

# Agenda

Advancing economics in business

## 'Could' or 'would'? The difference between two hypothetical monopolists

**Critical loss analysis is a simple, well-established tool for market definition. Combined with consumer survey data, it has frequently been applied to assess the competitive effects of mergers. But the devil is in the detail—a good deal of debate has arisen in the last few years over various aspects of the test, including the subtle (and more than semantic) distinction between whether a hypothetical monopolist 'could' or 'would' increase price**

Earlier this year the UK Office of Fair Trading (OFT) cleared the acquisition by LOVEFiLM International Limited of the online DVD rental business of Amazon Inc.<sup>1</sup> Since these two businesses represented around 80% and 13%, respectively, of all online DVD rentals in the UK, the transaction could be regarded as a merger to near-monopoly, unless the relevant market were to be defined more broadly than online DVD rentals.

As part of the market definition exercise, the parties presented a critical loss analysis based on a consumer survey. In essence, what this analysis sought to demonstrate was that a hypothetical monopolist of online DVD rental services could not profitably increase prices by 10%, since such an increase would result in too great a loss in sales (in the range of 30–40%).<sup>2</sup> In other words, the resulting sales loss after a small but significant and non-transitory price increase (known as a SSNIP) would exceed the critical loss, which indicates that the market is wider than just online DVD rentals. The survey found that consumers would switch to alternatives such as renting DVDs from shops or purchasing them, or would simply watch fewer films.

Critical loss analyses such as these are frequently used in merger cases. They are a way to apply the hypothetical monopolist (or SSNIP) test for market definition. The idea behind critical loss is straightforward and intuitive. Any price rise will normally have two effects:

- a fall in sales, as some consumers are no longer willing to buy at the higher price;
- a higher profit margin, made on sales to those consumers who continue to buy at the higher price.

These two effects work in opposite directions; the first decreases profits, the second increases profits.

Economists have developed the concept of critical loss, which is the proportion of sales lost after a given price increase for which the two effects exactly offset each other (see the box below). This critical level then provides a benchmark against which to compare the 'actual' sales loss following a price increase, evidence on which can be gathered, for example, by means of a consumer survey.

While the concept of critical loss is nearly 20 years old, in recent years there has been a good deal of debate and controversy around its application, both in the economics literature and in recent merger cases in the USA and the UK. This debate includes issues such as how to apply the critical loss test when differentiated products are involved, or when the merged entity controls two different but substitutable products, and the question of whether the 'break-even' variant or the 'profit-maximisation' variant of the critical loss test should be used. This article addresses the latter question.

### Spot the difference between these monopolists

Some of the confusion around the critical loss test as described in the box has arisen from the question of how critical loss actually relates to the SSNIP test. The SSNIP approach is now commonly used around the world as a conceptual framework for market definition. In order to capture the competitive effects from other products (or geographic areas), the test involves hypothetically monopolising the product (or geographic area) under consideration (often called the focal product/area), and then assessing the impact of a SSNIP, which is usually taken as 5–10%. But there are two variants of the SSNIP test—a fact that not all competition practitioners are aware of—and the critical loss test described above corresponds only to one of these.

**The standard critical loss test**

In the standard case there is one homogeneous product. There is a starting situation in which  $Q$  units of the product are sold at price  $P$ , which gives rise to a price–cost margin  $m = (P-C)/P$  (where  $C$  is marginal cost). There is then a hypothesised price increase  $x = \Delta P/P$ , which results in a fall in the quantity sold of  $\Delta Q$ .

The price increase leads to a gain in profits of  $P(Q-\Delta Q)x$ , whereas the quantity decrease gives rise to a loss of profits of  $P \Delta Q m$ .

