3

Market Definition and the Assessment of Market Power

3.1 INTRODUCTION

As we have seen, the concept of market power is central to competition policy. So far, we have dealt with this concept from a theoretical point of view. This chapter introduces the reader to the issue of how market power should be assessed in practice. Many competition law investigations will start with such an assessment.[1]

Ideally, one would like to estimate directly the extent to which a firm has (or increases its) market power. In merger cases, for instance, one might want to understand whether the merging firms will be able to profitably raise prices above the current level. Some modern econometric techniques (briefly analysed in the technical Section 3.3.2) allow us to do precisely that.

However, in many circumstances these econometric exercises are not feasible for lack of reliable data, and even when they are feasible, it might be a good idea to complement their results with the more traditional approach that evaluates the market power of firms by analysing the market in which they operate. In turn, this requires defining the "relevant market", that is the set of products and geographical areas to which the products of the merging firms belong. It is such a set of products (and areas) that might create competitive constraints to the firms under analysis.

In this perspective, the definition of the market (both from its product and geographical points of view) is a preliminary step towards the assessment of market power.

In this chapter, I first discuss how to define a market (Section 3.2) and then how to assess market power (Section 3.3) so as to mimic the sequence that cases often follow in many anti-trust jurisdictions. Nevertheless, it should be stressed first that market definition is not of interest by itself, but only as a preliminary step towards the objective of assessing market power.

[1] In merger cases and in monopolisation (or abuse of dominant position) cases, it is critical to determine the market power enjoyed by the firm(s) under investigation. But an assessment of market power is necessary also for tying and private price-fixing cases in the US (see Landes and Posner, 1981: 937–8).

3.2 MARKET DEFINITION

Since market definition is instrumental only to the assessment of market power, the relevant market should not be a set of products, which "resemble" each other on the basis of some characteristics, but rather the set of products (and geographical areas) that exercise some competitive constraint on each other. Suppose for instance that the anti-trust problem one faces is the likely effect of a merger between two sellers of bananas. The final objective being to which extent those sellers' market power is enhanced by the merger, the market definition investigation should reflect that objective. Accordingly, whether bananas are to be in a separate market, or not, should not depend on some particular characteristics they may or may not share with other fruits (for instance, they are "exotic" fruits, so that they might be put in the same market as pineapples, mangos and papayas), but rather on whether there exist other fruits that are substitutable enough to bananas so as to limit the possibility to raise the price of bananas.

The test that satisfies this requirement, and that should guide the analysis of market definition in both the product and the geographic dimension, is the so-called SSNIP (or hypothetical monopolist) test. For simplicity, I discuss this test and its practical implications first with reference to product market definition and then to geographic market definition.

3.2.1 Product Market Definition

3.2.1.1 The SSNIP (or Hypothetical Monopolist) Test

Let me continue with the previous example and suppose that we are interested in the impact of a merger between two sellers of bananas, and first focus on product market definition.[2] To find the relevant market, the US Department of Justice has introduced a test that is currently being used by anti-trust authorities worldwide.[3] The test is called SSNIP (Small but Significant Non-transitory Increase in Prices), and works as follows.

Suppose that there exists a hypothetical monopolist that is the only seller of bananas. Would this hypothetical monopolist find it profitable to increase the price of bananas above the *current* level in a non-transitory way, say by 5–10%?[4]

Imagine that the answer to this question is yes, that such a price rise would be profitable. This will mean that bananas do not face significant competitive

[2] In non-merger cases, the SSNIP test presents some difficulties (related to the so-called "cellophane fallacy" problem), as I discuss in Section 3.2.1.2 below.

[3] See US *Horizontal Merger Guidelines*, revised in 1992; *Commission Notice on the definition of the relevant market* and OFT *Market Definition Guidelines*.

[4] The US Department of Justice refers to a 5% increase in prices. The EC and the UK guidelines refer to a 5–10% increase.

constraints from other products, that is there are no other products that substitute enough for bananas for the hypothetical monopolist to lose much demand when it raises the prices of bananas. Accordingly, bananas should be considered as a separate market, and the test has already given its response.

Suppose now instead that the hypothetical monopolist would not find it profitable to increase prices by that amount, for instance because after the price rise a significant part of demand is redirected from bananas to kiwi fruits and to a lesser extent to pineapples and other fruits. Then this will imply that bananas should not be considered as a separate market on their own, as there exist other products that exercise a competitive constraint on sellers of bananas. The test should then continue, to consider a wider market, for instance bananas and kiwi fruits together. Would a hypothetical monopolist that is the only seller of bananas and kiwi fruits find it profitable to increase the price of these fruits above their current level by 5–10%? Again, if the price rise is profitable, the relevant market for our investigation will be found. Otherwise, the test should continue to include those products/fruits that exercise a constraint on bananas and kiwi fruits, and so on until a separate market has been found.

Demand and Supply Substitutability When looking for the products that exercise a competitive constraint upon the group of products we are analysing, it is natural to think first of products that are perceived by consumers as substitutes. This is substitutability on the side of demand. But there might also be substitutability on the side of supply, 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 (say, up to six months or one year) 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.

Suppose for instance that we are considering a merger between the only two providers of bus services between city A and city B. This is a commuter route and the train is not a good substitute because it takes too long and there is no direct service between the two cities. Accordingly, demand substitutability alone would call for a definition of bus services between A and B as the relevant market. However, there are other bus companies active in both cities A and B. Although they are operating other routes, say to cities C and D, to the extent that it is not difficult to obtain a license to operate the A to B service and there is some spare capacity on the other routes, these bus companies will exercise a competitive constraint and prevent a price rise on the A–B route from being profitable. Accordingly, the market can be defined more widely (say, bus services in cities A, B, C and D) than it would be by taking into account demand substitutability alone.

In *Torras/Sarrio*, the EC found that under demand substitutability alone separate markets should have been defined, each corresponding to a different degree of quality

paper (for instance, art books need high-quality paper, and low-coating paper would not be a good substitute for art publishers). However, paper manufacturers can easily and immediately change the degree of coating in the production, to make paper of a higher or lower quality, so that a wider product market was defined taking into consideration supply substitutability.

Supply Substitutability v. Entry That Constrains Market Power Note that 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. The producer of another good must already have the skills and assets required to produce the product under consideration, it should not incur considerable sunk costs, and any barriers to entry must be surmountable in a rapid and relatively cheap way. For instance, markets for civil air transport services in the EU are usually defined route by route,[5] say Brussels – Milan, Brussels – Munich, and so on. Supply substitutability cannot be invoked to widen the market in such cases, because most airports are congested and obtaining landing and take-off slots is a lengthy and sometimes impossible process. Likewise, the market for cola drinks cannot be widened by using supply substitutability arguments: although the technology of producing a cola is simple and some firms operating in other markets (say, producers of mineral water and those of other carbonated drinks) might have the necessary technology (bottling plants and distribution networks), important advertising campaigns are crucial to determine success in the cola market, and these entail huge sunk costs that make entry difficult and risky. In the *Nestlé/Perrier* case, for instance, the EC found that producers of soft drinks could have in principle started to produce and sell purified tap water immediately. However, for such a product to compete with spring mineral waters, producers should have incurred huge advertising outlays, so that supply substitutability could not be invoked to include soft drinks in the same market as mineral waters.[6]

As argued in Section 3.3, entry into an industry is also considered in the stage of the investigation which deals with the assessment of market power. (If entry is likely and relatively easy – even if not as timely as under supply substitutability – then it will constrain the market power of the firms in the market.) One can then wonder why it is necessary to consider supply substitutability at the market definition stage as well. The answer is that there is no reason to delay the moment at which substitutes on the supply side are considered. Immediate consideration of the existing competitive constraints will save time and help the investigation. Drawing the borders of the market in a narrower way than supply considerations would

[5] See for instance *Lufthansa/SAS*.

[6] In fact, the investigation indicated that purified tap water would not constrain the market power of mineral water producers even on a longer time horizon.

authorise might force an anti-trust agency to spend time and energy in justifying why a firm with a considerable market share does not actually have considerable market power. In contrast, if immediate consideration of supply substitutability arguments leads to a correct wider market, and accordingly a low market share, there will be an immediate presumption of absence of market power.[7]

3.2.1.2 A Problem in Non-Merger Cases: The "Cellophane Fallacy"

The use of the SSNIP test presents some difficulties when it is to be used in non-merger investigations. Consider for instance Article 82 under EU competition law, where a firm is investigated for alleged abuse of dominant position. In this case, a preliminary step in the investigation is to establish whether such a firm is dominant at all, that is if it has sufficient market power. But in such a case, the appropriate market definition test should not ask whether a hypothetical monopolist can increase prices in a small but significant way relative to *current* prices, but rather relative to *competitive* prices. Applying the SSNIP test to a current prices benchmark might lead to a too-wide definition of the market precisely *because* the firm under investigation has a dominant position. Suppose for instance that the firm is the only seller in the correctly defined product market. Being a monopolist, it might have set its prices at such a high level that a further increase above the current prices would not be profitable. Therefore, the SSNIP test might lead to a too-wide market definition, which in turn might lead to a calculation of small market shares, and to a finding of no dominance, for the firm under investigation.

This argument is known as the "cellophane fallacy", from the widely discussed *du Pont* case. The US Supreme Court maintained that the existence of high cross elasticity of demand between cellophane (sold by du Pont) and other flexible wrapping materials (such as paper bags) called for a wide definition of the market to include all possible wrapping materials. This decision was later criticised on the grounds that the presence of such a high elasticity of substitution was by itself an indication of the high market power enjoyed by du Pont. During the trial there was evidence that the firm was setting the price of cellophane so high that consumers of the product would have considered replacing it with inferior substitutes.

The cellophane fallacy argument calls for some caution in applying the SSNIP test in non-merger cases. Evidence that, say, a 5% price rise would lead to more than a 10–15% decrease in demand (which presumably implies non-profitability of the increase) should not be taken as decisive proof that the market delineation should be wider.

[7] Not considering supply substitution might distort an investigation. The finding of, say, an 80% market share would usually be associated with a presumption of dominance that would be hard to break at the market power stage of the investigation.

3.2.1.3 Implementing the SSNIP Test

The SSNIP test provides a very useful approach to market definition, but we should still discuss how to make it operational. Indeed, the very reliance on a hypothetical (monopoly) situation means that there exist no data that would allow for a literal application of the test. In what follows, I briefly discuss the tools that can be used to implement the test. The most important thing to recall throughout is that all the data and information available should be interpreted in the light of the test above.

