World Competition

Law and Economics Review

KLUWER LAW INTERNATIONAL

A WoltersKluwer Company

Published by:
Kluwer Law International
P.O. Box 316
2400 AH Alphen aan den Rijn
The Netherlands

Kluwer Law International
241 Borough High Street
London SE1 1GB
United Kingdom

Sold and distributed by:
Turpin Distribution Services Ltd
Stratton Business Park
Pegasus Drive
Biggleswade
Bedfordshire SG18 8TQ
United Kingdom
E-mail: kluwerlaw@turpin-distribution.com

Subscription enquiries and requests for sample copies should be directed to Turpin Distribution Services Ltd.

Subscription prices, including postage, for 2006 (Volume 29):
EUR 437.00 / USD 515.00 / GBP 306.00.
This journal is also available online. Please contact our sales department for more information at +31 (0)70 3081562 or at sales@kluwerlaw.com.

World Competition Law and Economics Review is published quarterly.

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ISSN: 1011 4548

World Competition **29(2)**: 315–336, 2006.

Using Conjoint Analysis for Market Definition: Application of Modern Market Research Tools to Implement the Hypothetical Monopolist Test

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Market definition is instrumental to the assessment of market power and central to competition policy. Until recently, the assessment of market boundaries has been primarily a qualitative judgemental process. However, the past years have not only seen the development of new quantitative methods of defining markets, but also a growing demand for these econometric methods. This article discusses some of the issues arising in the empirical implementation of the Hypothetical Monopolist Test by econometric tools. In particular, the article shows how a certain empirical methodology which has found broad acceptance in market research, Conjoint Analysis, can be applied to market definition.

I. INTRODUCTION

Market definition is a tool to identify and define the boundaries of competition between firms. In general, the more narrowly the market is defined the more likely a firm or firms will be found to have market power. As elaborated in the European Commission's *Notice on the Definition of Relevant Market for the Purposes of Community Competition Law*[1] the main purpose of market definition is to identify in a systematic way the competitive constraints that the undertakings involved face. The objective of defining a market in both its product and geographic dimension is to identify those actual competitors of the undertakings involved that are capable of constraining those undertakings' behaviour and of preventing them from behaving independently of effective competitive pressure. In the past, the assessment of market boundaries by competition and regulatory authorities in the European Union has been in most cases a qualitative judgmental process.[2] EC Courts as well as leading scholars[3] criticized this approach heavily. Today competition economics provides highly sophisticated quantitative and econometric tools to define relevant markets in accordance with legal requirements. Modern empirical methods can shed light on market definition issues.[4]

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[1] European Commission, Commission's *Notice on the Definition of Relevant Market for the Purposes of Community Competition Law*, Official Journal C 272, 09/12/1997 pp. 5–13.

[2] I. Dobbs, *Defining Markets for ex ante regulation using the Hypothetical Monopolist Test,* The University of Newcastle upon Tyne Business School, Working Paper, 2005, p. 3.

[3] G. Werden, *The Use and Misuse of Shipments Data in Defining Geographic Markets*, Antitrust Bulletin, Vol. 26, No. 4, pp. 719–737; R. Wish, *Competition Law*, Butterworths, London, 1993; Kauper, *The Problem of Market Definition Under EC Competition Law,* International Antitrust Law and Policy, Sweet & Maxwell, London.

[4] See, e.g. P. Massey, *Market Definition and Market Power in Competition Analysis: Some Practical Issues,* The Economic and Social Review, Vol. 31 No. 4, 2000, pp. 309–328; F. Latorre, and E. Canizares, *Dificultades para la definición del Mercado relevante,* Preparado para el Segundo seminario de derecho y economia de la competencia organizado por la Fundacion Rafael del Pino, Madrid, 2005.

This is of importance because "there is a growing concern over the lack of rigour and factual analysis by the European Commission and national competition authorities when defining markets and assessing market power."[5]

The approach on market definition with support of modern econometric tools is generally applicable and yields testable hypotheses. In this analysis, both qualitative and quantitative methods are applied. Qualitative methods, for example, include an examination of product characteristics and the intended use of a product by consumers, whereas quantitative methods involve the examination of price trends or the estimation of cross-price-elasticities. The European Commission's *Notice on the Definition of Relevant Market for the Purposes of Community Competition Law*[6] describes the modern methodology for market definition in a very detailed way: According to the Notice, firms are subject to three main sources of competitive constraints: demand substitutability, supply substitutability and potential competition. Demand-side substitutability is used to measure the extent to which consumers/ customers are prepared to substitute other products or services for the product or service in question, whereas supply-side substitutability indicates whether suppliers other than those offering the product or services in question would switch their line of production or offer the relevant products or services without incurring significant additional costs. Thus, substitutability on the supply-side occurs when producers that are currently supplying a different product possess those skills and assets that make it possible to switch production in a short period of time if a price rise occurs. In this case, the competitive constraint would not come from the fact that a considerable part of demand would be addressed to competing products when the price rises, but rather that the price rise attracts producers that are currently selling some other products. However, there are several conditions that should be fulfilled for supply substitutability to widen the relevant market. In particular, switching production must be easy, rapid and feasible. Considerable sunk costs should not occur and barriers to entry must be surmountable in a rapid and relatively cheap way. Supply substitutability plays in practice a minor role. Potential competition is not measured at all when defining markets: the bulk of the analysis is related to demand substitutability.

When considering the degree of demand substitutability it has to be clarified which products or services are considered substitutes against each other from the customers' perspective. Thus, the aim of the definition of the relevant product market is to identify the relevant choice set of customers according to the competitive forces in the market. The relevant product market consists of all those products and services which are seen as substitutable regarding their characteristics, price, and intended use by its customers. As to the definition of the relevant geographic market, the degree of substitutability from the view of the customers is fundamental too. The relevant geographic market,

[5] B. Harris, and C. Veljanowski, *Critical Loss Analysis: It's growing Use in Competition Law,* European Competition Law Review, Vol. 24 No. 5, 2003, p. 217f.

[6] European Commission's *Notice*, as note 1 above.

hence, comprises all areas in which the conditions of competition are homogeneous for the firms supplying the products or services under consideration and which are considerably different to other areas. The question to be answered is whether customers would switch to readily available substitutes or suppliers located elsewhere in response to a price increase in the products and areas being considered.

