

SAM 3 2010

ISSN: 0804-6824

JANUARY 2010

Discussion paper

Single-Product versus Uniform SSNIPs

BY
ØYSTEIN DALJORD AND LARS SØRGARD

This series consists of papers with limited circulation, intended to stimulate discussion.

Single-Product versus Uniform SSNIPs

Øystein Daljord and Lars Sørgard

Department of Economics

Norwegian School of Economics and Business Administration

Emails: oystein.daljord@nhh.no and lars.sorgard@nhh.no

January 2010

Abstract:

It is common to apply a SSNIP test with a uniform price increase on all products in the candidate market. We show that in situations with asymmetries – for example one product having a limited sale – a uniform SSNIP test can suggest that the relevant market should include more products even though it could be profitable to increase the price of only one product in the candidate market. Our results are illustrated with some findings from a survey in a local grocery market.

1. The introduction

Market definition has become the most important issue in almost all competition cases.¹ The method that is currently used in most countries for defining relevant markets is the SSNIP test, also known as the hypothetical monopolist test. It defines the market by including products in a candidate market until it is jointly profitable to raise any or all prices in the candidate market by 5-10%.

In practice the SSNIP test is often done by imposing an identical price increase on all products in the candidate market (a uniform SSNIP test). However, such a uniform price increase is not the only way it can be done.² Consider a candidate market with two products. One alternative to a uniform price increase on two products would be a price increase on only one product (a single-product SSNIP test).³ In a situation with identical sales and margins for those two products the price increase on only one product would be less profitable than a uniform price increase. The reason is that the quantity that is recaptured by the other product has a lower price-cost margin if there is a price increase on only one product. Apparently, this suggests that the uniform SSNIP test will always lead to narrower markets than the single-product SSNIP test. However, we show that this is not true. Even with a rather modest asymmetry between those two products – for instance a rather small difference in sales volume – we find that the uniform SSNIP test may lead to broader markets than an single-product SSNIP test.

In most competition cases there are asymmetries between firms. For example, often a large firm acquires a smaller firm. We might expect that a merger would lead to a higher price increase on the smaller product, simply because the large product recaptures a large fraction of the reduction in the sales of the smaller product. This suggests that we should consider an

¹ See, for example, Baker (2007). He claims that market definition has been decisive for the outcome in more competition cases in the US than any other substantive issue.

² Note that in the 1992 US Merger Guidelines the phrase ‘*whether to raise the prices of any or all of the additional products*’ is used (see page 7), indicating that a uniform price increase on all products is not the only option.

³ Note that both the uniform and the single-product SSNIP test we discuss put ad hoc restrictions on the pricing of the hypothetical monopolist: Either the price increase is identical for all products, or there is a price increase on only one product. Even if it is not profitable to raise prices by 5-10% according to any of those two tests, it can be profitable to raise the price of one of the products by 5-10% if the hypothetical monopolist is allowed to change prices on all products in the candidate market by unequal percentages. Both the single-product and the uniform SSNIP test are therefore biased towards defining markets that are too broad. While those two first alternatives can be implemented by simple formulas, this third alternative requires a more complex simulation analysis and is therefore seldom used by antitrust practitioners.

non-uniform price increase, where the price of the small product increases more than the price of the large product. Such considerations are not taken into account in the SSNIP test the way it is applied in most competition cases.⁴ On the contrary, it is common to assume an identical price increase on all products in the candidate market.⁵

The consequences of applying only the uniform SSNIP test are illustrated with some findings from a survey of shoppers in a local market for groceries in Norway. It is shown that there are cases where a uniform price increase for two outlets is unprofitable for a hypothetical monopolist controlling both outlets, while a corresponding price increase for only one of the outlets is profitable. If we follow the US Merger Guidelines, the relevant market is defined if 5-10% price increases on any (or all) products in the candidate market are profitable. This suggests that practitioners should use both the uniform and the single-product SSNIP test, and the relevant antitrust market is defined if it passes either of them.

