815
http://ssrn.com/abstract=2115382

Tilburg University

Understanding Society

Upward Pricing Pressure in Two-Sided Markets*

Pauline Affeldt, Lapo Filistrucchi and Tobias J. Klein†

July 2012

Abstract

Pricing pressure indices have recently been proposed as alternative screening devices for horizontal mergers involving differentiated products. We extend the concept of Upward Pricing Pressure (UPP) proposed by Farrell and Shapiro (2010) 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 formulas we derive are useful for screening mergers among two-sided platforms. Due to the two-sidedness they 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 evaluate a hypothetical merger in the Dutch daily newspaper market. Our results indicate that it is important to take the two-sidedness of the market into account when evaluating UPP.

JEL Classification: L13, L40, L82.

Keywords: Merger evaluation, two-sided markets, network effects, UPP.

*This paper is related to van Damme, Filistrucchi, Gerardin, Keunen, Klein, Michielsen, and Wileur (2010), a study performed for the Dutch competition authority (NMa). We appreciate financial support through a Microsoft grant to TILEC, which was provided in accordance with the KNAW Declaration of Scientific Independence. The views expressed here are not necessarily the ones of the NMa nor of the Microsoft corporation. We would like to thank participants to the 2012 CRESSE conference for helpful comments. All remaining errors are ours.

†Affeldt: E.CA Economics; Filistrucchi: CentER, TILEC, Tilburg University and University of Florence, Klein: CentER, TILEC, Tilburg University.

1 Introduction

Traditionally, 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. Hence, any HHI-based analysis neglects information on the substitutability between products. Additionally, assuming the relevant market has been defined, the well-known positive relationship between HHI and market power (or allocative inefficiency) holds perfectly only when firms chose quantities and products are homogeneous.

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) calculate the unilateral incentives to raise prices post-merger. These arise because post-merger, the merged entity will internalize externalities one of the merging parties exercises on the other. These are related to the pricing decision, as 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 depends 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 then customers who stop buying from the first firm would buy from a different, third firm.

In this paper, we develop UPP measures for two-sided markets.[3] Two-sided markets are markets in which a firm sells two different products or services to two distinct groups of customers. An example are newspapers, which cater both to readers and advertisers. A two-sided market is further characterized by indirect network externalities between the two groups of consumers. 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 ccustomers cannot internalize these externalities. In the case of newspapers, advertisers value advertising on a given newspaper more, the

[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.

[3] See Caillaud and Jullien (2001, 2003), Rochet and Tirole (2002, 2003, 2006), Evans (2003), Parker and van Alstyne (2005) and Armstrong (2006).

more readers the newspaper has. Conversely, it is not clear whether readers like, dislike or are indifferent towards advertising in a newspaper, but for the market to be a two-sided one already the presence of one indirect network effect is sufficient.

Also in two-sided markets UPP characterizes the incentive to unilaterally increase prices post-merger. This incentive is related to the value of diverted sales that are recaptured by the other, now merged, product post-merger and hence no longer lost to 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, hence readers like advertising. Firstly, 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. Secondly, 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, less 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 paper is organized as follows: Section 2 draws on Kemp and Affeldt (2011) and reviews UPP in one-sided markets. In Section 3 we extend the one-sided UPP formula for two-sided markets and present an application using data on the Dutch newspaper market. Section 4 concludes.

2 UPP in One-Sided Markets

Pricing pressure indices characterize the unilateral effects of horizontal mergers involving differentiated products by calculating the post-merger effects of marginal price increases above the pre-merger level. Prior to the merger, if one of the merging firms raises its 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 be recaptured by the second product (which used to be a competing product). Therefore, this price increase is now profitable and thus likely to occur in the absence of efficiency gains.

2.1 UPP

2.1.1 Original Formulation

The concept of Upward Pricing Pressure (UPP) has recently been advocated by Farrell and Shapiro (2010).[4] The basic idea is that equilibrium prices satisfy the first order condition that a marginal increase does not go along with increased profits. This changes when two or more firms merge. Then, evaluating the new first order conditions at the optimal pre-merger prices, granting the firms an efficiency credit, yields the Upward Pricing Pressure (UPP) measure, which characterizes the incentives to raise prices.[5] It 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. Hence, there are as many UPPs as products involved in the 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 "cannibalization". 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. The UPP measure is innovative because the authors propose a new way of expressing the incentives to increase prices post-merger.

The underlying assumptions are Bertrand competition with differentiated products where firms set prices independently pre-merger. Furthermore, Farrell and Shapiro (2010) assume that the merging firms are single product firms. No assumptions are needed on the demand structure or pass-through rates since UPP does not calculate the magnitude of the price change but only its direction. Finally, the measure holds the prices of all other products, including the price of the other merging party's product, constant, following a price change by one of the merging parties.

[4]The concept of measuring the upward pressure on prices post-merger due to unilateral effects goes 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 needed 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). In this paper, Shapiro describes how gross margin and diversion ratio indicate whether a horizontal merger between differentiated product firms gives rise to incentives to increase prices post-merger, assuming Bertrand competition and independent price setting by firms pre-merger.

[5]Here, we follow the exposition in Farrell and Shapiro (2010). See Section (2.1.2) for a formal derivation.

This is the main difference to merger simulation. Since merger simulation calculates a post-merger equilibrium, it takes price reactions by competitors into account. Simply put, UPP allows to look at the change in pricing incentives from the internalization of the externality between firm 1 and firm 2 without having to calculate a post-merger equilibrium, as is done in merger simulation. Post-merger, the now merged entity will maximize joint profits. Considering firm 1 and firm 2 as different divisions within the merged entity post-merger, headquarters want to impose joint profit-maximization. Headquarters can reach this joint profit-maximization outcome by imposing an internal tax equal to the cannibalization effect on each division and letting divisions continue maximizing individual profits. Since cannibalization is a negative externality one product exerts on the other, it is comparable to a tax. By framing the analysis in terms of a tax, the internalization of the externality post-merger (via the tax) can be treated as an increase in division's marginal costs. This increase in marginal costs is then directly comparable to the decrease in marginal costs due to possible merger-specific efficiencies.

