



# Quantifying the effects from horizontal mergers in European competition policy

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## Abstract

This paper starts from a recent case to study how merger analysis in Europe may be potentially improved. Starting from the geographic market definition in the Merger Decision, we formulate and estimate an oligopoly model with differentiated products. Based on the estimates, we compare several alternative market power tests: a hypothetical market power test, an actual market power test and a comparative market power test. Our comparison of these alternative tests illustrates that the recently introduced empirical techniques need not be in conflict with traditional policy practices in Europe, but should be seen as a natural extension of commonly accepted principles. Furthermore, we emphasize the importance of our dynamic comparative market power test in the European context. According to this test, the relevant point of comparison when assessing a merger is not the status quo, but rather a relevant alternative merger scenario that is likely to happen in the event the merger is rejected. In a European context, the choice is often to accept a sequence of regionally based mergers or rather a sequence of pan-European mergers. Finally, we also emphasize the importance of constructing confidence intervals when computing the predicted merger effects, especially if one is interested in testing the hypothesis that a merger has no effects.

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## 1. Introduction

Merger policy has shown several interesting new developments over the past years. In the U.S., the policy principles have been modified to incorporate recent theoretical developments in Industrial Organization, such as the analysis of oligopoly behavior and the role of efficiencies (see [European Commission, 1997](#)). This evolution is illustrated by the various revisions of the Merger Guidelines. At the same time, U.S. policy practice has shown **an increasing reliance on empirical methods and “simulation analysis.”** In Europe, policy principles have evolved more slowly, in part because of the shorter experience with European merger cases. The principles of market definition have been made more in line with U.S. rules in 1997 (see [Federal Trade Commission, 1997](#)). But once the market is defined, the actual merger investigation has traditionally been based on the concept of dominance. Only very recently, in 2002, the Commission has proposed reforms to make its policy principles more in line with economic thinking about oligopolistic behavior, while keeping the concept of dominance. Policy practice in the E.U. has up to now still been largely based on the assessment of market shares and qualitative criteria such as ease of entry and buyer power, with limited attention to econometric analysis.

This paper starts from a recent European case, the proposed Volvo/Scania merger, to draw lessons about how policy practice towards mergers may be improved in Europe. Taking the geographic market definition from the Merger Decision as given, we formulate and estimate a suitable empirical oligopoly model with differentiated products. As an initial specification test, we verify whether our parameter estimates imply a price elasticity of total market demand that is consistent with industry sources. We then show how the model can be used to quantify the market power effects from mergers. We look at the merger from several different angles. First, we propose a *hypothetical market power test*, which measures the extent to which hypothetical unilateral price increases by the merging parties would be profitable. This test has the advantages of imposing only weak assumptions on firm behavior and to be close to current E.U. merger principles on the relevant market definition. Second, we apply an *actual market power test*, which measures the actual expected price increases based on more specific assumptions about post-merger firm behavior. The test also allows one to evaluate the effects of efficiency claims, which is given more weight according to the recent E.U. reform. Third, we apply a *comparative market power test*. This test takes a dynamic approach and takes into account that the decision to accept or block a merger affects the subsequent merger process. According to this test, the relevant point of comparison when assessing a merger is not the status quo, but rather a relevant alternative merger scenario that is likely to happen in the event the merger is rejected.

There is an emerging literature on predicting merger effects.<sup>2</sup> Baker and Bresnahan already propose a first approach to this question in 1985. Later [Hausman, Leonard and Zona \(1992, 1994\)](#) advocate the use of econometric models in competition analysis.<sup>3</sup> [Werden and Froeb \(1994\)](#) calibrate (but do not estimate) a logit model to measure the effects of alternative mergers among U.S. long distance carriers. [Jayaratne and Shapiro \(2000\)](#) calibrate a nested logit model to assess the effectiveness of partial divestitures as a remedy to the possible anticompetitive effects

<sup>2</sup> Besides mergers, econometrics and statistical methods are now applied in many, if not all, domains of competition law. For a review, see [Bishop and Walker \(1999\)](#). See also the book edited by [Slotje \(1999\)](#).

<sup>3</sup> [Hausman, Leonard and Zona \(1994\)](#) estimate a multi-level demand model instead of using a logit-type model as most references in the econometric literature on competition policy. See also [Hausman and Leonard, 1997](#).) A discussion of the relative advantages of the two types of modeling is beyond the scope of this paper.

of horizontal mergers. *Nevo (2000)* estimates a general random coefficient model to study merger effects in the U.S. ready-to-eat cereal industry. *Pinkse and Slade (2004)* follow a distance metric approach to study mergers in the brewing industry. All these papers have their own focus of analysis, depending on the specifics of the case.

Relative to this literature our paper makes several contributions. First, we compare several alternative possible merger tests, which differ in the extent to which they conform to traditional policy practice in Europe. Our hypothetical market power test is clearly closest to E.U. merger principles and may therefore be particularly useful to gain more common acceptance by practitioners. Our actual market power test (often referred to as “simulation analysis” in the literature) is somewhat further apart from the strict dominance approach used at the time of the merger. However, after the recent reform by the European Commission the test should without ambiguity be seen as consistent with E.U. merger principles, in particular also regarding the possibility to explicitly treat efficiencies in the test.<sup>4</sup> Our comparative market power test does not seem to be included in the current merger framework, but we hope that our analysis shows it can be a fruitful way to think about mergers, as it is a natural extension of the previous tests. In sum, our comparison of the alternative possible merger tests illustrates that the recently introduced empirical techniques need not be in conflict with traditional policy practices in Europe, but should be seen as a natural extension of commonly accepted principles. It is thus not appropriate to view “simulation analysis” and related tests as a drastically different approach to merger analysis, as it is sometimes presented, but rather as a further development of the analysis.

Second, we stress the importance of our comparative market power test, especially in the European context (as opposed to a U.S. context where markets might be more integrated). Specifically, our test essentially considers a sequence of two regional mergers, i.e. between firms that are strong in the same geographic area. We compare the market power effects from this merger sequence with the alternative of two pan-European mergers, i.e. between firms that are strong in different geographic areas. This comparison is based on the assumption that Volvo and Scania (who are both strong in the Nordic countries) would seek for partners from other geographic areas, in the event the Commission blocks their proposed merger. In our application, we find that sequential pan-European mergers have substantially less anticompetitive effects than regional ones. We stress, however, that this finding is based on the assumption in our analysis that the truck market is not yet an integrated market.<sup>5</sup> Note that our approach could be helpful for competition authorities which have to consider a forward looking analysis when evaluating mergers, and in particular for the European authority which must take into account how possible future mergers may affect European integration.

Finally, we stress the importance of computing confidence intervals around the estimated merger effects. Because of the nonlinearity of the oligopoly model, it turns out that the distribution of the estimated consumer surplus and welfare effects is not symmetric. In our application, it is skewed to the left. This implies that our point estimates for consumer and

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<sup>4</sup> In our application the results from the actual market power test were broadly consistent with the results from a traditional market share analysis based on the dominance approach, i.e. our predicted market power effects are the largest in those countries where the Commission found the highest market shares. We emphasize that this is not generally true, since it will depend on the specific parameter estimates, so that an econometric approach is desirable.

<sup>5</sup> As will be discussed below, our paper does not directly analyze the issue of whether markets are indeed integrated. Instead, we base ourselves on the conclusions of the Commission, which conducted an institutional and empirical analysis of the geographic market definition.

welfare losses are somewhat higher than their expected value.<sup>6</sup> We conclude that empirical merger analysis should be careful in reporting confidence intervals around the point estimates of the predicted merger effects, especially if one is interested in testing the hypothesis that the merger had no significant effects.

The outline of the paper is as follows. Section 2 reviews the merger process in the E.U. and the U.S. to put our analysis in context. Section 3 summarizes the key aspects of the Volvo/Scania merger decision. Section 4 introduces the model and discusses the empirical results. Section 5 discusses the results from our merger analysis and alternative tests. Section 6 concludes.