The article is organised as follows. In the next section we describe the all-prices and the one-price increase criteria for defining the relevant market, including an extension of the all-prices criterion to a market with asymmetries in sales volume for the products in the candidate market. Then we report some findings from a survey in a local grocery market in Norway, to illustrate that the uniform price increase criterion and single-product price increase criterion can lead to different conclusions. Finally, we offer some concluding remarks and discuss the policy implications of our analysis.

2. The criteria for market delineation

Critical loss analysis was first introduced in Harris and Simons (1989). They analysed the profitability of a price increase for a hypothetical monopolist in control of all sales of one product. In O'Brien and Wickelgren (2003) the analysis was extended to the case where a hypothetical monopolist controlled the sales of two products. They assumed an identical

⁴ The method for applying the SSNIP test – the critical loss analysis – has with a few exceptions only considered a situation with symmetric prices and costs. Katz and Shapiro (2003) discussed the rationale behind a single-product SSNIP test. The criterion for a one-price SSNIP test was derived in Daljord, Sørsgard and Thomassen (2008) and applied in Daljord, Sørsgard and Thomassen (2007). Moresi, Salop and Woodbury (2008) also derive the criterion for a single-product SSNIP test (see their eq. 14 in the Appendix). Note, though, that they focus on the case with multiproduct firms. They do not discuss how asymmetries between products can influence the various SSNIP tests.

⁵ See, for example, Farrell and Shapiro (2008): *'In practice, Critical Loss Analysis typically assumes that the products are symmetric in price and costs, and studies only a uniform SSNIP imposed on all products.'*

price increase for those two products, and derived the criterion for when such a price increase would be profitable in the case of linear demand.⁶ Let us denote those two products as i and j , and let α denote the relative price increase and $L_i = (P_i - MC_i)/P_i$ the price-cost margin where MC_i and P_i are the margin and the price, respectively, for firm i . The diversion ratio from product i to product j is the following:

$$D_{ij} = - \frac{\frac{\partial q_j}{\partial p_i}}{\frac{\partial q_i}{\partial p_i}}$$

It is the fraction of the reduction in sales of product i that is diverted to product j following a price increase on product i . O'Brien and Wickelgren (2003) considered the symmetric case where $D_{ij} = D_{ji} = D$, and $L_i = L_j = L$. Given symmetry, they have shown that product i and j belong to the same market if:

$$D \geq \frac{\alpha}{\alpha + L}. \quad (1)$$

The right hand side is the critical diversion ratio, and those two products constitute a relevant market if the actual diversion ratio is higher than the critical diversion ratio.⁷

Note that D is the average of the two diversion ratios, and with symmetry an unweighted average (1) would strictly speaking be the following:

$$\frac{D_{ij} + D_{ji}}{2} \geq \frac{\alpha}{\alpha + L} \quad (2)$$

If asymmetry, we have to adjust the criterion. Let us assume that the price-cost margin is identical for those two products. If products are identical, quantity sold is expected to be

⁶ An alternative to a profitable price increase would be a profit-maximizing SSNIP. As shown in Werden (2002), an α percent price increase on all products are profit-maximizing if $D \geq \alpha/(2\alpha + L)$. Note that this formula differs from the O'Brien and Wickelgren (2003) formula and the one applied here (see eq. 1). Although it can be argued that the US Merger Guidelines proposes the profit-maximizing SSNIP, most critical loss studies use the formula derived by O'Brien and Wickelgren (2003). We follow this approach.

⁷ This formula of the critical diversion ratio happens to be identical to the formula of the critical loss derived in Harris and Simons (1989).

identical for the firms. With differentiated products, as is the natural case when market delineation is discussed, the relationship between margins and market shares is more complex. For example, firms can have identical margins but differ in sales volume. To simplify our exposition, we assume that firms have identical margin and sales volume differs between them. It can easily be verified that our main results would hold even if we had assumed that the product with the lowest sales volume had the lowest margin.⁸ The criterion for product i and j belonging to the same market can then easily be adjusted to:⁹

$$S_i D_{ij} + (1 - S_i) D_{ji} \geq \frac{\alpha}{\alpha + L}, \quad (3)$$

where $S_i = q_i / (q_i + q_j)$. The left hand side is the weighted actual diversion ratios, taking into account the asymmetries, while we denote the right hand side as the critical diversion ratio.