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]

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

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 and thereby reflects the degree of substitutability between product 1 and product 2.

Pre-merger, the two merging firms are competing with each other. If for example firm 1 increases its price, firm 2 will capture part of the lost sales of firm 1, depending on how close substitutes their products are. If firm 1 and firm 2 merge, customers switching from firm 1 to firm 2 following a price increase of product 1 will no longer be lost to the merged entity. The merged firm will internalize this effect post-merger. As stated above, Farrell and Shapiro (2010) view this as an opportunity cost or internal tax, that headquarters of the merged entity impose on firm 1 and 2, which are considered as different

[6] Both the UPP and GUPPI (presented below) formula can be adapted to account for Cournot competition (see Moresi (2009b)), bidding competition (see Moresi (2009a)) or multi-product merging firms (see Jaffe and Weyl (2011, 2012)). Jaffe and Weyl (2012) generalize the idea to Generalized pricing pressure (GePP), which allows for different types of non-Betrand conduct. They also discuss the relationship between pricing pressure, price changes and welfare changes.

divisions of the merged entity post-merger. By imposing an internal tax, headquarters force the divisions to internalize the externality their pricing decision exerts on the other division. This opportunity cost or tax for firm (division) 1 is equal to $D_{12}(P_2 - C_2)$, where $(P_2 - C_2)$ is the pre-merger profit margin of product 2 and hence represents the additional profits of firm 2 if it sells one more unit of its product. The cannibalization part of the UPP formula thus indicates how much additional profits firm 2 gains if firm 1 increases its price so that its sales of product 1 fall by one unit.

Post-merger, firm 1 (now division 1) will internalize the effect of its pricing decisions on the profits of firm 2 (now division 2). $D_{12}(P_2 - C_2)$ represents an additional opportunity cost which raises firm 1's marginal costs.[7] This increase in marginal costs creates an incentive to raise the price for product 1. The cannibalization effect is thus a measure of the gross upward pressure on the price of product 1 due to the loss of competition between firm 1 and firm 2. The same obviously holds the other way around for firm 2. Thus, even though each division still maximizes individual profits post-merger, the imposition of the internal tax increases marginal costs for the divisions, which will lead to higher prices and consequently to joint profit-maximization.

It should be noted that $D_{12}(P_2 - C_2)$ only captures the first-round tax or opportunity cost. If firm 1 raises the price for product 1, firm 2 has an incentive to raise the price for product 2, which will increase its margin and thus the opportunity cost or internal tax of firm 1.[8] Hence, the ultimate effect of a merger, even when rivals are assumed to keep their prices unchanged, is the outcome of an iterative procedure where $D_{12}(P_2 - C_2)$ and $D_{21}(P_1 - C_1)$ are initially calculated as above, then the oligopoly re-equilibrates and the internal taxes are recalculated. This process is repeated until convergence.

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, for example 10%. Absent 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 the upward pricing pressure created by the loss of competition between merging firms. Farrell and Shapiro (2010) do not look at efficiencies in detail in their paper. They propose instead 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. Neverthe-

[7] The opportunity cost is the loss in profits from product 2 as a result of a decrease in the price of product 1.

[8] Prices are strategic complements. The fact that firm 1 increases its price, increases the margin $(P_1 - C_1)$ in the formula for UPP_2, which increases the upward pricing pressure on firm 2.

less, the authors note that this default credit must not be narrowly interpreted as marginal cost reductions but could also contain for example an increase in product quality. Rather, it establishes a gross upward pricing pressure threshold below which mergers will not be further investigated.

Whenever the UPP measure is positive ($UPP > 0$), the merger is likely to give rise to upward pricing pressure 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 positive upward pricing pressure for at least one of the merging firms' products.

2.1.2 Formal derivation

We now relate the UPP measure to profit maximization. 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

$$Q_1 + (P_1 - C_1)\frac{\partial Q_1}{\partial P_1} = 0. \tag{1}$$

After the merger, prices are set as to maximize 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, and the derivative of those 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 one unit 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

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

At the pre-merger prices the first term is zero because of the first order condition (1). Recognizing that the second ratio of derivatives is the diversion ratio D_{12} gives the UPP formula presented above.

2.1.3 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

$$UPP_1^* = D_{12}\left(P_2 - (1 - E_2)C_2\right) - E_1 C_1.$$

This generally increases the incentive for firm 1 to increase prices.[9]

2.1.4 GUPPI

In their comment on updating the US merger guidelines, Salop and Moresi (2009) propose to use the Gross Upward Pricing Pressure Index (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.[10]

The assumptions for developing the GUPPI formula are the same as those of UPP. Hence, the formula is based on Bertrand competition with differentiated products where firms set prices in a competitive manner. Merging firms are single product firms and, as UPP, GUPPI holds the prices of all other products constant, including the price of the other merging party's product, following a price change by one of the merging parties. Also as before, no assumptions are needed about the demand structure or pass-through rates since the actual price change is not calculated.

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

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

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

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 dollar terms. 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 (see CRA (2010)), is slightly different from this formula. It is given by

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

This GUPPI formula generalizes Salop and Moresi's (2009) formula, which implicitly assumes equal pre-merger prices for the two merging firms.

Since GUPPI only captures the internalization of cannibalization 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.[11]

2.2 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. It can be measured directly using a survey among customers of firm 1, by asking them what they would do if firm 1 would raise the price such that they would no longer buy product 1.

