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A SSNIP-Test for the Relevant Geographic Market.

Abstract: I develop a method how to apply the general idea of the SSNIP-test to the definition of the relevant geographic market. The test applies to markets with heterogeneous goods. To find the correct relevant geographic market we only have to know three parameters which are not difficult to measure: 1. the maximum profitable transport distance, 2. the hypothetical switch ratio of demand from a more expensive to a cheaper good at a 10 % price difference, 3. the margin of the competitive price above marginal costs. For almost all manufactured products the relevant geographic market in Europe is substantially larger than even the largest national market.

A Introduction

The relevant geographic market is an important concept in the day to day work of competition authorities and courts. As regards the relevant product market, following the lead of the US Department of Justice, the European Commission has adopted the test of the hypothetical monopolist or SSNIP-test. But so far authorities have been reluctant to adopt a SSNIP-test also for the definition of the relevant geographic market. It appears to me that the reason for this inconsistency is a logical mistake that lies behind the way the relevant geographic market so far has been defined. And economists should point this out to the authorities. The logical mistake is the following. The authorities use product characteristics to define the geographic market. But these product characteristics should be taken into account when defining the relevant product market rather than when defining the relevant geographic market. In its Notice on the definition of the relevant market (European Commission 1997) the Commission writes:

"The Commission's approach to geographic market definition might be summarised as follows: it will take a preliminary view of the scope of the geographic market on the basis of broad indications regarding the distribution of market shares of the parties and their competitors as well as a preliminary analysis of pricing and price differences at national and

EU or EEA level. This initial view is used basically as a working hypothesis to focus the Commission's enquiries for the purposes of arriving at a precise geographic market definition.

The reasons behind any particular configuration of prices and market shares need to be explored. Companies might enjoy high market shares in their domestic markets just because of the weight of the past, and conversely, a homogeneous presence of companies throughout the EEA might be consistent with national or regional geographic markets. The initial working hypothesis will therefore be checked against an analysis of demand characteristics (importance of national or local preferences, current patterns of purchases of customers, product differentiation/brands, other) in order to establish whether companies in different areas do really constitute an actual alternative source of supply for consumers. The theoretical experiment is again based on substitution arising from changes in relative prices, and the question to answer is again whether the customers of the parties would switch their orders to companies located elsewhere in the short term and at a negligible cost..

If necessary, a further check on supply factors will be carried out to ensure that those companies located in distinct areas do not face impediments to develop their sales on competitive terms throughout the whole geographic market. This analysis will include an examination of requirements for a local presence in order to sell in that area, the conditions of access to distribution channels, costs associated with setting up a distribution network, and the existence or absence of regulatory barriers arising from public procurement, price regulations, quotas and tariffs limiting trade or production, technical standards, monopolies, freedom of establishment, requirements for administrative authorisations, packaging regulations, etc... In short, the Commission will identify possible obstacles and barriers isolating companies located in a given area from the competitive pressure of companies located outside that area, so as to determine the precise degree of market interpenetration at national, European or global level.

The actual pattern and evolution of trade flows offers useful supplementary indications as to the economic importance of each demand or supply factors mentioned above, and the extent to which they may or may not constitute actual barriers creating different geographic markets. The analysis of trade flows will generally address the question of transport costs and the extent to which these may hinder trade between different areas, having regard to plant location, costs of production and relative price levels.

Market integration in the European Union

Finally, the Commission also takes into account the continuing process of market integration in particular in the European Union when defining geographic markets, especially in the area of concentrations and structural joint ventures. The measures adopted and implemented in the internal market programme to remove barriers to trade and further integrate the community markets cannot be ignored when assessing the effects on competition of a concentration or a structural joint venture. A situation where national markets have been artificially isolated from each other because of the existence of legislative barriers that have now been removed, will generally lead to a cautious assessment of past evidence regarding prices, market shares or trade patterns. A process of market integration that would, in the short term, lead to wider geographic markets may therefore be taken into consideration when defining the geographic market for the purposes of assessing concentrations and joint ventures."

