Market definition with differentiated products – lessons from the car market

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Abstract. For a variety of reasons it is likely that the market definition approach will remain an important tool in competition policy analysis for some time, despite the increased importance of other tools such as the simulation approach. Against the background of the new block exemption regulation for cars in Europe, we suggest an econometric approach to define the relevant markets with differentiated products. On the one hand, the approach is directly consistent with the SSNIP-test, and it is in fact more satisfactory than previous approaches, such as critical elasticity analysis or the simple use of standard industry classifications. On the other hand, our approach shares a lot of features with the simulation approach (similar data requirements, and similar assumptions about current market power).

We find that the relevant market for minivan cars is defined at the widest level, i.e. at the aggregate country level. Furthermore, in Italy the relevant markets for domestic cars are defined at an intermediate level, i.e. at the segment level. In all other cases, the relevant markets for cars may be defined at the narrowest level, i.e. at the subsegment level. Based on these results, we identify the firms that may violate the market share thresholds stipulated in the block exemption regulation. We find that, if we would have used an approach based on standard industry classifications instead of our econometric approach, our conclusions would have been different and, in fact, inconclusive. We also draw attention to other issues in market definition that may be of use to practitioners.

1 Introduction

Market definition has been a key instrument in all areas of competition policy, including investigations of agreements between firms, abuses of dominant positions and mergers. The importance of market definition stems from the antitrust authorities' strong reliance on market shares as a measure for market power of the firms under investigation. To make market definition more consistent with economic notions of market power, current practice in both the U.S. and Europe requires that market definition should be based, at least in principle, on the hypothetical monopoly test (or SSNIP-test). Roughly speaking, this test asks whether a hypothetical monopolist over a group of products could profitably raise its prices by about 5-10%. If this is the case, the products are concluded to constitute a relevant market, in which firms with a high market share may exercise significant market power.

The modern market definition approach is considerably more in line with economic principles of market power. At the same time, however, the approach has recently been challenged in favour of other approaches, notably the "simulation approach". This approach directly specifies a model of the market, to make precise predictions about potentially anticompetitive events, such as mergers.[1] While one may expect an increased reliance on simulation approaches, it is also clear that market definition will remain important in the coming years. In most areas there are still influential legal guidelines which rely heavily on market shares as a basis for making decisions. Furthermore, there may not always be an obvious and commonly accepted model of the market that can be used for making market power predictions based on the simulation approach. It therefore remains important to continue thinking about carefully applying the market definition approach.

This paper aims to draw lessons from a rigorous application of the market definition approach when products are differentiated. We are inspired by a recent European case, the European Commission's new block exemption on vertical restraints in the car market, which heavily relies on the computation of market shares. The new

framework, Regulation 1400/2000, was introduced in October 2002 and allows a set of restrictive practices to all car manufacturers with market shares below certain thresholds. Specifically, manufacturers with a market share below 30% can choose to form either exclusive or selective distribution agreements with their dealers (but not both), and manufacturers with market shares between 30 and 40% can form selective distribution agreements. Firms with market shares above these thresholds cannot rely on the block exemption regulation to form exclusive or selective agreements.

To apply the Regulation, it is necessary to appropriately define the relevant markets. While this is not an easy task in general, it appears to be even more difficult in the case of cars for several reasons. First, cars are not homogenous products. Cars are differentiated and the degree of differentiation does not appear to be symmetric between different cars. To define the relevant markets, it is therefore essential to have a good understanding of the substitution patterns between cars. Second, the manufacturers do not sell cars directly to end-consumers, but rather indirectly through their retailers. It is thus necessary to understand the substitution patterns at the manufacturer level, but in practice we only have data at our disposal at the retail level. Third, to define the relevant markets, one has to know the manufacturers' price-cost margins and this information is not generally available at the product level for cars. Even if margin data would be available, it is questionable that they would be reliable.

Our approach to product market definition takes into account these various issues. We essentially require the following two pieces of information: (1) the statistical information necessary to estimate a product differentiated demand system at the retail level; and (2) a suitable oligopoly model to measure current price-cost margins and to link retail-level demand to wholesale-level demand. Based on this information, we define the relevant market based on the hypothetical monopolist or SSNIP-test. On the one hand, our approach is thus consistent with common market definition principles, and in fact it is more general than previous approaches to implement the SSNIP-test, notably critical elasticity analysis and market definition based on standard (and untested) industry classifications about market segmentation. On the other hand, our approach shares a lot of features with the simulation approach. It has similar data

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[1] This approach has originally been developed to predict the effects of horizontal mergers. For an application that predicts the effects of vertical agreements, see Brenkers and Verboven (2002).

requirements, and it makes similar assumptions about current market power in the industry.[2]

We first apply the market definition approach to the European car sector, and subsequently ask several questions that are relevant to practitioners implementing the block exemption regulation. Which firms would and which firms would not satisfy the market share thresholds to be eligible for selective or exclusive distribution? To which extent would our answers have been different if no rigorous market definition had been used, but rather a definition based on standard industry classifications? We find that our approach leads to different conclusions regarding market definition, as compared to a traditional approach based on standard industry classifications. In several cases a narrower market definition is warranted, while in other cases a wider definition is needed. As a result, our approach is able to more conclusively identify the firms that violate the market share thresholds stipulated in the block exemption regulation for cars. Apart from these general conclusions, we also highlight several practical issues in market definition that arise in this case, in particular issues relating to the fact that firms sell multiple products. These may play a role in other cases as well.

The outline of the paper is as follows. In section 2, we provide a background discussion on the regulation of vertical restraints in the car sector and the role of market share thresholds. In section 3 we present our methodology for defining the relevant product markets based on the hypothetical monopolist or SSNIP-test (taking as given that markets are geographically segmented in the national countries). Section 4 presents our results from the relevant market definition. Section 5 uses these findings to identify which firms do and do not satisfy the market share thresholds, and uses these findings to draw some policy implications to practitioners. Section 6 concludes.

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[2] Its main difference relates to the "thought experiment" about market power ex post. The market definition approach is vague about this, simply asking whether a group of firms could profitably raise prices by some percentage. The simulation approach is very explicit about it, and formulates a precise model of how market power would change in response to a merger, a vertical agreement, etc.

2 Vertical restraints, safe harbours and market share thresholds

Principles of block exemption regulations

Article 81(1) of the EC Treaty prohibits agreements that may affect trade between member states, and which prevent, restrict or distort competition. Article 81(3) allows for exemptions to this prohibition, if there are benefits that outweigh the anticompetitive effects and if consumers receive a fair share of these benefits. Such exemptions can be obtained on an individual basis, but to avoid replicating similar investigations exemptions can also be granted for whole categories of agreements. In this case they are referred to as block exemption regulations.

Block exemption regulations may be characterized by two main properties. First, they typically define a set of agreements and market share thresholds for which there is a *safe harbour*, i.e. a presumption that the benefits from the agreement outweigh the possible anticompetitive effects. If the firm proposing the agreement has a market share above the stipulated threshold, the agreement is not necessarily illegal, but an individual exemption needs to be obtained. Second, block exemption regulations may also define a set of agreements, called "hardcore restrictions", for which there is a presumption that the benefits would not outweigh the possible anticompetitive effects. These may be "black clauses", i.e. agreements that are illegal regardless of the market share of the firms.

The block exemption regulations for vertical agreements and for the car sector

An important block exemption regulation is Regulation 2790/1999 for vertical agreements.[3] The general principles behind this regulation were to be more consistent with economic analysis, and to be less prescriptive, i.e. provide more flexibility to the firms. The regulation provides safe harbours for several vertical agreements, such as single branding, exclusive distribution, selective distribution, tying, recommended

[3] See the Communication from the European Commission (2002a) for a helpful discussion on the competition rules for vertical restraints.

retail prices, etc. In particular, both exclusive distribution and selective distribution are exempted for firms with a market share of up to a 30%, even if these agreements are combined with each other or with other non-hardcore restrictions. The regulation on vertical agreements does not apply when there are other sector-specific block exemption regulations. This has been the case for the car sector since 1985.

