

# Quantifying the Effects from Horizontal Mergers: Comments on the underlying Assumptions

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## 1. INTRODUCTION AND CONCLUSION

In our paper published in this issue we measured the effects of the proposed Volvo-Scania merger. We first estimated an oligopoly model with product differentiation, and then used the parameter estimates to compute the post-merger equilibrium and the implied price and welfare changes under various alternative scenarios. In section 4.4 of our paper we discussed what we view as the most important sources of concern regarding our empirical analysis, in part based on the comments from the experts hired by Volvo during the case. The Hausman-Leonard (HL) paper elaborates in more detail on the specific points raised by the experts during the case. In this note we respond to these points.

Our conclusions may be summarized as follows. First, we point out flaws in the implementation of some of the specification tests and in the interpretation of the plausibility of the economic results. Second, because the number of possible specification tests that can be carried out is virtually unlimited, we recommend that they be selected based on commonly used principles. Third, when a model is rejected in favour of an alternative, more flexible model, the analysis should not stop there, but where possible, the implications for the merger effects in the more flexible model should be investigated. This is especially relevant since our assumptions were conservative regarding the expected merger effects. Based on these conclusions, we can only agree with HL's general policy recommendations (need for transparency, objective evaluator during the case).

## 2. THE DATA

We collected data on list prices, characteristics and sales of the base truck models. In section 4.4 of our paper we discussed the data limitations. Unfortunately, we have not been able to obtain access to individual transaction data, in particular because of the limited time available to conduct our study. It is difficult to assess how our aggregate price measure would affect the results. However, there are two

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reasons why we do not expected a systematic bias. First, any biases resulting from country-specific or firm-specific discounts are accounted for through the included fixed effects. Second, the error term in our econometric model reflects unobserved quality and/or measurement error in price, specific to products/markets/years. (See Berry, Levinsohn and Pakes, 1995.) Under the identification assumption that this error is uncorrelated with the instruments, the parameter estimates are consistent.

### 3. MODEL SPECIFICATION

#### 3.1. IIA assumption

The nested logit model has the property of independence of irrelevant alternatives (IIA), for products that belong to the same each nest (rigid or tractor in our application). This property implies that the ratio of choice probabilities for two products within the same nest remains the same when a third product is removed from the choice set. To test the IIA property, HL follow the idea of Hausman and McFadden (1984). They remove one product (one rigid truck) from the choice set, estimate this alternative model and perform a Hausman test. For this test to be valid, it is necessary that this alternative model produce consistent estimates. It turned out that this is not the case for two reasons. First, in the nested logit model, the IIA property does not hold for products belonging to different nests. Hence, removing one rigid truck from the choice set affects the relative choice probabilities, so that the alternative model is not consistent.<sup>1</sup>

The second problem stems from the way HL extend Hausman and McFadden's test, formulated for individual-level models, to our aggregate model. To simplify the exposition, consider the simple aggregate logit model and the standard notation:

$$\ln(s_j / s_0) = x_j \beta - \alpha p_j + \xi_j \quad \text{for any } j = 1, 2, \dots, J. \quad (1)$$

HL proceeds as follows. They remove one choice, say product 1, and then estimate:

$$\ln(s_j / (s_0 - s_1)) = x_j \beta - \alpha p_j + \xi_j \quad \text{for any } j = 2, 3, \dots, J. \quad (2)$$

Without further motivation, HL thus adjust the left-hand side variable in (1) by subtracting the market share of the removed product from the market share of product 0 (the outside good). Since at the aggregate level the ratio of market shares should remain the same if the logit model is correct, there is no reason for adjusting the left-hand side variable in the alternative model. In sum, we identified two reasons why the alternative model specified by HL does not produce consistent estimates, so that it cannot be used as a specification test.

### 3.2. Identical parameters across countries

Our empirical model assumed that the parameters are the same across countries (apart from the fixed effects). See for example Hausman, Leonard and Zona (1994), Verboven (1996), Nevo (2000) or Pinske and Slade (2004) for similar approaches towards countries or regions. HL test this restriction by comparing our parameter estimates with those obtained after removing the observations of three subsets of countries. We make two reservations with their approach. First, since there is a very large number of subsets of countries that may be removed, it is not surprising to find rejection of the hypothesis for some of the alternative models. It would thus be a reasonable practice to use some *a priori* defined principles when presenting the results from a few selected subsets.<sup>2</sup> Second, if the assumption of identical parameters appears to be violated, the implications for the merger effects should be investigated. Although we made available our merger simulation code, the parties' experts did not use it to analyse these implications during the case. When we rerun the simulations with the new parameter estimates,<sup>3</sup> our conclusions regarding the merger effects in the Nordic countries were unaltered. In their paper, HL only present an informal discussion of the merger effects when the Nordic countries are removed from the data set (the third subset of countries). They argue there would be no significant competitive problem from the merger for the non-Nordic countries. This is, in fact, entirely consistent with our own conclusions and those of the European Commission.