The basic approach of the European Commission – and for that matter most other antitrust authorities – then is that it looks at regional differences of relevant facts like market shares,

consumer preferences, prices etc. If these differences are significant then it sees distinct relevant geographic markets. In the last paragraph just quoted from the Commission Notice it does take account of the relevance of the European integration process for the definition of the relevant geographic market, but it is almost like an afterthought after having emphasised the regional differences within Europe. If one takes the "regional differences approach" towards the problem of defining the relevant geographic market, as the Commission does, it risks forgetting the competitive potential which arises out of the European process of integration. Thereby it risks losing sight of its own accomplishments in promoting competition across Europe by having done away with national trade barriers.

The results of this approach can be quite paradoxical. For a given group of products, due to differences in consumer habits, Germany and France may be considered to form separate relevant geographic markets. Yet the products both nations consume perhaps originate in China are then shipped to their different "markets" in Germany and France. Given that these products travel around half the globe from the manufacturing site to the place of consumption transport costs cannot be responsible for defining these two national relevant geographic markets. It is due to differences in tastes between the Germans and the French that authorities find distinct relevant geographic markets. But differences in tastes refer to differences in product characteristics; thus they should be dealt with in defining the relevant product market. Let product F be geared to French tastes and let product G be geared to German tastes. Thus the market share of F is large in France and small in Germany; and the market share of G is large in Germany and small in France. But it is likely – taking supply substitutability into account - that sales of product G in France are a closer substitute to sales of product G in Germany than are sales of product F in Germany. Thus any reasonable economic test would result in the sentence: if F sold in Germany is in the same relevant market as G sold in Germany then – a fortiori – G sold in France is in the same relevant market as G sold in Germany. Given that transport costs are not important for the question whether to ship to France or Germany the competitive constraints are not restricted by the question "where the product is consumed ?" but only by the question "which product is consumed?". And this latter question is answered by the definition of the relevant product market.

Take a merger case: there are two manufacturers, one producing product G for the German market, the other producing product G for the French market. If, due to the procedure of defining the relevant geographic market in the way described in the Notice quoted above, the

two firms may be seen to be part of two different relevant geographic markets. This then may have the result that there are no obstacles for their merger. On the other hand, if we consider the relevant product market and then deem G to be in a different product market from F then the fact that transport costs are irrelevant in this case will bring product G in Germany and product G in France into the same relevant market, and this will then result in a decision to block the merger.

Thus my proposal is this: any question about substitutability in terms of product characteristics should be dealt with in the definition of the relevant product market. Any question concerning the substitutability of location of production should be dealt with in the definition of the relevant geographic market. National taste differences, for example, then are a matter of product market definition. The relevant geographic market then is matter of transport cost and perhaps trade barriers imposed by governments. It is then possible to apply the SSNIP-test to the definition of relevant geographic market just in a similar way as it is applied for the definition of the relevant product market.

B The Model

In this section I present a simplified model of geographic competition. For simplicity of presentation I will make certain approximate calculations. But, as I will show, the exact derivation would lead to even wider geographic markets.

In any specific proceeding, say, a merger proceeding, it will be possible to find out how far products are being shipped on a regular basis. We then can presume that such shipping distance will be economical. By the "reach" of a plant we mean the maximum economic shipping distance observed in this industry. This may be less than the maximum observed shipping distance, because there are occasions in business life where an undertaking is willing to ship goods at a distance which is not commercially viable in the long run. Let t be the "reach" of plants in this industry. In my theory I want to derive the ratio between the radius r of the relevant geographic market and the reach of plants in the industry. Let me stress that my theory does not require a precise knowledge of the transport cost structure of the industry.

Transport costs enter the model indirectly, because they are important for the reach of plants. They do not enter the model directly.

In this model I assume that demand is distributed equally over the plane. I will discuss this assumption in section D. Moreover I assume that the average distance a of two neighboring plants is not larger than the "reach" of a plant t. This presupposes that the goods competing in this market are differentiated and not homogeneous. With homogeneous products we would expect that customers buy from the plant which is closest and that this implies a reach below the average distance between plants. We then assume that there is a regular "lattice" of plants with a distance $a \leq t$.