A new block exemption regulation for the car sector has been introduced in 2002, Regulation 1400/2002. On the one hand, the new regulation for cars was designed to be consistent with the general principles of the 1999 block exemption regulation on vertical agreements. On the other hand, the Commission found that a separate, stricter regulation for the car sector was desirable. This approach stemmed mainly from a concern with the "cumulative effect", i.e. the effects on competition when all firms in a market adopt similar vertical agreements. The result was a block exemption regulation for the car sector allowing firms to adopt either selective or exclusive distribution, but no longer the combination of both restrictions,[4] as would have been possible under the former regulation for cars or under the general block exemption regulation for vertical agreements. The condition for allowing the possibility to adopt either selective or exclusive distribution was that the firms should satisfy certain market share thresholds.

Market share thresholds in the block exemption regulation for the car sector

The market share thresholds stipulated under the block exemption regulation for the car sector are different from the thresholds under the general block exemption regulation for vertical agreements. In summary, the thresholds are more stringent and are as follows:

- 40% market share threshold as a safe harbour for selective distribution;

[4] For a detailed description of the meaning of selective and exclusive distribution, as well as other restrictions covered by the regulation, we refer to Brenkers and Verboven (2002). Briefly stated, throughout the text selective distribution refers to the manufacturer's practice of imposing qualitative and quantitative criteria to its dealers. Exclusive distribution refers to the practice of assigning an exclusive geographic territory to the dealers. Useful policy documents describing the perceived problems with selective and exclusive distribution is by the U.K. Competition Commission (2000) and the European Commission (2000). A useful policy document providing explanation of the block exemption regulation, including discussion on market definition and market share thresholds is the explanatory brochure of the European Commission (2002b) available at their website.

- 30% market share threshold as a safe harbour for exclusive distribution.[5]

In practice this means that a firm with a market share below 30% can freely choose between either selective or exclusive distribution. A firm with a market share between 30% and 40% can choose only selective distribution; to be allowed exclusive distribution it would need to obtain an individual exemption from the Commission. A firm with a market share above 40% does not fall under the block exemption; hence it would need to request an individual exemption for either exclusive or selective distribution.

3 Methodology for market definition

The discussion in section 2 has shown that the decision to provide a safe harbour for vertical restraints critically depends on the market shares of the firms. The idea behind this approach is that firms with sufficiently low market shares do not have significant market power, so that the vertical restraints are not expected to seriously damage the extent of competition. To make this approach convincing, it is necessary however to first define the relevant market based on sound economic principles.

In this section, we outline our methodology for defining the relevant markets. First, we provide a qualitative discussion of some preliminary steps. These steps motivate focusing our methodology on a SSNIP-test for product market definition and the role of demand substitution. Second, we outline our specific methodology, which essentially only requires information to estimate the demand for new cars, combined with a model of current equilibrium pricing behavior. Finally, we present the demand model to be estimated as the key input for implementing the SSNIP-test.

3.1 Preliminary steps

[5] The 30% market share threshold also applies to other non-hardcore restrictions. The hardcore restrictions listed in art. 4 of the block exemption regulation are, most notably, resale price maintenance, the combination of selective and exclusive distribution, and the restriction of passive selling outside an exclusive dealer's own territory.

SSNIP-test and focus on demand substitution

The principles for defining the relevant market are based on the hypothetical monopolist or SSNIP-test, similar to U.S. practice; see the Commission Notice 97/C, 372/03. The test searches for the smallest set of products for which a small but significant and non-transitory increase in prices would be jointly profitable. The considered price increase is typically in the range of 5-10%. The profitability of such a price increase may depend on three sources of competitive constraints: demand substitution, supply substitution (entry by existing firms) and potential competition (new entry). We discuss these in turn. First, the Commission Notice states that demand substitution constitutes the most immediate and effective disciplinary force on the suppliers, and should therefore necessarily be taken into account in the market definition stage. Second, supply substitution may in principle also be taken into account in the market definition stage, but since it is a less immediate constraint it requires additional analysis on the investment possibilities. Developing and marketing new cars typically involves substantial investment costs and significant time delays. This justifies that it is not necessary to account for supply substitution in our market definition test. Third, the Commission Notice explicitly states that new entry should not to be taken into account in the market definition stage, but rather at the assessment stage of competition policy analysis. In sum, to define the relevant market we apply the principles of the SSNIP-test, accounting solely for demand substitution as a competitive constraint.

Focus on product market definition

Market definition consists of both geographic and product market definition. To define the relevant geographic markets, we follow a largely qualitative approach. There exists an extensive previous documentation of large international price dispersion in the European car market. In addition, there is detailed institutional evidence that there are still existing trade barriers, even if there has been progress towards more integration over the past years. These existing trade barriers are to a large extent due to the selective and exclusive distribution system, which make it difficult for independent resellers and authorized dealers to engage in cross-border trade. This has been confirmed by some limited available evidence on low parallel

imports between countries despite the large price differentials. See Verboven (2002) for a more extensive discussion motivating to define the relevant geographic markets as the national markets.[6] Within the national markets, we then define the relevant product markets following a rigorous implementation of the SSNIP-test. We outline our general approach in the next subsection.

3.2 *The SSNIP-test for product market definition*

General framework

The above discussion allows us to focus on defining the relevant product market accounting for the role of demand substitution. Call the products for which the hypothetical price increase is considered the insider products, and the remaining products the outsider products. Consider first the joint profits earned on the insider products before the price increase, say $\pi_I(w)$. These profits depend on the wholesale prices w, as charged by the manufacturers to the dealers. The wholesale price vector w contains both the insiders' and the outsiders' wholesale price vectors, w^I and w^O, so we sometimes use $w = (w^I, w^O)$ to explicitly distinguish between both parts of the wholesale price vector. The insider products' joint profits before the hypothetical price increase equal the sum of each insider product j:

$$\pi_I(w) = \sum_{j \in I} (w_j - c_j) s_j^W(w) L, \qquad (1)$$

where I denotes the set of insider products, c_j is the marginal cost of product j, L is the total number of potential consumers, and $s_j^W(w)$ is the wholesale-level market share function of product j, i.e. the manufacturer's demand for product j as a function of the wholesale price vector. For expositional convenience and without loss of generality, the marginal cost c_j is assumed to include both the manufacturers' and the retailers' marginal cost. It is thus as if the dealers do not bear their own retail cost

[6] Detailed work documenting the presence of large price differentials, and the evolving role of trade barriers in the car market can be found in BEUC (1992), Competition Commission (2000), Degryse and Verboven (2000) and Goldberg and Verboven (2004).

directly, but rather indirectly through the wholesale price they pay to the manufacturers.

The SSNIP-test considers an increase in the insiders' wholesale prices, w^I, by a certain percentage λ, say 5 or 10 percent. Denote the new wholesale price vector by $w^{new} = ((1+\lambda)w^I, w^O)$. The insider products' joint profits after the price increase are equal to:

$$\pi_I(w^{new}) = \sum_{i \in I}((1+\lambda)w_j - c_j)s_j^W(w^{new})L. \qquad (2)$$

On the one hand, the insiders' profit margins increase from $w_j - c_j$ to $(1+\lambda)w_j - c_j$. On the other hand, the raise in the insiders' wholesale prices reduces the manufacturers' sales. The SSNIP-test simply compares the insiders' profits before and after the price increase, given by (1) and (2), and assesses whether the profit change is positive.

The above discussion implies that the SSNIP-test may be carried out with the following two pieces of information:

(i) the wholesale-level demand system $s^W(w)$;

(ii) the wholesale profit margins $w - c$.

In our application, we do not have data on manufacturers' wholesale prices, so we cannot directly estimate a wholesale-level demand system. We also do not have information on manufacturers' marginal costs, so that we cannot directly measure the wholesale profit margins. The only information we have at our disposal is demand information at the retail level (sales, retail prices and product characteristics), enabling us to estimate the retail-level demand system, $s^R(p)$, where p is the retail price vector. Fortunately, this information is sufficient if one adds a model of equilibrium pricing behavior of the manufacturers and the retailers.