Equivalently, it is the effect of a marginal price increase of product 1 on demand for product 2,

[11] 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). A GUPPI above 10% is, on the contrary, likely to result in more significant unilateral concerns. This 10% GUPPI has been derived by Moresi (2010) and is closely related to market definition. Moresi states that the two products of the merging firms constitute a relevant market for themselves if the GUPPIs satisfy $GUPPI_1 \geq 2s$ or $GUPPI_2 \geq 2s$, where s is a small but significant non-transitory increase in price. In case one of the GUPPIs satisfies this relation, "a hypothetical monopolist who would be the sole owner of the two products would find it profit-maximizing to raise the price of Product 1 alone (or Product 2 alone) by at least a SSNIP, even if one assumed that it did not also raise the price of the other product." (Moresi, 2010, p.7). In case s is 5%, as is currently used in the US guidelines, one arrives at the 10% threshold mentioned above. According to Moresi (2010) this relation of the GUPPI to market definition is its main advantage over UPP. Nevertheless, it has to be noted that the formula developed by Moresi (2010) relating the GUPPI to the SSNIP is based on a profit-maximizing SSNIP not simply a just profitable SSNIP, i.e. to the US Hypothetical Monopolist test rather than the EU SSNIP-test. Further, it relies on the additional assumptions of the merging firms facing linear demand and constant marginal costs. Hence, adopting this formula implies giving up the advantage of GUPPI of not having to assume a particular demand system. Further, the formula assumes a price increase for only one of the merging parties' products. This means that the two products could constitute a relevant market even if the two GUPPI measures are below 10% each.

divided by the marginal effect of this price change on demand for product 1, i.e.

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

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.[12]

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 sales data are usually readily available. See also Werden (1998).

3 UPP in Two-Sided Markets

In two-sided markets, firm 1 sets two prices. Our empirical example below is for the daily newspaper market, so we say that it sets P_1^A on the advertising market and P_1^R on the readership market.

[12]For multi-product firms is 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 Q_1 and P_1 the K_1-vectors of quantities and prices of firm 1, respectively, and by $\partial Q_1/\partial P_1$ the $K_1 \times K_1$ matrix of derivatives of components of Q_1 (in the rows) with respect to components of P_1 (in the columns). Likewise for the $K_2 \times K_1$ matrix of derivatives of Q_2 with respect to P_1, which we denote by $\partial Q_2/\partial P_1'$. Then, denoting by dg$A$ the matrix which of the same size as A but contains only the diagonal elements of A on its own diagonal, the $K_1 \times K_2$ matrix of diversion ratios is

$$D_{12} = \left(\mathrm{dg}\frac{\partial Q_1}{\partial P_1'}\right)^{-1}\left(\frac{\partial Q_2}{\partial P_1'}\right)'.$$

3.1 UPP

3.1.1 Formal derivation

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. In this section, we develop UPP measures taking this into account. To see that this is more complex, suppose firm 1 increases P_1^A, where the superscript "A" denotes the advertising side (so that P_1^A is the advertising price set by firm 1) and the superscript "R" will denote the readership side (so that P_1^R is the subscription price set by firm 1), 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 advertisers times the margin on advertisers. This is the same as in a one-sided market, except that now there are in addition 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 addition to the recaptured advertisers, and to the effect that is similar to the one in a one-sided market, firm 1 now also internalizes 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. In the following, we derive UPP measures for two-sided markets.

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. That is, 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.[13]

In the following, we denote these reduced forms for quantities as functions of prices only with hats.

[13] In practice, one can start with some initial guess for the quantities, e.g. 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, Levinsohn, and Pakes (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 1. Then, this is a contraction mapping with modulus less than 1 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.

We show in Section 3.2 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

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

and the optimal, observed prices solve the first order conditions

$$\begin{aligned} \hat{Q}_1^A + \left(P_1^A - C_1^A\right)\frac{\partial \hat{Q}_1^A}{\partial P_1^A} + \left(P_1^R - C_1^R\right)\frac{\partial \hat{Q}_1^R}{\partial P_1^A} &= 0 \\ \hat{Q}_1^R + \left(P_1^A - C_1^A\right)\frac{\partial \hat{Q}_1^A}{\partial P_1^R} + \left(P_1^R - C_1^R\right)\frac{\partial \hat{Q}_1^R}{\partial P_1^R} &= 0. \end{aligned} \tag{2}$$

After the merger, these prices are set as to maximize joint profits

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

incorporating efficiency credits E_1^A and E_1^R. The derivatives of those with respect to P_1^A and P_1^R are

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

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

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

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

and

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

Evaluating those expressions at the pre-merger prices amounts to substituting in the respective equations in (2). This gives

$$\begin{aligned} UPP_1^A &= D_{12}^{AA}\left(P_2^A - C_2^A\right) + D_{12}^{AR}\left(P_2^R - C_2^R\right) - E_1^A C_1^A - D_{11}^{AR} E_1^R C_1^R \\ UPP_1^R &= D_{12}^{RA}\left(P_2^A - C_2^A\right) + D_{12}^{RR}\left(P_2^R - C_2^R\right) - D_{11}^{RA} E_1^A C_1^A - E_1^R C_1^R, \end{aligned} \tag{3}$$

where

$$\begin{aligned} D_{12}^{AA} &= \frac{\partial \hat{Q}_2^A}{\partial P_1^A} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right) \\ D_{12}^{AR} &= \frac{\partial \hat{Q}_2^R/\partial P_1^A}{\partial \hat{Q}_1^R/\partial P_1^A} \frac{\partial \hat{Q}_1^R/\partial P_1^A}{\partial \hat{Q}_1^A/\partial P_1^A} = \frac{\partial \hat{Q}_2^R}{\partial P_1^A} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right) \\ D_{12}^{RA} &= \frac{\partial \hat{Q}_2^A/\partial P_1^R}{\partial \hat{Q}_1^A/\partial P_1^R} \frac{\partial \hat{Q}_1^A/\partial P_1^R}{\partial \hat{Q}_1^R/\partial P_1^R} = \frac{\partial \hat{Q}_2^A}{\partial P_1^R} \Big/ \left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right) \\ D_{12}^{RR} &= \frac{\partial \hat{Q}_2^R}{\partial P_1^R} \Big/ \left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right) \\ D_{11}^{AR} &= \frac{\partial \hat{Q}_1^R}{\partial P_1^A} \Big/ \left(-\frac{\partial \hat{Q}_1^A}{\partial P_1^A}\right) \\ D_{11}^{RA} &= \frac{\partial \hat{Q}_1^A}{\partial P_1^R} \Big/ \left(-\frac{\partial \hat{Q}_1^R}{\partial P_1^R}\right). \end{aligned}$$