The methodology which is applied to measure demand and supply substitutability as well as to define the relevant product and geographic market is the so-called Hypothetical Monopolist Test (HM Test).[7] In the United States, a similar test, the SSNIP Test (Small but Significant Non-transitory Increase in Prices) is used.[8] The HM test is an established economic tool in competition policy to measure how a hypothetical small, non-transitory change in relative prices might affect the buying behavior of customers in the market. By measuring the change in demand and extrapolating the change in revenue that results to the supplier, it is possible to evaluate the effect of a price increase on the product's profitability. If customers substitute products or geographic areas for another, and the resulting change in relative prices is not profitable any more for the undertaking, then the other products or geographic areas belong together i.e. the market can be defined in a wider context. This evaluation is continued until a permanent increase in prices would be profitable thereby defining the relevant product market. In particular, the relevant product market comprises all those products and or services which are regarded as interchangeable or substitutable by the consumer, by reason of the products' characteristics, their prices and their intended use.[9]

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[7] The Hypothetical Monopolist Test has received a considerable amount of discussion in recent years. B. Harris, and J. Simons, *Focusing Market Definition: How much Substitution is Necessary?,* Research in Law and Economics, 1989; M. Baumann, and P. Godek, *Could and Would Understood: Critical Elasticities and the Merger Guidelines,* Antitrust Bulletin, 1995; F. Johnson, *Market Definition under the Merger Guidelines: Critical Demand Elasticities,* Research in Law and Economics, 1989; G. Werden, *Four Suggestions on Market Delineation,* Antitrust Bulletin, 1992.

[8] See US Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines* (1992) (revised 1997); US Department of Justice, *Non-Horizontal, Merger Guidelines*, ch. 4 (1984); The US *Merger Guidelines* define a "market" as a product or group of products and a geographic area in which it is produced or sold such that a hypothetical profit-maximising firm, not subject to price regulation, that as the only present and future producer or seller of those products in that area likely would impose at least a "small but significant and nontransitory" 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 geographical area that is no bigger than necessary to satisfy this test. The *Merger Guidelines* first define the relevant product market with respect to each of the products of each of the merging firms. Starting with each product (narrowly defined) or each merging firm, the Justice Department and FTC continue to add the "next best substitute products" until reaching the point where a "hypothetical monopolist" could profitably impose the "small but significant and non-transitory" price increase without consumers switching to additional substitute products. A five percent price increase over a period of one year is given as a fair benchmark for most purposes, although higher or lower levels may be used depending on the industry. In considering the likely reaction of buyers to a price increase, the US authorities consider all relevant evidence, including, but not limited to, the following: evidence that buyers have shifted or have considered shifting purchases between products in response to relative changes in price or other competitive variables; evidence that sellers base business decisions on the prospect of buyer substitution between products in response to relative changes in price or other competitive variables; the influence of downstream competition faced by buyers in their output markets; and the timing and cost of switching products.

[9] European Commission's *Notice*, as note 1 above, pp. 5–13, para. 7.

This article discusses the practical application of the HM Test and is organised as follows: First, Section II describes the methodology of the HM Test as well as a few other approaches to delineate markets. In the following, Section III elaborates the implementation of the HM test. Section IV discusses how Conjoint Analysis can be applied to implement the HM Test and Section V concludes.

II. Market Definition and the Hypothetical Monopolist Test

Firms are subject to three main sources or competitive constraints: demand substitutability, supply substitutability and potential competition. From an economic point of view, for the definition of the relevant market, demand substitution constitutes the most immediate and effective disciplinary force on the suppliers of a given product, in particular in relation to their pricing decisions. A firm or a group of firms cannot have a significant impact on the prevailing conditions of sale, such as prices, if its customers are in a position to switch easily to suppliers located elsewhere. Basically, the exercise of market definition consists in identifying the effective alternative sources of supply for the customers of the undertakings involved in terms of geographic location of suppliers. The European Commission's *Notice* in paragraphs 16 and 17 refers to a speculative experiment. The *Notice* states that

> "(C)onceptually, this approach means that, starting from the type of products that the undertakings involved sell and the area in which they sell them, additional products and areas will be included in, or excluded from, the market definition depending on whether competition from these other products and areas affect or restrain sufficiently the pricing of the parties' products in the short term.
>
> 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 percent to 10 percent) 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."

The HM Test as defined by the European Commission is a thought experiment, postulating a hypothetical small, non-transitory change in relative prices and evaluating the likely reaction of customers to that increase. Thus, the methodology of the HM-Test focuses on demand as well as on supply substitutability. In practice, the HM Test is a two-step procedure:

1. The shift in the amount of consumers who do not buy the product due to an increase in price has to be calculated. This analysis depends on the own-price elasticity of the product or service as well as on the cross-price elasticities of the products or services under consideration.
2. A calculation has to take place as to whether the price increase was profitable. This calculation depends on the margin of the product or service in question.

Figure 1 illustrates this relationship.

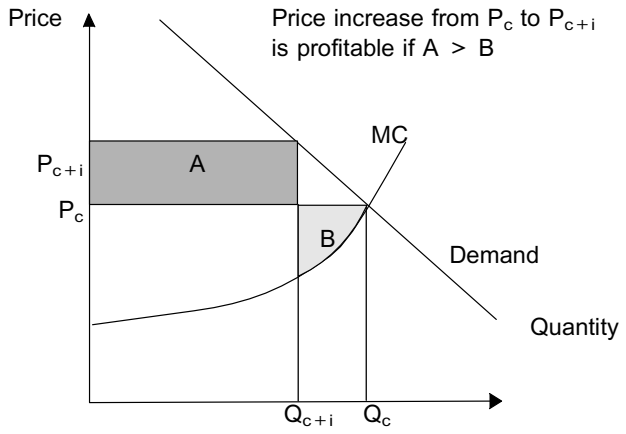

FIGURE 1: EFFECT OF THE PRICE INCREASE

Source: EE&MC.

Before describing the HM test in detail, it should be emphasised that defining a market in strict accordance with the test's assumptions is a demanding task. If customers/consumers are asked directly how they would react to a hypothetical price rise, answers should be treated with caution. In this respect, survey evidence might provide additional information for example, evidence on how customers rank particular products, whether and to what extent brand loyalty exists, and which characteristics of products are the most important ones to their decision to purchase. The main conclusion is that defining a market requires balancing various types of evidence and the exercise of judgement.[10]

One of the first components in the application of the HM test is the examination of pricing and pricing related issues. *Patterns in price changes* can be informative. For example, two products showing the same pattern of price changes, for reasons not connected to costs or general price inflation, could be - although not proof - two products being close substitutes.

Customer reactions to price changes in the past may also be relevant. Evidence that a relatively large proportion of customers had switched to a rival product in response to a relatively small price rise would provide evidence that these two goods are close substitutes. Equally price divergence over time, without significant levels of substitution, would be consistent with the two products being in separate markets.

Evidence on *own or cross-price elasticities* of demand are also helpful. The own price elasticity of demand measures the rate at which demand for a product changes when its

[10] Office of Fair Trading, *Market Definition Understanding Competition Law*, December 2004, 2.14.

price goes up or down. A high price elasticity of demand indicates that a small change in price will result in a proportionately much larger change in quantity demanded; i.e. it is price elastic. Where this is the case, firms will not be able to increase profits by raising price, since consumers would respond to such an increase by switching away. This would be the case even for a hypothetical monopolist. However, the simple statistical observation that over a certain period of time a, say, 10 percent increase in price is associated with a, say, 2 percent decrease in demand does not automatically imply a price elasticity of –0,2. A number of other variables may probably explain the change in demand. These aspects need to be considered when estimating the own-price elasticity for a certain product from such historical data.

