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Hinloopen, J.

Publication date
2008

[Link to publication](#)

Citation for published version (APA):

Hinloopen, J. (2008). *Towards a formalization of the Hypothetical Monopoly Test*. Afdeling Algemene Economie.

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Towards a formalization of the Hypothetical Monopoly Test

Jeroen Hinloopen*

July 2008.

Abstract

We provide the first formalization ever of the Hypothetical Monopoly Test (HMT) to identify relevant markets. This reveals that the outcome of the test crucially depends on the intensity of competition. For two types of competition intensities, one related to market structure and one related to firm conduct, the working of the HMT is illustrated.

Key words: Hypothetical Monopoly Test, firm conduct, product market competition.

JEL Classification: L40, L51.

*University of Amsterdam and Catholic University Leuven. Correspondence: University of Amsterdam, FEB/ASE, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands; J.Hinloopen@uva.nl; <http://www.few.uva.nl/io/jhinloopen>.

1 Introduction

An accurate definition of what comprises the relevant market is of fundamental importance for the application of competition policies. Deciding on an abuse of dominance crucially hinges on the dominant's firm market share and assessments of proposed mergers always include an analysis of the post-merger market structure.

For identifying the relevant market both the UK Office of Fair Trading and the European Commission rely on the Hypothetical Monopoly Test (HMT), also referred to as the SSNIP test.¹ This test is based on market reactions to small permanent price increases (European Commission, 1997, p. 4):

The question to be answered is whether the parties' customers would switch to readily available substitutes or suppliers located elsewhere in response to an hypothetical small (in the range 5%-10%), permanent relative price increase in the products and areas being considered. If substitution would be enough to make the price change 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 geographic areas is such that small, permanent increases in relative prices would be profitable.

Despite its wide use to date no formalization exists of the HMT. This paper provides such a formalization.

The formalization of the HMT also allows for a careful assessment of the so-called *cellophane fallacy* (Stocking and Willard, 1955) which is akin to the HMT. If price exceeds substantially marginal cost, price-elasticities are typically large. Hypothetical increases in price would then yield a substantial loss of customers, making it unlikely for this price increase to be profitable. Accordingly, the definition of the relevant market is widened and the effect of a hypothetical price increase is considered again. Indeed, the larger is the price elasticity of demand, that is, the more market power the firm under investigation has, the broader will be the relevant market as identified by the HMT, all else equal.²

¹See Office of Fair Trading (1999) and European Commission (1997); SSNIP stands for *small but significant and nontransitory increase in price*, and is first introduced in the 1992 US *Horizontal Merger Guidelines*.

²This fallacy surfaced first in the US antitrust case against Du Pont de Nemours & Co., a producer of plastic wrappings that had almost monopolized the market. It is generally held that in this case the US Supreme Court defined the relevant market too broad by including a range of flexible wrapping materials such as waxed paper. For the identification of the relevant market the Court relied on the HMT.

If anything the cellophane exemplifies the relation between competition intensity and the outcome of the HMT. To understand this relation I specifically take into account market structure and firm conduct. In particular, the formalization of the HMT takes into account firm’s beliefs about rival’s reactions to price or quantity changes, and it examines both price and quantity as the strategic choice variable. Qualitatively the two types of product market competition yield identical results: firm conduct influences fundamentally the outcome of the HMT, whereby more intense competition leads to the identification of smaller relevant markets, all else equal. I therefore conclude that any analysis to identify the relevant market should include a balanced assessment of competition intensity.

2 A frame of reference

Consider a representative consumer with utility function³

$$U = q_0 + \sum_{i=1}^n \left\{ aq_i - \frac{1}{2}q_i^2 - \sum_{j=1, j \neq i}^n \theta_{ij}q_iq_j \right\}, \quad (1)$$

where q_0 is a *numeraire* good. The parameter $\theta \in [0, 1]$ captures the extent to which two products are differentiated, since:

$$\frac{\partial^2 U}{\partial q_i \partial q_j} = -\theta_{ij}. \quad (2)$$

The smaller is θ_{ij} , the less marginal utility of product i is affected by the consumption of product j , the more product i and j are differentiated. If $\theta_{ij} = 0$ the two products are independent in demand while the two products are demand substitutes for all $\theta_{ij} > 0$. Products are homogeneous if $\theta_{ij} = 1$.

Within this setting I analyze how the HMT identifies two products to constitute together some relevant market. Note that the HMT starts with an *ad hoc* identification of all products that possibly belong to the relevant market of the product of interest.⁴ For the identification of these candidate competitors no universally accepted procedure exists. I assume therefore that product 2 is the “closest competitor” of product 1. The question then to be

³This specification is quite common in the IO literature (see e.g. Vives (1984) or Qiu, 1997). Martin (2001) traces it back to Bowley (1924).