## 2. The merger process in practice

### 2.1. General aspects of the merger process

The process of **evaluating mergers follows various stages**. A first stage usually asks whether the notified merger falls within the jurisdiction of the merger authority. In the European Union this includes the question whether the merger has a **European dimension**. If this is not the case, then the investigation is left to the individual country or countries.

The second stage considers the **definition of the relevant market**. The U.S. 1997 Horizontal Merger Guidelines explicitly state that “the market definition focuses solely on demand substitution factors, i.e., possible consumer responses.” Supply substitution factors do not fall under the market definition process, but are considered elsewhere. Since 1982, the Guidelines specify their approach more precisely, based on the **hypothetical market power test, or SSNIP-test**. This principle states that the relevant market is a group of products and a geographic area such that a hypothetical, profit-maximizing firm would impose a “small but significant and non-transitory increase in prices.” The profitability of such a price increase clearly depends on the extent of demand substitution. In a recent Notice (OJ C 372 on 9/12/1997), the European Commission has also set out its principles for market definition. Much in the spirit of U.S. practice, the focus is on demand substitution factors, with a reference to the SSNIP-test. “Small but significant” price increases are specified to be in the range of 5–10%. The attitude towards supply substitution factors is ambiguous. While it is stated that supply substitution constraints are taken into account at “the assessment stage of competition analysis,” it is also stated that they may be taken into account when defining markets.

The third stage constitutes the actual merger investigation. In the U.S., this stage involves an analysis of market concentration and an investigation of potential adverse competitive effects, including the ease of entry.<sup>7</sup> The anti-competitive effects from the mergers may be explicitly balanced against beneficial effects, in particular the presence of efficiencies. In the **European Union**, the merger investigation at the time of the Volvo-Scania Case focuses on an investigation of anti-competitive effects, without explicitly assessing beneficial effects, such as potential efficiencies. **The investigation amounts to assessing the presence of dominance. A dominant position is found when a firm (or a group of firms) would be able to behave to an appreciable extent independently of its competitors and consumers.** Assessing dominance is based on criteria

<sup>6</sup> More precisely, our point estimates refer to the median of the consumer and welfare losses, and these are lower (in absolute value) than the expected value.

<sup>7</sup> Willig (1991) shows that, “for a market where the structure of demand was well represented by the logit model, (...) analysis of merger would be accurately based on market shares (...).” This remark is particularly acute to shed light on our analysis.

such as the joint market share of the merging firms, the strength of the remaining competition, and potential competition. While the Commission's recent reform proposals keep the concept of dominance, they introduce more scope for more economic reasoning about market power effects in oligopoly, and for a more explicit consideration of efficiencies.

Neven et al., (1993) review the European merger decisions during the early nineties. They argue that the Commission has displayed little confidence in using the joint market share of the merging firms as the sole criterion. Their only consistent finding is that a joint market share of less than 25% is cleared within one month of notification. They also argue that the "strength" of the remaining competitors is most often used to complement information on the joint market shares. Finally, they observe the importance attached to buyer power and entry possibilities.<sup>8</sup>

## 2.2. Differentiated products in U.S. merger analysis

During the stage of the actual merger investigation the issue arises how markets with differentiated products should be treated. The European Merger Regulation at the time of the Volvo-Scania case does not consider this issue explicitly, in contrast to the U.S. Merger Guidelines. The Guidelines discuss the extent of product differentiation as one key determinant to identify a lessening of competition through unilateral effects (as opposed to coordinated interaction).<sup>9</sup> According to the Guidelines, the merging firms may find substantial price elevations profitable, depending on the extent to which the lost sales will be diverted to the product of the merging partner. If the merging firms' products are close substitutes relative to other products, the diversion will be particularly strong, making unilateral price increases more profitable. Interestingly, the Guidelines treat the observed market shares as an important indicator. According to the Guidelines, a significant share of consumers would be adversely affected if, among other things, the merging firms have a combined market share of at least 35%, and if a significant share of consumers of one merging firm's product regards the others as a second choice. Nevertheless, the Guidelines also state that market shares may both understate or overstate the competitive effects of concern.

Shapiro (1996) is more explicit about how the US antitrust agencies may conduct the actual merger investigation when products are differentiated. He distinguishes between four (pedagogical) steps in assessing the unilateral effects from a merger between brands "A" and "B." The first step is devoted to the measurement of the diversion ratio, which provides the fraction of sales lost by brand "A" that are captured by brand "B." Equivalently, it is the ratio of the cross-price elasticity of demand for "B" over the own price elasticity of demand for "A." At the second step, based on the diversion ratio and merging firms' current mark-ups, one calculates the post-merger price increase, assuming no synergies and no rival responses.<sup>10</sup> The third step attempts to account for the effects of price and product responses by the rival firms. Finally the fourth step evaluates the potential presence of synergies that could reduce marginal costs.

<sup>8</sup> More recently, Neven and Röller (2002) have also looked at the determinants of merger decisions in the E.U. They provide a framework within which they investigate whether the Commission has pursued different objectives from those that it has been assigned.

<sup>9</sup> The other determinant is the presence of capacity constraints.

<sup>10</sup> For example, under a constant elasticity demand, when firms are symmetric and sell only one product before merger, Shapiro recalls that the predicted price increase is equal to  $(p^* - p)/p = mD/(1 - m - D)$ , where  $p$  and  $p^*$  are the pre-merger and post-merger prices,  $D$  is the diversion ratio and  $m$  is the pre-merger markup.

Shapiro discusses that the practical implementation of these steps depends on data availability. If there are detailed data on sales and prices, an oligopoly model with differentiated products can be estimated or calibrated to simulate the post-merger prices. The first two steps are thus effectively combined; the diversion ratio is implicitly subsumed in the analysis. If no detailed data are available, Shapiro proposes to adopt the above steps and obtain the required information on markups and diversion ratios in other ways. For example, the diversion ratio can be directly computed through survey data or company documents on the consumers' first and second choices. In other cases, one may apply the result that, under certain assumptions, the market share of brand "B" relative to the market share of all brands except "A" may also be considered as a first proxy for the diversion ratio.<sup>11</sup>

### 3. The Volvo–Scania merger

The proposed merger between Volvo and Scania was notified to the European Commission on 22 September 1999 (Case No COMP/M. 1672). A Commission Decision on 15 March 2000 declared the merger incompatible with the Common Market and the functioning of the EEA Agreement. In light of our analysis, we now summarize the relevant aspects of the investigation by the European Commission, as discussed in the Commission's Decision.<sup>12</sup> We restrict attention to the analysis of the effects in the heavy trucks market.<sup>13</sup>

#### 3.1. Market definition

The analysis of the relevant product market is short, and does not refer to the SSNIP-test. The truck market is classified in three categories: light duty trucks (less than 6 tons), medium duty trucks (5–16 tons) and heavy duty trucks (more than 16 tons). The heavy truck market is further subdivided into two segments: rigid trucks and tractor trucks. Rigid trucks are integrated trucks, from which no semi-trailer can be detached. Tractor trucks are detachable. While it is recognized that rigid and tractors may not be fully substitutable, the overall conclusion is that the category of heavy trucks constitutes the single relevant market. Light and medium duty trucks are thus not included. No mention is made as to whether second hand trucks are part of the relevant market.

The analysis of the relevant geographic market is more detailed. Despite the views of the merging parties, the Commission concludes that the national markets constitute the relevant geographic market in the regions most affected. Several arguments are used to support this view. First, there are substantial price and markup differences across countries. Second, the models and technical configurations differ considerably, because of local consumer preferences and national technical requirements (e.g., the cab crash test in Sweden). Third, the selective and exclusive distribution system links the sales and after-sales services. The importance of profits from after-sales service may therefore induce dealers to charge higher prices to foreign customers. Finally, there are large variations in market shares across countries.

<sup>11</sup> For example, if brand "A" has a market share of 25% and brand "B" a market share of 15%, one could compute the diversion ratio as  $15/(100-25)=20\%$ . This is an exact measure if (i) all brands compete symmetrically, and (ii) no consumers quit consuming, i.e. market demand is inelastic.