Adding an equilibrium model of pricing

Following Brenkers and Verboven (2002) we specify a two-stage model of pricing behaviour by manufacturers and retailers. We provide a sketch of the model here, and

refer to that paper for detailed derivations.[7] Manufacturers first simultaneously choose their profit-maximizing wholesale prices, and retailers subsequently simultaneously choose their profit-maximizing retail prices. The second-stage Nash equilibrium retail price vector is a function of the wholesale price vector set in the first stage, and is written by the system of pass-through functions $p = p(w)$. Manufacturers in turn take into account these pass-through functions when setting their own wholesale prices in the first stage.

To derive the precise form of the pass-through functions we consider two possible scenarios of retail pricing in the second stage. In the first scenario there is perfect intrabrand competition. Retailers compete vigorously with other retailers selling the same brand, so that retail prices are equal to wholesale prices, i.e. $p = p(w) = w$. In this scenario wholesale prices are completely passed through into the retail prices. In the second scenario there is no intrabrand competition, so that retailers only compete with retailers selling different brands. The retail prices $p = p(w)$ are now implicitly defined by the system of first-order conditions for profit-maximization by the retailers, denoted by $f(p, w) = 0$. The solution to this system shows that retail prices exceed wholesale prices by a margin, which depends on the own- and cross-price elasticities of retail demand. In this scenario the wholesale prices are not passed through completely into the retail prices.

This framework enables us to obtain the two required pieces of information.

Wholesale-level demand system

The wholesale-level demand system $s^W(w)$ can be obtained by explicitly linking it to the estimated retail-level demand system $s^R(p)$, using the pass-through function $p(w)$. Specifically, we have:

$$s^W(w) = s^R(p(w)). \qquad (3)$$

[7] In the context of horizontal mergers, Hosken, O'Brien, Scheffman and Vita (2002) discuss related problems in evaluating mergers at the wholesale level, when the demand system is only known (i.e. estimated) at the retail level.

Intuitively, we are making use of the fact that manufacturers' wholesale-level demand is a derived demand, i.e. it is the demand by the dealers as derived from their own retail demand. In the first scenario of full intrabrand competition, the wholesale and retail prices coincide, i.e. $p=w$, so that the wholesale-level demand system reduces to the simple retail-level demand system, $s^W(w) = s^R(p)$. The SSNIP-test is then simply given by comparing profits (1) and (2) after replacing the wholesale-level demands $s_j^W(w)$ by the retail-level demands $s_j^R(p)$.

Things are more complicated in the second scenario of no intrabrand competition. As mentioned above, in this case the retail prices $p = p(w)$ are implicitly defined by the first-order conditions for retail profit maximization, $f(p,w)=0$. The SSNIP-test then compares profits (1) and (2) after substituting the wholesale level demands $s_j^W(w)$ by the retail-level demands using the implicit functions $p = p(w)$. We thus compare:

$$\pi_I(w) = \sum_{j \in I} (w_j - c_j) s_j^R(p(w))L \qquad (1')$$

with

$$\pi_I(w^{new}) = \sum_{i \in I} ((1+\lambda)w_j - c_j) s_j^R(p(w^{new}))L\,. \qquad (2')$$

Intuitively, the SSNIP-test considers an increase in the insiders' wholesale prices w^I by, say, 10 percent, resulting in a new wholesale price vector w^{new}. The new retail prices p are computed by numerically solving the system $f(p,w^{new})=0$. On the one hand, the insider products' retail prices will typically rise by less than 10 percent, because of incomplete pass-through. On the other hand, the outsider products' retail prices may respond positively. The new retail prices then determine demand according to the estimated retail-level demand functions.

Wholesale profit margins

To measure the wholesale profit margins $w-c$, we do not make use of accounting information. First, such information is difficult to obtain at the product level. The problem is further complicated in our application since both the wholesale prices and the marginal costs are not observed. Second, as has been extensively discussed in the

empirical oligopoly literature, accounting cost information does not adequately measure opportunity costs, which ultimately determine the firms' pricing decisions. In the case of cars, it is particularly noteworthy to point out that every new car sold generates a stream of future profits on repair and maintenance services.[8] These future profits may be viewed as a negative contribution to the manufacturers' opportunity cost for selling a new car. If they are large, it is even possible that the opportunity cost of selling a car is negative.

To resolve these issues, we measure the wholesale profit margins using the equilibrium first-order conditions for profit maximization at the wholesale and the retail stage. In the first scenario of full intrabrand competition, where $p = w$, the equilibrium wholesale profit margins reduce to the standard expression for multiproduct firms, as in Berry, Levinsohn and Pakes (1995). Loosely speaking, each product's profit margin is equal to price divided by the product's perceived price elasticity of demand.[9] In the second scenario of no intrabrand competition, the equilibrium wholesale profit margins are more complicated. Each profit margin takes a form as described in Rey and Stiglitz (1995), i.e. price divided by the product's perceived *adjusted* price elasticity of demand. The adjustment refers to the fact that manufacturers do not directly influence retail prices, but only indirectly through their wholesale prices, making competition between manufacturers less intense.

3.3 Retail demand for new cars

To implement the SSNIP-test, it remains to specify the retail-level demand system for new cars $s^R(p)$. As mentioned in section 3.1, our starting point is that the European car market is segmented into its various national markets. Within each national market, we then specify demand using a general version of the two-level nested logit. This logit model partitions the car market into various product segments according to common marketing classifications: subcompacts, compacts, intermediates,

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[8] These profits are generated with a high degree of certainty during the first two years when the car is still under the warranty period. But also after these two years repair and maintenance is often taken care of by the manufacturers.

[9] The term "perceived" is added to mean that both the own-price elasticity and the cross-price elasticities with respect to other products of the same firms enter the expression.

standard/luxury, sports and minivans. Each segment is further partitioned in two subsegments according to country of origin: domestic and foreign cars. Consumers' may have correlated preferences for all cars belonging to the same segment, because these cars share certain features such as size, performance or prestige. Furthermore, consumers may have even more closely correlated preferences for cars belonging to both the same segment and country of origin, because these cars may share additional features such as style or image. The degree of preference correlation for products in the same subsegments and segments determines the substitution patterns in the car market. If preferences for products in the same (sub)segments are strongly correlated, products from the same (sub)segment are strong substitutes (with high cross-price elasticities), while products from different (sub)segments will be weak substitutes (with low cross-price elasticities). A finding of strong preference correlation thus has potentially important implications for the product market definition.

Various versions of the nested logit model have been derived; see Berry (1994) for the basic one-level nested logit framework, and Goldberg (1995) and Verboven (1996) for applications to the car market using a two-level nested logit.[10] Specifically, the estimating demand equation takes the following simple linear form:

$$\ln(s_j / s_0) = x_j'\beta - (\alpha / y)p_j + \sigma_{hg} \ln(\bar{s}_{j/hg}) + \sigma_g \ln(\bar{s}_{h/g}) + \xi_j$$

where s_j is overall market share of product j, i.e. sales divided by the total number of potential consumers; s_0 is the overall market share of the outside good, i.e. total number of potential consumers minus total number of actual cars sold, divided by the total number of potential consumers; $\bar{s}_{j/hg}$ is the market share of product j in its subsegment h of segment g, and $\bar{s}_{h/g}$ is the market share of all products of subsegment h in segment g; p_j is the price of product j and y is income; x_j' is a vector of product characteristics (e.g. horsepower); ξ_j is the error term capturing unobserved product characteristics (to the econometrician); and β, α, σ_{hg} and σ_g are parameters to be estimated. Most notably, σ_{hg} and σ_g are "segmentation

[10] Following Brenkers and Verboven (2004), we estimate a further generalization of the nested logit model by allowing the segmentation parameters to differ across nests. At the same time, we are more restrictive than Brenkers and Verboven (2004) since we do not allow for heterogeneity in income levels across consumers; this considerably complicates estimation.

parameters", with $1 \geq \sigma_{hg} \geq \sigma_g \geq 0$. They roughly measure the correlation of preferences for cars of the same subgroup *h* of *g*, and the same group *g*, respectively. If σ_{hg} and σ_g are close to 1, preferences are strongly correlated within subgroups and groups, so that there is strong segmentation. If $\sigma_{hg} = \sigma_g = 0$, we obtain the simple logit model without segmentation.