These are diversion rations within and across market sides, respectively within and across firms. The terms $\partial \hat{Q}_1^R/\partial P_1^A \Big/ \partial \hat{Q}_1^A/\partial P_1^A$ and $\partial \hat{Q}_1^A/\partial P_1^R \Big/ \partial \hat{Q}_1^R/\partial P_1^R$ "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.[14]

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

$$\begin{aligned} D_{12}^{AA} &= \left(\mathrm{dg}\frac{\partial \hat{Q}_1^A}{\partial P_1^{A'}}\right)^{-1} \left(\frac{\partial \hat{Q}_2^A}{\partial P_1^{A'}}\right)' \\ D_{12}^{AR} &= \left(\mathrm{dg}\frac{\partial \hat{Q}_1^A}{\partial P_1^{A'}}\right)^{-1} \left(\mathrm{dg}\frac{\partial \hat{Q}_1^R}{\partial P_1^{A'}}\right) \left(\mathrm{dg}\frac{\partial \hat{Q}_1^R}{\partial P_1^{A'}}\right)^{-1} \left(\frac{\partial \hat{Q}_2^R}{\partial P_1^{A'}}\right)' = \left(\mathrm{dg}\frac{\partial \hat{Q}_1^A}{\partial P_1^{A'}}\right)^{-1} \left(\frac{\partial \hat{Q}_2^R}{\partial P_1^{A'}}\right)' \\ D_{12}^{RA} &= \left(\mathrm{dg}\frac{\partial \hat{Q}_1^R}{\partial P_1^{A'}}\right)^{-1} \left(\mathrm{dg}\frac{\partial \hat{Q}_1^A}{\partial P_1^{R'}}\right) \left(\mathrm{dg}\frac{\partial \hat{Q}_1^A}{\partial P_1^{R'}}\right)^{-1} \left(\frac{\partial \hat{Q}_2^A}{\partial P_1^{R'}}\right)' = \left(\mathrm{dg}\frac{\partial \hat{Q}_1^R}{\partial P_1^{A'}}\right)^{-1} \left(\frac{\partial \hat{Q}_2^A}{\partial P_1^{R'}}\right)' \\ D_{12}^{RR} &= \left(\mathrm{dg}\frac{\partial \hat{Q}_1^R}{\partial P_1^{R'}}\right)^{-1} \left(\frac{\partial \hat{Q}_2^R}{\partial P_1^{R'}}\right)' \\ D_{11}^{AR} &= \left(\mathrm{dg}\frac{\partial \hat{Q}_1^A}{\partial P_1^{A'}}\right)^{-1} \left(\frac{\partial \hat{Q}_1^R}{\partial P_1^{A'}}\right)' \\ D_{11}^{RA} &= \left(\mathrm{dg}\frac{\partial \hat{Q}_1^R}{\partial P_1^{A'}}\right)^{-1} \left(\frac{\partial \hat{Q}_1^A}{\partial P_1^{R'}}\right)'. \end{aligned}$$

3.1.2 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,

$$\begin{aligned} UPP_1^{A*} &= D_{12}^{AA}\left(P_2^A - C_2^A\left(1-E_2^A\right)\right) + D_{12}^{AR}\left(P_2^R - C_2^R\left(1-E_2^R\right)\right) - E_1^A C_1^A - D_{11}^{AR} E_1^R C_1^R \\ UPP_1^{R*} &= D_{12}^{RA}\left(P_2^A - C_2^A\left(1-E_2^A\right)\right) + D_{12}^{RR}\left(P_2^R - C_2^R\left(1-E_2^R\right)\right) - D_{11}^{RA} E_1^A C_1^A - E_1^R C_1^R. \end{aligned}$$

3.1.3 GUPPI

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

$$\begin{aligned} GUPPI_1^{A+} &= D_{12}^{AA} m_2^A \times \frac{P_2^A}{P_1^A} + D_{12}^{AR} m_2^R \times \frac{P_2^R}{P_1^A} \\ GUPPI_1^{R+} &= D_{12}^{RA} m_2^A \times \frac{P_2^A}{P_1^R} + D_{12}^{RR} m_2^R \times \frac{P_2^R}{P_1^R}, \end{aligned}$$

where

$$\begin{aligned} m_2^A &= \frac{\left(P_2^A - C_2^A\right)}{P_2^A} \\ m_2^R &= \frac{\left(P_2^R - C_2^R\right)}{P_2^R}. \end{aligned}$$

3.2 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 $Q_2 = \hat{Q}_2^R(P^A, P^R)$. To some extent, when market level or scanner data are available, one can choose whether to estimate the original demand equations (i.e. the ones without the "hat") or the reduced form equations (i.e. the ones with the "hat").[15] When instead data are elicited in surveys it is only possible to ask questions which provide information

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

on the direct demand equations.[16]

Hence, we now show how one can calculate the derivatives of those with respect to prices in firm 1 that are needed to calculate diversion ratios in a similar fashion as in a one-sided market.[17]

For this, stack all quantities and prices into the vectors Q^A, Q^R, P^A and P^R, respectively. Then, applying the implicit function theorem gives

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

where the quantities on the right hand side 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 matrixes above, we believe the implicit function theorem is straight-forward to implement in practice, once the relevant estimates are available.[18,19]

3.3 A tempting practical approximation to the two-sided UPP measures

We have seen that the difference between one-sided and two-sided UPP measures is on the one hand the incorporation of effects on the respective other market side and on the other hand the adjustment of the diversion ratios to take into account feedbacks between the two sides. A tempting practical approximation to (3) could be

$$\begin{aligned} UPP_1^A &\approx \tilde{D}_{12}^{AA}\left(P_2^A - C_2^A\right) + \tilde{D}_{12}^{AR}\left(P_2^R - C_2^R\right) - E_1^A C_1^A - \tilde{D}_{11}^{AR} E_1^R C_1^R \\ UPP_1^R &\approx \tilde{D}_{12}^{RA}\left(P_2^A - C_2^A\right) + \tilde{D}_{12}^{RR}\left(P_2^R - C_2^R\right) - \tilde{D}_{11}^{RA} E_1^A C_1^A - E_1^R C_1^R, \end{aligned} \tag{4}$$

[16]Intuitively, in our newspaper example below, one could ask a reader how she would react to a change in the cover price of the newspaper or in the amount of advertising in the newspaper but would not be able to ask how she would react to a change in the price of an advertising slot on the newspaper. Similarly, for advertisers.