In addition to own-price elasticities, cross-price elasticities might help to understand the competitive constraints exercised by other products or regions. The cross-price elasticity of demand measures the rate at which demand for a product (e.g. a rival product) changes when the price of another product goes up or down. When the own-price elasticity for the product considered, say product A, is high enough to lead one to believe that a hypothetical monopolist would not profitably raise prices of A in a small but significant way, it becomes important to clarify which products exercise a constraint on A. Cross-price elasticities might help to identify the close substitutes (which, together with product A, will become the objects of the next step of the HM Test).[11] A high cross-price elasticity of demand suggests that the two goods or services are good substitutes for each other, suggesting that the goods or services are in the same product market.[12] Again, as in the case of own-price elasticities, when it comes to estimate cross-price elasticities from historical data one has to carefully consider which other variables are likely to have an impact on the demand of the product under consideration - apart from its price and the prices of substitutes.

A straightforward way to estimate own- and cross-price elasticities in a certain market and thus to implement the HM Test may be to set up an econometric market model and to estimate the elasticities from time series data of prices and sales. However, when dealing with differentiated product industries building econometric models of those markets will rapidly lead to models of very high dimensionality which might render the approach of estimating elasticities from historical data impossible. Suppose for instance to estimate market power in a market characterised by n differentiated products. This would lead to a specification of an econometric model of n demand equations where the demand for each product is expressed as a function of the n prices of all products in the market and, say, k exogenous variables. Thus, even with linear or log-linear demands, estimating such a system would imply the estimation of $n*(n + k)$

[11] G. Werden, *Demand Elasticities in Antitrust Analysis,* Antitrust Journal 43, 1998, pp. 363–414, for example, proposes to use the cross-price elasticities to rank the substitutes which might be included into the relevant market according to the HM Test.

[12] See ibid., and L. Froeb, and G. Werden, *Residual Demand Estimation for Market Delineation: Complications and Limitations*, Review of Industrial Organisation 6, 1992, pp. 33–48, for a discussion of some of the problems that can arise.

parameters since each of the n demand equations will contain all the n prices plus the k additional explanatory variables. Such systems will rapidly become intractable due to lack of sufficient data.[13]

Another aspect, which needs a cautious treatment, is the appropriate price level. In case an undertaking has already market power it may operate in a market where the current price is substantially different from the competitive price. In such a case, cross-price elasticity for demand might provide misleading information, as prices are likely to have been raised to a level already where demand is relatively price sensitive (i.e. at to or near monopoly levels at the limit of what people are willing to pay). Other products appear to be adequate substitutes when this may not be the case. This phenomenon is known as the ''Cellophane Fallacy''.[14] In this case, involving cellophane, the US Supreme Court considered that a significant price rise would bring cellophane into competition with other products. This led the Supreme Court to conclude that other products served as sufficiently good substitutes to cellophane, so that cellophane could not be considered as being in a separate market. However, the then current prices were already far above the price that would prevail if the market was competitive.[15] To solve the Cellophane fallacy, a price needs to be used that would prevail if the market was competitive. In practice, a benchmarking of prices solves this problem.

In theory, different prices might be an indication for different relevant markets as well. *Price discrimination* occurs when the same good or service is sold to different groups of buyers at different prices. Significant levels of price discrimination can usually only be sustained where the price discriminating entity has market power. An entity is able to discriminate profitably because it is able to identify a group of buyers who are significantly less able or willing to switch to other suppliers. Differential pricing, however, will not always turn out to be actual price discrimination. Transport costs can result in price differences especially with regard to rural as compared to urban prices. It is common for variations in price to be explained by differences in cost.

As a general rule, the comparison of absolute prices of two (or more) products is not a valid means of determining whether those products are in the same product market. A more useful tool is to look at the *correlation of prices* over time (i.e. to analyse the relative price changes over time rather than to look at absolute prices). If prices are highly correlated, the products may fall within the same market. However, correlation does not tell us much (if anything) about causation. A high correlation coefficient might be explained by the similar underlying factors pushing the changes of both prices

[13] Suppose, for example, one wants to analyse a market with six products and that there are four additional exogenous explanatory variables considered relevant in explaining quantities sold. Then one would have to estimate a system of six equations each containing the six prices of the products and the four additional exogenous variables. That is, there are 60 parameters to be estimated. If there were additional seasonal and cyclical patterns and a trend in the series, as probably often will be the case, data requirements will become even more inflated.

[14] *United States v. EI Du Pont de Nemours & Co.,* 351 U.S. 377 (1956); 76 S.C.t. 994, L. Ed. 1264.

[15] Essentially, even where a product has no close substitutes, if the price is already high and a hypothetical price rise occurs, consumers would tend to switch to poorer substitutes more readily than they would if the price rise had occurred from a significantly lower level (such as would prevail if the market was already relatively competitive).

while there could be little real competition between the two products. Correlation between prices may diverge or get closer over time, due to such things as changes in underlying costs, or changes in service quality, or a different level of common influence imposed by some other factor. In the absence of being able to explain the price movement, it can be dangerous to draw inferences about market definition from price correlation data.

The *speed of adjustment* of a product price or geographic area to a price change of another product or geographic area, can also be used as a test for market definition. The test suffers from much the same problems as the price correlation analysis.

Evidence on the price-concentration relationship might be informative as well. *Price-concentration studies* examine how the price of a product in a distinct area varies according to the number (or share of supply) of other products sold in the same area. These studies are useful where data are available for several distinct areas with varying degrees of concentration. There is usually a high correlation between firms having a high market share and firms having market power. High market shares are, nevertheless, not sufficient of themselves to confer market power. However, where market power appears to be absent but an entity has very high market share, it places an additional burden on the parties to define correctly the relevant product market. Where concentration is very high and prices are not statistically different to those in other areas where concentration is low, this can suggest that: (1) the market has been drawn too narrowly. For example, if a firm had 100 percent of a market in location *X*, and 20 percent of the market in location *Y*, and prices were not statistically different between *X* and *Y*, it may be that either the product or the geographic market definition is too narrow. (2) The market is subject to 'hit and run' entry or firms in nearby markets are able to switch capacity fairly easily, so that the apparently dominant firm has no market power as a result of the ease of supply-side substitution. This issue can be solved by a price concentration analysis.