⁴One option here is to measure the “distance” between the product of interest and all possible competitors along all possible dimensions, and then to select those products that are “in the neighborhood” of the product for which the relevant market is to be defined (see e.g. Slade, 2004).

answered is whether products 1 and 2 together constitute the relevant market of product 1. According to the HMT, the answer to this question is “yes” if it is profitable for the two producers to jointly raise price by some small amount. If this is not profitable then either firm 1 is already a monopolist or more products have to be added to candidate relevant market.

3 Equilibrium behavior

There are two firms each producing one variety of the differentiated product. Standard optimization presuming the representative consumer to spend all its income on the bundle of commodities $\{q_0, q_1, q_2\}$ yields inverse demands:

$$\begin{aligned} p_1 &= a - q_1 - \theta_{12}q_2, \\ p_2 &= a - q_2 - \theta_{21}q_1. \end{aligned} \tag{3}$$

Product differentiation is symmetric in the sense that $\theta_{12} = \theta_{21}$. Accordingly, I set $\theta_{ij} = \theta$. Inverting the system of demand equations yields direct demand:

$$\begin{aligned} q_1 &= [(1 - \theta)a - p_1 + \theta p_2] / (1 - \theta^2), \\ q_2 &= [(1 - \theta)a - p_2 + \theta p_1] / (1 - \theta^2). \end{aligned} \tag{4}$$

3.1 Cournot competition

Holding the extend of product differentiation constant I now characterize the market equilibrium, first in case quantities are the strategic choice variable. If each firm produces with constant marginal cost c and fixed cost F , each firm maximizes:

$$\pi_i = (p_i - c)q_i - F \tag{5}$$

over q_i . The beliefs of either firm as to the behavior of its competitor is captured with a conjectural elasticity:

$$\alpha_{ij} = \frac{dq_j}{dq_i} \frac{q_i}{q_j}. \tag{6}$$

I assume beliefs to be symmetric, that is, $\alpha_{ij} = \alpha_{ji} = \alpha$.

Note that α is a measure for firm conduct. Negative values of α imply that rivals are believed to expand production in response to a decrease in own production while positive values of α indicate that rivals are believed to match qualitatively output changes. In the special case of α being equal to 0 both firms hold Cournot conjectures while in case of $\alpha = 1$ firms act jointly as a single monopolist.

Maximizing (5) over quantity assuming symmetric conjectures yields:⁵

$$q^C = \frac{(a - c)}{2 + \theta(1 + \alpha)} \quad (7)$$

and

$$p^C - c = \frac{(a - c)(1 + \alpha\theta)}{2 + \theta(1 + \alpha)}. \quad (8)$$

Equilibrium profits then equal:

$$\pi^C = \frac{(a - c)^2(1 + \alpha\theta)}{(2 + \theta(1 + \alpha))^2} - F. \quad (9)$$

3.2 Bertrand competition

Alternatively, both firms maximize (5) over price holding as conjecture:

$$\beta_{ij} = \frac{dp_j p_i}{dp_i p_j}. \quad (10)$$

The interpretation of the conjectural elasticity β is identical to that of α ; negative values of β refer to opposite price movements while positive values imply that price changes are matched qualitatively. The special case of $\beta = 1$ again corresponds to fully collusive behavior.

Maximizing (5) over price assuming conjectures to be symmetric gives:⁶

$$p^B - c = \frac{(a - c)(1 - \theta)}{2 - \theta(1 + \beta)} \quad (11)$$

and

$$q^B = \frac{(a - c)(1 - \beta\theta)}{(1 + \theta)(2 - \theta(1 + \beta))}, \quad (12)$$

with concomitant equilibrium profits:

$$\pi^B = \frac{(a - c)^2(1 - \theta)(1 - \beta\theta)}{(1 + \theta)(2 - \theta(1 + \beta))^2} - F. \quad (13)$$

⁵The second-order condition states that $2 + \theta\alpha(1 + \alpha) > 0$, while the stability condition requires that $|\partial q_i(q_j)/\partial q_j| < 1$, which translates into $|\theta(1 + \alpha)/2| < 1$. Obviously both conditions hold $\forall \theta \in [0, 1)$, $\alpha \in [-1, 1]$.

⁶The second-order condition requires that $\theta\beta < 1$, while the stability condition implies that $|\theta/(2 - \theta\beta)| < 1$. Again, both conditions hold $\forall \theta \in [0, 1)$, $\beta \in [-1, 1]$.