[17]See also Filistrucchi, Klein, and Michielsen (2010).

[18]In fact, the matrixes above are block-matrixes, in which each block has dimensions $K \times K$, where K is the number of products of the merging platforms.

[19]Whereas the application of the implicit function theorem is straight-forward, it requires that the reduced form demand functions above exist. The possibility that they do not exist has been highlighted by White and Weyl (2011), who propose to solve the issue by assuming firms charge insulating tariffs, i.e. price schedules conditional on quantities on the other side of the market. This guarantees also the existence of a unique equilibrium. We believe however that, while this theoretical issue would be more relevant in a full merger simulation, it is of lesser importance in the current context, as upward pricing pressure is already an approximation. For instance, the existence of the reduced demand equations above is guaranteed, if the indirect network effects are non-explosive, whenever the original demands on the two sides are linear or log-linear. Moreover, in the forthcoming revision of Filistrucchi, Klein, and Michielsen (2010), the authors show how, with the most commonly used functional forms, there exist testable conditions on the estimated parameters such that the above reduced form equations and a unique post-merger equilibrium exist.

where

$$
\begin{aligned}
\tilde{D}_{12}^{AA} &= \frac{\partial Q_2^A}{\partial P_1^A} \Big/ \left(-\frac{\partial Q_1^A}{\partial P_1^A}\right) \\
\tilde{D}_{12}^{AR} &= -\frac{\partial Q_2^R}{\partial Q_1^A} \\
\tilde{D}_{12}^{RA} &= -\frac{\partial Q_2^A}{\partial Q_1^R} \\
\tilde{D}_{12}^{RR} &= \frac{\partial Q_2^R}{\partial P_1^R} \Big/ \left(-\frac{\partial Q_1^R}{\partial P_1^R}\right) \\
\tilde{D}_{11}^{AR} &= -\frac{\partial Q_1^R}{\partial Q_1^A} \\
\tilde{D}_{11}^{RA} &= -\frac{\partial Q_1^A}{\partial Q_1^R}
\end{aligned}
$$

are approximations to the diversion ratios.

The approximations in (4) are tempting as they are equal to the one-sided UPP measures plus adjustment terms that involve estimates of the network effects. The main advantage of these approximations is that they do not require to use the implicit function theorem to recover the "correct" diversion ratios. Although the application of the implicit function theorem is quite straight-forward, in many cases using the approximations in (4) may be quicker. This comes however at the cost of an additional simplification. The approximated diversion ratios take into account only the direct effect of an increase in prices, holding the quantities on the other side fixed, and do not account for the feedbacks from one side of the market to the other. In other words, they are derived from the direct elasticities rather than the full elasticities which incorporate the indirect network effects. Clearly, the higher the network effects the worse the approximation.[20]

3.4 An example

We now apply these concepts to a hypothetical merger in the Dutch daily newspaper market. Filistrucchi, Klein, and Michielsen (2012) describe this market in detail and estimate demand for advertising and newspaper subscriptions and recover marginal costs. The reader is referred to that paper for a detailed description of the market and details on the estimation procedure. Here, we use these estimates to calculate the measures described above, both using the formulas for one-sided and for two-sided markets.

[20] Note that what matters is in practice the product of the two estimated network effects, e.g. 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.

The hypothetical merger we investigate is 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 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 evening edition, and PAR, TRO and VOL are other national level newspaper. The other group of newspapers owned by publisher 2, the Telegraaf group, 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 and the newspapers owned by publisher 2 are regional level newspapers and one tabloid national level newspaper.

Table 1 summarizes the estimates of demand elasticities, prices and recovered marginal costs that we will use in the following by means of averages within groups of newspapers owned by the two publishers. We proceed under the assumption that they 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, Filistrucchi, Gerardin, Keunen, Klein, Michielsen, and Wileur, 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.

The first part of the top panel of the table 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. These are based on a specification in which the demand for the amount of advertising, measured in column millimeters, is of constant elasticity with respect to the advertising per reader. Therefore, the elasticity with respect to the price is minus one times the elasticity with respect to the number of readers. It is estimated to be -0.70 and 0.70, respectively, and imposed to be the same for all newspapers.

The second part of the top panel shows elasticities of advertising demandwith respect to the advertising price and the subscription price, holding the respective other price fixed. We obtain those as described in Section 3.2. The former is similar to the one reported before. The latter varies across newspapers and is about -1.3 on average. This shows that newspaper prices have a larger effect on advertising quantities, through reduced circulation, than advertising prices have.

On the subscription side, holding the amount of advertising fixed, using a Logit model that is esti-

Table 1: Market characteristics

	group 1	group 2
average elasticities for advertising demand		
advertising price $(\partial Q_j^A/\partial P_j^A)/(Q_j^A/P_j^A)$	-0.70	-0.70
circulation $(\partial Q_j^A/\partial Q_j^R)/(Q_j^A/Q_j^R)$	0.70	0.70
average elasticities for advertising demand incorporating feedback		
advertising price $(\partial \hat{Q}_j^A/\partial P_j^A)/(Q_j^A/P_j^A)$	-0.72	-0.74
subscription price $(\partial \hat{Q}_j^A/\partial P_j^R)/(Q_j^A/Q_j^R)$	-1.42	-1.22
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 $(\partial \hat{Q}_j^R/\partial P_j^R)/(Q_j^R/P_j^R)$	-0.88	-1.36
subscription price $(\partial \hat{Q}_j^R/\partial P_j^A)/(Q_j^R/P_j^A)$	-2.02	-1.74
prices and marginal costs		
advertising price per column millimeter P_j^A	7.10	3.95
marginal cost advertising C_j^A	4.09	2.27
subscription price per year P_j^R	263.82	241.84
marginal cost subscription C_j^R	121.00	94.34

mated at the municipality level (Berry, 1994), we find a price elasticity of about -2 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 characterized by two indirect positive network effects between the demand for advertising and the demand for readership.