<sup>12</sup> For the complete Decision see [http://europa.eu.int/comm/competition/mergers/cases/decisions/m1672\\_en.pdf](http://europa.eu.int/comm/competition/mergers/cases/decisions/m1672_en.pdf).

<sup>13</sup> There was a separate analysis of the effects in the markets for buses and coaches.



### 3.2. Assessment

The Commission Decision explicitly describes its methodology for assessing the creation or strengthening of a dominant position. It uses traditional market power proxies, i.e., market shares, supplemented by qualitative factors such as customer purchasing power and the likelihood of entry. The investigation is limited to the five countries where the creation of a dominant position is found (Sweden, Norway, Finland and Ireland), or where this is found to be likely (Denmark).

For each of the five countries analyzed, the Commission takes the market shares as the starting point of the assessment. Table 1 gathers the market shares of the seven truck manufacturers. The table shows that the joint market share of Volvo and Scania is the largest in precisely the five countries where dominance is found (in the 49–91% range). This reveals that the Decision attached a high weight to the merging firms' joint market share in assessing dominance. In fact, from the borderline countries, namely Denmark and Portugal, one may infer that the critical market share for concluding dominance is around 44–49% in this case.

In its market share analysis the Commission also stresses that the merging firms' joint market share have remained stable, and showed no tendency to decline. Finally, the Commission points out the large difference between the joint market share of the merging parties and the market share of the largest remaining competitor in most of the five countries.

The Commission supplements its market share analysis with qualitative factors. First, the extent of brand loyalty and the customer structure is considered. For most of the five investigated countries, the Commission finds indicators of considerable brand loyalty and of a dispersed customer structure, with the large majority of transport companies owned by small operators. The Commission concludes that there is little customer purchasing power to compensate for the increased market power by the merging firms. Second, the likelihood of entry is assessed. Entry costs are calculated to be high, especially in light of the small size of

Table 1  
Market shares per country in 1998

	Daf	Daimler	Iveco	Man	Renault	Scania	Volvo
AU	5	18	6	34	4	16	12
BE	17	18	6	11	8	17	23
DK	4	18	7	10	3	30	29
FI	0	10	4	3	18	31	34
FR	8	16	8	5	38	9	14
GE	5	42	6	26	2	9	8
GR	3	36	2	12	3	17	24
IR	13	9	8	6	3	27	22
IT	4	16	41	6	9	12	12
LU	15	28	8	14	10	15	11
NE	33	12	3	9	3	23	16
NO	4	9	2	12	1	32	38
PO	14	12	7	6	17	19	25
SP	9	19	20	8	19	16	13
SW	2	6	0	0	1	46	45
UK	18	9	9	7	6	19	18
EEA	11	21	11	13	12	16	15

Source: Commission Decision, based on the Notification.

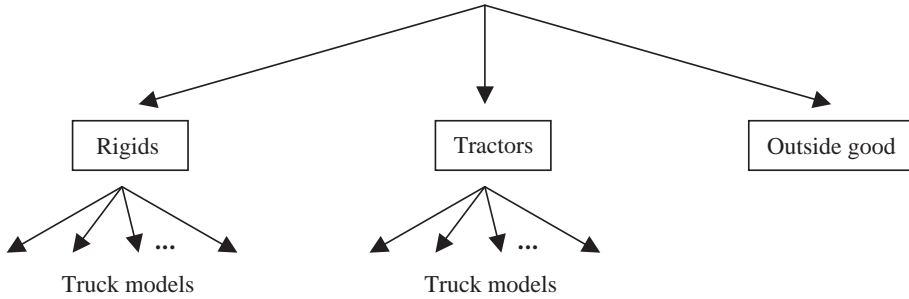


Fig. 1. The choice set.

the markets and the low population density. The cab crash test in Sweden is mentioned as an additional entry barrier.

4. The econometric model

We specify an oligopoly model for the European heavy truck market that starts from the market definition adopted by the Commission. We thus assume geographically segmented markets and product differentiation in two segments: tractors and rigids. The specification closely follows the exposition of the nested logit model in Berry (1994), as extended to multiproduct firms by Verboven (1996).

4.1. Consumers and demand

A typical consumer is here a freight transportation company. There are *N* potential consumers, who may either buy one of *J* products (heavy trucks),  $j=1, \dots, J$ , or otherwise choose the outside good 0, e.g. a medium duty truck, a second hand truck, or another transport mode.<sup>14</sup> The nested logit model classifies the products into *G* groups, and one additional group for the outside good. Products within the same group are closer substitutes than products from different groups. We consider two groups for heavy trucks: rigids (R) and tractors (T). The tree on Fig. 1 depicts the consumer choice set. Note that each group (buying a rigid truck or a tractor, or employing another transportation mean) corresponds to the use of a different logistic chain.

The utility to consumer *i* from purchasing product *j* is given by:

$$u_{ij} = \delta_j + \zeta_{ig} + (1 - \sigma)\epsilon_{ij}. \tag{1}$$

The first term,  $\delta_j$ , is the mean valuation for product *j*, common to all consumers. It depends on the price of product *j*,  $j_p$ , a vector  $x_j$  of observed characteristics of product *j*, and an error term  $\xi_j$  reflecting unobserved characteristics:

$$\delta_j = x_j\beta - \alpha p_j + \xi_j, \tag{2}$$

where  $\alpha$  and  $\beta$  are parameters to be estimated.

The second and the third term in (1),  $\zeta_{ig}$  and  $\epsilon_{ij}$ , are random variables reflecting individual *i*'s deviation from the mean valuation. The term  $\zeta_{ig}$  is consumer *i*'s utility, common to all products

<sup>14</sup> Note that in this industry, each manufacturer produces one model per type of truck, which can come under many variants.



belonging to group  $g$ , whereas the term  $\varepsilon_{ij}$  is consumer  $i$ 's utility, specific to product  $j$ . The parameter  $\sigma$  lies between 0 and 1 and measures the correlation of the consumers' utility across products belonging to the same group. If  $\sigma=1$ , there is a perfect correlation of preferences for products within the same group; so these products are perceived as perfect substitutes. As  $\sigma$  decreases, the correlation of preferences for products within same group decreases. If  $\sigma=0$  there is no correlation of preferences: consumers are equally likely to switch to products in a different group as to products in the same group in response to a price increase. In this case, we have the standard logit model in which products compete symmetrically.<sup>15</sup>

Each potential consumer  $i$  chooses the product  $j$  that maximizes utility. To compute the probability that a consumer chooses product  $j$ , the nested logit model assumes that the random variables  $\zeta_{ig}$  and  $\varepsilon_{ij}$  have distributions such that  $\zeta_{ig}$  and  $\zeta_{ig}+(1-\sigma)\varepsilon_{ij}$  have the extreme value distribution. Normalizing the mean utility level for the outside good to 0, i.e.,  $\delta_0=0$  the probability  $s_j$  that a potential consumer chooses product  $j$  is given by the following formula:

$$s_j = \frac{\exp(\delta_j/(1-\sigma))}{D_g} \frac{D_g^{1-\sigma}}{1 + \sum_{g=1}^G D_g^{1-\sigma}}, \quad (3)$$

where  $D_g$  is defined by:

$$D_g = \sum_{k \in G_g} \exp[\delta_k/(1-\sigma)]. \quad (4)$$

For the model to be consistent with (random) utility maximization,  $\alpha$  has to be positive and  $\sigma$  has to lie between 0 and 1. At the aggregate level, the choice probability  $s_j$  coincides with the market share of product  $j$ . The total quantity sold of product  $j$ ,  $q_j$ , is simply given by the probability that a potential consumer chooses product  $j$  times the total number of potential consumers  $N$ :

$$q_j = s_j N. \quad (5)$$

The net consumer surplus, CS, measures the attractiveness of the set of  $J+1$  products in monetary terms, after subtracting the price consumers have to pay. It is given by the expected value of the maximum of utilities. Using the assumptions of the nested logit model, the net consumer surplus CS equals (see, e.g., Anderson et al., 1992):

$$CS = \frac{1}{\alpha} \ln \left( 1 + \sum_{g=1}^G D_g^{1-\sigma} \right). \quad (6)$$

#### 4.2. Pre-merger and post-merger pricing

Each firm  $f$  produces a set  $F_f$  of products. Its profits are given by the sum of its operating profits for each product minus fixed costs  $K$ . The operating profits for product  $j$  equal the total sales of product  $j$  times the operating margin, i.e., the price  $p_j$  minus the (constant) marginal cost  $c_j$  for product  $j$ . Thus firm  $f$ 's profits are:

$$\pi_f = \sum_{j \in F_f} (p_j - c_j) q_j - K. \quad (7)$$

<sup>15</sup> In this case, the merger analysis can be based on market shares exclusively. See footnote 4.