In Daljord, Sørsgard and Thomassen (2008) it is argued that it is more natural to increase one instead of both prices if the asymmetry is sufficiently large. In particular, it is natural to assume that the price of the ‘small’ product is increased. To understand this, think about a product with a much lower sales volume than the other product. A price increase of the small product will lead to loss in sales of this product, but a large fraction of the reduction in sales may be picked up by the large product. On the other hand, the small product may only pick up a very limited fraction of the reduction in sales following a price increase on the large product. If a hypothetical monopolist controls both products, it can then be profitable to raise the price of the small product.

Let us assume that product i is the ‘small’ product, and that we have a price increase on only this product and not on the large product. It is shown in Daljord, Sørsgard and Thomassen (2008) that with such an asymmetric price increase and otherwise applying the same

⁸ All else equal, we would expect that in a non-cooperative equilibrium the product with the lowest sales volume has the lowest margin. If we had assumed a lower price-cost margin for the product with a low sales volume, it would be even more profitable to raise the price of the product with the low sales volume. That would divert sales from a product with a low margin to a product with a high margin, a mechanism not present in our model with identical margins.

⁹ See Daljord (2009) for the derivation of the criterion for a symmetric price increase. He derives the more general case with firms with different quantities of sales as well as different margins.

assumptions as in O'Brien and Wickelgren (2003), product i and j constitute a relevant market if:¹⁰

$$D_{ij} \geq \frac{\alpha}{L}. \quad (4)$$

Apparently, one would delineate markets more broadly if one applies the single-product SSNIP criterion. This is easily seen if we assume $q_i = q_j$ and $D_{ij} = D_{ji} = D$ and compare the single-product criterion in (1) to the uniform criterion in (4): Since then $\alpha/L > \alpha/(\alpha+L)$, the single-product criterion is harder to satisfy than the uniform criterion. In the symmetric case, the result that a uniform SSNIP is more profitable than a single-product SSNIP is driven by the fact that the price-cost margin on the sales volume recaptured by the other product is higher than with single-product price increase.¹¹

The argument is not necessarily true when considering an asymmetric market. To illustrate this, let us provide an example. Prices and marginal costs are assumed to be identical for all firms, while sales may differ between firms. Furthermore, we consider the case of two products where product i is the 'small' product with a lower sale than product j . We assume that diversion ratios are proportional to quantity sold, so that $D_{ji} = D_{ij}S_i/(1 - S_i)$. This is consistent with the assumption often applied in merger simulations.¹² It is a natural assumption, because it is assumed that what a product recaptures of lost sales of another product is proportional to the market shares. We can then rewrite the criterion for those two products belonging to the same market with a symmetric price increase:

$$D_{ij} \geq \frac{\alpha}{2(\alpha + L)S_i} \quad (3')$$

¹⁰ The criterion was first reported in an earlier, unpublished version of O'Brien and Wickelgren (2003). Note, though, that in Daljord, Sørsgard and Thomassen (2008) the criterion is derived for the more general case of asymmetries in price-cost margins.

¹¹ This is noticed in Daljord, Sørsgard and Thomassen (2008) as well as Farrell and Shapiro (2008), suggesting that as long as we search for the narrowest market definition one should only consider the symmetric SSNIP test.

¹² See, for example, Epstein and Rubinfeld (2001). They impose proportionality in their PCAIDS merger simulation model. The same is true with the logit model, a model often used for merger simulations (see Werden and Froeb, 2002). Note that Willig (1991) argued that the logit model provides an appropriate benchmark for analyzing mergers. For a more detailed discussion of the proportionality assumption, see Werden and Froeb (2008).

Comparing (3') and (4), one finds that the asymmetric SSNIP test leads to a narrower market if:

$$S_i < \frac{L}{2(\alpha + L)} \equiv S_i^* \tag{5}$$

The criterion in (3) defines a threshold level on the small product's market share. This illustrates that the single-product SSNIP test is expected to lead to a narrower market definition than the uniform SSNIP test if the asymmetry between those two products is sufficiently large. Note that if we had assumed that the 'small' product had a lower price-cost margin, this would probably make it even more profitable with an asymmetric price increase. The reason is that such a price increase would divert sales volume from a product with a low price-cost margin to a product with a high price-cost margin, a mechanism not present in our model.