Let r be the radius of a circle drawn around a specific plant, where this circle is proposed as the relevant geographic market of that plant. We assume $r \geq t$. We then apply the test of the hypothetical monopolist or SSNIP-test. The hypothetical monopolist is the sole supplier of all customers within the circle and does not serve any customers outside the circle. Initially the hypothetical monopolist charges a price which is the hypothetical competitive price. We assume that the competitive price is the same for all customers. This assumption will further be discussed below in section D. Let p_0 be the competitive price. At the competitive price the hypothetical monopolist has a percentage margin m above marginal cost. As we discuss a market with competition between heterogeneous goods the competitive margin is positive. See for example the model of monopolistic competition. For a further simplification of presentation we assume that marginal cost does not change with changing output. In that case the margin is of course necessary to cover set-up costs, i.e. costs, which arise even at output level zero.

Following the procedure of the SSNIP-test we ask the question: is it profitable for the hypothetical monopolist to raise his price by 10 %? He will then loose some of his sales; on the other hand he earns a higher margin on each unit sold. As a percentage of the competitive price his margin now is $m + 0.1$. The hypothetical monopolist owns the plant in the centre of the circle. Moreover he owns additional production capacity in the circle so as to serve all customers within the circle from a distance below the reach of plants t. On the other hand other suppliers serve the customers outside the circle. They do this partly from manufacturing capacity which is located inside the circle. A given plant may be hypothetically split into two parts: one part, which serves customers inside the circle and which is under the control of the

hypothetical monopolist; and another part, which serves customers outside the circle and which is under the control of other suppliers.

Let us then look at a ray starting in the centre of the circle and going east along one of the straight lines connecting the locations of the different plants. Thus it is a line which is part of the lattice whose nods are the locations of the different plants. Let the coordinate or "house number" of the center be 0 (zero). And let the "house number" s of any other point on this ray be equal to the distance (in kilometers) of this point from the centre. We then look at a location s with the following inequality

$$r - t < s < r \tag{1}$$

This inequality means that point s belongs to the customers of the hypothetical monopolist, but it is sufficiently close to the outside of the circle to be accessible by plants which serve the customers outside the circle and which therefore are under the control of suppliers distinct from the hypothetical monopolist. Indeed, there is a plant on the ray inside the circle, which also serves customers outside of the circle. We have a plant on the point na with n being an integer and so that

$$na \le r < (n+1)a \tag{2}$$

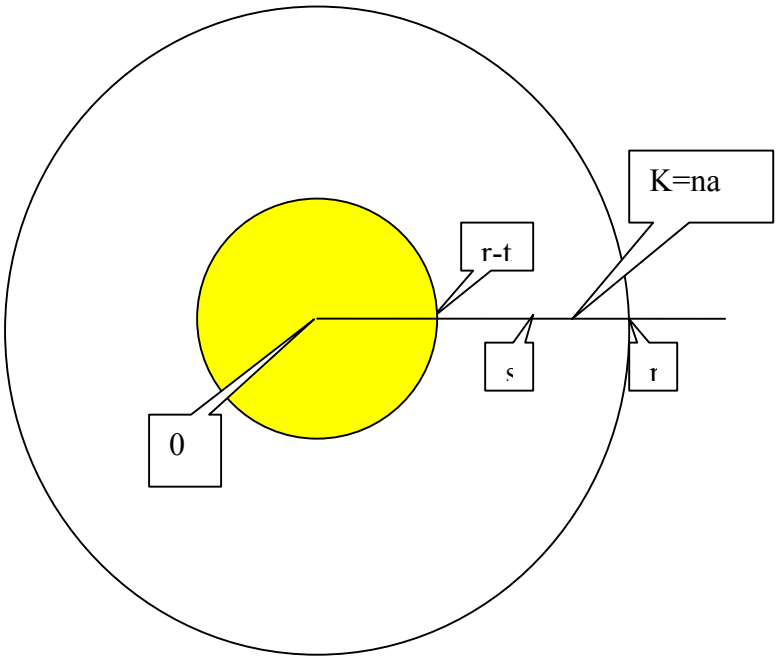
This plant has a reach which partly also goes outside the circle and which therefore to that extent is not under the control of the hypothetical monopolist. If now the hypothetical monopolist raises his price by 10 % a customer within the circle at point s could switch to this other supplier who (partly) controls the plant at na. For the inequalities (1) and (2) imply the following: If $s \ge na$ then