Producer surplus is simply the sum of these profits across firms. Total welfare is the sum of producer surplus and consumer surplus, defined earlier.

Firms choose the prices of their products to maximize profits, given the prices set by the other firms. Each firm trades off two effects when considering an increase in price by one unit: (i) it increases profits proportional to the current sales level of the firm, (ii) it reduces sales, which lowers profits proportional to the current markup. The multiproduct firm takes into account that the lost sales on one product may be partly compensated by increased sales on its other products. The importance of this effect depends on the above discussed diversion ratio between the products, i.e., the fraction of the sales lost due to a price increase that is recaptured by the other products owned by the firm.

Pre-merger and post-merger pricing follow a similar logic. One simply needs to appropriately reinterpret the set of products  $F_f$  owned by the merged firm. If there are no other changes due to the merger (such as cost synergies), then the merged firm will always have an incentive to raise prices. This is because it takes into account the effect of a price increase on the sales of its merging partner. The magnitude of the price increase will depend on the diversion ratio.

More formally, a multiproduct Nash equilibrium is given by the system of  $J$  necessary first-order conditions derived from Eq. (7), i.e. for each  $j$ :<sup>16</sup>

$$\sum_{k \in F_f} (p_k - c_k) \frac{\partial q_k}{\partial p_j} + q_j = 0. \quad (8)$$

The marginal cost for each product  $j$  is constant and depends on a vector  $w_j$  of observed characteristics of product  $j$ , and an error term  $\omega_j$  reflecting unobserved characteristics:

$$c_j = \exp(w_j \gamma + \omega_j), \quad (9)$$

where  $\gamma$  is a parameter vector to be estimated.

#### 4.3. Specification and estimation

We estimate the demand Eq. (3) and the pre-merger pricing Eq. (8), using the expressions for the mean utility (2) and marginal cost (9). The parameters to be estimated are  $\alpha$ ,  $\sigma$ ,  $\beta$  and  $\gamma$ . The observed variables are prices,  $p_j$ , sales,  $q_j$ , and the characteristics,  $x_j$  and  $w_j$ , influencing the mean valuation and marginal cost. The total number of potential consumers  $N$  is assumed to be known. The econometric error terms are the unobserved characteristics,  $\xi_j$  and  $\omega_j$ . They enter nonlinearly in both the demand Eq. (3) and first-order conditions (8). The system of pricing Eq. (8) can be inverted and log-linearized to obtain a solution for  $\omega_j$ . To linearize the demand Eq. (3), we follow the transformation procedure proposed by Berry (1994). We estimate the transformed demand and the pricing equations simultaneously using nonlinear three-stage least squares. This estimator takes into account cross-equation parameter restrictions and possible correlation between the error terms  $\xi_j$  and  $\omega_j$ . It also takes into account the endogeneity of prices and sales through instruments.

<sup>16</sup> In the following we assume that a Nash equilibrium exists. Caplin and Nalebuff (1991) prove existence in a general discrete choice model, assuming single product firms. Anderson and de Palma (1992) prove existence for the nested logit model with multiproduct firms, assuming symmetry.

Table 2  
Estimates of main parameters of interest

	Potential market factor			
	$r=0.5$		$r=3.0$	
	Estimates	Standard error	Estimates	Standard error
$\alpha$	0.312	0.092	0.280	0.094
$\sigma$	0.341	0.240	0.304	0.240

To estimate the model we use a panel of 16 countries in the E.E.A. over 2 years (1997 and 1998). Prices are list prices of a base model. Sales are total sales for the model range.<sup>17</sup> The characteristics vectors  $x_j$  and  $w_j$  contain the same exogenous variables: horsepower, a dummy variable to denote “tractor,” a set of dummy variables to measure country-specific effects, a set of dummy variables to measure firm-specific effects, and an interaction dummy variable to indicate whether the product is produced by a domestic firm.<sup>18</sup> To account for endogeneity of prices and sales, we use the following variables as instruments in the demand and pricing equation: the sum of horsepower of all competing products in a country per year, and the sum of horsepower of all competing products in a group (tractor or rigid group).

The total number of potential consumers  $N$  is set equal to the average total sales in the country over 1997–1998, multiplied by a potential market factor  $1+r$ . We consider two scenarios:  $r=0.5$  and  $r=3.0$ . In other words, we assume that the total potential market is either 50% or 300% larger than the average annual sales. We return to this assumption below.

Most parameter estimates for the characteristics (in the vectors  $\gamma$  and  $\beta$ ) are significant with the expected sign, and robust whether  $r=0.5$  or  $r=0.3$  is assumed. For example, the estimates of the firm-specific fixed effects show that a firm with a higher marginal cost also tends to have a higher mean valuation. Domestic firms also receive a higher mean valuation. They experience only an insignificant cost advantage over foreign firms.<sup>19</sup> Horsepower has a positive and significant effect on marginal cost; it has a negative but insignificant effect on the mean valuation by consumers. To interpret this, note that the horsepower variable may not only capture truck performance. It may also reflect unmeasured maintenance and operating costs for truck drivers, which do not affect marginal cost, but negatively affect the mean valuation. As a result, the effect of horsepower on marginal cost is unambiguously positive, whereas its effect on the mean valuation may be positive or negative.<sup>20</sup>

Most relevant for our purposes are the estimates of the parameters  $\alpha$  and  $\sigma$ , which determine the estimated price elasticities and markups, conditional on the potential number of consumers. Table 2 shows the estimates for the two assumed values of the potential market factor ( $r=0.5$  and  $r=0.3$ ). Note that these estimates satisfy the necessary restrictions for the nested logit model

<sup>17</sup> These data have been obtained from a survey run by the Merger Task Force under the conduct of the authors. The values of market shares obtained by that way are very close to the ones presented in Table 1.

<sup>18</sup> More specifically, DAF is a domestic firm in the Netherlands, MAN and Daimler are domestic firms in Germany, Renault is a domestic firm in France, Iveco is a domestic firm in Italy, and Volvo and Scania are treated as domestic firms in the Nordic countries.

<sup>19</sup> A cost advantage for domestic firms may occur for example because of lower transportation costs.

<sup>20</sup> The literature on the automobile market usually finds a significant and positive effect of horsepower on the mean valuation term. First, this literature may better control for maintenance costs in the mean valuation term, see, e.g. Berry, Levinsohn and Pakes (1995) who include fuel efficiency. Second, consumers of cars may put a higher weight on the performance of a car relative to the implied higher maintenance costs.

to be consistent with random utility maximization. Consumers respond to a price increase by reducing demand ( $\alpha \geq 0$ ). The hypothesis that trucks within the same group (rigid or tractor) are perfect substitutes can be rejected, since  $\sigma$  is significantly less than 1. The hypothesis of symmetric competition between trucks from the same group and trucks from different groups cannot be rejected, yet the 95% confidence interval for  $\sigma$  suggests that there is segmentation between segments. The estimated marginal costs  $c_j$  and mean valuations  $\delta_j$  implied by the estimates are positive for all products, and usually of a reasonable order of magnitude.

