

THE SSNIP TEST AND MARKET DEFINITION WITH THE AGGREGATE DIVERSION RATIO: A REPLY TO KATZ AND SHAPIRO

Øystein Daljord^{*}, *Lars Sørgard*^{**} and *Øyvind Thomassen*^{***}

ABSTRACT

The Hypothetical Monopolist or Small but Significant Non-transitory Increase in Prices (SSNIP) test defines the relevant market by determining whether a given increase in product prices would be profitable for a monopolist in the candidate market. The US Merger Guidelines do not specify whether the SSNIP test should be performed with an increase in one price, some prices or all prices in the candidate market. We argue that this should depend on characteristics of the market: if there are asymmetries between products, increasing only one price might be the best way to identify competitive constraints. Katz & Shapiro (2003) derive a one-price test criterion of critical loss in terms of the aggregate diversion ratio. Unfortunately, the derivation is incorrect. We show what the correct criterion should be.

I. INTRODUCTION

The Small but Significant Non-transitory Increase in Prices (SSNIP) test was introduced with the 1982 US Merger Guidelines and is widely used by competition authorities to define the relevant market. Starting with the narrowest possible market definition, if it is profitable for a hypothetical monopolist to increase the price(s) of the product(s) in this narrowly defined candidate market by 5%, substitution away from this class of products is small, so the products in the candidate market do not face significant competitive constraints from products outside it, and the candidate market is therefore the relevant market. If, on the other hand, the increase in price(s) is not profitable because consumers would substitute to products outside the candidate market, the market definition must be extended to include the closest of these substitutes, in order to ensure that any product exercising a competitive constraint on the product(s) in question is included in the market definition. Products are added to the candidate market until the price increase is profitable

* Economist, Norwegian Competition Authority, E-mail: oeda@kt.no

** Professor of Economics, Norwegian School of Economics and Business Administration, and Economist, Norwegian Competition Authority, E-mail: lars.sorgard@nhh.no

*** PhD student in Economics, University of Oxford, E-mail: oyvind.thomassen@economics.ox.ac.uk

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for a hypothetical monopolist owning all the products in the candidate market. The relevant market has then been found.

The purpose of market definition is to identify competitive constraints. Some economists have argued that market definition makes little economic sense, and that one should rather focus directly on the anti-competitive effects.¹ We agree that market definition is not a goal in itself, but rather an input to the analysis of possible anti-competitive effects. If only for legal reasons, market definition is and will continue to be an important part of antitrust practice. It is therefore important that the method used for market definition is based on economic reasoning.

When choosing the criterion for defining the relevant market one should anticipate how market power might in fact be exploited. For example, would a merger result in a symmetric increase in prices on all products controlled by the merged firm or would we expect some asymmetric price increases? If there are asymmetries, one should consider using a SSNIP test where prices are increased asymmetrically. In this case it should be possible to apply the criterion introduced by Katz and Shapiro for whether a product is included in the relevant market or not.² Unfortunately, their criterion is incorrect. When deriving their result they do not take into account the fact that by increasing the price of one product, some sales are diverted to the other products in the candidate market. We derive the correct criterion, and it turns out that markets are defined too narrowly if one uses the criterion of Katz and Shapiro.

In the next section we discuss the choice between two different versions of the SSNIP test. In section 3 we introduce the concept of critical loss. The derivation of the Katz and Shapiro critical loss criterion is done in section 4. We explain the error in the Katz and Shapiro criterion, and derive the correct criterion in section 5. In section 6 we offer some concluding remarks.

II. INCREASING ONE PRICE OR ALL THE PRICES

It is not clear from the wording of the US Merger Guidelines whether the SSNIP test requires a relative increase in the price of one, some or all of the products in the candidate market.³ The ambiguity of the Guidelines has led to different profitability criteria being used in the literature.⁴ Harris and Simons

¹ See for instance Marc Ivaldi and Szabolcs Lörincz: 'A Full Equilibrium Relevant Market Test: Application to Computer Servers', *CEPR Discussion Paper* no. 4917, February 2005 and Kai-Uwe Kuhn: 'Reforming European Merger Review: Targeting Problem Areas in Policy Outcomes', *Michigan Law and Economics Research Paper* No. 02-01, 2002.