Own-Price Elasticity One of the most useful pieces of information towards the definition of a product market is the own-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 a product.[8] Suppose for instance that we are still interested in the merger between two sellers of bananas and we want to define the relevant market. Knowing that the own-price elasticity is, say, 0.2, one can infer that a 10% increase in the price of bananas will lead to a 2% decrease in the demand for bananas. (Note that I refer to prices and quantities of all bananas, and not just to those of the two firms whose merger is investigated.) Since only a very small number of consumers will turn to other fruits (or stop buying altogether) the price rise is likely to be profitable.[9] Hence, with these (imaginary) data it would be appropriate to define the relevant market as the market for bananas.

The simple statistical observation that over a certain period a 10% increase in banana prices has been associated with a 2% decrease in the number of bananas sold does not get us very far: a number of other variables will probably play a role in the demand for bananas, such as the prices and availability of other fruit, the general price level, disposable income and so on. Imagine for instance that in the period considered the price of bananas rose by 10% but the prices of oranges, apples, pineapples and kiwi fruits all rose by a different extent. Then the observation that demand for bananas has decreased by 2% is of no help, as many other variables affecting the demand for bananas have also changed.

[8] Own-price elasticity ε is therefore defined as: $\varepsilon = -(dQ/Q)/(dP/P)$, where Q and P are quantities and prices of the product. In discrete terms, it will be $\varepsilon = -(\Delta Q/Q)/(\Delta P/P)$, where the operator Δ expresses the difference between the level of a variable after and before the change. Since demanded quantities usually decrease in response to a price rise, the fraction is multiplied by (-1) so as to define elasticity as a positive number.

[9] Call $R_0 = P_0 Q_0$ the revenue before the change, and $R_1 = P_1 Q_1$ the revenue after the change. One can then write $\Delta R = R_1 - R_0 = P_1 Q_1 - P_0 Q_0$. Dividing by R_0 both sides and re-arranging, one obtains $\Delta R/R_0 = (P_1/P_0)(\Delta Q/Q_0) + \Delta P/P_0$, which can be further simplified to become: $\Delta R/R_0 = (1 + \Delta P/P_0)(\Delta Q/Q_0) + \Delta P/P_0$. In the example, $\Delta P/P_0 = .1$ (that is, 10%), and $\Delta Q/Q_0 = -.02$ (that is, 2%). Therefore, we shall have $\Delta R/R_0 = .078$. In other words, revenue following a price rise will increase by 7.8%. Of course, to determine profitability one will have in general to consider also the reduction in total costs that follows a reduction in output. In this example, any decrease in costs would further increase profitability.

To take into account the different variables that are likely to have an impact on the demand for bananas, one should formulate and estimate an econometric model. It is from such a model, and to the extent that it gives results that are statistically significant, that one should obtain estimates of elasticities that can be safely used for anti-trust analysis. (The discussion of how to build an econometric model, evaluate the goodness of fit of the model and the significance of the estimates obtained is well beyond the scope of this book.)

As final (and perhaps very obvious) remarks, note that elasticity estimates should be obtained from representative data, and that the time span one looks at matters: consumers might take time to adjust their behaviour to a price change, and the demand reduction after a price rise is not likely to be immediate. (The appropriate time span will probably change from market to market.)

Cross-Price Elasticities If obtained from a properly specified econometric model, cross-price elasticities might also help to understand the competitive constraints exercised by other products on the product (or group of products) under examination for market definition purposes. 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.[10]

When own-price elasticity for the product considered, say product A, is high enough to lead us to believe that a hypothetical monopolist would not profitably raise prices of A in a small but significant way, it becomes important to identify which products exercise a constraint on A. Cross-price elasticities might help us to rank the closest substitute (which, together with A, will become the object of the next step of the hypothetical monopolist test).

When estimates of cross-price elasticities, say between bananas and any other fruit, are low, they indicate that such products are not perceived by consumers as substitutes for bananas, and suggest a separate market for bananas.

Price Correlation Tests To help define a relevant market, one can also use *price correlation* tests, which look at how price series of different products evolve over time. Stigler and Sherwin (1985: 555), the most authoritative proponents of this test, justify its use by resorting to the classical Marshallian definition of a market area: "A market for a good is the area within which the price of a good tends to uniformity, allowance being made for transportation costs".

The idea is therefore that if two products (but the same would hold for two geographical areas) belong to the same market, their prices will tend to move in the same way over time. Suppose for instance that a shock increases the price of product A. If product B is in the same market (that is, it is a good enough substitute

[10] Cross-price elasticity ε_{AB} between products A and B is therefore: $\varepsilon_{AB} = (dQ_B/Q_B)/(dP_A/P_A)$, or, in discrete terms, $\varepsilon_{AB} = (\Delta Q_B/Q_B)/(\Delta P_A/P_A)$.

of product A), then its demand will increase, leading also to an increase in its price.[11]

Stigler and Sherwin propose a number of possible correlation tests (correlation of prices, logarithms of prices, and first differences of logarithms of prices) based on this idea. In all cases, the higher the correlation the more likely two goods are within the same market area (or two regions in the same geographic market).

Some remarks should be made here. The first one is about how to choose the frequency of data. Should one take daily, monthly, or annual data when analysing price correlation? The results are likely to be affected by this choice, since price adjustments might take time. As for estimates of demand elasticity, the appropriate frequency will probably be different according to the nature of the product, and although common sense might be a good guide, it will be appropriate to repeat the test with different time spans to check the robustness of the results.

Second, other difficulties may arise from the fact that price series might diverge over time because the quality mix of different product specifications changes, or because the transportation and transaction costs vary.

Finally, a serious difficulty with price correlation tests is that common factors might induce a similar movement in prices of products that are in different markets. Imagine for instance that there exist variations in cost or demand conditions which depend on a common cause (for instance, inflation, an increase in property prices or in a common input). If this is the case, then we would observe price correlations even between products which are clearly not in the same industry. This is the problem of *spurious correlation,* which has called for more sophisticated tests relying on econometric techniques based on Granger causality tests and co-integration tests. Such techniques might be used to correct the results obtained from the impact of common shocks.[12]

Even without resorting to more sophisticated econometric techniques (the simplicity of the price correlation test being the main reason why one wants to perform such a test), one can derive useful information from price correlation tests. In particular, the presence of common shocks is likely to bias correlation tests in the sense of including two products in the same market when they should not. Accordingly, this test provides a useful screening device in indicating products that are *not* part of the same market, rather than products that are in the same market. For instance, a *correlation coefficient* between the price series of products A and B that is estimated

[11] A similar mechanism might be identified on the supply side too. If there exists supply substitutability between A and B, a shock that increases the price of A will lead some producers of B to switch and sell A, thereby causing a decrease in the supply of B and an increase in its price, whereas the price of A would move downwards after the supply adjustment. In the end, relative prices must be aligned again.

[12] See for instance Slade (1986) for the use of Granger-causality in price correlations tests. Werden and Froeb (1993) provide a detailed critique of price tests used for delineation of market areas. See also Sherwin (1993) for a reply to such arguments.

to be below a certain threshold (which may be, for instance, 0.8) will give us a strong presumption that these two products are not in the same market.[13]

In *Nestlé/Perrier,* the EC found that the correlation coefficients between prices of mineral water and prices of soft drinks were either very low or negative: in the five years before the investigation started, mineral water prices tended to increase whereas soft drink prices tended to decrease. This led the EC to (correctly) conclude that soft drinks did not exercise a competitive constraint on mineral waters. Similarly, in *Du Pont/ICI,* low correlation over time between the average prices of nylon fibres and polypropylene fibres suggested that these two products were not in the same market.

One must be more cautious in drawing conclusions when two products exhibit a very high correlation in prices, and analyse other tests before concluding that they are in the same market.

Price Differences The theoretical basis for the price correlation test is the idea that two products in the same market will tend to have the same price. One might then be tempted not only to look at whether price *changes* of two products are similar over time, but also at whether price *levels* of the two products are similar. In the past, for instance, the EC has used the existence of large differences in prices between two products as an indicator that they were not in the same market. In *Aérospatiale-Alenia/de Havilland,* jet aircraft and turbo-propeller aircraft were put in different markets because the prices of the former were on average twice as much as the prices of the latter. In *Du Pont/ICI,* the fact that nylon fibres and polypropylene fibres exhibited large price differences was taken as an indication that they belonged to different markets. In *Nestlé/Perrier,* large price differences between mineral waters and soft drinks also contributed to defining the relevant market as mineral waters alone.

However, using price differences as a criterion to define the relevant market is unsound. Recall that ultimately what we are interested in is the extent to which a product exerts a competitive constraint on the other (as expressed by the hypothetical monopolist test), but price differences do not give us any information on this point. It might well be, for instance, that the price of product A is twice as much as the price of B, but that it would not be profitable to raise the price of A even by a small amount since most of those buying it would switch to B. Markets that exhibit quality differentials are likely to be a case in point. Organic bananas might command a large price premium over bananas grown in plantations that use pesticides, a fact reflected in a higher price of the former over time. However, a further increase in the prices of organic bananas (say, because of a merger) is not profitable if there is

[13] The correlation coefficient between the price series of A and B will be given by $\rho = \sigma_{AB}/(\sigma_A \sigma_B)$, where σ_A, σ_B are the standard deviations of the price series of A and B respectively, and σ_{AB} is the covariance between them.

a sizeable proportion of consumers less keen on organic food who will then switch to non-organic bananas.

Hence, products at the bottom of the quality scale might well constrain the pricing behaviour of those at the top of the scale.[14] Price differences are not a good indicator for the purposes of the market delineation.

Characteristics and Usage of Products and Consumer Preferences Physical characteristics of products and their use might give some indication as to the possible degree of substitutability between products, but only insofar as this information is used in the framework of the hypothetical monopolist test. The fact that both mineral waters and soft drinks are consumed with the purpose of quenching one's thirst does not necessarily imply that these products should be included in the same relevant market. Conversely, the fact that two products obviously differ does not mean that they cannot be included in the same market: trains and buses are indeed different products, but to the extent that they provide a similar service in transporting people from city A to city B they might well be included in the same market.

Consumer surveys and market research studies might also contribute to understanding consumers' preferences and their perceived degree of substitution between different products.