In principle, the model can be estimated with a cross-section of products (cars), *j=1...J*. In our application, we have a panel of cross-sections with five different countries over thirty years. To estimate the model, the main identification assumption is that the product characteristics entering x_j are uncorrelated with the error term ξ_j. The price p_j and the market shares $\ln(\bar{s}_{j/hg})$ and $\ln(\bar{s}_{h/g})$ may however be correlated with the error term, so that an instrumental variable estimator should be used. We use a fixed effects two-stage least squares estimator, using instruments inspired by Berry, Levinsohn and Pakes (1995). Specifically, we adopt the following list of instruments, making use of the specific structure of the nested logit model: (i) the products' own observed characteristics x_j; (ii) the number of products, and the sums of characteristics of other products of the same firm belonging to the same subsegment, interacted with a subsegment dummy variable; (iii) the number of products, and the sums of the characteristics of competing products belonging to the same subsegment, interacted with a subsegment dummy variable; (iv) the number of products, and the sums of the characteristics of competing products belonging to the same segment, interacted with a segment dummy variable. Note that we interact the instruments in (ii)-(iv) with subsegment or segment dummy variables, since we allow the differentiation parameters σ_{hg} and σ_g to differ across subsegments and segments.

3.4 Summary and relation with other approaches

Summary

Our implementation of the SSNIP-test takes the following steps.

Step 1. Estimate the retail-level demand system;

Step 2. Specify a model of pricing behavior to compute:

- the wholesale-level demand system
- the current profit margins;

Step 3. Select a small set of insider products I as the candidate relevant market. Compute the insiders' current joint profits, and their new joint profits after a price increase by a percentage λ. If profits increase, this is a relevant market. Otherwise select a larger set of insider products and repeat Step 3.

It is instructive to relate our approach to two other approaches to define the relevant markets.

Technical specifications or standard industry classifications

A common approach in market definition is to use technical specifications of products. All products with similar characteristics are then included in the same relevant market. In specific cases, standard industry classifications are available, which are based on the technical specifications of the products. Using technical specifications or industry classifications can be misleading, since it has to be shown that consumers value the specifications in such a way that products with similar attributes are sufficiently close substitutes.

While our approach also makes use of standard industry classifications, it is important to stress that we test, using our demand model, whether these classifications are actually valid. We measure the extent to which consumers preferences are actually correlated within the segments, and also whether there is even further segmentation within the segments (by considering the subsegments).

Critical elasticity analysis

A more recent rigorous approach that has often been used to implement to the SSNIP test is critical loss or critical elasticity analysis as introduced by Harris and Simons and subsequently elaborated on by e.g. Werden (1998).[11] In its version of critical elasticity analysis, this approach typically starts from a set of homogenous products, and then derives the threshold elasticity corresponding to that set of products, above which a price increase would be unprofitable.[12] The threshold elasticity depends on the functional form of demand and on the set of products' current profit margins. In its ideal form, an econometric analysis would be required to estimate the price elasticity of demand corresponding to each selected candidate relevant market definition. If it turns out that the estimated elasticity is higher than the threshold, then a larger candidate market should be considered, and the price elasticity of demand at that level should be re-estimated. Apart from being cumbersome, this approach also has an inconsistency. The threshold elasticity formulas are computed based on the assumption that products within the selected market are perfectly homogeneous and that no homogeneous products are excluded. Hence, when the SSNIP-test is violated and additional products are added to the market definition, the assumption that products within the relevant market are homogeneous is no longer satisfied, so that the formula for the threshold price elasticity of demand is no longer valid. Our approach avoids these difficulties.

4 Results on market definition

4.1 The data

The data set to estimate the nested logit model and carry out the SSNIP-tests consists of prices, sales and physical characteristics of (essentially) all cars sold during 1970-1999 in Belgium, France, Germany, Italy and the United Kingdom. The total number of observations is about 12,000, so a bit less than 100 models are available in every

[11] Katz and Shapiro (2003) provide a very interesting recent discussion on some common misinterpretations of the critical elasticity formulas. One way to avoid the misinterpretations they identify is by "substituting out" the price-cost margins in the critical elasticity formulas, by using equilibrium price-cost margins from a theory of price-setting behaviour. Our approach is consistent with this, since we also use equilibrium price-cost margins.

market/year. The price data are pre-tax and post-tax list prices corresponding to the base model available in the market, as available in consumer catalogues.[13] We consistently use the prices from the August catalogues.[14] Sales are new car registrations for the model range. Physical characteristics (also from consumer catalogues) include dimensions (weight, length, width, height), engine characteristics (horsepower, displacement) and performance measures (speed, acceleration and fuel efficiency). The data set also includes variables to identify the model, the brand, the firm, the country of origin/production location, and the market segment. The data set is augmented with macro-economic variables including population, exchange rates, GDP and consumer price indices for the various markets over the relevant period. Finally, there is information on dealer discounts and gross dealer margins for a selected number of models/years.

To estimate the nested logit model, we need to define segments and subsegments. Following common industry and marketing classifications, we consider six different segments: subcompacts, compacts, intermediates, standards/luxuries, sports and minivans. We closely follow the classification of the magazine "l'Argus de l'Automobile", but check for consistency with alternative industry classifications; see Verboven (2002) for a detailed discussion on these classification issues. Each segment is further divided in two subsegments, according to country of origin: domestic or foreign. Table 1 provides summary statistics by market segment, for the 5 countries in 1999.

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[12] See Van Reenen for an example of critical elasticity analysis after having estimated a product differentiated system instead of assuming homogeneous goods.

[13] It is well known that transaction prices may differ from list prices because of discounts and other financial benefits offered by the dealers to the consumers. In the econometric literature on passenger car demand, a consensus has emerged that list prices are nevertheless informative in obtaining price elasticities if the model is specified in a sufficiently flexible way. The reason is that while deviations from list prices may be country-specific and brand- or even product-specific, they show relatively little variation over time. One can then account for deviations by including market and product effects. Additional measurement error on the price variable is absorbed by instrumenting for price.

[14] Manufacturers change list prices about three times per year. Rather than collecting price information on a weekly basis and computing the average over the year, we decided to measure the list price at a specific point in time. We chose the month of August since this falls in the middle of the year, during a period in which list prices show a long stability. For one or two markets/years (in the seventies) we were not able to obtain an August catalogue. We then used the closest available month instead. Any systematic biases will be absorbed in the market/year fixed effects.

Table 1. Summary statistics, by segment

	Mean	Std. Dev.	Mean	Std. Dev.
	Subcompact (144 obs.)		Compact (110 obs.)	
Horsepower (in kW)	41.73	5.46	60.61	11.39
Fuel inefficiency (litres per 100 km)	7.03	0.59	8.28	0.91
Width (in cm)	160.23	6.32	169.94	2.91
Height (in cm)	143.33	6.17	141.98	4.35
Foreign (1 if foreign)	0.35	0.48	0.36	0.48
Price (Euro)	7277	1435	10515	2420
	Intermediate (118 obs.)		Standard/Luxury (69 obs.)	
Horsepower (in kW)	75.73	14.11	96.93	11.07
Fuel inefficiency (litres per 100 km)	9.19	0.87	10.51	1.05
Width (in cm)	172.99	3.12	176.90	3.49
Height (in cm)	141.37	1.82	141.46	3.34
Foreign (1 if foreign)	0.31	0.46	0.36	0.48
Price (Euro)	13406	3669	18907	3779
	Sports (92 obs.)		Minivan (89 obs.)	
Horsepower (in kW)	99.42	24.42	80.45	19.31
Fuel inefficiency (litres per 100 km)	9.95	1.07	10.68	2.04
Width (in cm)	171.71	5.78	175.01	9.67
Height (in cm)	132.01	6.23	169.08	8.20
Foreign (1 if foreign)	0.33	0.47	0.31	0.47
Price (Euro)	18643	5405	15276	4360

