On merger simulation and its potential role in South African merger control

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Abstract

This paper simulates the price effects of the proposed Ferro Industrial Products (Ferro) and Powder-Lak merger in order to suggest the role that merger simulation models should play in South African merger control. Merger simulation can provide support to the Commission's analysis by: focusing parties' attentions on verifiable economic arguments; making transparent the values of the key parameters and assumptions in the Commission's analysis; producing quantitative estimates of the results of a given transaction; and indicating the amount of resources to allocate to proposed merger cases. However, it offers only one piece of evidence in a case and its results must be interpreted with an understanding of the potential limitations.

Keywords: Merger simulation

JEL L40, C15, K21

1 Introduction

The 1992 US Horizontal Merger Guidelines introduced an important distinction between coordinated effects and unilateral effects of mergers. Coordinated effects relate to the reduction in the number of competitors in a market which increases the potential for the remaining firms to coordinate their behaviour by tacitly or overtly colluding (see Hay & Werden, 1993). Unilateral effects recognise the ability of the merged entity to raise prices due to the internalisation of pre-merger competitive constraints.

The use of merger simulation analysis has increased in the U.S. and Europe in recent years. The European Commission's guidelines on the assessment of horizontal mergers promote the use of new economic analysis techniques. The concept of merger simulation, while simple, is soundly based on standard textbook economics. For instance, if the same, well-specified oligopoly model reasonably describes the outcome of the competitive process both before and after a proposed merger, that model can be used to generate a quantitative prediction of the merger's unilateral competitive effects. That is, after it is first calibrated to match the prices, shares, and so on, that would prevail but for the merger (see Froeb et al., 2004).

Merger simulation may circumvent the challenge of defining a relevant product and geographic market which is increasingly motivated more by rent seeking than by unbiased inquiries into the relevant market. According to Church and Ware (2000: 732–733) 'two high priced economists can always be found who support opposite contentions about the relevant market'. This makes it extremely difficult for consultants, competition analysts and courts to come to a consensus regarding the relevant product and geographic market definition (Werden, 1997). However, the importance of market definition stems from competition authorities' strong reliance on market shares as a measure for market power. In most countries around the world with competition policy, including South Africa, influential legal guidelines rely heavily on

market shares as a basis for making decisions. It is clear therefore that market definition will remain important in the coming years even as there may be some growth in the reliance on simulation approaches[1].

This paper will simulate the price effects of the proposed Ferro Industrial Products (Ferro) and Powder-Lak merger in order to suggest the role that merger simulation models should play in South African merger control. We acknowledge from the outset that merger simulation models do not necessarily allow merger analysts to avoid the competitive effects analysis relating to the relevant market, nor do they necessarily provide greater precision to merger control[2].

Examples of the use of merger simulation in the assessment of mergers include amongst others the Volvo/Scania merger and the Oracle/PeopleSoft merger. In the proposed merger between Sweden's Volvo and Scania in 1999, the European Commission (EC) commissioned a simulation study carried out by Ivaldi and Verboven. This study was based on a nested logit model using panel data on list prices and horsepower for two types of trucks for each of the seven major truck manufacturers in 16 different European countries in 1997 and 1998. The results of the simulation indicated serious anticompetitive price effects in the regions in question (Scandinavian countries and Ireland). Interestingly, this finding was in line with the conclusion reached by the EC's traditional analysis on the likely impact of the merger if allowed to go through[3].

In 2003, Oracle launched a hostile bid for its rival PeopleSoft. Oracle and PeopleSoft were the second and third largest vendors of enterprise application software (EAS) worldwide. Both the United States of America's Department of Justice and the Federal Trade Commission undertook in-depth investigations using a simulation model measuring the unilateral effects of the merger. Both models found high and similar price effects despite the different assumptions and market definitions made in the beginning of the study[4].

This paper uses a calibrated simulation model. Calibrated simulation models are very helpful absent reliable elasticity estimates. Merger analysts often face data limitations due to money and time constraints. Calibrated simulation models use small data to infer relevant unilateral effects of a merger. This means that the precision of the results in this paper affected by the closeness of the model to reality and data quality. A simple model which is a good description of reality combined with reliable data yields the best results. For instance, the merger simulation results of the unilateral effects of the proposed Ferro/Powder-Lak merger may give reasonable results if the market shares of Ferro's powder coating and Akzo Nobel's powder coating change by the same percentage if Powder-Lak's powder coating is taken off the market.