4 Relevant markets and firm conduct

According to the logic of the HMT products 1 and 2 constitute together the relevant market if it is profitable for both firms to jointly raise price by some small value δ . An important question here is which price should be taken as point of departure. For that I take the price that is most likely to be observed: the Nash equilibrium price. Applying then the HMT logic to the framework above yields:

Proposition 1 *Products 1 and 2 together constitute the relevant market if, and only if*

$$\delta < q^N(1 + \theta) - (p^N - c) = \delta^*$$

Proof. Jointly raising price with δ yields as profits

$$\pi' = \pi^N + \frac{\delta}{1 + \theta} (q^N(1 + \theta) - (p^N - c) - \delta).$$

It then follows that $\pi' > 0$ if, and only if, $\delta < \delta^*$. ■

The value of δ^* clearly depends on the type of product market competition. In case competition is over quantities it reads as:

$$\delta^C = \frac{(a - c)\theta(1 - \alpha)}{2 + \theta(1 + \alpha)}, \quad (14)$$

while for Bertrand competition it boils down to:

$$\delta^B = \frac{(a - c)\theta(1 - \beta)}{2 - \theta(1 + \beta)}. \quad (15)$$

Figure 1 displays both critical values as a function of the respective conjectural elasticities.⁷

For both types of product market competition a conjectural elasticity of one always induces the HMT to conclude that it is not profitable to jointly raise price. In this case either both firms already charge the monopoly price, which is the case here, or additional products have to be included into the basket of relevant competing products. This feature of the HMT can have a particular adverse effect. If it is used to establish the relevant market for abuse of dominance the HMT could lead to the erroneous inclusion of additional products into the basket of relevant competing products thus underestimating the market share of the companies involved. This is much in line

⁷Note that in case of demand complements both critical values δ^* are always negative. In this case the HTM would either conclude that both firms are charging the monopoly price already or that the two products together do not constitute the relevant market.

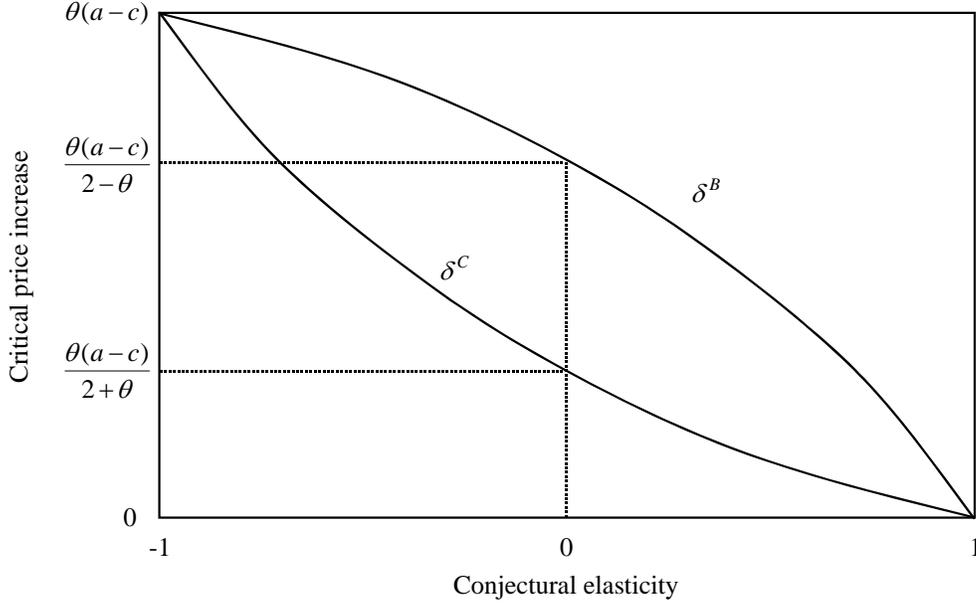


Figure 1: Critical price increases under Cournot and Bertrand competition as a function of conjectural elasticities.

with the cellophane fallacy albeit that the source of monopoly power is in firm conduct.

Second, the outcome of the HMT fundamentally depends on firm conduct. All else equal, the higher is the value of the conjectural elasticity the less likely it is profitable to jointly raise price, that is, the less likely the two products together are considered to constitute the relevant market. In general, if higher values of the conjectural elasticities are synonymous for a lower intensity of competition, the HMT is more likely to treat both products as comprising the relevant market the higher is competition intensity. Clearly this could lead to opposing conclusions across industries with identical structural characteristics but different competition intensities (see e.g. Konings *et al.*, 2005).

Third, for a given value of the conjectural elasticity it is more likely under Bertrand competition for the HMT to conclude that the two firms together constitute the relevant market as $\delta^B - \delta^C \geq 0$ in case $\alpha = \beta$. If anything, the use of the HMT should be accompanied with an in-depth analysis of the type of product market competition involved as the HMT might identify the two products constituting the relevant together under Bertrand competition while under Cournot competition the opposite conclusion is reached.

5 Conclusion

In this paper I provide the first formalization ever of the HMT. The analysis shows that the HMT is fundamentally affected by market structure and firm conduct. The lower is the intensity of competition the more widely defined will be the relevant market using the HMT, all else equal. This feature of the HMT might have particular adverse effects. For instance, firms that are accused of abusing a dominant position might be considered not to have such a position in case dominance allows them to reduce the intensity of competition in their respective markets.

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