The bottom panel shows prices and marginal costs. Advertising prices are per column millimeter and reflect the acquisition and typesetting costs for an additional column millimeter of advertising. Here, for simplicity, we ignore additional printing costs, as modeled by Fan (2012), that would also depend on circulation. All prices are in in year-2002 euros. The initial situation is the one at the end of 2009.

In Table 2, we present summary statistics of the estimated diversion ratios. Each row is for a particular product and we present the sum of the diversion ratios across competing products, when consumers stop buying a particular product. The table contains estimates that do not and do, respectively, take indirect network effects into account. The top part of the first of the three columns is zero because the econometric model in Filistrucchi, Klein, and Michielsen (2012) assumes that cross-effects are zero on the advertising market.[21] Then, one-sided diversion ratios on that side of the market are automatically

[21] An assumption that is commonly made in this context, see e.g. Rysman (2004), Van Cayseele and Vanormelingen (2009) and Fan (2012). It means that, holding the number of subscribers constant, advertising demand in newspaper *i* depends only on

zero once the quantity of readers is held constant. Still we can see that two-sided diversion ratios are positive. This is due to the fact that when the price of an advertisement in a given newspaper is raised demand for advertisements in that newspapers drops. The drop in advertising demand due to a drop in advertising prices negatively affects the sales of that newspaper and increases the sales of the other newspaper even though no ad sales are directly diverted to the other newspapers. This is summarized in the top part of the third column. However the changes in the readers demand in turn decrease further the sales of advertising on that newspaper but increase also the sales of advertising on the other newspapers. The two-sided diversion ratios in the top of the second column also take this effect into account. 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 the table, and also here the difference in the diversion ratios between column one and column three is small. To summarize, it is small for both sides because one of the two network effects is small and products on the advertising market are assumed to be independent once subscription demand is held constant.

We have also calculated the approximations to the two-sided diversion ratios in Section 3.3 and they are very similar to the exact ones for which we report summary statistics here. This is likely due to the small network effect from advertising to readers, by which the effect of the feedback loop described above is relatively small here.

Table 3 shows measures of one-sided UPP, ignoring the presence of indirect network effects. The cannibalization effect, denoted by 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 10 percent 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 zero (NEC) is zero.

On the subscription side, the numbers suggest that there is upward pricing pressure coming from NRN and PAR in firm 1 and all newspapers in firm 2. This, however, as we ignore indirect network effects, does not take into account that firms may actually be less inclined to raise prices on that side because a decreased circulation will also lower advertising demand. Hence, it is important to take this into account.

the price of advertising in that newspaper, and not in others. Rysman (2004) argues that this is a reasonable assumption once readers single-home.

Table 2: Diversion ratios

	without network effects	with network effects	
	same side	advertising	subscriptions
advertising: first firm with newspapers …			
AD1	0.00	0.01	0.02
NRC	0.00	0.01	0.01
NRN	0.00	0.00	0.01
PAR	0.00	0.00	0.00
TRO	0.00	0.00	0.00
VOL	0.00	0.01	0.01
… merging with the second firm with newspapers …			
GOO	0.00	0.00	0.00
HAR	0.00	0.00	0.00
LEI	0.00	0.00	0.00
NOR	0.00	0.00	0.00
TEL	0.00	0.01	0.01
subscriptions: first firm with newspapers …			
AD1	0.13	0.13	0.13
NRC	0.11	0.12	0.12
NRN	0.11	0.11	0.11
PAR	0.07	0.07	0.07
TRO	0.10	0.10	0.10
VOL	0.05	0.02	0.06
… merging with the second firm with newspapers …			
GOO	0.08	0.06	0.08
HAR	0.07	0.03	0.07
LEI	0.10	0.17	0.10
NOR	0.07	0.06	0.08
TEL	0.08	0.05	0.09

Each row i shows the sum of the diversion ratios, over products j of the other firm, from the advertising side of firm 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 revenues. That is, the cells contain values of $\sum_j D_{ij}^{\cdot A}$ in the first (top panel) and second column and $\sum_j D_{ij}^{\cdot N}$ in the first (bottom panel) and third column.

Table 3: One-sided UPP measures

	GUPP	EC	UPP	UPP^*	$GUPPI^+$	$GUPPI^{*+}$	NEC
advertising: first firm with newspapers …							
AD1	0.00	-1.00	-1.00	-1.00	0.00	0.00	0.00
NRC	0.00	-0.42	-0.42	-0.42	0.00	0.00	0.00
NRN	0.00	-0.22	-0.22	-0.22	0.00	0.00	0.00
PAR	0.00	-0.17	-0.17	-0.17	0.00	0.00	0.00
TRO	0.00	-0.20	-0.20	-0.20	0.00	0.00	0.00
VOL	0.00	-0.44	-0.44	-0.44	0.00	0.00	0.00
… merging with the second firm with newspapers …							
GOO	0.00	-0.04	-0.04	-0.04	0.00	0.00	0.00
HAR	0.00	-0.08	-0.08	-0.08	0.00	0.00	0.00
LEI	0.00	-0.10	-0.10	-0.10	0.00	0.00	0.00
NOR	0.00	-0.16	-0.16	-0.16	0.00	0.00	0.00
TEL	0.00	-0.75	-0.75	-0.75	0.00	0.00	0.00
subscriptions: first firm with newspapers …							
AD1	7.17	-10.70	-3.52	-2.93	0.03	0.03	0.07
NRC	10.48	-17.68	-7.20	-6.40	0.03	0.04	0.06
NRN	9.15	-5.24	3.91	4.61	0.05	0.05	0.17
PAR	13.01	-10.31	2.71	3.72	0.05	0.06	0.13
TRO	10.06	-15.25	-5.19	-4.41	0.03	0.04	0.07
VOL	11.03	-13.42	-2.39	-1.56	0.04	0.04	0.08
… merging with the second firm with newspapers …							
GOO	18.27	-9.42	8.85	10.62	0.07	0.08	0.19
HAR	15.95	-9.04	6.91	8.45	0.07	0.07	0.18
LEI	15.45	-9.04	6.42	7.86	0.07	0.07	0.17
NOR	9.31	-8.70	0.61	1.48	0.04	0.04	0.11
TEL	14.21	-10.98	3.23	4.49	0.06	0.06	0.13