The paper is organised as follows: Section 2 presents a brief background to the proposed Ferro and Powder-Lak merger. Section 3 deals with the methodology. Sections 4 and 5 discuss the data issues and the results of the simulation model, respectively. Section 6 concludes.

2
The proposed Ferro/Powder-Lak merger

On 12 October 2007, Ferro notified the Competition Commission (the Commission) about its intention to acquire Powder-Lak as a going concern, both companies incorporated under the laws of South Africa[5]. Both companies are active in the broader industrial chemicals sector, with Ferro being a major manufacturer and supplier of coatings (including powder), plastics and ceramics, while Powder-Lak is a medium-sized manufacturer and supplier of powder coating products. Powder coating was the main focus of the Commission's investigation as the only area in which there was a product overlap.

By way of background, powder coating is a form of coating which was patented in 1953 and produced for the first time in the 1960s. Before the invention of powder coating, paint came in a liquefied form only. Like liquid paint, powder coating is a product of the mixture of pigments (resins), and additives whereas other coatings are composed of pigments (resins), solvents and a binder. What mainly distinguishes powder coating from liquid coating is that it is solvent-

free. This feature ensures that powder coating does not emit volatile organic compounds; and as such makes powder coating the most environmentally-friendly form of coating.

Powder coating is used in the construction, white goods (i.e. fridges, microwaves, televisions, phones and other appliances), automotive, architectural and general metal finishing sectors. It is applied to products by means of a static electrical charge, and then baked in an oven. In the 1970s powder coating was manufactured in South Africa by the likes of Elvolac and Prolux. In 1976 Elvolac was acquired by Prolux and at a later stage transferred to AECI Paints (Dulux). In the same year, Plascon entered the South African powder coating market. In 1983 Plascon acquired Dulux to become the largest producer of powder coating in South Africa.

In 1985 Ferro (then owned by Ferro Corporation (USA)) entered the powder coating market and were followed by Powder-Lak three years later. Plascon lost market share post the entry of Ferro and Powder-Lak and reacted by entering into a joint venture with Courtlauds Coatings (Courtlauds)[6].

Courtlauds was then acquired by Akzo Nobel in 1998 and in 2002 the company also acquired the American and Asia Pacific powder coating business of Ferro Corporation. Azko Nobel then became one of the largest producers of powder coating in the world. In South Africa, Akzo Nobel and Ferro are the largest producers of powder coating while Powder-Lak is a relatively small player.

2.1 Market definition

The concept of a relevant market is at the centre of competition authorities' assessment of mergers. The hypothetical monopolist test based on a small but significant and non-transitory increase in price (SSNIP) is used to define a relevant market.

The merging parties argued that powder coating could be substituted for solvent-based wet coating, galvanising and anodising. The parties further cited a EC merger case between *Du Pont/Hoechst/Herberts*[7], in which the EC after its investigation found that '*powder coatings cannot be regarded as being a separate product market*'…'*and that from a demand-side this technology is perfectly substitutable by other coating technologies'*. The EC in the matter between *AKZO Nobel N.V. and Courtaulds PLC*[8]considered the effects of the transaction on the powder coating market although it did not conclude on the relevant market definition. Similarly, the Australian Competition and Consumer Commission in the matter between *ICI New Zealand Ltd and HB Fuller Holdings New Zealand Ltd* considered the relevant market for the manufacture and sale of powder coatings, although some end users indicated the possibility of using other surface coatings. With regard to the EC case (Du Pont/Hoechst/Herberts[9]) cited by the parties where powder coating was considered not to constitute a single market, the Commission noted that a definite conclusion on the relevant market was not reached in that case.

The Competition Tribunal (the Tribunal) had also dealt with similar problems in a number of its past decisions. In its decision in the matter of *JD Group Ltd / Ellerine Holdings Ltd* the Tribunal held that well-defined sub-markets may exist which, in themselves, constitute product markets for anti-trust purposes. The Tribunal's view in this matter was consistent with the principle of *practical indicia* for determining submarkets, which was first noted in the *Brown Shoe* matter that, 'industry or public recognition of the sub-markets as a separate economic entity, the product's peculiar characteristics and uses, unique production facilities, distinct customers, distinct prices, sensitivity to prices changes, and specialised vendors' should be considered when defining markets.