² Michael L. Katz and Carl Shapiro: 'Critical Loss: Let's Tell the Whole Story', *Antitrust Magazine*, spring 2003.

³ See, for instance, Michael Whinston: 'Antitrust Policy Toward Horizontal Mergers', in Mark Armstrong and Robert Porter (eds.), *Handbook of Industrial Organization*, vol. 3, pp. 2371 - 2415, 2007.

⁴ There is also a debate on whether the price increase is the optimal one, or the price

derive a criterion based on a uniform price increase on all products in the candidate market. Katz and Shapiro introduced a somewhat different test. They consider the effect of raising the price of only one product and derive a market definition criterion based on the aggregate diversion ratio. The basic question that distinguishes the two criteria is whether one in the SSNIP test should let one or all prices increase.⁵ Katz and Shapiro state:

*[...][W]e have followed the letter of the Merger Guidelines in asking whether the hypothetical monopolist would find it most profitable to raise the price of at least one product of the merging parties by some threshold amount above prevailing levels. However, we are aware that the market definition test often employed in practice is slightly different. Specifically, the test often takes the form of asking whether the hypothetical monopolist would find it most profitable to raise the prices of all of the products in the candidate market at least 5 percent above prevailing levels.*⁶

However, it can be argued that it is consistent with the Merger Guidelines to increase all prices, as is done by Harris and Simons.⁷ In fact, one cannot - as noted by Whinston - from theory alone argue that one of the approaches is better than the other one.⁸ The basic question is whether some products impose a competitive constraint on the pricing of one or several products, and that should be of importance when choosing the price test in a particular case. In some cases there may be important competitive constraints the all-price test misses, but the one-price test captures and vice versa in other cases.⁹ In most case studies we observe that a symmetric price increase is imposed on all

Increase is profitable as such. Arguably, the 1992 Horizontal Merger Guidelines endorse an optimality criterion, see Gregory Werden: 'Beyond Critical Loss: Tailoring Applications of the Hypothetical Monopolist Paradigm' . US DOJ Antitrust Division Economic Analysis Group Discussion Paper No. 02-9, 2002 for a discussion. We follow the approaches in Harris and Simons and Katz and Shapiro, and consider the profitability of a price increase not the optimal price increase.. For a discussion of the optimality criterion, see Simon Bishop and Mike Walker: *The Economics of EC Competition Law: Concepts, Application and Measurement*, Sweet & Maxwell, London, 2002.

⁵ Note that Katz and Shapiro caused a controversy over how much structure to impose when deriving the market delineation criterion, see the debate in the following papers: David T. Scheffman and Joseph J. Simons: 'The State of Critical Loss Analysis: Let's Make Sure we Understand the Whole Story', *Antitrust Source*, November 2003; Barry Harris: 'Recent Observations on Critical Loss', *FTC/DOJ Joint Workshop on Merger Enforcement*, February 2004, (available at www.usdoj.gov); John D. Harkrider: 'Operationalizing the Hypothetical Monopolist Test', *FTC/DOJ Joint Workshop on Merger Enforcement*, February 2004, (available at www.usdoj.gov); Michael Katz and Carl Shapiro: 'Further Thoughts on Critical Loss', *Antitrust Source*, March 2004. The question of structure, though, differs from the question of whether one should increase one, some or all prices.

⁶ See Katz and Shapiro (2003), p. 54.

⁷ See Harris and Simons (1989)

⁸ See Whinston (2007).

⁹ There might even be cases where a some-prices test is best suited to identify the relevant competitive constraints.

products in the candidate market. This seems to be a good idea in a candidate market with symmetric products - for example where all products have equal margins and demand structure - because a hypothetical monopolist is expected to raise prices on all those products symmetrically.