Other, more sophisticated econometric techniques for aiding in the delineation of antitrust markets are for example "*Granger causality tests*" and "*tests for cointegration*". The Granger causality test is a test for feedback effects between two price series, and can be used to determine whether determinants of prices for x include previous prices for y. It can be used as a test for exogeneity (whether disturbances in y are also influential in causing changes in x). On the other hand, the cointegration test is a test of whether or not two series are bound together or, in the long run, will drift further apart. Two series are cointegrated if each "first achieves stationarity after first differencing, but a linear combination ... is already stationary".[16] Both, the Granger causality and the cointegration tests suffer from problems similar to those affecting tests for correlation.

[16] G. Werden, and L. Froeb, *Correlation, Causality, and all the jazz: the inherent shortcomings of price tests for antitrust market definition*, Review of Industrial Organisation, 8; 1993, pp. 329–353, p. 344.

Event studies[17] are used to illustrate implications for the expected future profitability or valuation of firms typically resulting in share price movements. Where information is released which indicates a change in a company's competitive position, the information will result in a more or less immediate change in the company's share price. For market definition purposes, relative share price movements of firms competing within, or offering potential substitutes for, products in the candidate market, can provide information about the market's view of the degree of competition between firms or products. Thus, event studies might provide a valuable source of information relevant to market definition.

If firms provide goods or services on the basis of longer term contracts or large volume contracts, the closer the firms will compete with each other. In these circumstances, it would be expected that they work with the same clients. Such *client studies* do not typically involve econometric tests, and thus provide rather more general evidence than much of what is discussed above.

In some cases *critical loss* analysis (CLA)[18] may be relevant. One definition of critical loss is the minimum percentage loss in volume of sales required to make a 5 (or 10) percent price increase on a product unprofitable. The critical percentage tends to be lower when an undertaking has a high mark up over unit costs (since each sale lost entails a relatively large loss in profit). However, the fact that an undertaking can set a high mark up might also demonstrate that its current customer base is not particularly price sensitive. These potentially opposing effects might need to be balanced and assessed in conjunction with other evidence (e.g. estimates of elasticities of demand). CLA has been applied in the United States in recent years.

The calculation of the critical loss is a purely arithmetical exercise. The benefit to the hypothetical monopolist from a price increase is the amount of the price increase, Δp, times the quantity that will be sold at the new price, $(q + \Delta q)$, i.e. $\Delta p(q+\Delta q)$. The cost to the monopolist of the price increase is equal to lost sales, i.e. to the pre-merger margin, $(p\text{-}c)$, where c denotes average variable cost, times the quantity reduction, Δq, caused by the price increase, i.e. $-(p\text{-}c)\ \Delta q$. The critical loss is the percentage reduction in quantity which just balances the benefit and cost of the price increase, that is, for which:

$$\Delta p(q+\Delta q) = -(p-c)\ \Delta q \qquad (1)$$

holds.

Solving for the critical loss, $-\Delta q/q$, yields:[19]

[17] These events may include: earlier M&A activity, announcements about new products or services, technological developments, announcements about changes in regulation, sharp exchange rate changes, etc.

[18] Its basic idea is simple. One asks, given a certain price increase, what the percentage loss in unit sales would have to be to render the price increase unprofitable. If the actual loss is less than the critical loss, the price increase would be profitable, otherwise it would not and the definition of the relevant market has to be broadened by further substitutes or geographical areas.

[19] See D. O'Brien, and Wickelgren, *A Critical Analysis of Critical Loss Analysis,* 2003, p. 9.

$$-\frac{\Delta q}{q} = \text{Critical Loss} = \frac{\Delta p/p}{\Delta p/p+m}, \tag{2}$$

where $m = (p - c)/p$ is the contribution margin measured as a percentage of the price.

The actual loss in the single-product case can be easily calculated as:

$$\text{Actual Loss} = \varepsilon \frac{\Delta p}{p}, \tag{3}$$

where ε denotes the (own-) price elasticity (commonly just referred to as the "price elasticity") of demand, which is defined as the percentage change in the quantity demanded that follows a one percent increase in the price of the product.[20]

Thus, if:

$$\text{Actual Loss} = \varepsilon \frac{\Delta p}{p} > \frac{\Delta p/p}{\Delta p/p+m} = \text{Critical Loss}, \tag{4}$$

a price increase by $\Delta p/p$ would be profitable and the relevant market has to be augmented. Equation (4) also indicates that the price elasticity, ε, plays a decisive role in the determination whether a price increase would be profitable or not.[21]

In the multi-product case, the analysis is more complex. However, the same basic reasoning applies. If a hypothetical monopolist increases the prices of more than one product, the actual loss is reduced compared to the single-product case because some fraction of the reduction in the demands for the individual products is recaptured by the other products of the monopolist. The extent to which this occurs is measured by the cross-price elasticity or the diversion ratio.

For notational convenience, let us consider the symmetric case of two products, A and B, as an example.[22] The cross-price elasticity between products A and B is defined as the percentage change in the demand for product B when there is a one percent increase in the price of product A.[23] A $\Delta p/p$ percent increase in the price of product A causes the unit sales of product A to fall by the amount of the price increase times the own-price elasticity of demand, i.e. by $\varepsilon\Delta p/p$. Similarly, the price increase causes the unit sales of product B to rise by the amount of the price increase times the cross-price elasticity of demand, i.e. by $\varepsilon_{AB}\Delta p/p$. Since products A and B are symmetric in this

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[20] Technically, the (own) price elasticity ε is defined as $\varepsilon = \frac{\Delta q}{\Delta p}\frac{p}{q}$, *where p* denotes price and *q* the quantity of the product under consideration.

[21] Indeed, the analysis of the profitability of a hypothetical price increase sometimes is cast in terms of the "critical elasticity", $\varepsilon = \frac{1}{\Delta p/p+m}$. See Masseys, *Market Definition and Market Power in Competition Analysis: Some* Practical Issues, The Economic and Social Review, Vol. 31, No. 4, October 2000, pp. 309–328, p. 320. This formula for the critical elasticity can easily be derived from equation (4).

[22] Symmetry refers to the assumption that prices, quantities and elasticities are equal for both products. The basic argument given above can be extended to the n-product case and to asymmetric cases. See D. O'Brien, and Wickelgren, *A Critical Analysis of Critical Loss Analysis,* 2003.

[23] The cross-price elasticity ε_{AB} between products A and B is defined as $\varepsilon_{AB} = \frac{\Delta q_B}{\Delta p_A}\frac{P_A}{q_B}$, where p_A denotes the price of product A and q_B the quantity of product B.

example, a $\Delta p/p$ percent increase in the price of product B causes the unit sales of product B to fall by $\varepsilon\Delta p/p$ and the unit sales of product A to rise by $\varepsilon_{AB}\Delta p/p$.