Temporal Markets, Seasonal Markets, Multiple Markets In the spirit of defining markets according to the competitive constraints that products exercise on each other, notice that relevant markets might be defined in a way that might not appear *a priori* obvious. For instance, in most cities (including my home town, Milan, and my adoptive town, Barcelona) restaurants and bars might be part of the same market at lunch time, when most people look for a quick and light meal during the short office break; but at dinner time, when people go to restaurants to spend their evening in a nice environment and pleasant company, it is unlikely that good sandwiches sold by a bar would provide a good substitute for a good restaurant meal.[15]

Bananas are by and large available throughout the year, whereas oranges are mainly available in winter months, and much rarer in other seasons. Accordingly, bananas might belong to the same market as oranges in winter months but be in a separate market for the rest of the year.

Another consequence of the conceptual framework provided by the hypothetical monopolist test is that one can arrive at different definitions of markets according

[14] The UK *Market Definition Guidelines* are explicit about this point: "Although [a product] is of a lower quality, customers might still switch to this product if the price of the more expensive product rose and if they no longer felt that the higher quality justified the price differential".

[15] In Barcelona, it would not be uncommon to have lunch for 5–10 euro and dinner for three times as much in the same restaurant and for comparable meals.

to the starting point of the investigation. Consider the different ways of getting from city A to city B, and vice versa. One might expect some degree of substitutability between airplanes and trains, and between trains and buses, but air ticket prices are unlikely to be constrained by the existence of bus services. Suppose that we now look at a merger between an airline and a train company that both operate services between these two cities. Given the limited substitutability between air and bus travels, it is likely that air and train services will be found to be the relevant market.

Consider instead an investigation prompted by a proposed merger between a train and a bus company operating the same route as above. In this case, and for similar reasons, we might end up with a market definition that includes trains and buses, but not airplanes. Therefore, the same product (trains, in this example) might be placed in different markets, according to the nature of the investigation (that is, if the test starts from airplanes, or from buses).

After-Markets (or Secondary Markets) One important question that often arises is how to define markets when there exist primary and secondary products (also called *after-markets*), such as cars (primary product) and spare parts (secondary product), or washing machines (primary product) and technical assistance (secondary product). Often, a certain type of secondary product is designed for and can fit only a certain brand of the primary product. For instance, a certain brand of cars requires special headlights that do not fit any other brand. If the car-maker also produces headlights, defining the relevant product market as headlights for a particular brand of cars might result in a dominant position of the car-maker in the secondary market, even if the car-maker has a weak position in the primary market.

The framework offered by the SSNIP test turns out to be helpful in addressing this problem. The relevant question is whether a hypothetical monopolist (to continue the example) selling spare parts for a certain car brand would be able to profitably increase prices in a significant way. Note that if existing consumers have already bought that certain car brand they cannot turn to other spare parts (we are supposing they are incompatible). However, consumers who are considering whether to buy that particular brand of car might turn to other car-makers instead, to the extent that they base their purchase decision on the overall estimated life-time cost of the car, which includes the price of the car and the expected cost of replacing spare parts (and getting after-sales services, and so on). If the spare parts at hand are sufficiently important for the overall expected cost of the product, and there are a sufficient number of buyers who will take it into account, the hypothetical monopolist will not find it useful to raise prices in a small but significant manner, and the market should be defined as the market for cars and spare parts together.

In practice, the answer to the question of whether secondary products should be defined as a separate market will depend on the following variables. First, whether

the price of the secondary product at issue is a considerable proportion or not of the price of the primary product: ash-trays will more likely to be put into a separate market than car engines. Second, not only the price of the spare part but also the probability of replacement matters: prices being equal, a spare part which is commonly known as very likely to break down will be less likely to be put into a separate market than a spare part whose failure probability is widely expected to be very low (the latter would not be considered by consumers when buying the car). Third, some buyers are more sophisticated than others. When the buyers are final consumers, they might be less informed about the probability that spare parts or after-sales services are needed and they might be less aware of those secondary products' prices. Conversely, when the primary product is an input which is bought by a firm, we should expect the buyer to be better informed about the expected cost (both the probability that they are needed and their costs) of secondary products. In the latter case, the market definition will *ceteris paribus* be wider than in the former.

The most famous case about after-markets is *Kodak*, where that company's practice of tying the sales of spare parts for its photocopiers with assistance services was being considered. In this case, the US Supreme Court defined the market (in a majority decision) in a narrow way, as the secondary market for spare parts and services of Kodak photocopiers. Using this definition, Kodak was found to have almost 100% of the market for spare parts of Kodak photocopiers and 80–90% of the market for services and assistance of Kodak photocopiers. This led in turn to the finding that it had market power, despite the fact that Kodak had market shares which ranged from 2% to 23% in the primary markets. This judgment has been widely debated because it is far from clear that Kodak could really exercise market power in the secondary markets, given the strong inter-brand competition in the primary markets. It is also unclear whether this decision has had a permanent impact on the way secondary markets are defined. According to Peritz (1999), lower courts in the US have continued to define markets in a wider way, making it less easy to find market power by firms that face considerable inter-brand competition in the primary products.

In *Hugin v. Commission,* the market was defined as the UK market for spare parts of the cash registers manufactured by Hugin, a Swedish company that was found dominant although it had only 13% of the UK market for cash registers.[16]

In another European case, Kyocera, a producer of printers for computers, had been accused of having abused a dominant position in the market for secondary products of its printers. However, the EC rejected the complaint since it found that consumers took into account the prices of the secondary products (that accounted

[16] The *Hugin* case is probably more famous because Hugin's refusal to supply spare parts to Lipton was found to have no effect on the trade between Member States, and Article 82 of the Treaty did not apply.

for an important part of the cost of the life-time purchase of a printer) when buying the primary product, and that there was significant competition in the market for printers.[17]

Consistency of Market Definitions over Time A final observation pertains to the consistency that anti-trust agencies show with respect to market definitions over time. It might happen that the same firms, or similar products, are investigated on different occasions. In such cases, it would be of course recommendable that agencies would adopt the same market definitions for the same type of problem (we have just seen that if the anti-trust problem is different, a different market definition is fully justified). However, consumer preferences and technological conditions change over time, and consistency in such cases might be at the cost of making serious mistakes.[18]

For instance, advances in transportation technologies, in greenhouse cultivation, and in storing and refrigerating techniques imply that not only bananas, but also many other fresh fruits can nowadays be consumed all year round by European consumers. However correct the ECJ decision was of placing bananas in a separate market forty years ago, it would be much less likely today to find that other fruits do not exercise competitive constraints on bananas.[19]

3.2.2 Geographic Market Definition

Most of the considerations I have made above with respect to the definition of product markets hold good when considering how to define geographic markets. In particular, the SSNIP test is still the conceptual framework to be used and it is in its light that data and information must be interpreted.

Suppose for instance that a merger between mineral water producers in Italy is being considered. The SSNIP test then takes the following form: would a hypothetical monopoly seller of all Italian mineral waters find it profitable to increase the price of mineral water by 5–10%? If the answer is affirmative, then the geographic market will be defined as Italy. If not, for instance because one expects imports from France to render such a price rise unprofitable, as a considerable part of consumers

[17] *Pelikan/Kyocera,* in European Commission (1996: 140).

[18] More generally, an anti-trust authority should not feel constrained by a bad decision taken in the past. Such an issue has arisen in the past in merger investigations of the Merger Task Force of the EC. The MTF has to publish decisions under very tight constraints, and it might come up with incorrect market definitions for a merger analysed superficially because it obviously creates no competition problems. It would be wrong to ask it to adopt the same market definition when analysing subsequent mergers if it turned out to be incorrect after a closer investigation.

[19] Likewise, the existence of high-speed trains, which make use of a new tilting technology to work on the existing tracks might impose a competitive constraint on airlines for routes between cities located within a range of 300–600 kilometers. Such a constraint was much weaker only ten years ago.

demand French mineral water, then the test should be repeated on a hypothetical monopolist of Italian and French mineral waters, and so on.

When implementing the test in order to define a geographic market, in addition to estimates of elasticities and correlation tests, information related to imports and transportation costs might also be used, as indicated below.

3.2.2.1 The Role of Imports (Shipment Tests)

Elzinga and Hogarty (1973) propose to use shipment data to identify geographic market areas. The test has two components, the first to establish whether there is "*little in from outside*" (that is, imports account for a small part of local consumption) and the second that there is "*little out from inside*" (exports account for a small part of local production). The idea behind the test is that a given geographical area is defined as a relevant geographical market if both tests are satisfied, that is there is little movement of the product to and from other geographical areas.

The test might provide useful information, but it is likely to be biased and its results should accordingly be interpreted with care. Suppose for instance that a considerable proportion of trade was observed between one region and another. This would be a clear indication that the regions' producers are exercising a competitive constraint on each other. Accordingly, the two regions should not be defined as separate markets, and the test should be carried out again on further regions.

Suppose instead that the test is satisfied, in the sense that few shipments occur between region A and region B. This is not necessarily an indication that the two regions are not in the same market. If prices are the same, and there are some (even very small) transportation costs, one would not observe any delivery from one region to the other, even though they produce exactly the same good and are neighbouring. Yet, producers in one region strongly constrain those in the other. If A's producers tried to increase prices by even a small amount, A's consumers would switch to B's producers: such a price rise would not be profitable. Hence, the shipment test is biased, and its results should accordingly be discounted.

3.2.2.2 Transportation Costs

One useful piece of information that can supplement other tests is given by the importance of transportation costs relative to the prices of a given product. Even if no shipments had occurred in the past between one region and another, the fact that transport costs are low relative to prices would imply that such shipments are possible and that a competitive constraint will prevent that prices in a region are increased.

In some situations, these considerations will make the geographic extent of the market very small. Consider for instance a merger between food retailers in a given city. It would make little sense to define the market beyond the city borders, as transportation costs (which in this case include time spent by consumers travelling

to a shop) would prevent most citizens from going to neighboring cities to do their shopping.