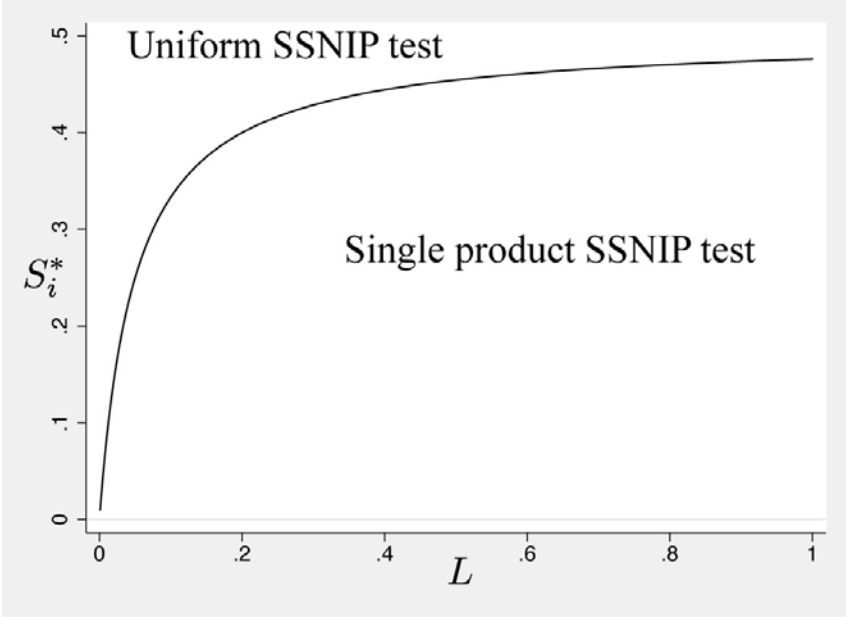


Figure 1: Which SSNIP test leads to a narrow market definition?

The solid curve shown in Figure 1 is the critical market share S_i^* defined in (5). It indicates that single-product SSNIP test may often lead to a narrower definition of the relevant market than the uniform SSNIP test. For example, consider the two-product case with $L = 30\%$ and $\alpha = 5\%$. We find that with these assumptions the single-product SSNIP test will lead to a narrower market definition if $S_i < 42.8\%$.

For illustration, let us further elaborate on our numerical example. We assume that firms have identical sales volume, $L = 30\%$ and $\alpha = 5\%$. It can then easily be verified that the critical diversion ratio is 16.7% if one apply a one-product SSNIP test and 14.3% if one apply a SSNIP test with a price increase on both products. The critical diversion ratio is higher for the one-product SSNIP test, which confirms what we explained concerning the symmetric case.

Let us now assume that the quantity sold of product j is four times higher than for product i . Given the proportionality assumption, we have that $D_{ij} = 4D_{ji}$. Let us set $D_{ij} = 20\%$. Then we have that $D_{ji} = 5\%$. The actual diversion ratios for a single-product and a uniform SSNIP test is then.

$$\text{Single-product price increase: } D_{ij} = 20\%$$

$$\text{Uniform price increase: } S_i D_{ij} + (1 - S_i) D_{ji} = 0.2 \cdot 0.2 + 0.8 \cdot 0.05 = 8\%$$

These two expressions should be compared with the critical diversion ratios we defined above. We see that the relevant market is not defined if we apply the uniform price increase. The weighted actual diversion ratio is only 8% , while we have shown above that the critical diversion ratio is 14.3% . Then we have to include more products than product i and j to conclude that the relevant market is defined.¹³

If we apply the one-product price increase on the small product, we see that the actual diversion ratio is 20% while the critical diversion ratio has been shown to be 16.7% . This implies that it is profitable to increase the price of product i , and the relevant market consists of product i and product j .