#### 4.4. Discussion of the empirical results

Within the limited time frame we had to conduct the empirical analysis, there was not much room for a detailed sensitivity analysis. We focused the sensitivity analysis to the assumed value of the potential market factor  $r$ . This is important since there is a close correspondence between the value of  $r$  and the level of the aggregate price elasticity, and hence the consumers' outside substitution possibilities. As  $r$  increases, the outside good becomes an important substitute for new trucks, so that the price elasticity of total market demand increases.<sup>21</sup> While  $r$  can thus in principle be estimated, just as one can estimate the price elasticity of total market demand, in practice this would require information for a sufficiently large time horizon. Since our product-level data set covers only two years, estimation of  $r$  proved difficult. Our solution to this problem was to consider two alternative scenarios for  $r$ , compute the implied price elasticities of total market demand and confront these with supplementary information from other studies on price elasticities.

The first scenario assumes that  $r=0.5$ , i.e., the potential market size is 50% larger than the actual average market size during 1997–1998 (measured by country-average annual shipments over the two periods). The second scenario assumes  $r=3.0$ , i.e., the potential market size is four times larger than the actual market size. The implied price elasticities of market demand are displayed in Table 3. In the first scenario, the implied price elasticity mostly varies between  $-0.5$  and  $-0.6$ , depending on the country. In the second scenario, the elasticities of market demand increase to the range of  $-1.0$  and  $-1.5$ . The reason for the lower elasticities of market demand in the first scenario is that in that case relatively few potential consumers are assumed to actually not buy a truck (only 50% on average), hence consumers view the outside good as a relatively poor substitute compared to the second scenario.

To check the plausibility of our estimates, the elasticities as implied by the model may be confronted with elasticities from existing evidence. The European Commission provided us their estimates obtained from industry sources, reporting that the price elasticity is around  $-0.9$  for heavy trucks above 16 tons, and  $-0.4$  for trucks above 24 tons. These numbers are thus of a comparable order of magnitude as the elasticities implied by our independently chosen scenarios. Our second scenario (i.e.  $r=3.0$ ) is the more conservative one: it assumes that consumers substitute more easily out of new trucks when all prices increase, so that the estimated anticompetitive effects from a merger will be smaller. We therefore decided to use the second scenario in our subsequent computations on the likely merger effects.

To obtain a further judgment on the reliability of our results, we now summarize the main criticisms that were raised by the Volvo economists in response to our analysis. One main

<sup>21</sup> For example, in the simple logit model ( $\sigma=0$ ) the price elasticity of market demand, measured at identical prices  $p$ , is equal to  $-\alpha[r/(1+r)]p$ .

Table 3  
Price elasticity of total market demand

	Potential market factor	
	$r=0.5$	$r=3.0$
Austria	-0.49	-1.53
Belgium	-0.49	-1.11
Denmark	-0.47	-1.02
Finland	-0.38	-0.98
France	-0.44	-1.17
Germany	-0.53	-1.52
Greece	-0.28	-0.63
Ireland	-0.34	-1.05
Italy	-0.61	-1.63
Luxembourg	-0.41	-0.94
Netherlands	-0.59	-1.54
Norway	-0.56	-1.14
Portugal	-0.46	-1.21
Spain	-0.44	-1.22
Sweden	-0.44	-0.96
United Kingdom	-0.56	-1.27

*Note:* The price elasticity of total market demand in this differentiated product model is defined as the percentage change in total demand for trucks when the prices of all trucks increase by 1%.

comment was that our analysis is based on information on list prices rather than actual transaction prices. While this is a valid criticism, data on discounts were not available to us at the time of estimation. We were however informed that discounts tend to vary more across markets or time, than across individual consumers. This implies that at least part of this data problem is controlled for by our inclusion of market and time fixed effects.

Other comments on the empirical analysis related to the need for further sensitivity analysis. First, the demand side was estimated separately, without imposing cross-equation restrictions from the supply side (exploiting the assumption of pre-merger Nash equilibrium). This produced imprecise results for several demand parameters, which has also been observed in other studies where the demand equation was estimated separately with data on only a limited number of periods. Second, the model was estimated after excluding some of the countries. When only a few countries were excluded the results remained robust. Excluding up to half of the countries, however, generated rather imprecise parameter estimates.

Finally, there were comments on the interpretation of our parameter estimates, and the implications for the estimated price cost margins. One remark was that it is not possible to reject the hypothesis that the segmentation Parameter  $\sigma$  is equal to zero, implying symmetric substitutes. However, our interpretation of the estimated  $\sigma$  is that the data are insufficiently informative to make precise predictions on the extent of substitution within and between nests. Despite this, we are able to reject the hypothesis that brands within a nest are perfect substitutes ( $\sigma=1$ ). This is an important finding since it would otherwise not be possible to rule out the possibility that the merger has insignificant price effects. (This is because a merger has no effects when products are perfect substitutes and the merger does not create a monopoly).

Another remark related to the price–cost margins or the Lerner indices as implied by our estimates. Market average Lerner indices range from .346 in Italy to .563 in Sweden (with standard deviations in the .1–.2 range depending on the country). These numbers are higher than the average gross margin of .3 as cited by the Volvo experts. Our response to this criticism was that the margins predicted by the model should not necessarily coincide with margins that are

directly computed from accounting cost data and are affected by the rules for allocating fixed costs in particular. For example, in times of overcapacity the short run economic marginal cost may be rather low. Furthermore, in the truck market sales are linked to after-sales services; manufacturers may take the future profits from these after sales services into account when setting their prices.

## 5. Merger analysis

We now show how the econometric model can be used to assess merger effects. We begin with a discussion of the results from our first test, a hypothetical market power test. This test is informative since it requires no assumptions about firm behavior after the merger. It also relates to the spirit of the SSNIP-test. Next we consider an actual market power test, which uses more precise assumptions about firm behavior after the merger to obtain more precise predictions about price effects and effects on consumer surplus and total welfare. This test also allows one to account for possible efficiencies realized through the merger. Finally, we consider an extension to our original analysis. We take a dynamic perspective to account for the effect of a merger prohibition on subsequent mergers in the market.

### 5.1. *Hypothetical market power test*

Our first test is a *hypothetical market power test*. This test computes the profitability of unilateral and nontrivial price increases by the merging firms. More specifically, we consider price increases by 5%, 10% and 25%. The elements of this test are defined as follows:

- *Profitability*. The profitability of a price increase depends on the diversion ratio and the pre-merger markups. The greater is the diversion ratio between the two merging firms' products, the more the merging partners can recapture each other's lost sales from the price increase. The larger are the markups, the more the partners gain from the recaptured sales.
- *Unilateral price increase*: The rival firms are assumed not to respond to the price increase, e.g., by partially raising their prices as well.
- *Nontrivial price increase*: A small price increase after the merger would necessarily be profitable. It has a negative but negligible effect on the product's own profits, and a positive and non-negligible effect on the profits of the merging partner's profit.<sup>22</sup> In contrast, a sufficiently large price increase eventually becomes unprofitable: The negative own-profit effect becomes substantial and at some point outweighs the positive profit effect of the merging partner. We consider nontrivial price increases of 5%, 10% or 25%.

Note that the test is related to the previously discussed SSNIP-test, yet the focus is somewhat different. The SSNIP-test asks how many firms are needed to make a given price increase profitable, for the purpose of defining the relevant antitrust market. Our hypothetical market power test asks whether the two merging firms can profitably raise prices by alternative amounts. The purpose is here to examine the potential of increased unilateral market power.

<sup>22</sup> This is because the negative own-profit effect is a second order effect, since firms are already maximizing their own pre-merger profits. The positive effect on the merging partner B's profit is a first order effect, proportional to the pre-merger markup of firm B.

Since our hypothetical market power test relates to the SSNIP test, it has the advantage of being familiar to antitrust practitioners. Furthermore, the test does not require specific assumptions about firm behavior after the merger. Hence, the test can be applied whether or not coordinated effects are a source of concern. This is important since there is no obvious way to select a plausible post-merger equilibrium when coordinated effects are possible. It is, of course, necessary to decide what constitutes a nontrivial price increase. This problem is however of a similar nature as deciding what constitutes a nontrivial price increase when defining the relevant market.