The key question is then: What is the maximum decrease the quantity may suffer before the price increase becomes unprofitable? The answer is: it is the  $\Delta Q$  for which the profit gains from the price increase are equal to the loss of profits from the decrease in the quantity. This leads to the ‘break-even’ equation:

$$(1) \quad P(Q-\Delta Q)x = P \Delta Q m$$

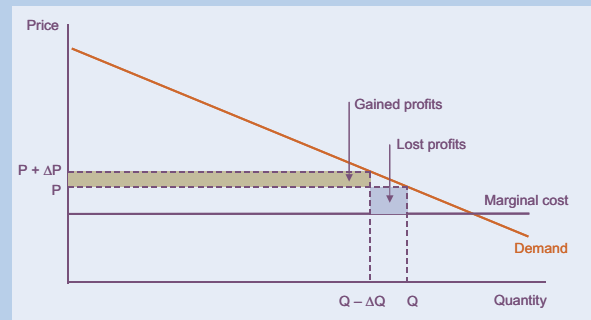
The gain is on the left-hand side, the loss on the right-hand side. The equation can be solved for the unknown  $\Delta Q$ , delivering the standard formula for the critical loss expressed as a fraction of the original sales of the product:<sup>1</sup>

$$(2) \quad \text{critical loss} = \Delta Q/Q = x/(m+x)$$

Notes: <sup>1</sup> This is the standard formula proposed by Harris, B.C. and Simons, J.J. (1989), ‘Focusing Market Definition: How Much Substitution is Necessary?’, *Research in Law and Economics*, 12, pp. 207–26.

This situation is illustrated in the figure. The profits gained by the price increase are represented by the shaded rectangle between  $P$ ,  $(P+\Delta P)$  and  $(Q-\Delta Q)$ ; the profits lost by the quantity reduction correspond to the shaded rectangle between  $Q$ ,  $(Q-\Delta Q)$ ,  $P$  and marginal cost.

For any given price increase  $x = \Delta P/P$ , the critical loss is the  $\Delta Q/Q$  for which the two shaded rectangles have the same surface. Note that marginal costs are assumed constant for simplicity. Demand is depicted as linear, but the above critical loss formula holds for any shape of the demand curve (see main text).



The SSNIP test is set out in policy guidance in the USA, UK and EU, respectively, as follows.

- **US Horizontal Merger Guidelines.**<sup>3</sup> ‘A market is defined as a product or group of products and a geographic area in which it is produced or sold such that a *hypothetical profit-maximizing firm*, not subject to price regulation, that was the only present and future producer or seller of those products in that area likely *would* impose at least a “small but significant and non-transitory increase in price”, assuming the terms of sale of all other products are held constant. A relevant market is a group of products and a geographic area that is no bigger than necessary to satisfy this test.’ (emphasis added)
- **UK Competition Commission merger guidelines.** ‘In using the concept of the SSNIP test for product market definition the CC will consider whether a hypothetical monopolist of a certain product or set of products, which might constitute a market, *could profitably* impose a small but significant non-transitory increase in price (SSNIP). The principle behind the test is that a market is defined as a product, or collection of products, the supply of which can, hypothetically, be monopolised *profitably*.’<sup>4</sup> (emphasis added)
- **European Commission Notice on market definition.** ‘The question to be answered is whether

the parties’ customers would switch to readily available substitutes or to suppliers located elsewhere in response to a hypothetical small (in the range 5%–10%) but permanent relative price increase in the products and areas being considered. If substitution were enough to make the price increase *unprofitable* because of the resulting loss of sales, additional substitutes and areas are included in the relevant market. This would be done until the set of products and geographical areas is such that small, permanent increases in relative prices would be *profitable*.’<sup>5</sup> (emphasis added)

The difference is subtle. The US definition refers to what a *profit-maximising* monopolist *would* do. This is based on the notion that a hypothetical monopolist would set a profit-maximising price in line with standard economic theory—see box below. The question is then whether that profit-maximising price is at least 5–10% higher than the pre-monopolisation price (eg, the current price in the market).