At the other side of the spectrum, there are markets which are correctly defined as global. A case in point is markets for aircraft, where transportation costs are irrelevant relative to their prices.[20]

3.2.2.3 Other Characteristics

In some cases, especially when the question is whether to define a market at a national or supranational level, consumer preferences might be an important variable. For a number of products, preferences follow national borders. This implies that separate markets should be defined. Different national tastes might be reflected in different perceived qualities, and in turn different market prices across countries. Yet, as we have seen above when discussing price differences, this does not necessarily mean that imports do not exercise a competitive constraint: a further increase in prices in a country's products might trigger a substantial diversion of demand towards foreign products. In some cases, however, taste differences might be so strong that it would make little sense to define markets across countries: Italians would not buy pasta unless made of durum wheat, whereas French and Germans would buy it in any case.

An example of markets that are (at the moment) unlikely to be defined at the supranational level are media (publishing and broadcasting) markets. A merger between two French newspapers will probably result in a geographic market definition not wider than France, in part due to language, in part because it is unlikely that French citizens are interested in the Swiss and Belgian news covered by newspapers in Geneva or in Brussels. For language reasons, a merger between two German television broadcasting companies will lead at most to a geographic market comprehending also Austrian and Swiss–German television stations.[21]

3.3 THE ASSESSMENT OF MARKET POWER

Market power is defined as the ability of a firm to raise prices above its marginal cost.[22] However, firms lack market power only in the abstract and unrealistic world of perfect competition or in the Bertrand model with homogeneous goods and perfectly symmetric firms (see Chapter 8). In real-world industries, where there

[20] World markets have been found by the EC in *Aérospatiale-Alenia/de Havilland, Boeing/McDonnell Douglas,* and *General Electric/Honeywell.*

[21] Examples of media markets where language has determined a less-than-European wide geographic market are *Kirch/Richemont/Telepiù, CLT/Disney/SuperRTL* and *Nordic Satellite Distribution.*

[22] Sometimes, it is defined as the ability to set prices above the *competitive* price level. But the competitive price is nothing else than the price that a firm would charge under perfect competition, that is, its marginal cost.

exist fixed costs and products are unlikely to be perceived as perfect substitutes by all consumers, we should expect every firm to have *some degree* of market power.

This calls for two issues to be addressed. First, which measure of market power should be used, and second, which threshold of market power should be taken to indicate that a firm has enough market power for it to call for the attention of competition authorities. The second question calls largely for an arbitrary answer, and it is solved in different ways by the different anti-trust legislations, or even within the same legal framework (see below for the different threshold values of market share used by the EC and the ECJ in their decisions). Let us dwell upon the first question before coming back to the second issue.

A (theoretical) measure of market power is given by the *Lerner index*, defined as the firm's mark-up (that is, the difference between the price p_i and the marginal cost C_i') over price ratio: $L_i = (p_i - C_i')/p_i$. The index increases with the mark-up charged by the firm, which should be the most desirable feature of any index of market power.

One might be tempted to apply the Lerner index directly to real-world cases. However, its direct application would create problems of a different nature.[23] Firstly, estimating the marginal cost of a firm is not an easy task. Determining the impact of a marginal change in the quantity produced by a firm on the total cost of production is often beyond practical feasibility even with the best knowledge of the technological conditions under which a firm operates. Indeed, there might be large differences in the estimates of marginal costs even within the management of the same firm. Competition agencies with an imperfect knowledge of the sector, the technology, and the firm itself would certainly have a much more difficult task.[24]

Secondly, high costs can be inherent to monopoly power. As seen in Chapter 2, one should expect a monopolistic firm to be characterised by productive inefficiency. Paradoxically, by applying the Lerner index one might find that a firm is not dominant because it has (relatively) high costs (and relatively low margins), whereas such high costs are the result of its monopoly power.[25,26]

Given the difficulties entailed by the direct application of the Lerner index, an alternative approach might be based on the fact that the Lerner index of a

[23] See also Landes and Posner (1981) and Neven et al. (1993, ch. 2) among the many contributions that start from the Lerner index in their discussion on how to evaluate market power.

[24] Note that a firm would not have an incentive to reveal its true costs to the anti-trust agencies. Rather, it might try to artificially inflate its costs through the manipulation of its accounting books.

[25] See for instance Neven and Röller (1996), who find that airlines less exposed to competition share rents with workers, thereby increasing costs.

[26] Of course, low prices might also be the *result* of monopoly power: In predatory pricing cases (see Chapter 7), a price very close (or inferior) to marginal costs should obviously not be taken as a proof that a firm has no market power.

monopolistic firm corresponds to the inverse of the elasticity of demand faced by it: $L_i = 1/\varepsilon_i$ (see Chapter 8.2, as well as 3.3.1.6). Indeed, the direct estimate of the elasticity of the (residual) demand faced by a firm is at the core of one of the modern econometric techniques of assessment of market power, as I discuss in Section 3.3.2.1 below.

However, the estimate of the residual demand elasticity faced by a firm, as well as the use of other econometric techniques aiming at estimating (or forecasting) directly from market data the market power enjoyed by a firm or a group of firms, is not always possible (for lack of data) and, when possible, is not necessarily without problems, as discussed in Section 3.3.2 below. These econometric techniques certainly represent a very promising tool for anti-trust analysis, but as reliable data do not always exist and such techniques are not completely standard, a more traditional approach might be used for the assessment of market power.

The traditional approach assesses market power in an indirect way. It attributes a key role to the market share held by the firm(s) under investigation, but market share is only one of the variables that one must look at in order to determine market power. Other variables are the relative position of competitors, the existence of potential entrants, and the countervailing power of buyers.

In what follows, I discuss how these different variables contribute to the assessment of market power.

3.3.1 Traditional Approach: (Indirect) Assessment of Market Power

3.3.1.1 The Central Role of Market Shares

The typical procedure followed by anti-trust authorities all over the world is to first define the relevant market and then assess market power in that market. In this second step, the analysis rotates around the measurement of market shares held by the firm (or firms).

Giving an important role to market shares in a market power analysis makes sense. After all, one would expect (other things being equal) a monopolistic firm, that is one that has 100% of the market, to have the highest possible market power. Conversely, one would expect a firm holding a tiny share of the market to be unable to exercise much market power; a restraint on the ability of setting high prices will come from competitors, and a firm's low market share will indicate that this firm has strong competitors.

However, a firm's high market share is not sufficient to conclude that it is dominant. As we shall discuss below, such a firm would not be able to increase prices substantially if entry in the industry was very easy, or if there was a strong buyer ready to use its countervailing power and switch to competing suppliers (or to integrate vertically). None the less, it is reasonable to start from a measurement of market share as a first step of the analysis of market power of a firm, and the simple

technical Section 3.3.1.6 below confirms the positive relationship between market share and market power.

3.3.1.2 Which Thresholds for Market Shares?

The centrality of market shares in market power assessments suggests that they might be used as a screening device. For instance, if the market share of a firm being investigated were below a certain threshold (say, 40%) there might be a presumption that the firm does not hold enough market power to be considered dominant, and the case might be dismissed (or the burden of proving that there is dominance should fall entirely on the anti-trust authority). If it were above another threshold (say, 50%) there might be a presumption that the firm is dominant, and the burden of proving that dominance does not exist should fall on the defendant; and for intermediate market shares a more open investigation might take place.

This approach would be helpful to increase legal certainty and reduce the cost of the investigations. Of course, using such thresholds aims at distributing the burden of proof, and should not hide that many other elements (see below) must be assessed before reaching a final conclusion about the market power of a firm.

Some anti-trust authorities are explicit in the way they would use market share thresholds as a screening device. The "Assessment of Market Power" Guidelines (point 2.11) released by the UK Office of Fair Trading indicate two thresholds that appear very sensible: below 40% it is unlikely that a firm is considered dominant; above 50% dominance can be presumed.

Neither the EC nor the European Court of Justice are equally explicit, but in practice their approach is probably not so different. Since the earliest cases, the ECJ has indicated that a number of factors must be considered in assessing dominance, but has attributed an important role to market shares:

> The existence of a dominant position may derive from several factors which taken separately are not necessarily determinative but among these factors a highly important one is the existence of very large market shares.[27]

In *United Brands,* the defendant was found to be dominant with market shares around 40–45% (but again, this was only one of the elements considered by the ECJ), and somehow this range is still considered to cover the benchmark levels for the presumption of dominance. In *Akzo v. Commission* the ECJ stated that a market share persistently above 50% is an indication that the firm is dominant in the absence of evidence to the contrary.

It is not clear below which threshold the ECJ would consider a firm *not* to be dominant. The European Commission would probably set that threshold at 25%, given that Article 15 of the Merger Regulation states that a concentration is presumed

[27] *Hoffman/La Roche:* 520. A similar statement is also made in *United Brands.*

not to impede competition if the merging firms' combined market share does not exceed 25%.

US courts seem to indicate higher thresholds for finding dominance. In *Alcoa,* Judge Learned Hand wrote that a market share of 33% is certainly not sufficient to establish dominance, and in *Jefferson Parish Hospital* a 30% market share has been deemed far too low for dominance. In *Times-Picayune,* a firm with a 40% market share was not found to be dominant.

3.3.1.3 Measuring Market Shares and Assessing Relative Strengths

Once a market has been defined, market shares of all the relevant firms in the market can be calculated. This will give a first picture of the relative competitive positions of the firms in that market.

If the relevant market in the investigation at hand coincides with the market that firms and business magazines usually make reference to, there might be several sources that one can use to derive market shares. A more unusual market definition might imply a divergence between desired data and firm or industry data, but even so, sales data are usually readily available.

In some cases, market shares both in number of *units* and in *values* might be available. The latter generally have more economic meaning, although the former might contain some additional information about the relative market positions.[28]

In certain industries where production is limited by a crucial input, existing *reserves* might be more informative than market shares. For instance, if one looks at a mineral industry, it would be meaningless for competition analysis purposes to report that a certain firm has (or had) a 20% market share, if its reserves will be completely exhausted within little time: the future market share of that firm is going to be nil, and it will not exercise any competitive constraint on its rivals.[29]

Similar considerations might apply when one of the market participants is very unlikely to be a relevant market player in the near future, because of an older or less efficient technology or other reasons. In this case, considering the current (or past) market share would over-estimate the competitive constraints that this firm exercises on its competitors. It might then be appropriate to exclude its current sales from the calculations of market shares.[30]

The degree of *excess capacity* held by rival firms also gives important information. If the existing capacity of these firms is just enough to satisfy their current demand,

[28] For instance, in *Nestlé/Perrier,* the EC calculated market shares in the French mineral water industry both in volumes and values. The three major firms held higher shares when total values were considered, indicating that consumers were willing to pay higher prices for a bottle of their water than for that of competitors.