4.2 The demand parameter estimates

We only provide a brief discussion of our demand parameter estimates, with a focus on the role of the segmentation parameters σ_{hg} and σ_g, since these play a central role in the subsequent SSNIP-tests. For a more extensive discussion of the demand results, in a richer econometric framework, we refer to Brenkers and Verboven (2002). Table 2 shows the results. The first two columns refer to the simple logit specification, in which all segmentation parameters σ_{hg} and σ_g are assumed to be equal to zero. This specification *a priori* rules out any segmentation within the national market, since consumers have no correlated preferences across cars within the same segment or subsegment. The third and the fourth column present the results from a restricted specification, in which σ_{hg} is equal across all twelve subsegments, and σ_g is equal across all segments. This is the commonly estimated version of the (two-level) nested logit model. The fifth and sixth column present the results of a more flexible nested logit specification, in which the subsegmentation and segmentation parameters are

allowed to vary by segment. To reduce the number of σ's to be estimated, we constrain $\sigma_{Dg} = \sigma_{Fg}$ (where D denotes domestic and F denotes foreign), i.e. the degree of heterogeneity within a domestic subsegment is the same as that within its foreign counterpart.

Table 2. Parameter estimates for the logit and nested logit models

	Logit		Restricted nested logit		Flexible nested logit	
	Estimate	St. Error	Estimate	St. Error	Estimate	St. Error
Mean valuation parameters						
Constant	-20.209	.980	-12.853	.687	-11.176	.593
Horsepower	-.007	.002	.004	.002	.001	.001
Fuel inefficiency	-.124	.013	-.066	.008	-.050	. 007
Width	.074	.004	.042	.003	.034	.003
Height	.036	.005	.023	.003	.018	.003
Foreign	-1.848	.025	-1.048	.047	-.918	.038
Price	-2.320	.231	-2.225	.130	-1.755	.098
Subsegmentation parameters						
Subcompact			.525	.028	.765	.025
Compact			same		.567	.030
Intermediate			same		.538	.033
Standard/luxury			same		.697	.028
Sports			same		.445	.032
Minivan			same		.042	.041
Segmentation parameters						
Subcompact			.318	.030	.298	.035
Compact			same		.379	.041
Intermediate			same		.311	.042
Standard/luxury			same		.450	.035
Sports			same		.143	.042
Minivan			same		.151	.066
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Market dummies	Yes	Yes	Yes	Yes	Yes	Yes
Product dummies	Yes	Yes	Yes	Yes	Yes	Yes

The simple logit specification in Table 2 shows that some of the characteristics parameters have the unexpected sign (e.g. the horsepower coefficient). This no longer appears to be the case for the nested logit specifications. The parameters of the included characteristics are of the expected sign and usually significant. Horsepower, width and height positively affect the consumers' mean valuation, whereas fuel inefficiency (measured as litres per 100 km) has a negative impact. Similarly, price has a significantly negative effect. The foreign firm effect is negative and significant,

meaning that the domestic incumbents face a competitive advantage over their foreign competitors in terms of the mean consumer valuation.

The segmentation parameters σ mostly satisfy the condition that $1 \geq \sigma_{hg} \geq \sigma_g \geq 0$, as required for the model to be consistent with random utility theory. This means that consumers tend to have more strongly correlated preferences for cars of the same subsegment than for cars of a different subsegment but within the same segment. They also have more strongly correlated preferences for cars of the same segment than for cars of a different segment. These findings imply that there is indeed strong segmentation according to the subsegments, and weaker segmentation according to the segments. The only exception to our finding of strong segmentation and subsegmentation is given by the minivan cars. This suggests that consumers do not have strongly correlated preferences across minivan cars. This may seem surprising since minivans have in common an important dimension ("space"). The interpretation for this finding is however simple. European classifications define minivans as a fairly heterogeneous group. They do not just include the larger minivans (such as Renault Espace) but also smaller ones, which are derived from cars in the subcompact, compact or intermediate segments (e.g. the Renault Scenic). As such, the minivan segment is currently defined as a fairly heterogeneous group, so that a finding of limited segmentation relative to other cars is natural.[15]

The role of the segmentation parameters is further illustrated in Table 3, showing the cross-price elasticities for cars of the same subsegment under alternative demand specifications. In the simple logit model, these cross-price elasticities are very small. In the nested logit models, they are considerably larger and also show substantial variation across models.

Table 3. Substitution Patterns
Cross price elasticities with respect to cars from same subsegment

	Logit		Restricted nested logit		Flexible nested logit	
	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.
Subcompact	.0021	.0029	.056	.078	.148	.212

[15] As an alternative approach, one might classify each segment (say the compact segment) in two groups, i.e. minivan compact segment, and non-minivan compact segment. Or one might follow a non-nested GEV model, in which "minivan" forms a separate principle of differentiation, as in Bresnhan, Stern and Trajtenberg (1997).

Compact	.0033	.0044	.108	.160	.098	.144
Intermediate	.0025	.0033	.124	.188	.105	.161
Standard/luxury	.0018	.0028	.273	.395	.463	.675
Sports	.0005	.0007	.187	.205	.117	.132
Minivan	.0011	.0014	.187	.283	.010	.014

To check the sensitivity of the results, we also considered various alternative specifications. We found most parameter estimates to be robust. Most interestingly, we considered a specification for two separate subperiods, i.e. the period 1970-1985 and 1986-1999. This specification is motivated by the fact that the industry has experienced various changes over the last three decades, notably a gradual progress towards integration (Goldberg and Verboven, 2005) and a correspondingly increased competition by foreign firms (i.e. non-domestic European and Japanese firms). These changes may be reflected in both a change in the mean valuation for foreign cars, and in a change in the variance around that mean (i.e. the σ_{hg} parameters, referring to the domestic/foreign subsegments). We found that the mean negative valuation for foreign cars is significantly stronger during the period 1970-1985 than during the subsequent period. However, we did not find significant changes in the deviations from that mean (i.e. the subsegmentation parameters σ_{hg}). As such, the increased integration and foreign competition is only manifested in a rise in the mean valuation attached to foreign cars, but not in changes in the deviation around that mean. These findings imply that our conclusions on market definition below remain robust when based on the estimates of the most recent period.

4.3 Implementing the SSNIP tests

Selecting candidate relevant markets

Textbook descriptions usually describe the following procedure for selecting candidate relevant markets; see e.g. Church and Ware (1999). As a first candidate relevant market, select the considered product and its next-best substitute, defined as the product with the largest cross-price elasticity of demand. If the SSNIP-test fails, progressively add products that are next-best substitutes until the SSNIP test is

satisfied. Assuming that the next-best substitutes can be unambiguously ranked, this procedure would lead to a unique relevant market for every product that is considered. In principle, we could follow this mechanical procedure since we can rank all products according to their estimated cross-price elasticities. In practice, several considerations lead us to conclude that this procedure would be rather impractical.

The first consideration is that the number of products for which a relevant market needs to be defined is quite large; there are about 100 different car models in each country. Since the ranking of next-best substitutes may be different for each product, this implies that a large number of candidate relevant markets and corresponding SSNIP-tests would need to be considered. Furthermore, this would result in a set of market definitions specific to every single product. For example the relevant market for product A may consist of product A and B, whereas the relevant market for product B would consist of products A, B and C. While there is nothing wrong with this in principle, it prohibits a simple and transparent presentation of the relevant markets.

The second consideration is that all firms sell multiple products. Once the relevant markets have been defined for every product of the firms, it will be necessary to assess each firm's market share within each of these relevant markets corresponding to the firm's different products. This procedure will inevitably be quite cumbersome.