In contrast, the EU and UK definitions ask whether the hypothetical monopolist *could* raise the price *profitably* by 5–10%. In other words, would a 5–10% price increase result in higher profits than currently? This is not to say that the USA and Europe always use different approaches—indeed, despite the profit-maximisation formulation in the Horizontal Merger Guidelines, in practice US court cases often use the break-even variant

(and previous versions of the Merger Guidelines had the latter variant as well).<sup>6</sup>

So which definition corresponds to the ‘standard’ critical loss test as described above? The answer is: the latter. The standard critical loss test provides the answer to the question whether a 5%–10% is *profitable*, as it gives the proportion of sales loss at which the monopolist breaks even—ie, where profits before and after the price increase are equal. Therefore, this standard critical loss test is also referred to as the ‘break-even critical loss test’.

## What would the monopolist do?

The SSNIP test as defined in the US guidelines can also be expressed in terms of critical loss, but the formula for this profit-maximisation critical loss test is different—see box below. The intuition behind this difference is that, while it may be *profitable* to raise prices by 5–10% in that profits after the price increase are higher than before, it may also be the case that this price increase is not the *profit-maximising* one.

In fact it can be shown theoretically that the break-even price increase is twice as high as the profit-maximising

### Profit-maximisation critical loss

Any economics textbook explains that a monopolist maximises profits by setting marginal revenue equal to marginal cost. This optimal point is illustrated in the figure below on the left, which shows a linear demand curve. (For the profit-maximisation critical loss, the shape of demand curve assumed is of importance; the logic of the profit-maximisation critical loss is easiest to explain with linear demand.)

A relevant concept worth explaining here is that of demand elasticity—a summary measure of the responsiveness of demand to price, defined as the percentage change in demand divided by the percentage change in price. For example, if a price increase of 10% leads to a sales loss of 35% (similar to the LOVEFILM/Amazon case mentioned above), the elasticity is  $-3.5$  (10 divided by  $-35$ ).

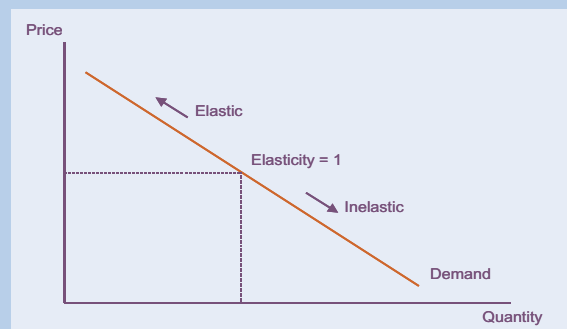
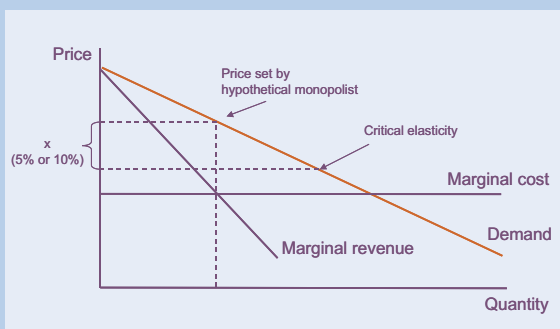
At the profit-maximisation point, the price-cost margin,  $(P-C)/P$ , always equals  $-1$  divided by the elasticity at that point. In this regard it is useful to know that, for a linear demand curve, demand gradually becomes more elastic the further one moves to the top left. This is illustrated in the figure on the right. The intuition behind this is that towards the left of the curve, quantity demanded is already small, so any further price increase leads to a relatively large proportionate decrease in demand. A monopolist would always set the profit-maximising price on the elastic part of the curve, where the elasticity is greater than 1 (in absolute terms, that is, since the elasticity is negative).

The SSNIP test as defined in the US Horizontal Merger Guidelines works as follows. There is a given starting

price (which could be the competitive price—ie, equal to marginal cost—or a higher price; this does not really matter here). Next, the product in question is hypothetically monopolised. As a consequence, the price ‘shoots up’ to the profit-maximising price. The SSNIP question then asked is whether this price increase is at least 5–10%.

The figure to the left illustrates this. It shows the price increase (the SSNIP), which can be either 5% or 10%, and in the first box was defined as  $x$ . It is clear from the figure that if the starting price is anywhere to the right of the point labelled ‘critical elasticity’, the price ‘shoots up’ by more than  $x$  to reach the profit-maximising point. In other words, if demand is less elastic than the ‘critical’ level of elasticity, the hypothetical monopolist would indeed impose a SSNIP.