Combining both effects, a price increase of $\Delta p/p$ percent for both products causes a reduction in unit sales of $(\varepsilon-\varepsilon_{AB})\Delta p/p$ percent for both products. Thus, the actual loss for the hypothetical monopolist from a $\Delta p/p$ percent price increase is:[24]

$$\text{Actual Loss} = \frac{\Delta p}{p}\,(\varepsilon - \varepsilon_{AB}). \tag{5}$$

Equation (5) shows that because some of the loss in sales is recaptured by the other product of the hypothetical monopolist, the actual loss of a price increase is reduced compared to the single-product case.

Thus, one can conclude from the discussion above that both the own-price as well as the cross-price elasticities are decisive in evaluating whether a price increase of a hypothetical monopolist would be profitable or not and hence how to define the relevant market. In other words, the eventual change in the profit of a hypothetical monopolist after a price increase can only be answered empirically.

To conclude, the process of market definition is ultimately an empirical matter, although in many cases it can be determined sufficiently accurately without the need for complex econometric studies. Obtaining accurate consumer information through surveys about future (hypothetical) economic behavior is a critical task in the implementation of the HM Test. Econometric techniques that are based on historical data are backward-looking, and thus define markets as they were in the past. In the case of market definition for merger cases these definitions may not hold. Where markets need to be defined by reference to empirical methods, however, it should be done by experts; even apparently simple econometrics can turn out to be very complex.

III. Implementation of the HM Test

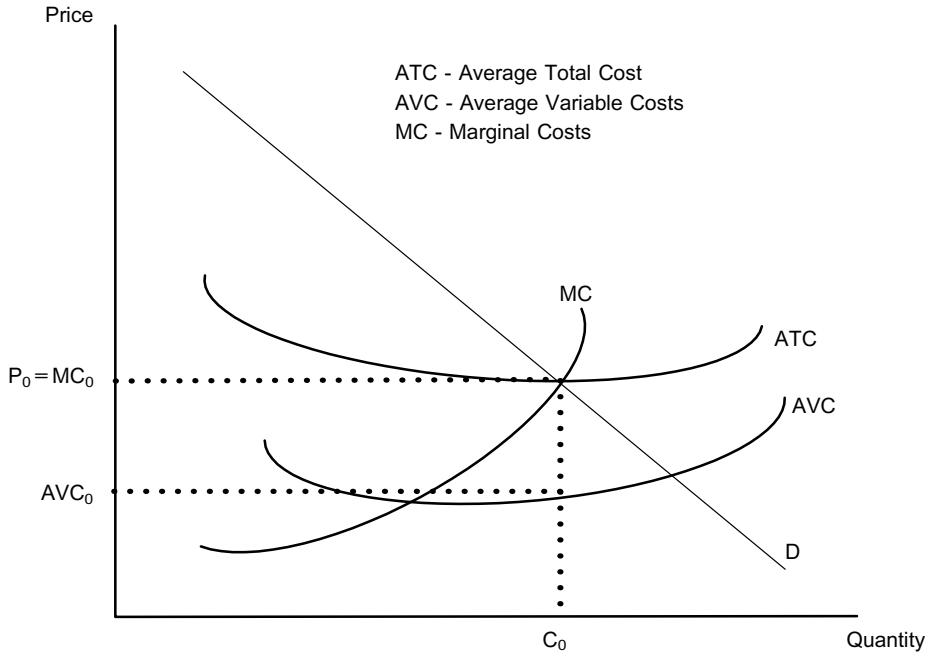
The HM Test provides a well defined and coherent approach to market definition, but it has to be made operational. Indeed, by its very nature of describing a hypothetical (monopolist) situation it implies that no actual data are available that would allow for a literal application of the test. This hypothetical nature of the test one has to bear in mind when assessing any implementation. In the following, the economics of the HM Tests are elaborated. Within Figure 2, MC represents the marginal cost curve and D the demand curve of the hypothetical monopolist that is formed from the consolidation of a number of firms, which were in competitive equilibrium. The hypothetical monopolist is assumed to inherit a situation where price is initially equal to marginal cost.

The marginal cost at Q_0 is MC_0, and the profit in this situation is $Profit_0$ which equals the firms' revenues (P_0Q_0) minus the total costs incurred in producing Q_0. The

[24] See D. O'Brien, and Wickelgren, as note 19 above, at p. 12.

total cost covers variable and fixed costs. The variable cost term is equal to Q_0 times average variable cost (Q_0 * AVC_0) or the sum of all points along the marginal cost curve from one to Q_0, this means $\sum_{i=1}^{Q_o} MC_i$. So the profit is defined as: $Profit_0 = P_0Q_0 - Q_0 * AVC_0$ – Fixed Costs. Figure 3 shows the situation after the hypothetical price increase.

FIGURE 2: HYPOTHETICAL MONOPOLIST PROFIT



P_0 = initial price, Q_0 = initial quantity
Source: R. H. Frank, *Microeconomics and Behavior*, 3rd Edn, Boston, McGraw-Hill, 1997.

The increased price is P_1, the new quantity is Q_1, and marginal costs are MC_1. $Profit_1$ is equal to $P_1Q_1 - Q_1$* AVC_1 – Fixed Costs. The conclusion is that the critical loss in sales that would make a given price increase unprofitable is the level that makes firms indifferent between the market prices P_0 and P_1. So the critical loss is the level that implies that $Profit_0$ equals $Profit_1$. As illustrated, the effects on a firm's profits are determined by the difference between the additional revenue gained from the price increase and the decreased costs caused by a reduction in sales/production and the loss in revenue resulting from a sales reduction. Thus, it is necessary to calculate the profits before and after the price increase in order to determine if the price increase will be profitable or not as well as reactions of consumers on a (hypothetical) price increase.

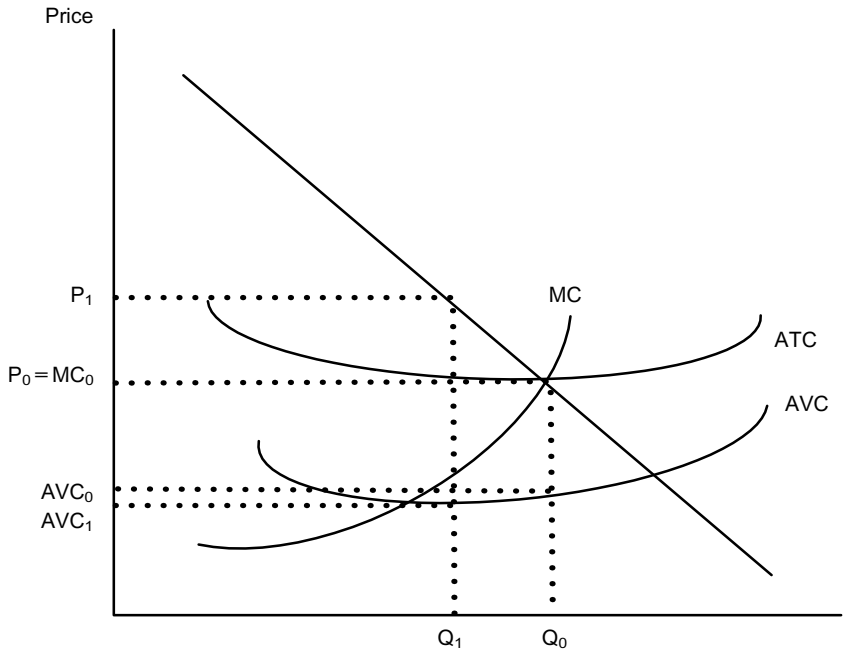


FIGURE 3: HYPOTHETICAL MONOPOLIST PROFIT AFTER PRICE INCREASE
Source: R. H. Frank, *Microeconomics and Behavior*, 3rd Edn, Boston, McGraw-Hill, 1997.