[29] See for instance *Gencor/Lohnro.*

[30] In *Boeing/McDonnell Douglas,* it was debated to which extent McDonnell Douglas (that in the long-run would be unlikely to survive) obliged Boeing and Airbus – the two main players in the market for aircraft – to set lower prices.

their supply elasticity (that is, their ability to react to an increase in prices and serve new customers) is very low. If, on the other hand, they have a considerable excess of capacity, then it is reasonable to expect that the market power of the firm being investigated is reduced. Because of this observation, the share of the capacity of each firm over total industry capacity might be relevant information.[31]

For the cases where supply substitution has been taken into account, and hence the relevant market includes firms that are not currently selling the market products, an estimate of capacity might again be used as a proxy for sales, and market shares should be estimated accordingly.

Some markets are characterised by large and infrequent orders made by a small number of buyers. In these markets, there might be a large variance in market shares if they are calculated over a small time period, as one order alone might represent a considerable proportion of the period's sales. As a consequence, market shares should be calculated over a relative long period, say three to five years (depending on the frequency of the orders).[32]

Furthermore, it is not only the existence of a certain pattern, but its *persistence* over time that might give a strong indication of an industry situation. If a firm's market share was consistently above say 50% over a time horizon of five to ten years, that might be a further indication (other things being equal) of its likely dominance. Conversely, a distribution of market shares among the main players that varies considerably over a relatively short time period might be suggestive of a more competitive situation where no single player is dominant.[33]

As a final remark, note that the aggregate level of market power (that is, the extent to which firms in the industry can on average raise prices above their marginal costs) increases with the degree of concentration, other things being equal (see also technical Section 3.3.1.6). This observation is not relevant for the assessment of individual market power, but it is very important when mergers are analysed (see Chapter 5). Indeed, measures of industrial concentration are often used as a first device to screen mergers that might have some anti-competitive effects.

3.3.1.4 Ease and Likelihood of Entry

If a firm tried to increase its prices, its existing competitors might react by increasing their capacity. To the extent that its competitors will respond aggressively, the market power of a firm is limited.

[31] In *Nestlé/Perrier*, distribution of capacities was again an important consideration.

[32] Examples of industries that fit this description of large and infrequent orders are aircraft and trains, as in *Aérospatiale-Alenia/de Havilland, Boeing/McDonnell Douglas, General Electric/Honewell* and *ABB/Daimler-Benz*.

[33] In *Airtours*, the market shares held by the leading firms had changed considerably in the few years prior to the Commission investigation of the proposed merger between Airtours and First Choice. See Section 5.6.1.1 for a discussion of the case.

Aside from existing competitors, potential entrants might also constrain the ability of a firm (or a group of firms) to raise prices. Indeed, the most important insight of contestable markets theory (see Chapter 2) is that if entry is easy, rapid and costless, a firm would not be able to charge a high margin because large profits would attract competitors into the industry.

The criticisms addressed to this theory have stressed the key role played by fixed sunk costs as an obstacle to entry. The higher sunk costs the less likely that entry will occur, which in turn makes it less likely that new firms will discipline the incumbents. Note that fixed sunk costs can be either exogenous or endogenous, or both.[34] Exogenous sunk costs refer to the investment a firm has to incur in order to endow itself with the plants and machines (or more generally, technology) it needs for producing and distributing the good. By and large, such an investment is not a choice variable for the firms operating in the industry. Endogenous sunk costs refer to R&D and advertising outlays that firms make in order to increase the perceived quality of their products, and they are indeed a choice variable for the firm. As discussed in Chapter 2, endogenous sunk cost industries are typically characterised by a lower bound to concentration and it is unlikely that entry will discipline the market power of the incumbents in such industries.

When analysing market power in an industry, it is crucial to understand the likelihood of entry, and care should be devoted to a number of details. For instance, the existence of switching costs, lock-in effects and network externalities (see again Chapter 2) might represent an obstacle to entry, as consumers do not have the right incentive to turn to new suppliers, even when they are more efficient and/or offer superior products.

Care should also be devoted to the history of the industry, in particular previous episodes of entry and the incumbent's reactions. Suppose for instance that the market leader has consistently priced aggressively whenever new competitors have entered the industry. Then it will have built a reputation of being a tough player, and potential entrants will take this into account at the moment they decide on entry: the expectation that the incumbent will set low prices after their entry might discourage them from entering in the first place (see Chapter 7 for a discussion of predatory behaviour by an incumbent dominant firm).

3.3.1.5 Buyers' Power

The ability of a firm to charge high prices also depends on the degree of concentration of the buyers. A firm is clearly more free to exert market power if it faces a large number of dispersed consumers or buyers than if it faces one or a few strong buyers.[35] A strong buyer can make use of its bargaining power to stimulate

[34] See Sutton (1991, 1998).

[35] Galbraith (1952) is probably the first author who has argued that countervailing power of buyers can considerably restrain the market power of sellers.

competition among sellers, either by threatening to switch orders from one seller to another, or by threatening to start upstream production itself.[36]

Because of coordination problems, entry into the sellers' industry by new firms can also be easier when buyers are concentrated. Imagine for instance a situation where there is an incumbent monopolist, and where potential entrants would have to make a considerable sunk investment to operate in this market. If buyers are dispersed, and potential entrants have similar cost levels, orders are likely to be distributed across sellers. Winning orders from a few buyers might not be enough to justify this investment, and as a result no new firm might enter the industry, even though each potential entrant is more efficient than the monopolist. Because buyers are not coordinating their decision of which seller to select, they might end up having the monopolist as the only seller in the industry, and hence face much higher bills than if entry had occurred. When instead there is just a single buyer (or all the buyers coordinate), then it will order from one of the entrants, thereby making entry into the industry possible.[37]

Several empirical works have tried to test the countervailing power hypothesis, and there appears to be some evidence that buyer concentration does negatively affect the market power of the sellers.[38]

The role of buyer power in constraining sellers is typically well taken into account by anti-trust agencies. In European merger cases, for instance, it has led the EC to clear mergers that would otherwise have been blocked.

In *Enso/Stora*, the merging firms produced Liquid Packaging Board (LPB), used for the packaging of milk and fruit juice. The merger was expected to give them a market share between 50 and 70%. Other industry characteristics, such as high barriers to entry, also suggested an anti-competitive impact. Yet, the merger was approved on the grounds that buyer power in this industry was so large (Tetrapak alone buys 60–80% of total sales) that the merging firms would have been unlikely to exercise market power. The EC argued that the main buyer, Tetrapak, "would have the option of developing new capacity with other existing or new suppliers, should the parties attempt to exercise market power" (*Enso/Stora:* para. 91).

A similar argument was used by the EC in the *ABB/Daimler-Benz* case, which was cleared (subject to conditions) mainly on the grounds that Deutsche Bahn (the German railways operator), the only buyer for mainline trains, would have exerted

[36] See Scherer and Ross (1990: ch. 14) for a discussion and a number of examples. An interesting case is in particular when a buyer produces itself a part of the inputs it needs (*tapered integration*). This makes a potential switch from suppliers to internal production more credible and has the additional advantage of giving the buyer information about the cost of production in the upstream industry, information which can be very useful in price negotiations.

[37] For a formal presentation of this argument, see Fumagalli and Motta (2000).

[38] See Scherer and Ross (1990: 533–5) for a review of this literature, initiated by Lustgarten (1975). Among more recent works, Schumacher (1991) also supports the countervailing power hypothesis in a study based on US manufacturing industries, whereas Connor, Rogers and Bhagavan (1996) find no evidence of countervailing power in the US food manufacturing industries.

competitive pressure on the producers of trains and railways materials (see Chapter 5 for a detailed discussion).

Finally, an interesting issue is to what extent final consumers benefit from buyer power. Von Ungern-Sternberg (1996) and Dobson and Waterson (1997) find that lower prices obtained by buyers are passed on to consumers only if there exists enough competition among the buyers themselves.

3.3.1.6 Market Power, Market Shares and Concentration*

Suppose we are interested in studying the market power of a firm i in a certain (well-defined) market. Assume also that firms compete in quantities, produce a homogenous good (there is only one market price, p), and have a constant marginal cost c_i. Firm i's profits can be written as

$$\pi_i = p(Q)q_i - c_i q_i, \tag{3.1}$$

where $Q = q_i + \sum_{j \neq i} q_j$ is the total industry output and q_i and q_j denote respectively the output of firm i and that of any of its rival firms j. Maximisation of its profits given the output of its rivals will lead to the following FOC:

$$\frac{d\pi_i}{dq_i} = p(Q) + \frac{dp}{dq_i}q_i - c_i = 0. \tag{3.2}$$

The equilibrium price p^* in this market will be defined by the solution of all the FOCs. At such a price, the FOC for firm i can be re-written as

$$p^*(Q) - c_i = -\frac{dp}{dQ}\frac{dQ}{dq_i}q_i, \tag{3.3}$$

Dividing both sides of this expression by p^*, multiplying and dividing by Q the RHS, and noting that in a Nash equilibrium in quantities rivals' quantities are given (so that production of one additional unit by a firm corresponds to production of an additional unit for the industry as a whole: $dQ/dq_i = 1$), we have

$$\frac{p^* - c_i}{p^*} = -\frac{dp}{dQ}\frac{Q}{p^*}\frac{q_i}{Q}, \tag{3.4}$$

which one can finally re-write as

$$L_i = \frac{m_i}{\varepsilon}, \tag{3.5}$$

where L_i is firm i's Lerner index of market power, m_i is firm i's market share, and $\varepsilon = -(dQ/Q)/(dp/p)$ is the elasticity of *market* demand with respect to price. Note that for the monopoly case one finds the well-known relationship $L_i = 1/\varepsilon$.

Building on this result, one can also find an aggregate index of market power for an industry as a whole. Denoting with $L = \sum_i m_i L_i$ such an index, and using (3.5)

one obtains

$$L = \sum_i \frac{m_i^2}{\varepsilon} = \frac{HHI}{\varepsilon}, \tag{3.6}$$

where $HHI = \sum_i m_i^2$ is the Herfindahl–Hirschman Index of concentration. This establishes that there is a direct relationship between the degree of industrial concentration and the average degree of market power, a result that has been used to justify the prominent role assigned by the US DOJ to the HHI as a screening device in merger analysis.[39]

Other works have shown that the individual Lerner index depends on the firm's market share as well as the market demand elasticity and the elasticity of the supply of the rivals.[40] This stresses that firm i's market power is constrained by the extent to which rival firms are able to respond to an increase in firm i's prices by increasing their output.