Notice that if we were to start with a price increase only on the large product, we would find a diversion ratio of 5% , which would be lower than the critical diversion ratio of 16.7% . Of course, that would not imply that the two products do not constitute a relevant market and that

¹³ If we had not adjusted the criterion for the symmetric price increase, we would have overestimated the true diversion ratio. An unweighted diversion ratio would be equal to 12.5% . This is clearly wrong, because the diversion ratio from the small product to the large product would have the same weight as the diversion ratio from the large to the small product.

we have to add a third product to define the relevant market. Before adding a third product, we would have to first consider a price increase only on the small product.

4. An application: A local grocery market in Norway

A recent study from a local grocery market in Norway illustrates that there might be substantial asymmetries concerning diversion ratios, and that the choice of test matters for market definition.

Voss is a village in the Western part of Norway with several grocery outlets, with a long distance to other outlets. It is safe to conclude that the geographical market does not consist of more than those grocery outlets at Voss. These grocery outlets are of different size. Let us consider the eight largest outlets, with a joint market share of 90.8 % of annual turnover at Voss. The market share of the largest one is approximately three times the market share of outlet no. eight, which illustrates that we do have quite large asymmetries.

Halleraker and Wiig (2008) report the results from an empirical study of the grocery market at Voss.¹⁴ They conducted surveys of 800 shoppers, approximately 100 shoppers outside each of the eight outlets. Among other questions, they asked each shopper which outlet they would have chosen if this outlet was not available. Then they revealed each shopper's second choice. The information from all the shoppers was aggregated to find the revenue diversion ratios, *i.e.*, how large fraction of the revenue at one outlet that was diverted to another specific outlet. Since they did so at all eight outlets, they could estimate diversion ratios in both directions for each pair of outlets. This made it possible to detect any asymmetry in diversion ratios. Figure 2 report the diversion ratios for each pair of outlets. Since there are eight outlets, there will be 28 different pairs of outlets. The diversion ratios in both directions for each pair of outlets are shown in Figure 2 with a diagonal square mark.

If we assume that the price-cost margin is 25 % and the price increase 5 %, then we know that with a uniform price increase and symmetric firms the critical diversion ratio is 16.7 %. This is marked in Figure 2 with the circle on the 45⁰ line. In such a case the diversion ratio for a pair of outlets is identical in both directions, and we can apply the uniform price increase

¹⁴ For a description of their study, see Mathiesen, Nilsen and Sørgard (2009). They use the data for diversion ratios to construct a merger simulation model.

formula for symmetric firms.¹⁵ If we assume a price increase on only one of the products, the critical diversion ratio is 20 %. This is marked in Figure 2 with the horizontal and vertical solid lines at 20 %.