As already discussed, in order to implement the HM test the purchasing decisions of customers need to be evaluated. Probably the most widely used method in price analysis in market research is the so-called "Conjoint Analysis". Conjoint Analysis is an empirical tool, which allows a proper performance of the HM test. Customers buy products not only based on price, but consider in their buying decisions other factors, such as quality, service, past experiences etc. as well. "Smart" customers will almost always deny a question in a simple paper and pencil questionnaire as to whether a customer would accept a price increase in the range of 5 percent to 10 percent. As a consequence, markets would be defined very narrowly. Conjoint Analysis instead examines the benefit a product represents for the customer and values it. Pricing and market segmentation are typical areas where Conjoint Analysis is frequently used. Competition analysis is another one.[25]

[25] The choice-based approach of Conjoint Analysis employing a logit-model is based on D. McFadden, *Conditional logit analysis of qualitative choice behavior,* in: P. Zarembka, *Frontiers in Econometrics,* Academic Press, New York, 1974. It has been adapted to marketing research by G. Punj and R. Staelin, *The choice process for graduate business schools,* Journal of Marketing Research 15, 1978, and D. Gensch, and W. Recker, *The multinominal multiattribute logit choice model,* Journal of Marketing Research 16, 1979.

IV. Modelling Customer Choice with Conjoint Analysis

The course of Conjoint Analysis follows a well established methodology.[26] Preferably a computer-based Conjoint Analysis is applied to examine the benefit a product represents for the customer and how he or she values it. Different software packages are available to conduct Conjoint Analyses. The software permits analysing the relationship between the prices of a product and the choice behaviour of consumers. Recent years have seen a continuous development within Conjoint Analysis.[27] One focus of these extensions has been on the modelling of individual differences in choice-based models based on hierarchical Bayesian methods.[28]

Conjoint Analysis deals with preference intensity and can be used to estimate the best possible predictive validity of marketplace behaviour and consumer reaction.[29] At its heart lies the estimation of a formal model of choice, usually a so-called *logit-model*. The components of this method are:

(1) a technique of data collection requiring a respondent to consider ''trade-offs'' among desirable alternatives;
(2) a computational method which derives ''utilities'' accounting as nearly as possible for each respondent's choice behaviour.

There are many product attributes for which ideal levels in fact differ from customer to customer like promotional support or brand awareness. For attributes such as convenience, economy, or level of performance, however, it can be assumed that every customer would prefer a product having as high level of each attribute as possible. What is needed in such cases is information about customers ''trade-offs''. It is relevant to determine how customers value various levels of each attribute and the extent to which they would forego a high level of one attribute to achieve a high level of another. Customers make a selection of different product concepts, which are marked by different sets of characteristics. The price determines the decision to buy a product as well as the possibilities to use it. By carrying out the HM Test with support of Conjoint Analysis, the attractiveness of products or the utilities of each product attribute are determined. The utilities of individual customers are added up and transferred into a

[26] Most studies of conjoint analysis have involved a verbal description of product profiles. Due to increased computing capabilities, ongoing research has developed approaches to integrate virtual reality and conjoint analysis. See, e.g., J. Dijkstra and H. J. P. Timmermans, 1997, *Employing the possibilities of conjoint measurement as a decision-making tool for virtual wayfinding environments.*

[27] For an overview see, eg., Paul E. Green and V. Srinivasan, *Conjoint Analysis in Marketing: New Developments with Implications for Research and Practice,* Journal of Marketing 54, 1990; Paul E. Freen, Abba M. Krieger and Yoram Wind, *Thirty Years of Conjoint Analysis: Reflections and Prospects,* Interfaces 31, 2001.

[28] See, eg., Greg M. Allenby, Neeraj Arora and James L. Ginter, *Incorporating Prior Knowledge into the Analysis of Conjoint Studies,* Journal of Marketing Research 32, 1995; Greg. M. Allenby and James L. Ginter, *Using extremes to design products and segment markets,* Journal of Marketing Research 32, 1995; Peter J. Lenk, Wayne S. DeSarba, Paul E. Green and Martin R. Young, *Hierarchical Bayes Conjoint Analysis: Recovery of part-worth heterogeneity from reduced experimental designs,* Marketing Science 15, 1996.

[29] For a discussion of Conjoint Analysis see, e.g., D. Aaker, et al, *Marketing Research*, 8th Edn, Wiley, 2003; A. Gustaffsson, A. Hermann, and F. Huber, (Eds), *Conjoint Measurement: Methods and Applications,* Springer Verlag, Berlin, 2000.

demand curve. The result of a Conjoint Analysis is a demand curve/function, which is used to examine hypothetical price changes and their effect on demand.

With the implementation of the HM Test, in most studies the so-called "Choice-Based Conjoint" Analysis (CBC) is applied. CBC software provides all the tools needed to conduct a choice-based conjoint study: a questionnaire module for designing and conducting PC-based interviews, three analysis modules, and a market simulation module for testing "what if" scenarios. The output is used by the market simulation module, which estimates the share of choice for products that are made up of combinations of the study's attributes. The main characteristic distinguishing choice-based from other types of Conjoint Analysis is that the respondent expresses preferences by choosing concepts from sets of concepts, rather than by rating or ranking them.[30] Within the framework of the HM test, a Conjoint Analysis is carried out as follows: on the basis of the products in question, a questionnaire is designed and programmed; attributes and interviewees have to be selected. Below is a scheme of the key processes.

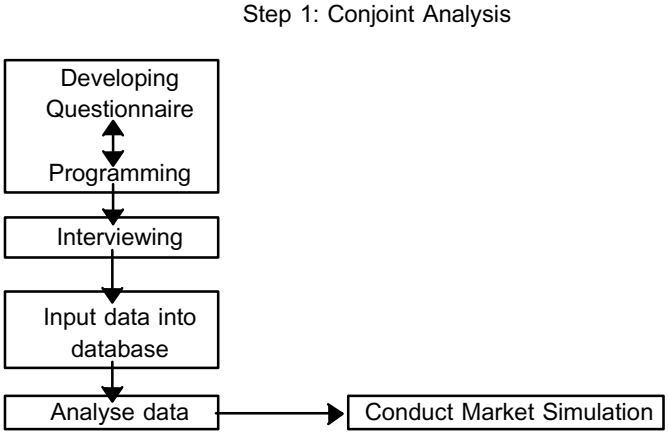


FIGURE 4: HYPOTHETICAL MONOPOLIST TEST STEP 1

Source: EE&MC.