The formula for this profit-maximisation critical elasticity can be derived from the same textbook monopoly model (it is somewhat more complicated than the derivation of the break-even critical loss shown in the first box).<sup>1</sup> It equals  $1/(m+2x)$ , where  $m$  is the pre-monopolisation price-cost margin, as defined in the first box. From this the profit-maximisation critical loss can be derived, which equals  $x/(m+2x)$ . This is different from the expression for the break-even critical loss, which is  $x/(m+x)$ . It can be seen that the profit-maximising critical loss is always lower than the break-even variant (as the factor  $2x$  in the denominator is larger than  $x$ ), such that the break-even test will tend to lead to narrower markets.



Notes: <sup>1</sup> See Werden, G. (1998), ‘Demand Elasticities in Antitrust Analysis’, *Antitrust Law Journal*, 66.

price increase (assuming linear demand and constant marginal cost). As a consequence, markets defined using the break-even critical loss will tend to be narrower than markets defined using the profit-maximisation critical loss—the break-even hypothetical monopolist has more room to raise prices before losing too many sales than the profit-maximising monopolist has (see box above).

Does this distinction between break even and profit maximisation matter in practice? In most cases it will not, or should not, matter too much. Table 1 compares the critical loss under the two formulations for a 10% price increase and various margins (the profit-maximisation critical loss formula requires an assumption on the shape of the demand curve, while the break-even formula holds for any demand curve). It can be seen that the critical loss levels generated under these two variants are not necessarily very different for a range of margins, in particular when seen in light of the uncertainty that often exists around empirical measures of the actual sales loss against which the critical sales is compared. For example, for a margin of 40%, the profit-maximising critical loss is 16.7% and the break-even critical loss is 20.0%, but when estimating the actual loss there will often be some confidence interval around the estimate that may well span the difference between 16.7% and 20%.

One case where the choice of critical loss formulation did matter was a phase 2 inquiry into the merger between two hospitals in the Netherlands in 2005.<sup>7</sup> The Dutch Competition Authority (NMa) commissioned a study on the demand elasticity of patients in order to determine the relevant geographic market in which these hospitals operated. The study estimated a ‘time-elasticity’ of demand—ie, the sensitivity of patients with respect to travel time, but then translated this into a price-elasticity of demand so as to compare the results with the critical loss formula.

**Table 1 Break-even versus profit-maximising critical loss for  $\alpha=10\%$**

Margin (m), %	Break even: $x/(m+x)$ , %	Profit maximisation (linear demand): $x/(m+2x)$ , %
100	9.1	8.3
90	10.0	9.1
80	11.1	10.0
70	12.5	11.1
60	14.3	12.5
50	16.7	14.3
40	20.0	16.7
30	25.0	20.0
20	33.3	25.0
10	50.0	33.3
0	100.0	50.0

For one product market—clinical treatments—the study found an actual sales loss of just under 10%, with the confidence interval of plus and minus 2.8% around this estimate (reflecting statistical uncertainty). Based on a margin estimate of around 70% (this high-level margin reflects the fact that hospitals have relatively high fixed costs and low marginal costs), the study calculated the break-even critical loss to be around 12.5%.<sup>8</sup> It concluded from this that the SSNIP was profitable and hence the geographic market was not wider than the area surrounding the two hospitals. However, if the profit-maximisation critical loss had been used, a margin of around 70% would imply a critical loss of around 11.1% (see Table 1). This was well within the confidence interval around the actual loss, and hence cast doubt on the conclusion that the SSNIP was profitable. In the end, based on various other factors including this one, the NMa concluded that the hospitals did compete in a wider market and approved the merger.

Perhaps the main lesson from this example is that care should be taken when the actual loss estimates are very close to the critical loss percentage, and that the two different critical loss variants can provide a useful sensitivity check for each other—ie, both could be calculated and the results compared.