3.3.2 Econometric Techniques: (Direct) Assessment of Market Power*

The purpose of this section is to give an overview of two recent quantitative techniques that are used to assess market power and estimate the likely effects of a merger. Section 3.3.2.1 briefly describes the method based on the estimation of residual demand elasticities, and Section 3.3.2.2 deals with logit demand models that can be used both to estimate market power and to simulate effects of mergers.

One reason for the popularity of these two techniques is that they both allow us to reduce dimensionality problems when dealing with differentiated product industries (logit models and residual demand elasticities methods therefore provide two alternative answers to the same problem). Suppose for instance that one wanted to estimate market power in a market characterised by n differentiated products. A natural approach would be to specify a system of n demand equations, where the demand for each product is expressed as a function of the prices of all products in the market. Even with linear or log–linear demands, estimating such a system would imply estimating more than n^2 parameters, since each of the n demand equations will contain the prices of all n products, plus all other relevant explanatory variables. It is clear that as n becomes large, the dimensionality problem becomes very important (even when imposing restrictions, such as symmetry, on the model). Residual demand analysis and logit models offer two ways to deal with this dimensionality problem.

A complete analysis of these and other techniques is beyond the scope of this book, but the following notes, however incomplete and short, should give an idea of

[39] See Dansby and Willig (1979) and, more recently, the discussion in Rey (2000: 32–4). See also Chapter 5 on the role of the HHI in US merger investigations.

[40] See for instance Encaoua and Jacquemin (1980), Landes and Posner (1981) and Neven et al. (1993: 20–8).

the help modern econometric and computing tools might give in concrete anti-trust cases.

3.3.2.1 Elasticity of Residual Demand*

A very useful quantitative technique for evaluating market power and assessing the effects of mergers is due to Baker and Bresnahan (1985, 1988), and is based on the direct estimation of residual demand elasticities. Here I briefly recall the main features of this technique.

I have already mentioned the dimensionality problem when dealing with differentiated products. An additional problem arises because a price increase by firm A would generally not leave the price set by the other firms unchanged (as it was implicit in technical Section 3.3.1.6): for a correct assessment of the market power enjoyed by a firm, one should also estimate to what extent a price increase by such a firm would be followed by each of the rivals. This would add complexity to the task of assessing market power.

The estimation of the residual demand function is a technique which considerably simplifies this task, and reduces the need for data. To assess the market power of firm A, this technique involves the estimation of just one coefficient. This is the elasticity of its *residual demand function,* that is the demand function faced by firm A once the reaction of all the other firms is taken into account. Instead of asking by what percentage a price rise of firm A would increase demand of firm B, C, and so on, this technique just asks by what percentage a price rise of firm A would decrease its own residual demand, that is the demand that is left after all the other firms have satisfied theirs. A low estimate of the residual demand elasticity would then suggest high market power of firm A, as a considerable proportion of consumers would continue to buy from firm A rather than switching to other firms (or ceasing to buy the product). Vice versa, a high estimate would suggest low market power.

Regressing the residual demand function of a firm alone would result in an estimator which is not *consistent,* as equilibrium price (and quantity) are jointly determined by both the demand and the supply schedules of a firm. Therefore, the estimation of the residual demand elasticity is usually accompanied by the use of the *instrumental variable* method (for which firm-specific cost data of the firm whose market power we would like to assess are needed), to solve the simultaneous relation problem and obtain consistent estimators.

Note that the estimation of the residual demand elasticity cannot tell us whether market power is low because of competition from firm B, or C, or other, since the rival firms are considered as a collective, and their specific role in constraining the market power of firm A cannot be singled out. However, the advantage of this method is that it allows us to save on the data required to perform an econometric assessment of the market power of a firm. Since it is very often the case that data at

the disaggregated level are scarce or difficult to obtain, this is an important step for the feasibility of the application of quantitative methods to the analysis of market power.

The application of this method to the analysis of mergers is straightforward. Imagine that one is interested in knowing the likely market power enjoyed by a firm which results from the merger of, say, firms A and B. One could use the technique briefly described above with a minor modification, that is by computing two (*partial*) residual demand elasticities for each of the two firms.[41] For instance, for firm A, the first is its own elasticity, ϵ_{AA}^{pr}, which estimates the percentage decrease in the residual demand of firm A following a one percent increase in A's price; the second is the cross-elasticity ϵ_{AB}^{pr}, which estimates the percentage increase in the residual demand of firm A following a one percent increase in the price of firm B. This helps to understand how these two firms restrain each other in the market. By subtracting the two elasticity estimates thus obtained, one obtains the value $(\epsilon_{AA}^{pr} - \epsilon_{AB}^{pr})$ which is an assessment of the market power enjoyed by the merging firm. This difference expresses the idea that when the insiders coordinate their actions and increase their prices simultaneously, firm A will lose all the consumers going to all the other firms *minus* the consumers who would have gone to firm B if the merger had not occurred (and firm B had therefore priced its product independently of firm A).

This way, with relatively small data requirements, it is possible to obtain an estimate of the likely effects of a merger. This technique is increasingly being used by economic experts and in court proceedings, and although it is unlikely that merger appraisal will be based uniquely on it, it certainly complements other information collected and the analysis of the market where the merger takes place. Residual demand estimation can also be used to define the relevant market in merger cases, as explained in Scheffman and Spiller (1987).[42]

Estimation of the Residual Demand Elasticity** Consider an industry with n single product firms. First we want to derive the residual demand faced by one such firm, and see how it can be used to estimate its market power. Then we extend this approach to estimate the market power created by a merger.[43]

Direct demand faced by a firm $i = 1, \ldots, n$ can be written as

$$q_i = D_i\left(p_i, \mathbf{p}_{-i}, \mathbf{y}\right), \tag{3.7}$$

where bold-faced letters indicate vectors and $-i$ refers to all other firms but i. The vector $\mathbf{y}$ denotes a vector (of size S) of exogenous variables which affect demand.

[41] When estimating the residual demand of firm A one takes into account how an increase in the price of A redirects customers to all rivals, without separating the effect of competition from B or any other $(n-2)$ firms. With the concept of partial residual demand function, instead, the merging partner's reaction (B's reaction) is separated from that of the other firms.

[42] See Froeb and Werden (1991) for a critical assessment.

[43] The use of residual demand elasticities as a method to measure market power of one or more firms is due to Baker and Bresnahan (1985, 1988).

For each of the firms, the first-order conditions of profit maximisation define the best-reply functions

$$p_i = R_i\left(\mathbf{p}_{-i}, \mathbf{y}, \mathbf{w}, c_i\right), \tag{3.8}$$

where $\mathbf{w}$ denotes the vector of size L which contains the industry-specific cost variables, and c_i denotes the firm-specific cost of firm i. From the previous expression one can obtain the vector of the best-reply functions of all firms but i as

$$\mathbf{p}_{-i} = R_{-i}\left(p_i, \mathbf{y}, \mathbf{w}, \mathbf{c}_{-i}\right), \tag{3.9}$$

where $\mathbf{c}_{-i}$ denotes the vector of all the firm-specific cost variables apart from those specific to firm i. By substituting back into the direct demand, we obtain the residual demand function of a firm i, $q_i^r = D_i(p_i, \mathbf{p}_{-i}(p_i, \mathbf{y}, \mathbf{w}, \mathbf{c}_{-i}), \mathbf{y})$or, more simply[44]

$$q_i^r = D_i^r\left(p_i, \mathbf{w}, \mathbf{c}_{-i}, \mathbf{y}\right). \tag{3.10}$$

The equation to be estimated would then take the form

$$\ln q_i^r = \alpha_i + \beta_i \ln p_i + \sum_{s=1}^{S} \gamma_{is} y_s + \sum_{l=1}^{L} \mu_{il} w_l + \sum_{k \neq i} \delta_{ik} c_k + \nu_i, \tag{3.11}$$

where α_i is a constant; β_i gives the estimate of the (opposite of) residual demand elasticity (because $d \ln q_i^r / d \ln p_i = -(dq_i^r/q_i^r)/(dp_i/p_i) = \epsilon_{ii}^r$);[45] the coefficients γ_{is}, μ_{il}, δ_{ik}, are the parameters of demand, industry-wide costs and cost other than firm i; and ν_i is the error term.

However, regressing (3.11) alone would not give a consistent estimator, as there is a problem of simultaneity between p_i and q_i which are jointly determined in the supply – demand system (they are both endogenous variables, and p_i appears at the right-hand side of equation (3.11)).

Typically, this problem is solved by estimating equation (3.11) by using the instrumental variable method. In this case, the method implies using c_i as an instrument for the price p_i, since c_i (the firm-specific cost of firm i) is correlated with p_i, is not correlated with the residuals, and is not an explanatory variable in (3.11).

By doing so, we obtain an estimate of the residual demand elasticity of firm i, which in turn, is an estimate of its market power: the lower the estimated value of ϵ_{ii}^r, the higher the market power of the firm.

Note that the only firm-level data needed for this method are those on the price, quantity and firm-specific cost of the firm whose market power we are interested in.[46]

[44] Note that this way of proceeding amounts to assuming that the firm whose residual demand function we build behaves as a Stackelberg leader.

[45] Note that $\epsilon_{ii}^r = \epsilon_{ii} - \sum_{j \neq i}^{n} \epsilon_{ij}\eta_{ij}$, where $\epsilon_{ii} = -(\partial q_i/q_i)/(\partial p_i/p_i)$ is the own price elasticity of the (standard) demand function, $\epsilon_{ij} = (\partial q_i/q_i)/(\partial p_j/p_j)$ is the cross-price elasticity between firm i and firm j and $\eta_{ij} = (\partial p_j/p_j)/(\partial p_i/p_i)$ is the elasticity of best reply functions, and measures by how much a rival j increases its price following a price increase by firm i.

[46] Possibly complemented by data which can summarise $\mathbf{c}_{-i}$.