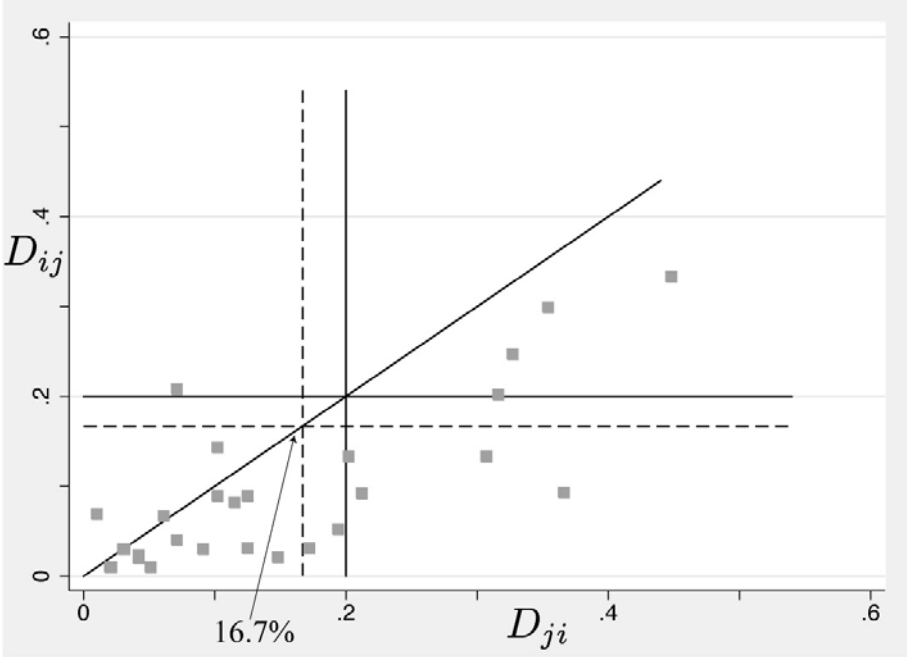


Figure 2: Actual diversion ratios for each pair of outlets

If we have a square mark on the 45⁰ line, then the diversion ratios for that particular pair of outlets are identical. We see that some of the square marks for the pair of diversion ratios are located far away from the 45⁰ line. This makes it natural to check whether a single-product SSNIP test will lead to a narrower market definition in any of these cases than a uniform SSNIP test.¹⁶

First, let us consider the uniform SSNIP test. It is obvious that if diversions ratios in both directions for a pair of outlets are below the critical diversion ratio for the symmetric case of 16.7 %, then we can safely conclude that in the relevant market there are more than those two outlets. This implies that for each of the pair of outlets in the rectangle to the South-West of

¹⁵ Strictly speaking we should calculate the weighted diversion ratios, using market shares as weights. But if those two diversion ratios are identical, then it would not make any difference if we use the weighted or the unweighted diversion ratio.

¹⁶ In theory we could also have that the single-product SSNIP test would lead to a broader market. However, it can easily be verified that this is not the case in any of the examples shown in Figure 2.

the dotted lines the relevant market is larger than those two outlets. This is more than half the pair of outlets; 16 out of 28.

We see that three pairs of outlets are located North-East of the dotted lines in Figure 2, with higher diversion ratios in both directions than the critical diversion ratio 16.7 %. Then we can conclude that each of those pairs of outlets constitutes a separate relevant market.¹⁷

We see from Figure 2 that there are nine pairs of outlets in the two rectangles North-West and South-East of the dotted lines. In these cases we cannot from the location in Figure 2 conclude whether each of those pair of outlets constitutes a separate relevant market or not according to the uniform SSNIP test. When we employ the test for a uniform price increase shown in (3), we find that in five of these pair of outlets there are separate relevant markets. These are the five pair of outlets that are located to the East in the rectangle South-East of the dotted lines.

Second, let us check whether any of the remaining four pairs can be defined as a relevant market according to the single-product SSNIP test. The critical diversion ratio in the single-product SSNIP test is 20 %, and shown with the solid horizontal and vertical lines in Figure 2 at 20 %. We can see directly from the Figure that the actual diversion ratio is higher than the critical diversion ratio (shown with the solid lines) for the two pair of outlets in the North-West rectangle, but not for the two pair of outlets in the Western part of the South-East rectangle.¹⁸ This implies that two of those four pairs, the two in the South-East rectangle, are not defined as a relevant market even with an single-product SSNIP test. The remaining two, in the North-West rectangle, constitutes a relevant market if we impose a single-product SSNIP. Those two cases show that it matters whether we impose a price increase on only one or all the products.

¹⁷ Note, though, that when defining the relevant market we check for the lowest number of products that must be included for a price increase being profitable. In our case we could have that some of the four pairs in the North-East rectangle are overlapping. Then we should proceed by considering which one is the candidate market. For example, in a merger case we know which outlets that are directly involved. We should then start with this pair and check whether they belong to the same market, and proceed until we have defined the relevant market.

¹⁸ It can be seen from Figure 2 that one of those pair of outlets is very close to pass the single-product price test. In that particular case the actual diversion ratio in one direction is 19.9 %.

5. Policy implications

Market definition is crucial in most competition cases, and the SSNIP test is the accepted method for defining the relevant market. This should call for a careful investigation of how the SSNIP test is performed. Although asymmetries between firms – for example concerning sales volume – obviously is more often the rule than the exception in markets, in almost all SSNIP tests a uniform price increase is imposed on all products. We have shown that the single-product SSNIP test can define a narrower relevant market than the uniform SSNIP test, for example if we have one product with a large market share and one with a small market share. The intuition for this is quite straight forward. If one increases the price on the large product, only a small fraction of sales is expected to be diverted to the small product. On the other hand, it is plausible that the large product can recapture a large fraction of lost sales for the small product. Then it is quite natural that a price increase on the small product is more profitable than a price increase on the large product. The results from the survey in the local grocery market in Norway did indeed show that the test can make a difference. We have shown that in two cases, with two different pairs of outlets as the candidate market, the relevant market is defined if we apply the single-product SSNIP test but not defined if we apply the uniform SSNIP test.