$$s - na \le r - na \le a \le t$$

And if $na \ge s$ then

$$na - s \le r - s \le t$$

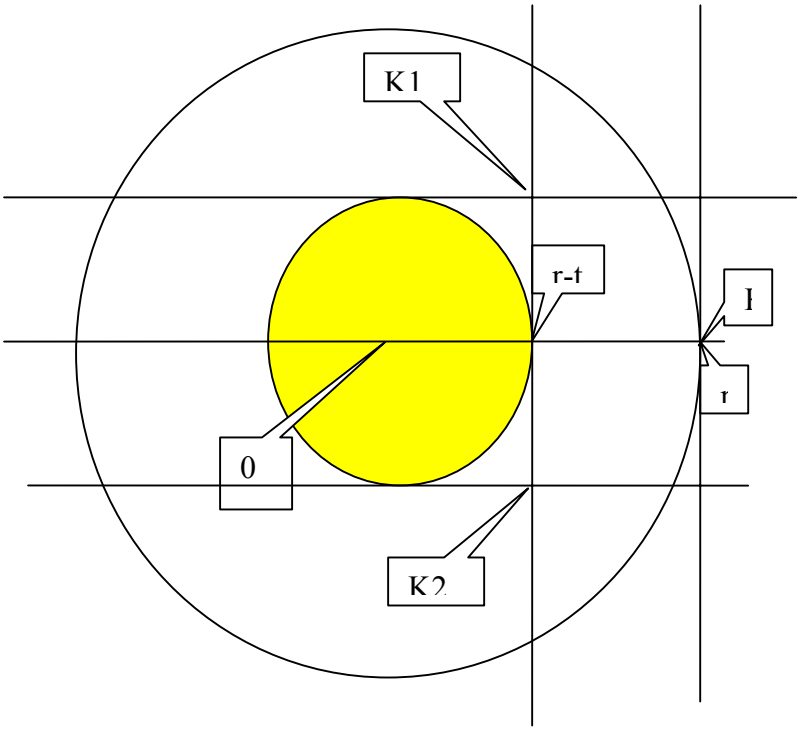
So point s can economically be served by somebody else than the hypothetical monopolist. We may call the location of the plant of the competitor "K". Of course $K = na$. We then have the following picture.



We now could provide a similar analysis for rays from the centre which are not part of the lattice for the plants. It would be more complicated. Instead I simply draw a second picture to convince the reader that any point in the circle which is closer to the outside than t can be reached by a plant, which also serves customers outside the circle and thus a customer at this point can switch to a competitor, once the hypothetical monopolist raises his price above the competitive value. In this second picture I have located two additional plants K1 and K2 which also serve customers outside and which prove that every point of the white area to the east of the centre can be reached by plants which also serve customers outside of the circle. Similar considerations can of course be performed for the "western" part of the circle. Thus we can conclude that any point in the circle which is closer to the outside than the reach of plants t can be served by potential competitors of the hypothetical monopolist. The picture drawn is of course a special case in which we have $r = 2t = 2a$. But it is clear that whenever r is not an integer times a the plant K is inside the circle and thus imposes even more competitive pressure on the hypothetical monopolist.

The result of our analysis then is: any point served by the hypothetical monopolist closer to the outside than the reach of plants could be served by plants under the control of competitors of the hypothetical monopolist. Even some points, which are even further away from the

outside than the reach of plants, could be served by competitors. But we ignore this effect thereby simplifying our analysis, but erring in the direction of finding too small a relevant geographic market.