Residual Demand Elasticity in Merger Analysis The same method can be applied to the analysis of mergers to estimate the joint market power possessed by two merging firms. Suppose for instance that we are interested in the likely impact of a merger between the first two firms, call them 1 and 2, in our industry of n firms. By proceeding in a similar way as above, one obtains the (partial) residual demand functions for firms 1, 2 as

$$q_i^{pr} = D_i^{pr}\left(p_1, p_2, \mathbf{w}, \mathbf{c}_{-1\&2}, \mathbf{y}\right), \qquad i = 1, 2, \tag{3.12}$$

which in logarithm becomes

$$\ln q_i = \alpha_i + \beta_{ii} \ln p_i + \beta_{ij} \ln p_j + \sum_{s=1}^{S} \gamma_{is} y_s + \sum_{l=1}^{L} \mu_{il} w_l + \sum_{k=3}^{n} \delta_{ik} c_k + \nu_i, \qquad (i, j = 1, 2; i \neq j) \tag{3.13}$$

By using the firm-specific cost variables c_1 and c_2 as instruments for p_1 and p_2, and jointly regressing the two partial residual demand curves (3.13), the coefficients β_{ii}, β_{ij} give an estimate of the partial residual demand elasticities $\epsilon_{ii}^{pr} = -(dq_i^{pr}/q_i^{pr})/(dp_i/p_i)$ and $\epsilon_{ij}^{pr} = (dq_i^{pr}/q_i^{pr})/(dp_j/p_j)$.[47]

These coefficients provide an estimate not only of the market power of each of the two firms, but also of how much the market power of, say, firm 1, is constrained by firm 2 (and vice versa). Note that the value $(\beta_{ii} - \beta_{ij})$ gives an estimate of the market power that the merging firms will enjoy in the market, as the difference between these two coefficients tells us by how much the demand faced by firm 1 decreases if both p_1 and p_2 increase by the same percentage after the merger. The lower the estimated value of this difference, the higher the market power that the merging firms are likely to enjoy, and hence the more adverse effects of the merger (other things being equal, of course).

3.3.2.2 Logit Models**

In this section, I briefly introduce the main features of a technique which is based on a *multinomial logit demand*, itself derived from a discrete choice model of consumers' behaviour.[48] Logit models, due to McFadden (1973), allow one to sharply reduce the dimensionality problems when dealing with differentiated products. They have become very popular in recent years, and have been used to estimate market power of firms and to test whether there is collusion in an industry. They also provide the

[47] Baker and Bresnahan (1985) estimate the partial residual demands jointly for the two firms by the method of three-stage least squares, to increase the power of the estimators. See Baker and Bresnahan (1985: 436–7).

[48] I draw here mainly on Werden and Froeb (1994) and Werden, Froeb and Tardiff (1996). See also Anderson, De Palma and Thisse (1992).

basis for simulations that aim at predicting the likely effects of mergers, that is the extent to which market power will be exercised by merging firms.[49]

The Logit Demand Model Suppose there exist n products that are mutually exclusive alternatives for consumers and that exhaust the set C of possible choices. Assume that consumer i has the following utility from consuming product j:[50]

$$U_{ij} = \alpha_j - \beta p_j + e_{ij}, \tag{3.14}$$

where the explanatory variable, the price, is alternative-specific (that is, it refers to the products) and it has the same coefficient for all alternatives ($\beta_j = \beta_k = \beta$ for all j and k),[51] α_j is a product-specific constant, and where the random component e_{ij} can be either unobservable product characteristics or (equally unobservable) subjective preferences of individual i.

Maximisation of the individual utility gives the probability that j will be chosen for the population of all consumers:

$$\pi_j = \Pr(U_j > U_k), \qquad \text{for all} \quad k \in C, \quad k \neq j, \tag{3.15}$$

which can be re-written as

$$\pi_j = \Pr[(e_{ik} - e_{ij}) < (\alpha_j - \beta p_j) - (\alpha_k - \beta p_k)], \qquad \text{for all} \quad k \in C \quad k \neq j. \tag{3.16}$$

Note that each $(e_{ik} - e_{ij})$ is a random variable. By specifying the distribution of all residuals, one can obtain the joint cumulative distribution of the multivariate random variable (of $n-1$ dimensions), which expresses π_j, the probability of choice of product j, as a function of product characteristics and parameters. More specifically, it is possible to prove that if all residuals are independently and identically distributed according to the *extreme value distribution*, one obtains that π_j takes a logistic distribution function (Anderson et al., 1992: 39–40):

$$\pi_j = \frac{\exp(\alpha_j - \beta p_j)}{\sum_{k \in C} \exp(\alpha_k - \beta p_k)}. \tag{3.17}$$

Estimation of Logit Models The parameters that one would like to estimate in the logit model are those pertaining to the utility functions, that is the α_js and β. Now that we know the probability π_j, and given the availability of data on individual choices and on prices, the Maximum Likelihood method can be used

[49] Willig (1991) is perhaps the first author who has suggested the use of the logit model for merger analysis.

[50] For simplicity, I assume from the outset that the utility function takes a linear form and that the price is the only relevant product characteristic.

[51] This model is known as a *conditional logit* model.

to estimate the α_js and β.[52] To solve the problem of indeterminacy inherent to the logit model, one of the α_j must be set equal to an arbitrary value, and the nth product is taken as an outside good, whose price is assumed to be zero. Call *inside goods* all goods but the nth.

There is one difficulty with this method. The probability of choosing a certain product depends not only on the utility of that product, but also – as we have seen from equation (3.15) – on the utility of the other products that have not been chosen. This requires us first to identify the set of the possible choices available and second to find data on the characteristics of all the choices that have not been made, which might well be very difficult and costly.

Alternative ways of proceeding are to use *choice-based sampling*, that is to use data only on individuals who make certain choices; or data on the ranking of choices that particular individuals would make.[53]

Estimation of logit models with data on individuals and the choices they make will present *endogeneity* problems when observed choice characteristics co-vary with unobserved choice characteristics. This is the case, for instance, when the unobserved quality of a product increases the price of that product (the ML estimate might suggest that consumers will want to buy a product with higher prices, whereas it is the unobserved quality variable which drives them). The use of instrumental variables estimation can help solve this problem.[54]

The own-price (here expressed as a positive number) and cross-price elasticities of demand are given by

$$\varepsilon_{jj} = \beta p_j (1 - \pi_j); \tag{3.18}$$

$$\varepsilon_{jk} = \beta p_k \pi_k. \tag{3.19}$$

The estimates of the α_js and the β obtained above are therefore used to compute all the relevant elasticities of the model (since from those estimates one can obtain all probabilities π_j, as in Equation (3.17)).

Independence of Irrelevant Alternatives and Nested Logit Models A crucial property of the logit model is the so-called property of *Independence of Irrelevant Alternatives* (IIA), according to which the odds ratio of any two choices is independent of other available choices. In other words, the choice of a consumer between buying product A or product B must be independent of whether any product C is also available or not. An implication of the IIA property is that the cross-price

[52] McFadden (1973) studied ML estimation and its properties. He showed that ML estimators are asymptotically efficient under general conditions.

[53] See Werden et al. (1996: 90–2) for a discussion of this point.

[54] See Berry, Levinsohn and Pakes (1995); and Hausman, Leonard and Zona (1994), who use the price in other cities to instrument for the price of any given city.

elasticity between a given product j and any product $k \neq j$ is always the same (Anderson et al., 1992: 44). Clearly, this property is based on assumptions about the pattern of substitutability that might be too strong. Consider for instance the choice of an individual who is indifferent between buying a general newspaper, call it *Corriere*, and a sports newspapers, call it *Gazzetta dello Sport*. If these two are the only newspapers available, then the probabilities of buying one or the other will be equal: Pr(*Corriere*) = Pr(*Gazzetta*) = 1/2.

But suppose now that the same consumer is given another choice, which is another sports newspaper, *Tuttosport*, very similar to *Gazzetta*. Now this consumer should be indifferent between buying the general newspaper and one of the two sports newspapers and, conditional on buying a sports newspaper, indifferent between *Gazzetta* and *Tuttosport*. Therefore, the probability of choosing each newspaper will be Pr(*Corriere*) = 1/2 and Pr(*Gazzetta*) = Pr(*Tuttosport*) = 1/4. In this example, the IIA property does not hold, because the odds ratio of any two choices is not independent of the presence or the absence of other possible choices. Indeed, the ratio between the probabilities of buying *Corriere* and *Gazzetta* is 1 if *Tuttosport* is not an available choice for the consumer, but 2 if *Tuttosport* is available.

To see whether the substitutability among the products in the industry is compatible with the IIA property or not, econometric tests can be employed. The idea behind such tests is as follows. Suppose that in the market being analysed there exist subsets of products that might be closer substitutes for each other, for instance, in newspaper markets one can suspect that general newspapers are close substitutes among each other and poorer substitutes of sports newspapers, and that sports newspapers are close substitutes among each other but poorer substitutes of general ones. One could first run estimates of a model where observations on the choice of all newspapers are included in the sample, and then run estimates with only a subset of observations (for instance, dropping the observations related to *Tuttosport* in the above example). If the two estimates obtained are close enough to each other, then the pattern of substitution implied by the data is compatible with the IIA property; otherwise, it is not. (Whether the coefficients are close enough or not should be assessed with a formal test, such as the Hausman test, that provides a formal test of the null hypothesis that the coefficients obtained from the two estimations are "identical".)

If the econometric tests indicate that the IIA is not consistent with the data, one could adopt a so-called *nested logit* model, where choices of different orders are assumed. With a single nest, for instance, the set C of all possible choices is divided into two subsets: one, that groups all products included in the nest, and the other that includes all the remaining products. (For instance, in the example above one could put all the sports newspapers in a nest.) There exist then expressions that give the unconditional choice probabilities for products that belong to the set and for the remaining ones and, starting from these probabilities, one can proceed towards an estimate of the model.

Nested logit models become more complex as one adds more nests into the analysis. An alternative approach, when the pattern of substitutability among products is unlikely to be reflected in a simple nested model, is to use *random-coefficients logit* models. Such models assume that consumer preferences are heterogenous, and estimate the unknown parameters of the distribution of consumers' heterogeneity. Some of the most interesting contributions in the econometric estimates of market power and collusion make use of this technique.[55]

Simulating Effects of a Merger with Logit Models So far, I have presented the logit model as a model used to estimate with a maximum likelihood approach the elasticities of demand of certain products. The logit model, however, intended as a model of consumer choice, can also be used to simulate the effects of a merger. This different approach is not aimed at providing econometric estimates, but rather at predicting the after-merger prices from some available data.