To resolve these practical difficulties, we follow a simplified procedure. Instead of starting with a candidate relevant market that only includes the considered product and its closest substitute, and then progressively adding next-best substitutes, we immediately start by including all products belonging to the considered product's subsegment. If the SSNIP-test fails for this subsegment, we include all products belonging to the same segment as the candidate relevant market. And if the SSNIP-test also fails here, we take the products of all segments excluding the outside good. This procedure is in the same spirit as the textbook selection procedure, but has the advantages of limiting both the number of considered candidate relevant markets and the number of actual relevant markets defined.

Are the subsegments relevant markets?

Table 4 presents the results from applying the SSNIP-tests in all five countries for all twelve subsegments, i.e. the six domestic and the six foreign subsegments. For example, the domestic subcompact subsegment in France in 1999 consists of all French subcompact cars, i.e. Citroën AX and Saxo; Peugeot 106, 205 and 206; and Renault Clio and Twingo. Each cell considers the percentage profit change from a joint price increase by 10% in the subsegment. Each cell contains two numbers: the first number assumes no intrabrand competition and the second number assumes full intrabrand competition. To demonstrate the importance of the demand specification, we present both the results based on the parameters of the simple logit model (top part of table), and the results based on the parameters of the flexible nested logit (bottom part).[16]

Consider first the results based on the simple logit estimates, as shown in the top part of Table 4. All profit changes are negative, implying that the subsegments do not constitute relevant markets in any of the countries if the simple logit demand specification would be correct. This is true under both full and no intrabrand competition, although the profit changes are closer to zero under no intrabrand competition. The largest percentage profit decreases occur in the standard/luxury and sports subsegments (both domestic or foreign); they occur especially in Italy and the United Kingdom. The reason why subsegments do not constitute relevant markets is that the logit model assumes that all cars are symmetric substitutes. Hence, when the prices of all products in a certain subsegment increase, this may lead to a substantial amount of substitution towards other subsegments.

[16] We also considered the results from the restricted nested logit model, but in our application this gave no substantial new insights compared to the flexible nested logit, so we omitted it from the tables.

Table 4. Profit changes when subsegments are candidate relevant markets

Results based on logit estimates

	Belgium		France		Germany		Italy		U.K.	
	Domestic subsegments									
Subcompact	0.0	-0.2	0.0	-0.4	0.0	-0.5	0.0	-0.6	-0.1	-0.7
Compact	0.0	-0.3	-0.2	-1.1	-0.1	-0.8	-0.6	-1.8	-0.4	-1.4
Intermediate	-0.2	-1.0	-0.3	-1.3	-0.7	-1.9	-0.9	-2.3	-1.0	-2.4
Standard/Luxury	-1.1	-2.6	-1.9	-3.4	-1.1	-2.5	-2.2	-4.3	-2.0	-3.8
Sports	-1.3	-2.8	.	.	-1.4	-3.0	-2.0	-3.6	-1.5	-3.0
Minivan	-0.6	-1.7	-1.7	-3.2	-1.2	-2.6	-2.0	-3.6	-1.7	-3.2
	Foreign subsegments									
Subcompact	.	.	0.0	-0.3	0.0	-0.4	0.0	-0.2	0.0	-0.5
Compact	.	.	-0.1	-0.8	0.0	-0.7	-0.2	-1.1	-0.3	-1.2
Intermediate	.	.	-0.3	-1.4	-0.2	-1.1	-0.7	-2.0	-0.6	-1.9
Standard/Luxury	.	.	-1.3	-2.9	-0.9	-2.3	-2.7	-4.8	-1.8	-3.6
Sports	.	.	-0.9	-2.3	-0.6	-1.9	-1.4	-2.9	-2.2	-4.1
Minivan	.	.	-0.5	-1.7	-0.3	-1.3	-0.8	-2.2	-0.9	-2.3

Results based on flexible nested logit estimates

	Belgium		France		Germany		Italy		U.K.	
	Domestic subsegments									
Subcompact	9.3	16.8	2.4	9.9	4.7	12.8	-0.3	-0.6	1.9	10.3
Compact	4.5	9.7	0.6	3.0	2.5	6.5	-0.8	-2.2	2.1	5.4
Intermediate	5.6	9.8	1.0	2.7	1.8	3.9	-0.9	-2.3	0.6	3.5
Standard/Luxury	17.3	26.3	-1.7	2.4	8.7	19.2	-3.8	-5.8	-2.3	2.7
Sports	4.3	7.1	.	.	2.1	4.3	-1.5	-2.8	0.9	3.5
Minivan	0.2	0.2	-0.6	-1.6	-0.4	-1.2	-1.1	-2.6	-0.7	-1.8
	Foreign subsegments									
Subcompact	.	.	7.3	14.3	8.8	16.1	12.6	19.8	12.7	19.9
Compact	.	.	3.4	6.6	2.5	4.8	5.5	9.7	5.3	8.2
Intermediate	.	.	3.4	5.5	4.0	6.5	6.5	9.5	6.4	9.2
Standard/Luxury	.	.	12.9	20.7	7.0	10.8	10.6	17.9	15.9	25.2
Sports	.	.	3.6	6.6	2.7	5.0	4.2	7.3	5.1	7.5
Minivan	.	.	0.0	-0.6	0.0	-0.4	0.0	-0.3	-0.1	-0.8

Note: Each cell contains two percentage price increases. The first cell is the percentage profit increase under no intrabrand competition; the second cell is the corresponding number under full intrabrand competition.

The picture looks different when the SSNIP-tests are based on the demand parameters of the nested logit model, which we showed to be empirically superior to the simple logit model in our application. The bottom part of Table 4 shows that profits increase in most subsegments, both under full or no intrabrand competition. The main

exceptions are (1) the minivan subsegments in all countries, whether domestic or foreign, and (2) all domestic subsegments in Italy. We conclude that most subsegments may be defined as relevant markets, with the exception of the minivan subsegments and the domestic subsegments in Italy. This conclusion holds regardless of whether there would be full or no intrabrand competition: under both cases the signs of the profit changes are usually the same, and only the magnitudes differ.[17] It is interesting to observe that the magnitudes of the profit effects are usually smaller (in absolute value) under no intrabrand competition than under full intrabrand competition. The interpretation is as follows. Under full intrabrand competition, a 10% wholesale price increase is fully passed onto the consumers, whereas under no intrabrand competition, it is only passed on incompletely. Hence, under no intrabrand competition the retail price increase is typically lower than 10%, making the magnitude of the profit effects (whether positive or negative) closer to zero.

We now discuss why the minivan subsegments and the domestic subsegments in Italy do not constitute relevant markets. The explanation for the minivans clearly has to do with our obtained demand parameter estimates. Recall that most of the segmentation parameters were estimated to be substantially larger than zero, implying that consumers are not very much inclined to substitute out of a subsegment or segment when prices increase in that segment. We only found the segmentation parameters of the minivan subsegments and segments to be close to zero. As a result, consumers are comparatively more likely to substitute out of the minivan subsegments after a price increase. The amount of substitution out of the minivan subsegments thus apparently turns out to be sufficiently large to render a 10% price increase unprofitable.

Our finding that the domestic subsegments in Italy are not the relevant markets may seem more surprising at first, since we estimated a relatively strong degree of segmentation in all non-minivan subsegments. The explanation is that a single firm, Fiat, owns all the products in the domestic subsegments in Italy, and that this firm is already setting its prices to maximize the profits. These two elements imply that Fiat would have no incentives to further raise prices in the domestic subsegments in Italy. This of course resembles the issues in the notorious Cellophane case (U.S. versus E.I.

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[17] There are two exceptions. For the French and U.K. luxury/standard subsegments, we find positive profit effects under full intrabrand competition, but negative profit effects under no intrabrand

du Pont, 1956). The SSNIP-test only shows that there are no profit incentives for additional price increases above the current levels in the domestic subsegments in Italy. But this does not mean that current market power is not already high. To resolve these issues, practitioners have often advocated a SSNIP-test that considers price increases above a competitive benchmark, rather than price increases above the current level. But this leads to the question what exactly should be that competitive benchmark. As an alternative solution, we simply turn next to consider wider candidate relevant markets, i.e. the various segments. We then come back to the issues later and will discuss whether they are of practical relevance in our specific application.