I now introduce a parameter, which characterises the willingness of customers to switch upon a price rise by 10 %. Thus let w be the proportion of customers who switch from the hypothetical monopolist after a price rise of 10 %, given that a competitor can reach them.

We now can find out whether the price rise by 10 % by the hypothetical monopolist is profitable or not.

The area of a circle with radius r is of course πr^2, where $\pi \approx 3{,}14$ is the ratio of circumference to the diameter of the circle. The area of the yellow inner circle accordingly is $\pi(r-t)^2$, whereas the area of the white part of the circle equals $\pi(r^2-(r-t)^2)=\pi(2rt-t^2)$. In the case $\frac{r}{t}=2$, for example we have a ratio of "yellow" to "white" of 1 to 3.

Let x_0 be the volume of sales of the hypothetical monopolist at the old (competitive) price p_0. If sales per square kilometer are b/π then sales at the old price are

$$x_o = br^2$$

Let x_1 be sales at the new price. In the yellow inner circle the price rise has no effect, because there the customers are not reachable by competitors. These sales in the yellow area amount to $b(r-t)^2$. In the white area a proportion of w customers switch to the competition. Thus sales in the white area after the price rise amount to $b(1-w)(r^2-(r-t)^2)$. So total sales are

$$x_1 = b(r-t)^2 + b(1-w)(r^2-(r-t)^2) = b(w(r-t)^2) + (1-w)r^2)$$

Now we can compute profits before and after the price rise. "Profits" (including covering of set-up costs) before the price rise are

$$\pi_0 = x_0 p_0 m = br^2 p_0 m$$

Profits after the price rise then are

$$\pi_1 = x_1 p_0 (m+0{,}1) = b(w(r-t)^2 + (1-w)r^2) p_0 (m+0{,}1)$$

If the price rise reduces profits then the proposed relevant geographic market was too small. If the price rise raises profits the proposed relevant geographic market was not too small. If we look at the smallest radius so that the profits do not decline after the price rise we are looking for the radius at which the equation $\pi_1 = \pi_0$ holds. We then have the equation

$$bp_0 r^2 m = bp_0 (w(r-t)^2 + (1-w)r^2)(m+0{,}1)$$

From this we can compute

$$\frac{(r-t)^2}{r^2} = \frac{m-(1-w)(m+0{,}1)}{w(m+0{,}1)} = \frac{wm-(1-w)0{,}1}{w(m+0{,}1)}$$

Denoting the right side by φ we then can obtain

$$\frac{r}{t} = \frac{1}{1-\sqrt{\varphi}} \tag{3}$$

This then is the equation for the relevant geographic market. For this equation to have a real valued solution φ must be non-negative. But economic considerations show us that φ must be non-negative. If φ were negative then the numerator would be negative. Then we would have $(1-w)(m+0{,}1)-m>0$. This would mean that even if the whole circle would be accessible by competitors the price rise would be profitable. But this, by the SSNIP-test, simply means that the relevant product market has not been defined correctly. And then it is of course not possible to define the geographic market correctly. The correct product market definition implies that φ is non-negative.

Our model then tells us that the relevant geographic market is determined by three parameters which describe the business world of the particular industry. These are t, the reach of a plant which itself generally depends on transport costs. Then m, the margin of the competitive price above marginal cost (the "Lerner index"). And finally w, the propensity of customers to switch suppliers after a price rise by 10 % of their actual supplier. All three parameters are not too difficult to measure in real life merger cases.

C Numerical evaluation

In the following table I present the ratio of the radius r of the relevant geographic market to the reach of plants t as a function of the two parameters m and w.

Table 1: Values of $\frac{r}{t}$ as a function of the margin and the switch ratio

	$m = 0{,}1$	$m = 0{,}2$	$m = 0{,}25$	$m = 0{,}3$
$w = 1$	3,41	5,45	6,46	7,46
$w = 0{,}9$	3,00	4,84	5,75	6,66
$w = 0{,}8$	2,58	4,23	5,04	5,85
$w = 0{,}7$	2,15	3,62	4,33	5,04
$w = 0{,}6$	1,69	3,00	3,62	4,23
$w = 0{,}5$	1,00	2,37	2,90	3,41
$w = 0{,}4$	-	1,69	2,15	2,58
$w = 0{,}3$	-	-	1,28	1,69

Thus, for example, if the margin is 25 % and if the switching coefficient is 60 % then a reach of plants of 300 km implies a radius for the relevant geographic market of

$$r = 3{,}62 * 300km = 1086km$$

Some cells in the table are without a number. They correspond to those combinations of m and w which yield negative values for φ.