The methodology that follows is taken from Werden and Froeb (1994) and Werden et al. (1996), who re-parameterise the model by using as primitives an aggregate demand elasticity (see below) and market shares.

Consider a version of the logit model where the nth product is the outside good whose price is set equal to zero. Werden and Froeb (1994) define an *aggregate elasticity price of demand for the inside goods* as

$$\varepsilon \equiv [\partial \pi_I(\lambda \mathbf{p})/\partial \lambda]\,[\overline{p}/\pi_I(\mathbf{p})] = \beta \overline{p} \pi_n, \tag{3.20}$$

where $\mathbf{p}$ is the vector of the prices of all inside goods, $\overline{p}$ is some benchmark weighted average price, $\pi_I \equiv 1 - \pi_n(\mathbf{p})$ is the sum of the choice probabilities of the inside goods, and λ is a scalar. This industry elasticity measures the increase in the demand of the set of all inside goods when all inside prices are increased by a factor λ. Werden and Froeb (1994) and Werden et al. (1996) take it as a primitive of the model. The other primitive of their model is given by individual *market shares*, that is the choice probabilities for the inside goods conditional on an inside good being chosen. They are given by

$$s_j = \frac{\pi_j}{1 - \varepsilon/(\beta \overline{p})}. \tag{3.21}$$

By replacing $\pi_j = s_j\,(1 - \varepsilon/(\beta \overline{p}))$ in equations (3.18) and (3.19) and rearranging, one obtains the individual own-price and cross-price elasticities (which are going

[55] The main references are Berry (1994), Berry, Levinsohn and Pakes (1995) and Nevo (2001). Nevo (2000) offers a discussion of the recent advances in such models.

to be used below to derive the price–cost margins) as

$$\varepsilon_{jj} = \frac{p_j}{\overline{p}}\left[\beta\overline{p}(1 - s_j) + \varepsilon s_j\right]; \tag{3.22}$$

$$\varepsilon_{jk} = \frac{p_k s_k}{\overline{p}}\left[\beta\overline{p} - \varepsilon\right]. \tag{3.23}$$

Given prices and market shares, β and ε (which are industry, and not individual firm's, variables that might be available from previous studies, might be estimated, or are guessed at) the own- and cross-price elasticities of demand can be recovered.

The choice probabilities of an inside product j and of the outside good are given by expression (3.17), and the logarithm of their ratio will be

$$\ln\left(\frac{\pi_j}{\pi_n}\right) = \ln\left(\frac{e^{\alpha_j - \beta p_j}}{e^{\alpha_n}}\right), \tag{3.24}$$

where $p_n = 0$ has been used. By simplifying and rearranging this becomes

$$\alpha_j = \alpha_n + \beta p_j + \ln \pi_j - \ln \pi_n, \qquad j = 1, 2, \ldots, n-1. \tag{3.25}$$

From (3.20) we know that $\pi_n = \varepsilon/(\beta\overline{p})$, and we also know that $\pi_j = s_j(1 - \varepsilon/(\beta\overline{p}))$, where $\overline{p}$ is the share-weighted average pre-merger price. Substituting them into the previous expression (3.25) gives

$$\alpha_j = \alpha_n + \beta p_j + \ln s_j + \ln\left(\frac{\beta\overline{p}}{\varepsilon} - 1\right), \qquad j = 1, 2, \ldots, n-1. \tag{3.26}$$

This equation says that the α_j's can all be found analytically, given that the variables at the RHS are known (and α_n is set equal to an arbitrary constant): β and ε are known; and prices and market shares are data that are assumed to be available.

To complete the model, assume that (1) each firm before the merger produces only one differentiated product; (2) each firm has no fixed costs and a constant marginal cost c_j; (3) firms compete in prices; (4) all other product characteristics are fixed (that is, the merger could neither lead to entry nor product re-positioning by the existing firms).

Under such assumptions, we know that the FOCs for profit maximisation can be re-written as: $(p_j - c_j)/p_j = 1/\varepsilon_{jj}$ (this is nothing else than the Lerner index). By using expression (3.22) we can then obtain each firm's margin as

$$p_j - c_j = \frac{\overline{p}}{\beta\overline{p}(1 - s_j) + \varepsilon s_j}, \qquad j = 1, 2, \ldots, n-1, \tag{3.27}$$

which implies that a firm's margin increases with its market share (s_j) and decreases with the substitutability among the inside products (β), and decreases with the

substitutability between inside and outside goods (ε). Equation (3.27) allows us to find analytically the marginal costs of each firm, since it expresses c_j as a function of p_j, $\overline{p}$, β, s_j, and ε, which are all given.

The next step is to see what happens under a merger. Without loss of generality, suppose that firms 1 and 2 merge, and call m the resulting firm. The FOCs of price maximisation for firm m imply that

$$p_1 - c_1 = p_2 - c_2 = \frac{\overline{p}}{\beta \overline{p}(1 - s_m) + \varepsilon s_m}, \tag{3.28}$$

where s_m is the pre-merger market share and $\overline{p}$ is the share-weighted average price before the merger. Since all parameters are known (marginal costs have been derived by using the FOCs and actual pre-merger prices, as explained above), replacing them in equations (3.28) gives the predicted post-merger prices. From these, one could also predict the effect of the merger on consumer surplus and total welfare.[56]

3.4 EXERCISES

Exercise 3.1 Briefly describe the hypothetical monopolist test and explain the rationale for using it as a market definition test. Then apply the test to define markets for goods you are familiar with. For instance, (a) is there a separate market for pizzerias in your town? Or should pizzerias be included in a wider market including also fast-foods and restaurants? (b) Is there a separate market for the bus service (or train, or airplane services) between your home town and your university town (or any two towns you know)? Or is there a wide market including all types of transportation between such two towns? (c) Is there a separate relevant market for anti-trust textbooks?

Exercise 3.2 The extent to which a firm can exercise market power is limited by the existence of potential entrants, or more generally by firms that can start supplying a competing product once attracted by higher prices in the market. Should these considerations be taken into account when defining the relevant market or when assessing market power?

Exercise 3.3 A well-known premium brand of tennis shoes and a cheap minor brand of tennis shoes are considering a merger, and you have to determine the relevant market. One piece of information you have is the wholesale prices set by the producers for the last five years, and this shows that the premium brand's price is consistently twice as much as the minor brand's price. Will you conclude that the two products should be put in the same, or in separate markets?

[56] See Werden and Froeb (1994) and Werden et al. (1996) for a complete discussion, that includes an overview of the implications of the logit demand model, reports the expressions that can be used to compute consumer surplus and welfare, and presents some applications.

Exercise 3.4 What considerations should be taken into account when defining product markets and assessing market power in after-markets or secondary markets (that is, the markets for spare parts or services for a particular brand of a product)?

Exercise 3.5 What is the rationale for using market shares as a screening device in the assessment of market power stage of investigations? What other variables would you like to know before concluding whether a firm with a given market share is dominant?

Exercise 3.6 *Briefly explain the rationale for using the residual demand elasticity analysis and the logit model for investigations on market power in differentiated products industries.

Exercise 3.7 ***(Buyer power coordination – from Fumagalli and Motta (2000))* An incumbent firm, I, has already sunk its market-specific cost, and a potential entrant, E, still has to incur this fixed sunk cost, F. If it enters, it would produce the same homogenous good as the incumbent. The potential entrant is more efficient, with a unit variable cost c_E strictly lower than the cost of the incumbent, c_I. Buyers have unit demands for the good and their maximum willingness to pay (valuation for the good) is V. At $t = 0$, N buyers call a procurement auction for the good. At $t = 1$, the incumbent and the potential entrant simultaneously make their (public) bids to all the buyers. At $t = 2$, each buyer observes the bids and (independently of the others) decides whether to accept the incumbent's or the entrant's offer. At $t = 3$ the incumbent fulfils all the orders it has received; the entrant observes the number of buyers who addressed it, and decides whether to actually enter the industry or not. In the former case, it immediately makes the necessary investment and fulfils the orders. In the latter case, it stays out and has payoff 0. At $t = 4$, the buyers whose orders have not been fulfilled by firm E can turn to the incumbent. We assume that (A1) $F > V - c_E$, i.e., a single buyer is never enough to trigger entry, and (A2) $F < N(c_I - c_E)$, i.e., entry is viable if the entrant charges some price $p \geq c_I$ and is addressed by all buyers. Show that there exists an equilibrium where the potential entrant does not enter the industry and indicate under which condition this occurs.

3.4.1 Solutions to Exercises

Exercise 3.7 We will solve the game by backward induction.

$t = 4$: If E did not enter, I will offer the good at $p_I = V$ to the buyers who addressed E in $t = 2$ but were not served by E.

$t = 3$: E receives a number S_E of orders. Given the price he quoted in $t = 1$, he will enter if $S_E(p_E - c_E) \geq F$.

$t = 2$: Buyers observe the bids p_I and p_E. Case 1: $p_I < p_E \leq V$ (we will ignore cases where either of the two firms quotes a price above V). All N buyers will address I. Case 2: $c_I \leq p_E \leq p_I \leq V$ (we will ignore cases where either of the

two firms quotes a price below c_I). Then, buyers know that E will only enter if $S_E \geq F/(p_E - c_E) = S_E^*(p_E)$. By (A1), we know that a single buyer will never be enough to trigger entry, i.e. $S_E^*(p_E) > 1$ for all $p_E \in [c_I, V]$. At this stage, the buyers' choice game has only two equilibria: $S_E = N$, $S_I = 0$ (all buyers patronise the entrant, who will enter since by (A2) entry is worthwhile, and supply the good at a lower price than I); and $S_I = N$, $S_E = 0$ (the "mis-coordination" equilibrium, where all buyers address the incumbent; note that a single buyer has no incentive to deviate, as he alone would not be able to trigger E's entry, so he would have to turn to I in $t = 4$ and buy the good at price V instead.)

$t = 1$: equilibrium 1: $S_E = N$, $S_I = 0$ will only be sustained by the price pair $p_E^* = p_I^* = c_I$ (quasi Bertrand with unequal marginal cost). Equilibria 2 (mis-coordination equilibria): $S_I = N, S_E = 0$ will be sustained by $p_I^* = V$ and any $p_E^* \leq p_I^*$ (I will anticipate buyers' mis-coordination and therefore charge the maximum price they are willing to pay, i.e., V).