If we observe asymmetries, this may no longer be true. Then a hypothetical monopolist might increase prices more on some products than others. This could be true, for example, if we have a private label with limited sales and small margins that competes (or not) with a national brand with large sales and high margins. Then it might be natural to assume an asymmetric price increase when one examines the market for the private label and the national brand. A uniform price increase may lead to large absolute losses for the national brand compared with the private label. If only the price of the private label is increased, diversion to the national brand may make the price increase jointly profitable. If so, the Katz and Shapiro criterion should be preferred. This shows that which criterion to use - the one with an asymmetric price increase or the more common one with a symmetric price increase - should be determined by the characteristics of the candidate market in question.¹⁰

III. CRITICAL LOSS

The Critical Loss test of Harris & Simons (1989) is an empirically useful reformulation of the SSNIP test. The test measures the relative reduction in quantity following a given relative price increase on *all* the products in the candidate set that keep their joint profits unchanged. The critical loss defines a profitability threshold to compare with the actual relative quantity reduction of the candidate set of products following the price increase. If the actual loss is smaller than the critical loss, the price increase is jointly profitable and the market is defined. The requirement that the increase in price should be profitable can be stated as

$$((1+x)p-c)q(1-CL)-(p-c)q > 0 \quad (1)$$

where x is the price increase, CL is the critical loss and p and q are the prevailing price and quantity, respectively, of the candidate market in question. Starting from this expression, a few arithmetic steps leads to a simple criterion for market definition. The actual loss, represented on the left hand below, is smaller than the critical loss, represented on the right, if and only if

$$x\eta < \frac{x}{x+m} \quad (2)$$

¹⁰ See Øystein Daljord, Lars Sjørgard and Øyvind Thomassen: 'Market definition with shock analysis', *mimeo*, 2007 for an empirical application of these principles. See also the rebuttal expert report from July 13 2007 by Kevin Murphy in the Whole Foods acquisition of Wild Oats case, where he applies the method proposed by Katz and Shapiro.

where η is the elasticity of demand of the products in the candidate market and $m = (p-c)/p$ is the price-cost margin. The critical loss test is general in the sense that it does not rely on strong economic assumptions and applicable in that it relies on relating just a few variables: margins and demands sensitivity to price changes. Various versions of the Harris and Simons procedure of increasing all prices in the candidate market have been applied in competition cases.¹¹

IV. KATZ AND SHAPIRO'S FORMULATION

Katz and Shapiro state their criterion for defining the market in the following way:

*If and only if the aggregate diversion ratio is larger than the critical loss, then the actual loss is less than the critical loss and thus a hypothetical monopolist would find a SSNIP profitable.*¹²

This statement is incorrect. The result refers to the following derivation:¹³ Let there be two products, 1 and 2, with equal price-cost margins. Let the product specific elasticity of product 1 be related to the margin by the inverse pricing rule as

$$\eta = \frac{1}{m} \quad (3)$$

where η is the own-price elasticity of product 1 and $m = (p-c)/p$ is the price-cost margin of both products. Then, assuming linear demand, the actual loss in demand of product 1 with an x percent price increase is

$$AL = \frac{x}{m} \quad (4)$$

Let the diversion ratio of product 2 and product 1 be given by

$$D = \frac{\partial q_2}{\partial p_1} / \frac{\partial q_1}{\partial p_1} \quad (5)$$

The diversion ratio measures the fraction of sales lost on product 1 that is diverted to product 2 following the price increase. Since the hypothetical

¹¹ For a critical review of some examples see Ioannis Kokkoris: 'Critical Loss, Critically III?', *European Competition Law Journal*, Issue 9, p.517-524, 2005 and Daniel P. O'Brien and Abraham Wickelgren: 'A Critical Analysis of Critical Loss Analysis', *Antitrust Law Journal*, Vol. 71 p. 161-84, 2003.

¹² Katz and Shapiro at p. 53.

¹³ id. note 25.

monopolist earns a margin on the sales that is diverted from product 1 to product 2, it is *as if* the hypothetical monopolist only lost a fraction $1-D$ of sales on product 1. Accordingly, we may rewrite the actual loss in terms of the relative decline in sales of the hypothetical monopolist as

$$AL = \frac{x(1-D)}{m} \quad (6)$$

Katz and Shapiro then state:

Recall that the critical loss is $CL = x/(x+m)$. With a few steps of algebra, it can be shown that $AL < CL$ if and only if $D > CL$.

The steps are algebraically correct, but the derivation relies on the false premise that the critical loss when increasing only one price is $x/(x+m)$.¹⁴ Katz and Shapiro apply the Critical Loss expression of Harris and Simons for the case where *all* prices are increased, to their case, where only one price is increased. The two thresholds are not equal, as we show in the next section.

V. THE ERROR IN THE KATZ AND SHAPIRO CRITERION

We first derive the critical loss and the actual loss *of product 1* when increasing the price of only product 1 in the case of two products in the candidate market. All results generalize easily to the case of J products.