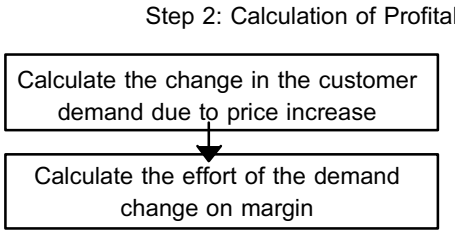


FIGURE 5: HYPOTHETICAL MONOPOLIST TEST STEP 2

Source: EE&MC.

[30] W. Desarbo, and V. Ramaswamy, *Market Segmentation with Choice-Based Conjoint Analysis,* Marketing Letters 6:2, 1995.

STEP 1: CONJOINT ANALYSIS

The basic idea of Conjoint Analysis is to confront the customer with different product concepts characterised by varying specifications of their attributes. The methodology described here is based on the assumption that consumers' choices are the result of a trade-off between different levels of utility derived from different products. Although it may not be possible to describe this trade-off explicitly it can be revealed by choosing between different product concepts. These choices allow researchers to draw inferences about the implicit importance of certain product features to the respondent.

Within Conjoint Analysis different product options characterised by a variety of different attributes, only one of them being its price, are presented. Consumers are asked to evaluate these different product concepts. This evaluation is often done by binary choice, i.e. by presenting two different product concepts to the respondent and asking him to make a decision for one of the two.[31] Figure 6 shows an example of such a choice question.[32]

Viscose	Lyocell
The fibre is biodegradable	Wet tenacity is essential
€1,20/kg (US $ 1,47/kg)	€2,25/kg (US $ 2,76/kg)
The level of quality is high and steady.	The quality of fibres is low (e.g. causing standstill period).

FIGURE 6: EXAMPLE OF A CONJOINT QUESTION

Source: EE&MC.

Thus, Conjoint Analysis is based on a formal, structural model of consumers' choice which implies that

– consumers aim to satisfy a need. This need is satisfied by the utility derived from the consumption of the product and its perceived attributes;

[31] The choice-based approach of Conjoint Analysis employing a logit-model is based on D. McFadden, *Conditional logit analysis of qualitative choice behavior,* in: P. Zarembka, *Frontiers in Econometrics,* Academic Press, New York, 1974. It has been adopted to marketing research by G. Punj and R. Staelin, *The choice process for graduate business schools,* Journal of Marketing Research 15, 1978, and D. Gensch, and W. Recker, *The multinominal multiattribute logit choice model,* Journal of Marketing Research 16, 1979.

[32] Due to increased computer capacities, approaches have been developed to integrate virtual reality systems into Conjoint Analysis. See, e.g., J. Dijkstra and H. Timmermans, *Exploring the possibilities of Conjoint Measurement as a decision-making tool for Virtual Wayfinding Environments,* in: Yu-Tung Liu (Ed.), *CAADRIA '97. Proceedings of The Second Conference on Computer Aided Architectural Design Research in Asia*, Hu's Publishers Inc., Taipeh, 1997, pp. 61–72.

- the comparison of the benefits and costs of the different product concepts lead to a preference towards the product;
- the buying intention becomes an actual buying decision by devoting real resources to it.

The reasons that Conjoint Analysis is especially well suited to estimate price sensitivity of demand within the HM Test are

- the possibility to jointly consider the elements relevant to a consumer's buying decision;
- the high similarity of the choice decision with real buying decisions. It is because of this realistic choice situation that respondents are supposed to give very valid responses of their true preferences and buying motives.

Conducting a Conjoint Analysis reveals the attractiveness, called the "part-worths", of each attribute of the product to the respondent. The sum of the part-worths of the combined product features gives the utility of that certain product concept to the consumer. The wording "conjoint" relates to the fact that relative utilities of certain product features might not be measurable if considered separately but that a joint consideration of the different product features will reveal the relative utilities of the distinctive features.

Since within Conjoint Analysis in accordance with legal requirements each product concept is characterised by the product, its price, quality, and its intended use, the application of various "what if" scenarios allows estimating the importance of these product features when the price is changed. In these simulations, the part-worths of each attribute of the products are evaluated. The sum of all part-worths of the attributes of a certain product determines its utility from the point of view of the consumer. Finally, these utilities of different product concepts derived from the choices of the respondents can be aggregated to conduct market simulations of different, hypothetical price scenarios. Based on the choices of the respondents, the hypothetical changes in demand for a certain product after a hypothetical price change are estimated. The market simulation module allows the analyst to determine the products considered in different scenarios of competition, to evaluate the part-worths based on these scenarios, to aggregate the utilities of the products and to model the behaviour of the respondents within this market.

Figure 7 illustrates the relative importance of the attributes of the products under consideration in the fibre example. It shows that the product itself is the most important aspect in the choice of customers with a weight of 41 percent in his decision process. Quality contributes to 22 percent and price to 32 percent to the decision. Intended use is of only minor importance in shaping the choice of the customers with a weight of 5 percent.

Figure 8 shows the effect of a 5 percent price increase on demand in the fibre example. The price response function is not very steep implying that a price increase leads only to minor reduction in demand.

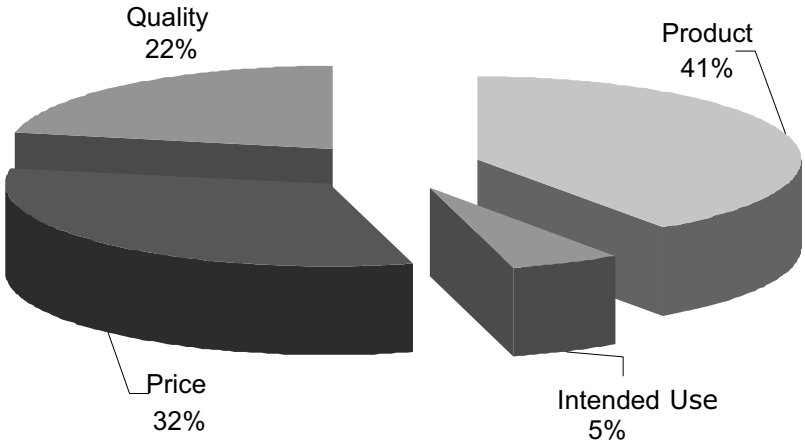


FIGURE 7: RELATIVE IMPORTANCE OF THE ATTRIBUTES IN THE FIBRE EXAMPLE
Source: EE&MC.