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 10 percent efficiency credit for newspaper i, $0.1 * C_i$; 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 i are taken into account, so $UPP^*_{ij} = \sum_j D_{ij}(P_j - 0.9 \cdot C_j)$; $GUPPI^+ = \sum_j D_{ij}(P_j - C_j)/P_i$; $GUPPI^{*+}$ that takes efficiency gains in i in a similar fashion into account as UPP^*, so $GUPPI^{*+} = \sum_j D_{ij}(P_j - 0.9 \cdot C_j)/P_i$; and NEC: the efficiency credit for newspaper i on the same side that is necessary to completely offset the UPP, $\sum_j D_{ij}(P_j - C_j)/C_i$.

Table 4: Two-sided UPP measures

	GUPP	EC	*UPP*	*UPP**	*GUPPI*$^+$	*GUPPI*$^{*+}$	NEC
advertising: first firm with newspapers ...							
AD1	2.60	0.09	2.69	2.87	0.15	0.16	0.26
NRC	1.56	0.50	2.06	2.16	0.21	0.23	0.37
NRN	0.79	-0.12	0.67	0.72	0.20	0.22	0.35
PAR	0.22	0.04	0.25	0.27	0.07	0.08	0.13
TRO	0.53	0.18	0.71	0.74	0.15	0.16	0.27
VOL	2.01	0.25	2.26	2.39	0.26	0.28	0.45
... merging with the second firm with newspapers ...							
GOO	0.01	0.00	0.02	0.02	0.02	0.02	0.03
HAR	0.02	0.00	0.02	0.03	0.01	0.02	0.03
LEI	0.02	0.01	0.03	0.03	0.01	0.01	0.02
NOR	0.08	-0.01	0.07	0.07	0.03	0.03	0.05
TEL	1.94	0.07	2.01	2.18	0.15	0.16	0.26
subscriptions: first firm with newspapers ...							
AD1	7.74	-10.43	-2.68	-2.04	0.03	0.03	0.07
NRC	11.35	-17.43	-6.08	-5.20	0.04	0.04	0.06
NRN	9.84	-5.17	4.66	5.43	0.05	0.05	0.19
PAR	14.65	-10.11	4.54	5.73	0.06	0.06	0.14
TRO	10.95	-15.15	-4.19	-3.33	0.04	0.04	0.07
VOL	11.91	-13.18	-1.27	-0.35	0.04	0.05	0.09
... merging with the second firm with newspapers ...							
GOO	19.11	-9.85	9.26	11.13	0.08	0.09	0.20
HAR	16.65	-9.04	7.61	9.23	0.07	0.08	0.18
LEI	16.27	-8.88	7.40	8.94	0.07	0.08	0.18
NOR	9.70	-8.46	1.24	2.16	0.04	0.04	0.11
TEL	15.01	-10.40	4.61	5.96	0.06	0.07	0.14

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

Table 4 shows the same measures but now adjusted for the presence of indirect network effects.[22] Now, there is evidence for substantial UPP on the advertising side, independent of the measure that is used. There is still evidence for UPP on the readership side, but comparing GUPPI across market sides suggests that for the first firm UPP is actually bigger on the advertising side than on the readership side. This effect can (does not necessarily have to) arise if advertisers care more about readers than readers care about advertising, and for that reason firms would be more inclined to increase advertising prices. This is also reflected in the efficiency credits that are necessary to offset UPP, which are reported in the last column.[23]

Comparing Table 3 to Table 4 is informative about the difference in the conclusions one would draw

[22]The efficiency credit can now be negative because it involves across-market side effects.

[23]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. In principle, this can be generalized to a weighted efficiency credit where weights are given by, e.g., profit shares.

when ignoring the two-sidedness of the market. Looking for instance at the bottom part of the column for UPP in both tables one can see that UPP measures on the readers' side do not change much when one correctly takes into account the two-sided nature of the market. But looking instead at the top part of the column one can see that UPP on the advertising market is detected only when the two-sided nature of the market is taken into account. Since we saw in Table 2 that diversion ratios from advertising to advertising do not change much when the two-sided nature of the market is taken into account, this effect is almost completely due to the use of the correct formulas for the calculation of UPP in two-sided markets: there are two parts in equation (3)—the first measures the effect of an increase in the advertising (readers) price on advertising (readers) profits and the second one measures the effect of an increase in the advertising (readers) price on readers (advertisers) profits. Using a one-sided market formula ignores this second part and may lead to wrong conclusions, in this case that there is no UPP on the advertising side, while in fact there is.

4 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 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 a major advantage since it is often problematic to define the relevant market in differentiated product industries. Another advantage of these indices is that they do not require any assumption on the shape of demand functions.

In this paper, we show how an analysis of likely unilateral effects of a horizontal merger can be performed in a two-sided market. It turns out that additional complications such as feedback effects that are due to the presence of indirect network effects arise. We show how these can be overcome.

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 unilaterally increase prices 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 (for example Schmalensee (2009) raises this point).

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[24] and also in the merger between the Dutch yellow page directories[25]. 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 (Bailey, Leonard, Olley, and Wu, 2010; Schmalensee, 2009; Werden and Froeb, 2011).