It is clear from equation (3) that r/t must be at least unity. The radius of relevant geographic market is always larger than the reach of plants. The economics of this result is of course

straightforward. In a circle of radius less than the reach of plants and under the assumption that the distance of plants is not greater than the reach of plants it is the case that every point in the circle can be reached by a plant not under the control of the hypothetical monopolist. Thus, granted that the product market has been defined correctly, every customer of the hypothetical monopolist has a sufficiently high propensity to switch after the price rise to make the price rise unprofitable.

In the table I have colored some of the entries red. I consider these to be realistic combinations of switching rates and margins. There is of course a negative relation between the propensity of customers to switch and the equilibrium competitive margin. Price competition implements a Bertrand-Nash equilibrium; and, as is well known, this equilibrium goes with a margin which is inversely related to the propensity to substitute among customers.

A typical margin between price and marginal cost in manufacturing is in the range of 20 % and 30 %. On this see for example Hall (1988) or Domowitz et al (1988). A Lerner index of 25 % corresponds to an own price elasticity of demand of 4. In the case of a linear demand function this implies that a 10 % price rise reduces demand by 40 %. But this is of course not the elasticity of demand facing the hypothetical monopolist, but rather actual demand elasticity of suppliers competing with heterogeneous goods. But the hypothetical monopolist in our mental experiment faces competition from products which have the same brand as the goods sold by him. For, all goods sold in the real world under the same brand outside the proposed relevant geographic market are treated in this exercise as goods sold by a competitor. We therefore can expect that the elasticity of demand for the products of the hypothetical monopolist is higher from those customers, who are close enough to the outside of the circle to be accessible by the hypothetical competitors of the hypothetical monopolist. As we then put the switching coefficient at a value of 50 % or 60 % rather than 40 % we take account of this intra-brand competition.

The red figures then all are around 3. This implies that the radius of the relevant geographic market is about three times the radius of the area, which can be reached economically from the location of a single plant. This then also means that the relevant geographic market of a single plant has nine times the sales which come from that plant.

With very few exceptions modern manufacturing plants in Europe have a reach of several hundred kilometers or more. This is certainly so for almost any finished product like consumption goods or investment goods. There may exist a few intermediate goods like certain building materials in which transport costs limit the reach to 100 kilometers or less. But even among manufactured intermediate goods this is rather the exception than the rule. This indicates that most of the time the radius of the relevant geographic market in Europe is at least 1000 kilometers. Its diameter then is in the order of 2000 kilometers, thus covering a very substantial part of Europe and certainly covering an area which is substantially larger than even any national geographic market in the European Community.

Obviously the situation is different for services and to a certain extent also for certain agricultural products.

D Discussion of the Key Assumptions

Assumption 1: The reach of plants is greater than the average distance between neighboring plants. This assumption certainly is empirically valid in Europe. How can we explain this phenomenon? First of all, almost all industrial product markets are markets characterized by product differentiation. End consumers and hence middlemen like the large retailers do not simply buy the cheapest product. They are brand conscious, they are aware of the "lemons problem" and thus do not simply assume that all products on the market are of the same quality. They are prepared to pay more for a brand which they consider to provide good quality etc. This then means that in an industry transport costs are not minimized. It is not the case that the good comes from the nearest plant. Most plants then are able to sell at prices which cover transport costs for distances above the average distance to the nearest competing plant. Second, due to improved transport technology, improved road infrastructure, improved communication technology and due to the elimination of national trade barriers the reach of plants in Europe generally has increased through time. But plant locations only change slowly and thus the distribution of plants across Europe still represents a time gone, in which the reach of plants has been substantially lower than today.