### A critical choice?

The European Commission and the UK and US competition authorities seem to have already made a choice—whether conscious or not—between one or other of the break-even and the profit-maximisation variants of the critical loss test, by adopting a certain definition of the hypothetical monopolist (or SSNIP) test in their guidelines.

Among economists there is still debate about which test has greater merits. Proponents of the profit-maximisation variant point out that it is more in line with economic theory—after all, a hypothetical monopolist would be expected to *maximise* its profits just like any other monopolist would.<sup>9</sup> That means setting price such that marginal revenue equals marginal cost, the textbook situation. The fact that this monopolist *could* raise price even further and still make greater profits than in the starting situation (as in the break-even test) is of little relevance since the monopolist *would* not do that. In this view, the hypothetical monopolist definition adopted in the US Horizontal Merger Guidelines is a ‘purer’ definition.

Against this, however, it can be said that the break-even critical loss variant has some significant practical advantages over the profit-maximising variant.

- First, the break-even critical loss formula does not depend on the shape of the demand curve, and

hence does not require any potentially highly sensitive assumptions regarding the demand curve (such assumptions can sometimes unduly influence the outcome of the analysis). In terms of the first box above, the break-even analysis is a purely arithmetical exercise to compare the two rectangles; indeed, the figure in that box could even be drawn without any demand curve in it.

- Second, the break-even approach is arguably more intuitively linked to the concept of critical loss in the first place. Ultimately, critical loss analysis seeks to test the effect of a price increase on profitability; specifically, it seeks to determine the ‘critical’ threshold of sales loss above which the price increase becomes unprofitable. It is therefore more intuitive to

define the SSNIP test in terms of whether prices could be raised profitably.

- Third, the break-even question can also more readily be tested empirically—eg, through consumer surveys. It is more straightforward to posit consumer responses to a 5–10% price increase than to analyse what price level a hypothetical monopolist would set, and whether this price is then more than 5–10% above the starting price.

Ultimately, however, as also discussed in this article, the choice of test should arguably not have a decisive impact on the result of a market definition exercise in practice. Rather, one test can always usefully be applied as a sensitivity test for the other.

<sup>1</sup> OFT (2008), ‘Anticipated Acquisition of the Online DVD Rental Subscription Business of Amazon Inc. by LOVEFILM International Limited’, Decision, May 8th. Oxera advised the merging parties on this case.

<sup>2</sup> Para 16 of the OFT decision presents this range. The actual figure is confidential.

<sup>3</sup> Department of Justice and Federal Trade Commission (1992), ‘Horizontal Merger Guidelines’.

<sup>4</sup> Competition Commission (2003), ‘Merger References—Guidelines’, June, para 2.4. The OFT’s guidelines use a similar wording. OFT (2004), ‘Market Definition’, December.

<sup>5</sup> European Commission (1997), ‘Notice on the Definition of Relevant Market for the Purposes of Community Competition Law’, 97/C372/03, para 17.

<sup>6</sup> See Farrell, J. and Shapiro, C. (2008), ‘Improving Critical Loss Analysis’, *Antitrust Source*, February and Ten Kate, A. and Niels, G. (2008), ‘The Relevant Market: A Concept Still in Search of a Definition’, *Journal of Competition Law and Economics*, currently available at <http://jcle.oxfordjournals.org/>.

<sup>7</sup> NMa (2005), ‘Zaak 3897/Ziekenhuis Hilversum–Ziekenhuis Gooi-Noord’, June 8th. Oxera advised the merging parties on this case.

<sup>8</sup> See Table 2 and accompanying text of the NMa decision. The actual figures are confidential so those presented here are approximations.

<sup>9</sup> See Werden, G. (2008), ‘Beyond Critical Loss: Properly Applying the Hypothetical Monopolist Test’, *Global Competition Policy*, February.

If you have any questions regarding the issues raised in this article, please contact the editor, Derek Holt: tel +44 (0) 1865 253 000 or email [d\\_holt@oxera.com](mailto:d_holt@oxera.com)

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