### 3.3 Weighted estimation

HL estimate our model after weighting the demand side observations in order to control for heteroskedasticity. The weighting scheme they have chosen is one among many others and is not based on commonly used principles. First, the weighting scheme is not directly related to the market size, whose variance HL claim to be the source of heteroskedasticity.<sup>4</sup> Second, while it is well-known that a demand system may be not homoskedastic when an error term is added to the model,<sup>5</sup> this is not the case here. Indeed, our error term has the structural interpretation of unobserved quality or

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<sup>1</sup> The IIA property still holds for products of the same nest. HL could thus in principle have estimated the model for observations of the same nest, and then an alternative model that removes one alternative. But this is not what they did.

<sup>2</sup> For example, in their report, the experts defend removing the observations from Greece and Luxembourg since this reduces the number of observations by the very small amount of 0.6%. This is not correct. It constitutes 0.6% of the sales, but about 12% of the observations.

<sup>3</sup> In contrast to HL's conclusions, we obtained estimates for the price and nesting parameters that were either of the expected sign and significant, or insignificant.

<sup>4</sup> Their weights in the demand equation are specified as  $w_j = \sqrt{\tilde{s}_j N / (1 - \tilde{s}_j)}$ , where  $\tilde{s}_j$  is defined by  $\tilde{s}_j \equiv s_0 \exp(x_j \hat{\beta} - \hat{\alpha} p_j + \hat{\sigma} \ln s_{j/g})$ , where the hats indicate parameter estimates from unweighted estimation. Note that  $\tilde{s}_j$  does not have the interpretation of predicted market shares since they are not computed from solving the simultaneous equations system.

<sup>5</sup> See e.g. Brown and Walker (1989).

measurement error in price and it is built into the model before the share equation is derived. (See Berry, 1994).

### *3.4. Sensitivity of the results*

HL criticize the fact that we do not estimate but rather assume a value for the potential market size. It is well-known that this parameter is hard to identify when there is a limited number of years,<sup>6</sup> so the literature has typically assumed a value. In contrast to HL's claim, we did base it on outside empirical evidence. As discussed in our paper, we used empirical evidence provided to us by the European Commission (obtained from an academic expert). This evidence led us to focus on the scenario for the potential market size that implied the largest price elasticities of market demand (and thus was most conservative regarding the predicted merger effects).

HL state that our results are sensitive to software used and to iterating the non-linear least squares results. In a detailed Addendum to our initial report submitted to the Commission (which we provided to the parties' experts during the case) we presented the parameter estimates using alternative software and using iterated three stage least squares. The parameters remained within similar range,<sup>7</sup> and more importantly, the merger simulations lead to identical conclusions.

## **4. ECONOMIC PLAUSIBILITY OF RESULTS**

HL discuss the Lerner indices implied by our model. The Lerner indices refer to the economic profit margins (expressed in percentages), and are used as a measure of market power. The average Lerner index (averaged over products) was lowest in Italy (0.34; standard deviation of 0.107), and highest in Sweden (0.56; standard deviation of 0.164). There are a few instances of rather large Lerner indices. HL argue that this casts doubt on the economic plausibility of the results, quoting that gross margins are 30%. We do not know how HL estimated this number. However, if it is based on accounting data, this number should be interpreted cautiously; see Bresnahan (1989). Two examples illustrate why economic or opportunity costs may be considerably lower than accounting costs. First, there may be excess capacity, implying the opportunity cost is lower than the accounting cost. Second, in the European truck market (as in the car market) sales are linked to after-sales services. Profit-maximizing sellers would take into account the expected future gains from after-sales services, implying their opportunity cost is lower than the accounting cost of selling a new truck.

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<sup>6</sup> Estimating the potential market size would translate into estimating the price elasticity of market demand. This would require a large number of years, with sufficient variation between the years.

## References

- Berry, S.T. (1994), Estimating Discrete Choice Models of Product Differentiation, *Rand Journal of Economics*, 25, 242-262.
- Bresnahan, T. (1989), Empirical studies, in Schmalensee, R. and R. Willig, *Handbook of Industrial Organization*, North-Holland, Amsterdam.
- Brown, B.W. and M.B. Walker (1989), The Random Utility Hypothesis and Inference in Demand Systems, *Econometrica*, 57, 815-829.
- Hausman, J., G. Leonard and J.D. Zona (1994), Competitive Analysis with Differentiated Products, *Annales d'Economie et de Statistique*, 34, 159-180.
- Hausman, J. and D. McFadden (1984), Specification tests for the multinomial logit model, *Econometrica*, 52, 1219-40.
- Nevo, A. (2000), Mergers with Differentiated Products: the Case of the Ready-to-Eat Cereal Industry, *Rand Journal of Economics*, 395-421.
- Pinkse, J. and M. Slade (2004), "Mergers, Brand Competition, and the Price of a Pint," *European Economic Review*, 48(3), 617-643.
- Verboven, F. (1996), International Price Discrimination in the European Car Market, *Rand Journal of Economics*, 27, 240-268.

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<sup>7</sup> For example, when using different software the price parameter changes increase from 0.280 to 0.347, while the nesting parameter drops from 0.304 to 0.256. The implications for merger simulations are unaffected.