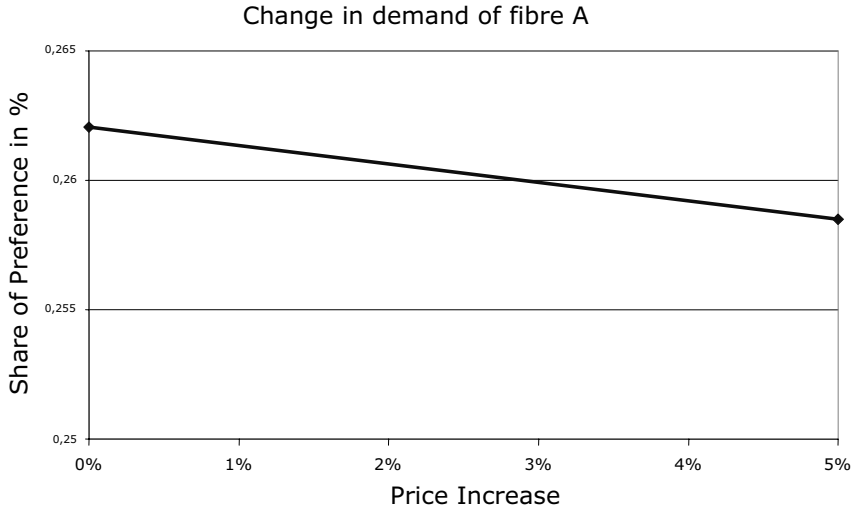


FIGURE 8: PRICE RESPONSE AFTER A 5% PRICE INCREASE IN THE FIBRE EXAMPLE

The two theoretical concepts fundamental in this methodology are the concept of a utility function for individual product concepts and a preference function summarising the utilities derived from the different product concepts which can be used for market simulation purposes. These two concepts will be discussed briefly.

Estimation of the utility functions: The first step in applying the above sketched decision model is to derive the utility functions. The utility function maps the

specifications of the different product attributes onto a value called the utility of this particular product concept. This mapping reveals how the different attributes are valued by consumers. A basic assumption is that consumers would like to have a level as high as possible of the levels of the product's attributes such as to maximise their utility.

Consumers choose between differing concepts of products. During the Conjoint Analysis respondents are confronted with product concepts which consist of one particular specification of either all attributes (full profile method) or a selection of them (fractional design). Conjoint Analysis estimates the part-worths of each product attribute from the choice decisions of the respondents. Preferences are a linear combination of the part-worths of the product's attributes. That is:

$$U_{ij} = \alpha_j - \beta p_i + \gamma x + e_{ij}, \tag{6}$$

where U_{ij} denotes the consumer j's utility derived from product i, α_j is a constant basis level of utility, β is a parameter of the consumer's price sensitivity, p_i the price of product i, x a vector of other product attributes, γ a vector of the part-worths of these attributes, and e_{ij} a random component, which can be either unobservable product characteristics or (equally unobservable) subjective preferences of the consumer. The estimates of the utility function are deduced indirectly from the choice decisions of the respondents. The choices of all respondents are seen as the realisations of a common decision model and based on these realisations, the choice model is estimated.

Preference function: From the utilities derived from certain product concepts one can calculate the share of preferences a certain product concept receives within a given set of products. The share of preferences of a certain product is related to a logistic transformation of the individual utilities. The utilities are rescaled such that the sum of the (antilogs of the) utilities of all products equals 100. Thus, P_i denotes the probability that product i will be chosen.

$$P_i = \frac{u_i}{\sum_{te C} u_t}, \tag{7}$$

where P_i denotes the share of preferences of product i,, C is the set of possible choices and u_t is the utility transformed by the logistic function.

The model implies that consumers do not always choose the product yielding the highest utility, but that this product has the highest probability of being chosen.

From the part-worth of the attribute "price" the price elasticity of the product under consideration as well as the cross-price elasticise are readily computed. These, in turn, can be applied to evaluate the competitive constraints of the products in the market on the product under consideration and to implement the HM Test to define relevant product and geographic markets.

STEP 2: CALCULATION OF PROFITABILITY

The calculation of the profit of a hypothetical price increase is the second step in the application of the HM Test after the estimation/calculation of the price elasticity on the demand side took place. Both, the (likely) decrease in demand as well as the change of the contribution margin in case of a hypothetical price increase, are influencing the profit/loss situation. To calculate the profits, turnover data (NOS—Net Outside Sales) as well as variable cost data (TDC—total direct costs) are required. These data are provided by the company under investigation. TDC or the equivalent of Cost of Goods is the sum of the cost for raw material, packaging material (e.g. bottles, labels), conversion costs to finished products (e.g. labour cost, machine depreciation), and delivery cost (e.g. transportation and warehousing cost from the manufacturing plant to the customers warehouse). Costs for marketing are included in the TDC as well.

The volume of the product is defined in statistical units (SU) upon which the accounting system of the company is based. This converts amount of product sold into a common measure, i.e. statistical units.

The contribution margin is defined as NOS minus TDC. The profit or loss of the hypothetical price increase is calculated by comparing the contributions margins before and after the price increase.

After the provision of the accountancy data by the company, the profit or loss of the hypothetical price increase is calculated on the basis of the following steps:

- First, the reduction in volume in SU (Statistical Units) calculated by means of the price elasticity using the market simulator with the conjoint analysis.
- Secondly, change in turnover (NOS) is calculated. In most cases, a price increase for the product under investigation results in a reduction of the purchase likelihood. This figure is used to calculate the reduction in volume terms. The hypothetical volume is multiplied with the price resulting in the new, hypothetical turnover.
- In a next step, changes in total direct costs (TDC) are calculated. This is done by reducing the TDC of the base scenario by the percentage in changes of demand which results in hypothetical TDC.
- Finally the hypothetical profit has to be identified. The hypothetical profit is calculated as hypothetical NOS minus hypothetical TDC.

If this profit is lower than the profit before the price increase, a price increase is obviously not profitable for the company, which proves that the relevant market is wider. Other products in the consumers' choice set exercise a competitive constraint on the product under consideration.

If the profit is higher than the profit before the price increase, the price increase is profitable. This means that substitutability is not enough to constrain a hypothetical monopolist. Thus, the relevant market has to be defined narrowly.

V. CONCLUSION

Recent years have seen a growing number of quantitative empirical tools to perform market definitions in competition and merger cases. Although these statistical and econometric methods are of great value in clarifying market definition issues they face some crucial practical problems.

In this article, empirical techniques how to implement the Hypothetical Monopolist Test were discussed. In particular, the practical application of a modern market research methodology, Conjoint Analysis, was discussed. Conjoint Analysis constitutes an empirical method which is particularly well suited to estimate the effects of a hypothetical price increase on demand and hence on profits of a firm. It offers a well established econometric tool which can be applied in practice to implement the Hypothetical Monopolist Test in order to define the relevant product and geographical markets in accordance with the legal requirements.