Table 4 shows the (normalized) percentage profit changes accruing to Volvo and Scania, when both firms would unilaterally raise the prices of all their products by 5%, 10% and 25%.

A robust finding is that a hypothetical price increase by 5% is profitable in almost all countries. Only in four countries would Volvo and Scania's joint operating profits (slightly) decrease after this hypothetical price increase. The highest profit increases are found in Sweden, Norway, Finland, Ireland and Denmark.

A different picture emerges for a hypothetical price increase by 10%. On the one hand, such a price increase is unprofitable for nine countries. On the other hand, for markets where the price increase is profitable, it is frequently more profitable than the 5% increase. This is most notably true in Sweden, Norway, Finland and Denmark. This conclusion extends to the considered large price increase of 25%. Such a price increase is only profitable in Sweden, but the profit increase is larger.

One may also interpret the results in Table 4 in terms of the market definition based on the SSNIP test. Following the rule that the relevant market is the minimum number of firms that can profitably raise prices by 5%, the merging firms by themselves constitute the relevant market in twelve out of the sixteen countries. Modifying the rule to a 10% price increase (the upper bound in the European Notice), the merging firms still constitute the relevant market in seven out of the

Table 4  
Hypothetical market power test

Price increase	Profit change of merging firms from alternative price increases		
	5	10	25
Austria	-0.70	-5.96	-35.09
Belgium	1.05	0.49	-8.63
Denmark	1.63	2.09	-2.25
Finland	2.51	2.98	-4.89
France	0.18	-1.40	-13.86
Germany	-0.23	-2.79	-19.70
Greece	1.39	-0.02	-14.49
Ireland	2.12	1.70	-10.02
Italy	-1.14	-7.63	-41.79
Luxembourg	-0.07	-1.51	-11.86
Netherlands	0.77	-2.47	-26.70
Norway	2.74	3.58	-2.37
Portugal	1.16	-0.12	-13.37
Spain	0.23	-2.05	-18.65
Sweden	2.95	4.91	5.67
United Kingdom	1.28	0.49	-11.04
European Union	1.00	-0.49	-14.32

Note: Profit effects are based on the parameter estimates of scenario 2 ( $r=3.0$ ). The numbers are normalized such that the average percent profit change in the European Union under a 5% price increase is equal to one.



sixteen countries. Hence, for these countries our analysis implies there is a merger to monopoly, in the traditional antitrust sense.

We note that the ranking of the countries based on the hypothetical market power test is not inconsistent with the Commission's ranking in terms of the merging firms' joint market shares. One notable difference occurs in the top 5, where Denmark and Ireland switch places. However, the similarity between the results from our hypothetical market power test and the Commission's traditional market share analysis is not true in general. In our application, it follows in part from the fact that the estimate of our segmentation parameter  $\sigma$  was relatively low (though imprecisely estimated). In general, it is only possible to find out after the estimation of the model and the application of the hypothetical market power test whether the results are similar to the traditional market share approach. Furthermore, the hypothetical market power test has the advantage of using a more consistent rule in determining the cut-off points at which a merger would be considered as potentially harmful.

### 5.2. Actual market power test

The above test assessed the potential of increased market power, by looking at the profitability of price increases without making detailed assumptions about post-merger firm behavior. The advantage of the test are that it relates the practitioners' familiar SSNIP-test, and that it can be used without making specific assumptions about post-merger firm behavior. However, the test is conservative in that it underestimates the profitability of joint price increases in two respects. First, it considers a percentage price increase that is the same for all products of the merging partners. In practice, the merging firms will typically find it optimal to increase the prices of their products by different amounts. The profitability of optimal price increases is thus typically larger. Second, the test ignores responses by competitors. In practice, competitors may respond to a price increase by also raising their prices. This is most obviously the case if the merger triggers collusive responses by the other firms; in this case price matching could be complete. Yet also if the rivals behave non-cooperatively, one may expect positive – albeit incomplete – price responses.

An alternative approach is the actual market power test, which imposes more specific assumptions about firm behavior after the merger. In our application we assume that firms continue to set prices non-cooperatively after the merger, hence we assume that there are only unilateral effects in the merger. In principle, one could consider an indeterminate number of alternative coordinated effects equilibria. Our discussion above, however, emphasized it may be better to use a hypothetical market power test if one is not sure about how coordinated effects would materialize after the merger.<sup>23</sup>

To implement the actual market power test, we numerically compute the post-merger Nash equilibrium, with a modified ownership structure, and compare this to the pre-merger Nash equilibrium. This amounts to solving a system of 14 pricing and demand equations, to obtain the equilibrium prices and quantities of the 14 products.<sup>24</sup> We do not consider the possibility that behavior shifts from non-cooperative before the merger to something more collusive after the merger.

<sup>23</sup> Nevertheless, if one is sure about the exact coordinated equilibrium after the merger, an analysis based on simulation analysis would predict stronger market power effects, since it accounts for collusive reactions by the rivals.

<sup>24</sup> Recall that there are 7 firms and 2 groups of products.

### 5.2.1. No efficiencies

In our initial analysis we computed the effects of the merger on prices, consumer surplus and total welfare assuming that the merger does not entail any efficiencies. As is well known, in this case the merger will necessarily increase prices and reduce consumer surplus. Hence, to appropriately interpret the results from a simulated merger absent efficiencies, the policy maker should apply a reasonable “tolerance level” regarding price increases absent efficiencies. This tolerance level may for example be based on a general presumption regarding the average size of efficiencies expected from mergers; see Fisher and Lande (1983), and Röller *et al.*, (2001) for a discussion on the general presumptions approach.

We first looked at the effects of the merger on the individual prices in the various countries. Generally speaking, Volvo and Scania are predicted to raise their prices by more than 10% in several countries, in particular the Nordic countries and Ireland. It is interesting to note that the predicted price responses by the competitors are positive, but quite small. Most firms in most countries respond by negligible price increases or price increases by less than 1%, even in countries where the merging firms raise their prices by substantial amounts of more than 10%.

To summarize the results about the mergers’ price effects, one may look at the estimated effects from the merger absent efficiencies on consumer surplus. Decreases in consumer surplus may be viewed as increases in an industry price index. The results are shown in the first column of Table 5. There are two countries for which the estimated decline in consumer surplus is greater than 10%: Norway (−10.71%) and Sweden (−17.77%). For an additional three countries the estimated decline in consumer surplus is greater than 5%: Denmark (−6.02%), Finland (−8.44%) and Ireland (−7.00%). For all countries, the 95% confidence intervals of the consumer surplus effects are negative, which is unsurprising given the significantly negative estimate for the parameter  $\alpha$

Table 5  
Actual market power test Welfare analysis with and without cost efficiencies