The actual loss of product 1 following an increase of p_1 of x percent is still given by

$$AL = x\eta_{11} \quad (7)$$

where η_{11} is the own-price elasticity of demand of product 1. The critical loss of product 1 is given by the relative decline in sales of product 1 that keeps the joint profits of the two products unchanged, i.e. satisfy the equality

$$\pi_1(p^s) - \pi_1(p) + \pi_2(p^s) - \pi_2(p) = 0 \quad (8)$$

where $p^s = ((1+x)p_1, p_2)$. Expanding the equation, we get

¹⁴ These are the steps:

$$AL < CL \Leftrightarrow \frac{x(1-D)}{m} < \frac{x}{x+m} \Leftrightarrow D > \frac{x}{x+m} = CL$$

In the case of unequal mark-ups, the Katz and Shapiro criterion generalises to $\lambda D > CL$, where

$$\lambda = (p_2 - c_2)/(p_1 - c_1).$$

$$\begin{aligned} &((1+x)p_1 - c_1)q_1(1-CL) - (p_1 - c_1)q_1 \\ &+ (p_2 - c_2)q_2(1+x\eta_{21}) - (p_2 - c_2)q_2 = 0 \end{aligned} \quad (9)$$

where η_{21} is the cross-price elasticity of product 2 with respect to p_1 . The expression simplifies to

$$(x + m_1)R_1(1-CL) - m_1R_1 + x\eta_{21}m_2R_2 = 0 \quad (10)$$

where $R_j = p_j q_j$ and $m_j = (p_j - c_j)/p_j$. Solving for CL , we get

$$CL = \frac{x}{x + m_1}(1 + \lambda D) \quad (11)$$

where $\lambda = (p_2 - c_2)/(p_1 - c_1)$ measures the relative profitability of the two products, and D is the diversion ratio as defined in (5). The critical loss of product 1 is the expression of Harris and Simons for the critical loss *when increasing the price of all products in the candidate market* plus a term proportional to λD accounting for the diversion of sales to product 2.

By combining (7) and (11) it can be seen that the actual loss of product 1 is smaller than the critical loss of product 1 in the case of increasing only one price if and only if

$$x\eta_{11} < \frac{x}{x + m_1}(1 + \lambda D) \quad (12)$$

Using (4) this simplifies to

$$\frac{x}{m_1} < \lambda D \quad (13)$$

In the symmetric case analysed by Katz and Shapiro, $\lambda = 1$, and the criterion is reduced to

$$\frac{x}{m_1} = AL < D \quad (14)$$

where we have suppressed the subscripts for convenience. We can now compare the corrected criterion to the original

$$\text{Correct: } \frac{x}{m} < D \quad \text{Wrong: } \frac{x}{x+m} < D \quad (15)$$

and we find that the corrected criterion fortunately is just as simple in terms of information requirements as the incorrect one. Note that x/m is everywhere

larger than $x/(x+m)$. This means that in some cases when the relevant market is defined according to the Katz and Shapiro criterion, at least one more product must be included before the price increase is profitable using the correct criterion. It implies that the Katz and Shapiro criterion would lead to market being defined too narrowly.

The actual loss of product 1 is smaller than the critical loss if and only if the (aggregate, mark-up weighted) diversion ratio is larger than the Actual Loss. That is simply another way of stating that the diversion ratio equals the (correct) critical loss. The correction implies a restatement of Katz and Shapiros market definition criterion:

If and only if the aggregate diversion ratio is larger than the actual loss, then the hypothetical monopolist would find a SSNIP profitable

VI. CONCLUSION

Katz and Shapiro showed that the criterion for two products belonging to the same market becomes quite simple and easy if one is willing to impose some structure. Unfortunately, there is an error in the derivation. Applying the criterion reported by Katz and Shapiro tends to define markets too narrowly.

In most case studies we observe that a symmetric price increase is imposed on all products in the candidate market. The US Merger Guidelines leave it an open question whether one should increase one, some or all prices in the candidate market when performing a SSNIP test. The ambiguity should be embraced. How to increase prices should be determined by the characteristics of the candidate market in question. When products in the candidate market are asymmetric, imposing asymmetric SSNIPs may make more economic sense.