Assumption 2: Price independent of the transport distance. Again, this assumption is reasonably realistic for a majority of manufacturing industries in Europe. It is quite generally

the case that an industry is characterized by slack capacity. Here I do not want to explain this fact theoretically. Most markets are buyers markets, and sellers are interested to sell more than they actually can sell at the going price. But then the owner of a plant does not only experience rising transport cost with a rising shipping distance, but also rising competitive pressure from suppliers whose relative transport cost position improves as the shipping distance of the first plant owner rises. These two effects on pricing approximately cancel each other with the result that the price neither rises nor falls with a rising shipping distance. As businessmen would express this: "heavy competition forces us to absorb transport costs". Nevertheless I admit that this is only an approximation of the real world.

Assumption 3: Equal distribution of customers in the two dimensional landscape. Obviously this is an assumption to make the computation easy. And obviously reality does not exactly conform to this assumption. Nevertheless I believe it to be a reasonable assumption, because in fact, different distributions of customers on the plane would not make too much of a difference. The reason why I believe the results to be rather insensitive with respect to changes in the distribution of customers on the plane is the following thought experiment.

Assume that customers are equally distributed along a line, i.e. in one dimensional Euclidean space. We then can make the analogous computation of the relevant geographic market. Table 2: Value of $\frac{r}{t}$ in a two dimensional and a one dimensional world

	Equal distribution in the plane	Equal distribution on the line
$w = 1$	6.46	3.5
$w = 0{,}9$	5.75	3.15
$w = 0{,}8$	5.04	2.8
$w = 0{,}7$	4.33	2.45
$w = 0{,}6$	3.62	2.1
$w = 0{,}5$	2.90	1.75
$w = 0{,}4$	2.15	1.4
$w = 0{,}3$	1.28	1.05

Without going into the formulas (they are analogous to the formulas derived in section B above) we report certain numerical results. Table 2 is an example of such results. It compares

the ratio of $\frac{r}{t}$ for a margin of 25 % and for different switch ratios for the two dimensional case and for the one dimensional case.

Now, even if the surface of the earth would be one-dimensional the relevant geographic market would be substantially above the reach of plants. And clearly the real world comes closer to the idealized model of the equally populated plane than to the idealized model of the equally populated line. The important point is this: As the reach of the plant doubles in the real world the number of accessible customers rises approximately fourfold in the real world. This the real world has in common with the equally populated plane. In the one-dimensional world the number of accessible customers doubles as the reach of the plant doubles. But this means that for a given radius/reach ratio the proportion of customers of the hypothetical monopolist who are accessible by competitors is much larger in the two dimensional case of the real world or the idealized plane than in the one-dimensional world. And it is this proportion of customers who are accessible by competitors which determines the relevant geographic market by the SSNIP-test.

Indeed, take the case of a switch ratio of 60 %. Then at the correct relevant geographic market the proportion of customers accessible by competitors must be equal to 11/21. This proportion is reached in the plane at a radius/reach ratio of 3.62; and it is reached on the line at a radius/reach ratio of 2.1. We thus can expect that in the real world the appropriate radius/reach ratio is closer to the ratio given by the equally populated plane than the ratio given by the equally populated line.

E Conclusion

Competition policy is at the heart the commitment of the European Union to implement a Common Market. In the decades past much has been achieved to accomplish this goal. National trade barriers have been substantially reduced if not eliminated. International, intra-European trade has increased greatly. On the other hand, so far competition policy tended to have too narrow a view on the geographical extension of competitive forces. This is particularly due to a concept of the relevant geographic market which emphasises national differences in tastes and habits. But those are really issues concerning the relevant product market. If we strip the concept of the relevant geographic market from these mistaken limits and consider it to be an issue only of the location of production then we quite generally obtain

results for the manufacturing sector which are more in line with the intuition of the business world, namely that competition in manufacturing almost universally is at least European wide, if not world wide. My proposal for a method how to go about defining relevant geographic markets is, I believe, more in line with the real competitive forces than the traditional approach of geographic market definition.

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