	No cost efficiency of 0%		5% cost efficiency	
	Change in		Change in	
	Consumer surplus	Total welfare	Consumer surplus	Total welfare
Austria	−1.09 [−1.10, −0.44]	−0.35 [−0.36, −0.09]	0.02 [−1.09, 1.70]	0.01 [−0.37, 0.58]
Belgium	−3.05 [−3.11, −1.11]	−1.16 [−1.16, −0.33]	−1.41 [−2.85, 1.17]	−0.56 [−1.12, 0.48]
Denmark	−6.02 [−6.22, −2.04]	−2.48 [−2.49, −0.82]	−4.25 [−5.83, −0.26]	−1.79 [−2.38, −0.11]
Finland	−8.44 [−8.82, −3.06]	−3.51 [−3.55, −1.23]	−6.93 [−8.52, −1.99]	−2.93 [−3.46, −0.87]
France	−1.04 [−1.05, −0.43]	−0.34 [−0.35, −0.08]	0.10 [−1.06, 1.84]	0.04 [−0.36, 0.62]
Germany	−0.62 [−0.64, −0.23]	−0.19 [−0.19, −0.03]	0.24 [−0.66, 1.63]	0.08 [−0.21, 0.48]
Greece	−3.46 [−3.73, −0.86]	−1.30 [−1.32, −0.35]	−2.06 [−3.41, 0.60]	−0.80 [−1.25, 0.21]
Ireland	−7.00 [−7.12, −3.03]	−2.87 [−2.87, −1.03]	−5.15 [−6.77, −1.17]	−2.16 [−2.77, −0.49]
Italy	−1.03 [−1.05, −0.40]	−0.33 [−0.34, −0.07]	−0.02 [−1.07, 1.63]	0.00 [−0.36, 0.51]
Luxembourg	−0.59 [−0.60, −0.18]	−0.19 [−0.19, −0.04]	0.24 [−0.66, 1.69]	0.08 [−0.22, 0.50]
Netherlands	−2.85 [−2.94, −1.03]	−1.02 [−1.02, −0.27]	−1.30 [−2.67, 1.19]	−0.48 [−1.00, 0.43]
Norway	−10.71 [−11.55, −2.99]	−4.68 [−4.88, −1.34]	−8.95 [−11.07, −1.89]	−3.96 [−4.72, −0.86]
Portugal	−3.34 [−3.39, −1.34]	−1.27 [−1.28, −0.39]	−1.78 [−3.18, 0.81]	−0.70 [−1.25, 0.34]
Spain	1.39 [−1.40, −0.57]	−0.48 [−0.49, −0.12]	−0.20 [−1.39, 1.60]	−0.07 [−0.50, 0.59]
Sweden	−17.77 [−20.97, −4.80]	−8.05 [−9.13, −2.10]	−15.89 [−20.13, −3.48]	−7.23 [−8.85, −1.58]
UK	−3.77 [−3.86, −1.36]	−1.46 [−1.46, −0.43]	−2.13 [−3.57, 0.65]	−0.85 [−1.41, 0.28]

Note: The calculations are based on the parameter estimates of scenario 2 ( $r=3.0$ ). Confidence intervals are in parentheses, based on a bootstrapping procedure as described in the text.

and the estimate of  $\sigma$  significantly different from 1.<sup>25</sup> A careful look at the confidence intervals gives more interesting results. The confidence intervals are skewed: the upper bound of the confidence interval (in absolute value) is closer to the point estimate than the lower bound. For example, in Sweden the 95% confidence interval around the point estimate of  $-17.77$  is  $[-20.97, -4.80]$ ; in Austria the 95% confidence interval around the point estimate of  $-1.09$  is  $[-1.10, -0.44]$ . Furthermore, the expected values of the consumer surplus effects are lower (in absolute value) than our reported point estimates. The skewness is the result of the nonlinearity of consumer surplus in the parameters  $\alpha$  and  $\sigma$ . As a way of comparison, we also constructed confidence intervals for the expected price increases per product (not reported in Table). The skewness was found to be considerably less pronounced. For example, the point estimate of the price increase for a Volvo tractor in Sweden was 9.98, with a confidence interval of  $[3.46, 23.78]$ ; for the same model in Austria it was 1.88, with a confidence interval of  $[0.42, 4.25]$ .

For completeness Table 5 also reports the changes in total welfare (i.e. the sum of producer and consumer surplus), although it is interesting to note that the European Commission essentially did not pay much attention to this. The expected welfare effects of a merger are a priori ambiguous even when the merger does not entail efficiencies, because of a possibly beneficial output reallocation effect.<sup>26</sup> In our application, however, the welfare effects (and the confidence intervals) are negative for all countries.

### 5.2.2. *Efficiencies*

In an extension of our analysis we considered the possibility that the merger creates efficiencies, in the form of savings in marginal costs. Under these circumstances, the merger has two effects: first, the merging firms take into account the effect of a price change on each others' sales and profits power, inducing the merging firms to set higher prices; second, there is a cost saving, which may induce firms to (partially) pass on these cost savings to consumers. As a result, in the presence of efficiencies the post-merger Nash equilibrium will no longer necessarily entail higher prices than the pre-merger equilibrium.

The second part of Table 5 summarizes the results when the merger contains efficiencies in the form of marginal cost savings. We consider a merger with a hypothetical marginal cost saving of 5%. This is the maximum efficiency claim that the Commission presumed to be reasonably plausible (without however doing a very detailed analysis on these cost savings as it was common practice before the recent reform proposals).<sup>27</sup> The point estimates show that a 5% cost reduction increases consumer surplus in four countries and lowers consumer surplus in the remaining twelve countries. In fact, for five of the twelve countries with a negative point estimate the entire 95% confidence interval for the effect on consumer surplus is negative: Denmark, Finland, Ireland, Norway and Greece. Hence, for these countries one may conclude at a 95% confidence level that the merger would lead to a lower consumer surplus, even when there

<sup>25</sup> To compute the confidence intervals, we followed a parametric bootstrap procedure. We draw alternative parameter values for  $\alpha$  and  $\sigma$ , assuming that they have a multivariate normal distribution with a covariance matrix equal to our estimated covariance matrix. For these draws we compute the post-merger equilibrium and the implied changes in price, consumer surplus and welfare. Our results are based on 1000 draws.

<sup>26</sup> The output reallocation effect stem from the fact that a merger may cause production to shift to more or less efficient firms. This effect is beneficial if the social value of the outsiders' products is sufficiently high, which occurs if they have a high market share in equilibrium. See Farrell and Shapiro (1990) for an analysis in a Cournot model.

<sup>27</sup> The percentage cost reduction applies to the average of the marginal costs across countries. Since the estimated marginal costs may differ across countries (because of local costs), the percentage cost reductions may actually differ across countries.

are 5% efficiencies. Incidentally, as discussed above, the European Commission found the merger to cause dominance in precisely these countries.<sup>28</sup> It will, of course, not generally be true that the results from a simulation approach will coincide so closely with the European Commission's dominance approach, but it does illustrate that both approaches are not necessarily in conflict with each other. As a final remark, we can have a look at the U.K. Out of the large E.U. countries, the Commission found the effects in this country to be somewhat borderline (using its traditional market share analysis). Based on our finding this can be translated in a statistical sense: one cannot conclude at a 95% confidence level that consumer surplus would decrease in the U.K. after a merger with 5% efficiencies, though one could conclude it at a lower (unconventional) confidence level, e.g. at the 80% level.

Similar findings obtain for total welfare. The estimated welfare effect is negative for twelve out of the sixteen countries. Furthermore, in five countries the entire 95% confidence interval for the welfare effect is negative (the same five countries as before).

### 5.3. Comparative market power test

The potential and actual market power tests are consistent with current competition policy rules because they analyze the effects of the actually proposed merger. However, a relevant question that is currently ignored in the merger decision process is what will happen next. For example, if claims of cost-savings in the form of returns to scale are valid, it seems reasonable to expect that other firms with similar scale may propose further mergers. If the competition agency continues to apply the same criteria it may be difficult to block the second merger once the first merger has been allowed. In our application, the question of alternative sequential mergers is especially important from an international European integration perspective. The proposed merger between Volvo and Scania is essentially a regional one, meaning that the two merging firms' market shares are strongly correlated across countries: Volvo tends to have a high market share in those countries where Scania also has a large market share (the Nordic countries) and a low market share in countries where Scania has a low market share (and vice versa). Hence, if this regional merger would be approved, then a second regional merger should likely to be approved as well if the same criteria are applied. A merger authority should therefore take a dynamic position, and also ask what will happen after the merger has been approved or blocked.

To illustrate, we consider the following realistic example. We assume that the merger between Volvo and Scania would trigger an additional regional merger, between Renault and Iveco, who have stronger positions in the southern parts of Europe. We compare this regional merger scenario with an alternative scenario of two pan-European mergers. This scenario assumes that when the Commission blocks the Volvo–Scania merger, Volvo would seek another partner, Renault, and subsequently Scania and Iveco will merge.<sup>29</sup> Table 6 compares the effects of the two sequential regional mergers, Volvo/Scania and Renault/Iveco, with the alternative of two sequential pan-European mergers, Volvo/Renault and Scania/Iveco. All four firms have comparable European level sales, so that scale economies should be comparable.