In theory the single-product SSNIP test consists of a separate test for each product in the candidate market, and in that respect it is more time consuming than the uniform SSNIP test. However, economic reasoning could guide us on the procedure when the hypothetical monopolist test is done. For example, if products have only small differences in price-cost margins the first candidate to check for a single-product price increase is the product with the highest aggregate diversion ratio to other products in the candidate market. If it is profitable to raise the price of that product with 5-10%, a relevant market is delineated and no more tests are needed.

References

Baker, J. (2007): 'Market definition: An analytical overview', *Antitrust Law Journal*, 74, 129.

Daljord, Ø. (2009): 'An exact SSNIP test for asymmetric products', *Journal of Competition Law and Economics*, 5(3), 563-569.

Daljord, Ø., L. Sørgard and Ø. Thomassen (2007): 'Market definition with shock analysis', Discussion Paper 36 2007, Department of Economics, Norwegian School of Economics and Business Administration.

Daljord, Ø., L. Sørgard and Ø. Thomassen (2008): 'The SSNIP test and market definition with the aggregate diversion ratio: A reply to Katz and Shapiro', *Journal of Competition Law and Economics*, 4(2), 263-270.

Epstein, R. J. and D. Rubinfeld (2001): 'Merger simulation: A simplified approach with new applications', *Antitrust Law Journal*, 69, 883-919.

European Commission (2005): 'DG Competition discussion paper on the application of Article 82 of the Treaty to exclusionary abuses', Brussels, December 2005.

Farrell, J. and C. Shapiro (2008): 'Improving critical loss analysis', *Antitrust Source*, February 2008.

Halleraker, N. and G. Wiig (2008): 'Empirisk undersøkelse av konkurransen i dagligvaremarkedet' (An empirical study of the competition in the grocery market), Master thesis, June 2008, Norwegian School of Economics and Business Administration.

Harris, B. C. and J. J. Simons (1989): 'Focusing on market definition: How much substitution is necessary?', in R. O. Zerbe (ed.): *Research in Law and Economics*, volume 12.

Katz, M. L. and C. Shapiro (2003): 'Critical Loss: Let's Tell the Whole Story', *Antitrust Magazine*, spring 2003.

Mathiesen, L., Ø. A. Nilsen and L. Sørgard (2009): 'Merger simulations with asymmetric firms: The application of diversion ratios', mimeo, Department of Economics, Norwegian School of Economics and Business Administration.

Moresi, S. X., S. C. Salop and J. R. Woodbury (2008); 'Implementing the hypothetical monopolist SSNIP test with multi-product firms', *Antitrust Source*, February 2008.

O'Brien, D. and A. Wickelgren (2003): 'A critical analysis of critical loss analysis', *Antitrust Law Journal*, 71(1), 161-184.

Werden, G.J. (2002): 'Beyond critical loss: Tailoring applications of the hypothetical monopolist paradigm', mimeo, U.S. Department of Justice.

Werden, G. and L. M. Froeb (2002): 'Calibrated economic models add focus, accuracy, and persuaviness to merger analysis', chapter in *The Pros and Cons of Merger Control*, The Swedish Competition Authority, Stockholm.

Werden, G. and L. M. Froeb (2008): 'Unilateral competitive effects of horizontal mergers', in P. Buccirossi (ed.): *Handbook of Antitrust Economics*, The MIT Press.

Willig, R. D. (1991): 'Merger analysis, industrial organization theory, and merger guidelines', *BROOKING PAPERS ON ECONOMIC ACTIVITY, MICROECONOMICS*, 299-305.



NHH

**Norges
Handelshøyskole**

Norwegian School of Economics
and Business Administration

NHH
Helleveien 30
NO-5045 Bergen
Norway

Tlf/Tel: +47 55 95 90 00
Faks/Fax: +47 55 95 91 00
nhh.postmottak@nhh.no
www.nhh.no