Another shortcoming of UPP and GUPPI is that both indices ignore supply-side 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 underestimates 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) but also strategic substitutes Fahri and Hagiu (2008). Therefore, UPP and GUPPI may either underestimate or overestimate the incentives to increase prices. Furthermore, both UPP and GUPPI do not account for possible repositioning or entry post-merger (see for example Shapiro (1996) or Epstein and Rubinfeld (2010)).

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 UPP is an especially useful device in the initial screening phase, which may be complemented with conducting a full-fledged merger simulation at a later stage. Nonetheless, if one were to use UPP to evaluate a merger, using one-sided formulas and disregarding the two-sided nature of the market might lead to biased conclusions. In this paper, we have shown how one could overcome this by accounting for the two-sidedness of the market.

[24] Case No 5901/184 Bloemenveiling Aalsmeer/FloraHolland [2007] NMa.

[25] Case 6246 European Directories/Truvo Nederland [2008] NMa.

References

ARMSTRONG, M. (2006): "Competition in two-sided markets," *RAND Journal of Economics*, 37(3), 668–691.

BAILEY, E., G. LEONARD, G. S. OLLEY, AND L. WU (2010): "Merger Screens: Market Share-Based Approaches Versus "Upward Pricing Pressure"," *Antitrust Source*.

BERRY, S. (1994): "Estimating Discrete-Choice Models of Product Differentiation," *Rand Journal of Economics*, 25(2), 242–262.

BERRY, S., J. LEVINSOHN, AND A. PAKES (1995): "Automobile Prices in Market Equilibrium," *Econometrica*, 63, 841–890.

CAILLAUD, B., AND B. JULLIEN (2001): "Competing cybermediaries," *European Economic Review*, 45(4-6), 797–808.

——— (2003): "Chicken and egg: competition among intermediation service providers," *RAND Journal of Economics*, 34(2), 309–328.

CRA (2010): "Scoring Unilateral Effects with the GUPPI: The Approach of the New Horizontal Merger Guidelines," CRA Competition Memo.

EPSTEIN, R., AND D. RUBINFELD (2010): "Understanding UPP," *The B.E. Journal of Theoretical Economics, Policies and Perspectives*, 10(1), Article 21.

EVANS, D. S. (2003): "The Antitrust Economics of Multi-Sided Platform Markets," *Yale Journal on Regulation*, 20, 325–382.

FAHRI, E., AND A. HAGIU (2008): "Strategic Interactions in Two-Sided Market Oligopolies," Mimeographed, Harvard University.

FAN, Y. (2012): "Market Structure and Product Quality in the U.S. Daily Newspaper Market," Mimeographed, Yale Univsity.

FARRELL, J., AND C. SHAPIRO (2010): "Antitrust evaluation of horizontal mergers: an economic alternative to market definition," *The B.E. Journal of Theoretical Economics, Policies and Perspectives*, 10(1), Article 9.

FILISTRUCCHI, L., T. J. KLEIN, AND T. MICHIELSEN (2010): "Merger Simulation in a Two-Sided Market: The Case of the Dutch Daily Newspapers," NET Institute Working Paper No. 10-15.

——— (2012): "Assessing Unilateral Merger Effects in a Two-Sided Market: An Application to the Dutch Daily Newspaper Market,," *Journal of Competition Law and Economics*, 8(1), 1–33.

JAFFE, S., AND E. WEYL (2011): "Price theory and merger guidelines," *Competition Policy Interna-*

tional Antitrust Chronicle.

JAFFE, S., AND G. WEYL (2012): "The First-Order Approach to Merger Analysis," Mimeographed.

KEMP, R., AND P. AFFELDT (2011): "Upward Pricing Pressure Indices in Horiztonal Merger Analysis: A Review of the Literature," .

MORESI, S. (2009a): "Bidding competition and the UPP test," HMG Review Project - Comment, Project No. P092900.

——— (2009b): "Cournot competition and the UPP test," HMG Review Project - Comment, Project No. P092900.

——— (2010): "The use of upward price pressure indices in merger analysis," *Antitrust Source*.

PARKER, G. G., AND M. W. VAN ALSTYNE (2005): "Two-Sided Network Effects: A Theory of Information Product Design," *Management Science*, 51(10), 1494–1504.

ROCHET, J.-C., AND J. TIROLE (2002): "Cooperation among competitors: some economics of payment card associations," *RAND Journal of Economics*, 33(4), 549–570.

——— (2003): "Platform Competition in Two-Sided Markets," *Journal of the European Economic Association*, 1(4), 990–1029.

——— (2006): "Two-sided markets: a progress report," *RAND Journal of Economics*, 37(3), 645–667.

RYSMAN, M. (2004): "Competition between Networks: A Study of the Market for Yellow Pages," *Review of Economic Studies*, 71(2), 483–512.

SALOP, S., AND S. MORESI (2009): "Updating the merger guidelines: comments," Mimeographed.

SCHMALENSEE, R. (2009): "Should new merger guidelines give UPP market definition?," *Competition Policy International Antitrust Chronicle*, 1, 1–7.

SHAPIRO, C. (1996): "Mergers with differentiated products," *Antitrust*, pp. 23–30.

VAN CAYSEELE, P., AND S. VANORMELINGEN (2009): "Merger Analysis in Two-Sided Markets: the Belgian Newspaper industry," Mimeographed.

VAN DAMME, E., L. FILISTRUCCHI, D. GERARDIN, S. KEUNEN, T. J. KLEIN, T. MICHIELSEN, AND J. WILEUR (2010): "Mergers in Two-Sided Markets: A Report to the NMa," Dutch Competition Authority.

WERDEN, G. (1996): "A robust test for consumer welfare enhancing mergers among sellers of differentiated products," *The Journal of Industrial Economics*, 44(4), 409–413.

——— (1998): "Demand Elasticities in Antitrust Analysis," *Antitrust Law Journal*, 66(2), 363–414.

WERDEN, G., AND L. FROEB (2011): "Choosing among tools for assessing unilateral merger effects," Mimeographed.

WHITE, A., AND G. WEYL (2011): "Insulated Platform Competition," NET Institute Working Paper No. 10-17.