Are the segments relevant markets?

Table 5 considers the larger market definitions, i.e. the segments, which include the domestic and the foreign subsegments. As before, the top part of the table shows the results using the parameters of the simple logit model, while the bottom part shows the results using the parameters of the nested logit model. The results based on the simple logit parameter estimates confirm our earlier findings: even enlarging the market definition to include both domestic and foreign products of the same segment, leads to negative profit effects. Hence, using a simple logit model would still be misleading and show that segments do not constitute relevant markets.

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competition.

Table 5. Profit changes when segments are candidate relevant markets

Results based on logit estimates

	Belgium		France		Germany		Italy		U.K.	
Subcompact	0.0	-0.2	0.0	-0.1	0.0	-0.3	0.0	0.0	0.0	-0.4
Compact	0.0	-0.3	-0.1	-0.8	0.0	-0.5	-0.2	-1.1	-0.2	-1.0
Intermediate	-0.2	-1.0	-0.3	-1.2	-0.4	-1.3	-0.7	-2.0	-0.6	-1.9
Standard/Luxury	-1.1	-2.6	-1.4	-2.9	-1.0	-2.4	-2.4	-4.4	-1.8	-3.6
Sports	-1.3	-2.8	-0.9	-2.3	-1.2	-2.7	-1.5	-3.0	-1.8	-3.5
Minivan	-0.6	-1.7	-1.1	-2.4	-0.7	-1.8	-0.9	-2.3	-1.1	-2.5

Results based on flexible nested logit estimates

	Belgium		France		Germany		Italy		U.K.	
Subcompact	9.3	16.8	4.4	12.9	7.4	16.2	4.9	7.7	8.4	18.1
Compact	4.5	9.7	3.6	8.6	3.4	8.4	5.4	9.8	6.3	11.7
Intermediate	5.6	9.8	2.9	6.0	4.4	8.2	5.8	9.0	6.4	11.2
Standard/Luxury	17.3	26.3	13.8	23.1	10.8	21.9	10.3	16.4	17.1	27.4
Sports	4.3	7.1	3.6	6.6	2.7	5.4	3.7	6.2	3.8	7.2
Minivan	0.2	0.2	0.0	-0.2	0.1	0.1	0.1	-0.2	0.0	-0.2

Note: Each cell contains two percentage price increases. The first cell is the percentage profit increase under no intrabrand competition; the second cell is the corresponding number under full intrabrand competition.

The results based on the nested logit model show that almost all segments can now profitably raise their prices by 10%, under both the scenarios of no and full intrabrand competition. In particular, this is also true for the segments in Italy. Hence, to obtain a relevant market definition for the domestic products in Italy it is sufficient to enlarge the market definition from the subsegment to the segment level.

The only segments for which price increases by 10% sometimes remain unprofitable are the minivan segments. This is the case in France, Italy and the U.K. under the scenario of full intrabrand competition. In the other minivan cases the profit effects are positive, but they are typically very small. These findings again follow from our demand parameter estimates, which showed that the minivan segments are not clearly segmented from the other products. Note however that we found positive profit effects for the minivan segments when we considered 5% price increases instead of 10% price increases. Hence, deciding whether to consider minivan segments as separate relevant markets appears to be a borderline decision for practitioners. In the discussion below, we take a prudent approach and will assume that the minivan

segments are no relevant markets. This implies that for these products the relevant market definition is at the aggregate country level, i.e. all new cars.[18]

5 Policy implications

Our results from applying the market definition tests at various levels may be summarized as follows:

- The relevant market for minivan cars is defined at the highest level, i.e. at the aggregate country level.
- In Italy, the relevant markets for domestic cars are defined at an intermediate level, i.e. at the segment level.
- In all other cases, the relevant markets for cars are defined at the lowest level, i.e. at the subsegment level.

Given these relevant market definitions, we can now analyse which firms satisfy the market share thresholds required to be eligible for selective or exclusive distribution under the block exemption regulation. Since a firm sells multiple products, it will typically be present in several relevant markets, e.g. in both the subcompact market and the intermediate markets. It is therefore necessary to verify whether the firms satisfy or violate the 30% or 40% market share thresholds in each of the defined markets in which they are active.[19]

We begin with an overview of the firms violating the 30% and/or 40% market share thresholds. Next, we discuss several general lessons that may be drawn from our approach.

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[18] We implemented SSNIP-tests at the country level and found that profit effects are positive for all countries.

[19] Our calculations should be seen mainly as illustrations to make general points, and not as concrete policy recommendations. The actual computation of market shares may depend to some extent on choices where to classify some of the cars. This could be relevant when the violations of the thresholds are borderline.

5.1 Firms violating the market share thresholds

We begin by identifying the firms that violate the 40% market share threshold. These are the firms that cannot rely on the block exemption regulation to be eligible for either selective or exclusive distribution. We proceed in three steps. First, we compute the firms' market shares under three possible levels for market definition: the subsegment level, the segment level, and the aggregate country level. Second, we identify all firms violating the 40% market share threshold in each of these market definitions. Third, we identify the *critical* violations, i.e. we add an asterisk to those cases for which our earlier results imply that it is actually appropriate to define the market at that level (or at a more narrow level). The firms appearing without an asterisk are thus firms that would violate the thresholds based on standard industry classifications, but without solid econometric support from our SSNIP-test methodology. The results from this procedure are shown in Table 6.

To explain Table 6, consider Germany as an example. First, no firm in Germany exceeds the 40% threshold at the aggregate country level. Hence, if practitioners would apply a country-level market definition for all new cars, this would make all car manufacturers in Germany eligible to form selective distribution agreements. However, we found earlier that the relevant markets may be defined at more narrow levels (with the exception of minivans). Consider first the segment level. There is one firm in Germany that exceeds the 40% market share threshold at the segment level: VW in the compact, intermediate and sports segments. These violations are also critical, since we previously found that markets may be defined at the segment level (with the exception of minivans). Consider now the even narrower subsegment level. Several additional firms in Germany exceed the 40% thresholds at this level: Mercedes in the domestic standard/luxury subsegment, VW in nearly all of the domestic subsegments, and Renault in the foreign minivan subsegment (due to the Renault Espace). But the 40% threshold violations are only critical for VW and Mercedes, and not for Renault, since we could not define a separate market for the foreign minivan subsegment where Renault's violation occurs.

Table 6. Firms with market shares above 40% within alternative product markets

	Belgium	France	Germany	Italy	U.K.
	Country-level market definition				
	--	--	--	--	--
	Segment-level market definition				
Subcompact	--	--	--	Fiat*	--
Compact	--	--	VW*	--	--
Intermediate	--	PSA*	VW*	--	--
Standard/Luxury	--		--	--	--
Sport	VW*	VW*	VW*	--	--
Minivan	--	Renault	--	Renault	--
	Subsegment-level market definition, domestic subsegments				
Subcompact	--	PSA* Renault*	VW*	Fiat	Ford*
Compact	--	PSA* Renault*	VW*	Fiat	Ford*
Intermediate	--	PSA*	VW*	Fiat	Ford* GM*
Standard/Luxury	--	Renault*	Mercedes*	Fiat	GM*
Sport	--	--	VW*	Fiat	Ford*
Minivan	--	Renault	--	Fiat	Ford
	Subsegment-level market definition, foreign subsegments				
Subcompact	--	--	--	--	--
Compact	--	--	--	--	--
Intermediate	--	--	--	--	--
Standard/Luxury	--	--	--	--	--
Sport	VW*	VW*	--	--	--
Minivan	--	--	Renault	Renault	Renault

Note: All firms with a market share above 40% in the considered market are listed. If the considered market was also found to be a relevant market, than the firm is denoted with an asterisk.