The first column in Table 6 show that the two regional mergers (absent efficiencies) reduce consumer surplus by more than 3% in most countries, and by more than 5% in five countries.

<sup>28</sup> This is a coincidence since we constructed the confidence intervals after the European has made its decision.

<sup>29</sup> The possibility that Volvo would merge with Renault if it could not buy Scania, was of course not known with certainty at the time. But it was clear that Volvo would seek for other partners and Renault was a real possibility. In fact, the merger was proposed and accepted shortly after the Commission's decision to block the Volvo–Scania merger.

Table 6  
Comparative market power test Alternative merger sequences

	Change in consumer surplus		Change in total welfare	
	Two regional mergers	Two pan-European mergers	Two regional mergers	Two pan-European mergers
Austria	-1.24	-0.88	-0.40	-0.27
Belgium	-3.31	-1.88	-1.25	-0.66
Denmark	-6.23	-2.30	-2.54	-0.82
Finland	-8.93	-5.53	-3.67	-2.09
France	-3.48	-4.58	-1.26	-1.74
Germany	-0.72	-0.60	-0.21	-0.17
Greece	-3.46	0.00	-1.30	0.00
Ireland	-7.23	-2.59	-2.94	-0.91
Italy	-4.10	-4.37	-1.52	-1.64
Luxembourg	-1.31	-1.49	-0.42	-0.48
Netherlands	-2.91	-0.78	-1.04	-0.25
Norway	-10.73	-0.75	-4.69	-0.26
Portugal	-4.25	-3.90	-1.57	-1.42
Spain	-4.11	-4.03	-1.47	-1.43
Sweden	-17.78	-0.37	-8.05	-0.13
UK	-4.35	-3.00	-1.64	-1.07

Notes: The calculations are based on the parameter estimates of scenario 2 ( $r=3.0$ ).

The four firms involved in the two regional mergers effectively succeed in dividing the market, with regional blocks being formed. The second column considers the two pan-European mergers. Even though the same firms are involved, the merger effects are considerably smaller for most countries. The reduction in consumer surplus is larger than 3% in only six countries, and larger than 5% in only 2 countries. Similar conclusions can be drawn from looking at the total welfare effects from the merger.

This example illustrates that the competition authorities should not restrict attention on the immediate effects of a proposed mergers. It is necessary to take a dynamic perspective and ask what would happen next, i.e. after the merger has been approved or rejected. In the context of segmented markets, the choice may often be between accepting sequential regional or sequential pan-European mergers.

## 6. Concluding remarks

Using the Volvo/Scania case as a background, we have shown how the econometrics of differentiated products markets can be performed and applied to help European antitrust authorities in their investigation of mergers. We hope to have shown that this technique is a fruitful tool to evaluate the issues at stake and to account for effects that are otherwise very hard to measure, like actions of rival firms in terms of price and strategy, cost efficiencies and alternative merger sequences. Compared to the previous literature we made the following contributions. We proposed a range of alternative possible tests, to emphasize that the recent techniques do not necessarily conflict with traditional merger practice based on the dominance concept. We specifically emphasized the importance of a comparative market power test, which does not compare the merger outcome with the status quo but rather with a relevant and realistic alternative merger scenario. Finally, we showed the importance of constructing confidence intervals in conducting these tests.

The model involves assumptions about cost conditions, demand conditions and market equilibrium. All together they produce a model that is parsimonious in the number of parameters to be estimated. This approach is necessary given European merger investigations provide rather limited time to collect data and perform a quantitative analysis. However, we believe that the model still provides a good approximation of the working of the heavy truck market and that the assumptions are favorable to the merging firms. In other words, our chosen simplifying assumptions tend to generate either unbiased or conservative estimates of the merger effects on prices and welfare. We now review the role of these assumptions.

### *6.1. Cost assumptions*

It is assumed that marginal cost is constant, i.e., independent of output. The predicted price increases arising from the merger would be stronger if marginal costs were decreasing in output.<sup>30</sup> In contrast, the price effects would be weaker in the reverse case of increasing marginal costs (a capacity constrained industry). In fact, it is rather unlikely that marginal costs are increasing, given the cyclical nature of the market and the need for firms to invest in a sufficient amount of capacity *ex ante*.

The model neither estimates fixed costs nor assesses fixed cost savings. Since the primary interest of the competition agency is in the price or consumer surplus effects, this assumption does not affect our analysis.

### *6.2. Demand assumptions*

The demand side of the model is based on the nested logit model, which generates the following substitution pattern. When the price of one product increases by 1%, it increases the demand for the other products within the same segment by an equal percentage, whereas it increases the demand for products in a different segment by a lower percentage. Intuitively, the nested logit model thus imposes symmetric substitution patterns within a segment, yet it allows for asymmetric substitution patterns across segments, while remaining parsimonious in the number of parameters to be estimated. Moreover, the assumptions of the nested logit model regarding the substitution patterns may be viewed as favorable to the merging firms regarding the predicted price effects arising from the merger for two reasons. First, all products are symmetric substitutes within a segment, whereas a separate investigation described in the Commission's Decision concluded that the merging firms are likely to be closer substitutes. If this is true, our analysis would underestimate the price effects. Second, the elasticities are increasing in prices, while in the econometric antitrust literature, one often either assumes constant elasticities, or otherwise performs simulation analysis with a "linearized" model assuming elasticities do not change. When price changes are large, the assumption of constant elasticities or the "linearization" may yield a significant overestimation of the price effects.

The model is usually described as a discrete choice model, in which each consumer buys a single truck. The model can be straightforwardly reinterpreted to describe demand behavior whereby each consumer buys more than one truck, but still a fixed number of the same brand. Recently, it has been shown that the discrete choice model can also be re-interpreted as a

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<sup>30</sup> This is because an increase in price implies a lower production, which in turn implies a higher marginal cost under decreasing marginal costs. The price effect would, however, be less than proportional to marginal cost, since marginal costs are passed on incompletely.



representative consumer model, in which one consumer has a taste for diversity and decides to purchase multiple brands of trucks (see e.g. [Anderson et al., 1992](#), for the logit model).

When truck manufacturers are selling trucks in large amounts to transport firms, they may find it optimal to apply discounts. Our econometric model at least partially control for discounts. First, as discussed earlier, the model includes firm-specific and country-specific dummy variables, thereby controlling for firm- and country-specific discounts. Furthermore, the econometric error term in the demand equation may be interpreted as capturing product-specific price measurement error, which we incorporated by applying instrumental variables ([Berry, 1994](#)). However the model does not allow for individual-specific quantity discounts. From a theoretical point of view only a few studies have looked to competition with nonlinear pricing and asymmetric information between buyers and sellers. Generally speaking, it seems fair to say that competition may limit the feasibility of quantity discounts. Hence a merger, which reduces the number of competitors, could create the potential for more price discriminating discounts. This would imply a greater loss in consumer surplus, since the manufacturers can extract more to their own gain. Note that quantity discounting also raises consumer switching costs, since it induces consumers to stay with the same firm. Indeed, at the equilibrium, discounts must be such that the consumer has no incentive to leave for a competing contract, in addition to be incentive-compatible and individually rational (see [Ivaldi and Martimort, 1994](#)).

### *6.3. Conduct assumptions*

The model assumes that the competition between firms selects a static Nash equilibrium. However, alternative equilibrium concepts may well be more realistic in some situations. For example, the merger may facilitate collusive behavior, whereby firms behave cooperatively rather than non-cooperatively. Second, the merger may trigger other mergers. The price effects of such other mergers may especially be large in a more concentrated industry.

Summing up, several assumptions can be debatable. Nevertheless, care has been taken so that the assumptions lead to no clear bias, or in fact lead to conservative estimates of the price effects. Furthermore, it is because we have a quantified model that one is able to assess the effects of the assumptions. Here we have just provided an example to illustrate how quantification can help the effectiveness of economic evidence.

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