More generally, Table 6 reveals the follow patterns regarding the identity of firms that critically violate the 40% thresholds. First, the main critical violations of the 40% thresholds turn out to come from the European mass manufacturers: Renault, PSA, VW, Fiat, Ford and GM. The European producers active in the niche segments (BMW, Mercedes) and the Asian producers (e.g. Toyota, Nissan, Mazda) do not violate the 40% thresholds. Second, the critical violations by the European mass producers are mainly due to a strong presence in their home countries: Renault and PSA in France, VW and Mercedes in Germany, Fiat in Italy, and Ford and GM in the U.K. The only critical violations by European firms in foreign markets are by VW, which has a market share exceeding the 40% threshold in the foreign sports subsegment in Belgium and in France.

We now identify the firms violating the 30% but not the 40% threshold. Those firms could still not rely on the block exemption to be eligible for exclusive distribution, but they could rely on it for selective distribution. The results are presented in Table 7. Several points are worth noting. First, the critical violations again mainly come from the European manufacturers. Second, the violations now no longer necessarily come from the European mass manufacturers in their respective home countries. They also come from the European niche players and/or European manufacturers in foreign markets: BMW in Belgium; VW, BMW and Mercedes in France; Mazda and Ford in Germany; VW, BMW and Mercedes in Italy; BMW and PSA in the U.K.[20] Finally, there is one non-European based firm that critically violates the 30% threshold, i.e. Mazda in Germany (due to its strength in the sport segment).

[20] Note that there are some subtleties in interpretation due to the fact that some firms own brands from different country of origin. First, Ford owns the German/U.K. Ford brand, but also the Swedish Volvo brand and the U.K. Jaguar brand. The mentioning of Ford among foreign brands in Germany follows from the strong market share of Volvo among the foreign standard/luxury products. Second, BMW owns both the German BMW brands and the U.K. Rover brands. This is why BMW can appear under both the domestic and the foreign subsegment in the U.K.

Table 7. Firms with market share between 30% and 40% in alternative product markets

	Belgium	France	Germany	Italy	U.K.
	Country-level market definition				
	--	--	VW*	--	--
	Segment-level market definition				
Subcompact	--	PSA* Renault*	--	--	--
Compact	--	--	--	--	--
Intermediate	--	--	--	VW*	--
Standard/Luxury	BMW*	--	BMW* Mercedes*	Fiat*	BMW*
Sport	--	--	--	--	Ford*
Minivan	--	--	--	--	Renault
	Subsegment level market definition, domestic subsegments				
Subcompact	--	--	--	--	GM*
Compact	--	--	--	--	GM*
Intermediate	--	--	--	--	--
Standard/Luxury	--	--	BMW*	--	BMW*
Sport	--	--	Mercedes*	--	--
Minivan	--	--	GM VW	--	GM
	Subsegment level market definition, foreign subsegments				
Subcompact	--	VW*	--	--	PSA*
Compact	--	VW*	--	VW*	--
Intermediate	--	VW*	--	VW*	--
Standard/Luxury	BMW*	BMW* Mercedes*	Ford*	BMW* Mercedes*	BMW*
Sport	--	--	Mazda*	VW*	--
Minivan	--	GM	--	--	--

Note: All firms with a market share between 30 and 40% in the considered market are listed. If the considered market was also found to be a relevant market, than the firm is denoted with an asterisk.

5.2 Discussion

We now turn to a discussion of several specific points. First, we come back to the issues in Italy, where we could not define relevant markets at the domestic subsegment level, due to the strong market power of Fiat (resembling the issues in the Cellophane case). Table 6 shows that Fiat violates the market share thresholds in all domestic subsegments (with a market share of virtually 100%) but that these violations are non-critical since the markets are not defined at the subsegment level in Italy. In our application, however, the end result for Fiat is not seriously affected. In two cases Fiat turns out to critically violate the market share thresholds at the larger segment level, for which we could define a relevant market. It violates the 40%

market share threshold in the subcompact segment, and the 30% threshold in the intermediate segment.

Second, we discuss how the conclusions from our market definition methodology may differ from those based on more traditional "intuitive" approaches. One approach would be to define the markets at the aggregate country level. In this case, only one firm would be detected to violate the 30% threshold (VW) and no firm would be found to violate the 40% threshold. Another approach would be to simply which define the markets at the segment level following standard industry classifications. We can distinguish between two types of possible mistakes here. On the one hand, the segments may define the markets too narrowly, so that firms are mistakenly concluded to violate the thresholds. This turns out to be the case for Renault. In the minivan segment, it has a market share of over 40% in France and Italy, and one of over 30% in the U.K. (due to the strong position of the Renault Espace). Our analysis implies that it would be unwarranted to conclude that Renault violates the thresholds here, since we found that the market for minivan cars is wider than the segment level. On the other hand, the segments may also define the markets too widely, so that firms may be mistakenly concluded to satisfy the thresholds. We find several examples of this. For example, Ford and GM in the U.K. and Mercedes in Germany satisfy the 40% threshold at the segment level, but not at the subsegment level, which our analysis showed to be a narrower relevant market. Similarly, BMW and Mercedes in France and in Italy, Ford and Mazda in Germany, and GM and PSA in the U.K. all satisfy the 30% threshold at the segment level, but again not at the narrower and more relevant subsegment level. In sum, compared to market definition approach based on standard industry classifications, our methodology may result in detecting either more or fewer firms violating the market share thresholds.

Finally, we discuss an issue that relates to the fact that firms sell multiple products. What should practitioners decide if firms violated the market share thresholds in only one or a few of the subsegments in which they are active? Strictly speaking, this would imply that such firms are eligible for selective or exclusive distribution only for those products that belong to the subsegments with sufficiently low market shares. For example, Table 6 implies that Mercedes in Germany could not form either selective or exclusive distribution for its products in the standard/luxury segment, but it can form selective distribution in the other subsegments. If Mercedes finds it technologically

impractical to set up a separate distribution network for its cars in the standard/luxury segments, it may be forced to refrain from both selective and exclusive distribution for all its products. Hence, because firms sell multiple products and may not be able to set up product-specific distribution systems, there is a risk that a mechanical application of the market share criteria may be overly, and presumably unintentionally restrictive. For this reason, practitioners may find it desirable to interpret their rules less strictly, e.g. by allowing at most one violation in the various relevant markets if technical constraints prevent separate distribution systems for the different products.

6 Conclusions

Against the background of the new block exemption regulation for cars, this paper has studied the relevant product markets in five countries of the European passenger car sector. We suggest an econometric approach that is directly consistent with the SSNIP-test and that is more satisfactory than previous econometric approaches, such as critical elasticity analysis or the use of standard industry classifications to define markets. We account for the following factors: products are differentiated; there is only information to estimate a retail-level demand system and not to estimate a wholesale-level demand system; and price-cost margins are not directly observed at the product level.

Regarding market definition, we find that the relevant market for minivan cars is defined at the highest level, i.e. at the aggregate country level. Furthermore, in Italy the relevant markets for domestic cars are defined at an intermediate level, i.e. at the segment level. In all other cases, the relevant markets for cars may be defined at the lowest level, i.e. at the subsegment level. Based on these results, we identify the firms that violate the market share thresholds stipulated in the block exemption regulation. We find that mainly some European domestic mass producers violate the 40% thresholds and are therefore not immediately eligible for either selective or exclusive distribution. Some European mass producers violate the 30% but not the 40% threshold in their foreign markets and are therefore only immediately eligible for selective distribution. Finally, some European niche players and one non-European firm violate the 30% but not the 40% market share thresholds.

If we would have defined the markets based on standard industry classifications instead of our empirical methodology, our conclusions would have been different and, in fact, inconclusive. On the one hand, assuming that the market definition is at the country level would not identify any firm violating the 40% threshold and only one firm in one country violating the 30% threshold (VW in Germany). On the other hand, using standard industry classifications to define the markets at the segment level for all products (and thus not at the subsegment level as we found) would not detect some firms violating the 40% thresholds in Germany (Mercedes) and in the U.K. (Ford and GM), and it would also not detect some firms violating the 30% thresholds. These examples illustrate that it is important to take the market definition methodology seriously, and where possible apply a more rigorous approach than has often been used in the past. Apart from these general conclusions, our analysis also highlights several practical issues in market definition, which arise in this case and which may play a role in other cases as well, in particular issues relating to the fact that firms sell multiple products.

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