In addition, in the matter of *Massmart Holdings Ltd and Moresport Ltd* the Tribunal held that *practical indicia* are considered by competition authorities not simply to determine that one business is different from another, but for the purposes of determining the market in which companies (businesses) strive for profit or where in fact competition exists[10]. The market definition exercise should strive to identify from whom and from where a business faces competitive constraints or *effective* competition".

Customers of the merging parties interviewed by the Commission indicated that there are

quality and technical limitations that inhibit switching from powder coating to other forms of coating. The Commission took the view that the observed switching cited by the merging parties could be a result of the *cellophane fallacy*[11]. The cellophane fallacy is observed in instances where a monopolist will set prices at the point where consumers are just on the margin of switching to some other product or of dropping out of the market altogether so as to maximise profits. When monopoly prices prevail in the market, there will appear to be many substitutes for the monopolists product. The appearance of substitutes at prevailing prices does not necessarily mean that they should be included in the same market.

In a merger case, the concern is whether the merger is going to enhance the firm's market position in a way which might lessen or prevent competition. The question of interest, is whether as a consequence of the merger, a SSNIP of between 5 to 10 per cent above the current level can be sustained by the merged firm. Although there were certain customers that stopped using powder coating and switched to other forms of coating, this, as the Commission found, was a result of supra-competitive prices of powder coating as it was no longer profitable to use the product, in other words it was not switching in response to a SSNIP of a competitively priced product. A better procedure is to start by ascertaining what level of prices might prevail were the market to be competitive, and then use that as the basis of the SSNIP test.

The SSNIP test presents another challenge in defining markets in the present case. Ferro and Akzo Nobel's prices for powder coating were consistently 30 per cent higher than Powder-Lak's. The immediate problem relates to the difficulty in differentiated products of identifying the competitive level of prices to be used as a benchmark to assess the impact of a SSNIP. With differentiated products, price, quality and performance variations can be very substantial and markets may appear to be fragmented (see Pleatsikas & Teece, 2001).

It is the holistic view on the *practical indicia* that matters the most, which in this case showed that Powder-Lak's powder coating had a competitive constraint on Ferro and Akzo Nobel's products. The Commission defined the relevant market as that for the manufacture and supply of powder coating in South Africa.

2.2 Assessment of competition

The Commission assessed the competitive effects of the transaction in the powder coating market in South Africa, as merging parties faced minimal competition from imports and supplied their products largely from their centrally located bases. Ferro and Powder-Lak had market shares of approximately 35 per cent and 19 per cent, respectively. Their main competitor, Akzo Nobel, had about 30 per cent market share, while the residual was accounted for by imports mainly from India. The intended merger was going to reduce the number of firms in the powder coating market in South Africa from three to two, in a highly concentrated market[12].

In its assessment of the merger, the Commission benchmarked the strength of competition in the powder coating market in South Africa against such structural factors as entry barriers, countervailing power, import competition and prevailing market dynamics. The Commission found the existence of high entry barriers in the powder coating market largely due to stringent quality requirements by customers, as well as the lack of local technical expertise in the field. On average, incumbent firms extracted high gross profit margins, which suggested that the market was quite profitable. Even in these circumstances, the market had not attracted new entry for more than 15 years. Some firms had tried to enter the market in the past but failed.

The merging parties were at pains arguing that imports of powder coating could counteract an exercise of market power by the merged entity in South Africa[13]. Most of the imported product had been for large and higher end customers who could achieve the minimum viable scale of 10 tonnes for a consignment; but there were smaller customers (largely supplied by Powder-Lak) who consumed less than a tonne per year. Importation of powder coating from various sources generally takes 10 to 12 weeks lead time, while sourcing the product locally takes only 5 days. Not only were local customers concerned

about long lead times for importation, they also had reservations about the quality of the imported product[14]. Even in instances when domestic prices rose, imports did not rise, which affirmed the negligible impact of imported products in South Africa.

Before Powder-Lak entered the powder coating market it was impossible for consumers who needed small quantities to source this within the country; Powder-Lak had made this possible while Ferro and Akzo Nobel did so on a small scale. Powder-Lak also produces relatively large consignments which exerted a competitive constraint on Ferro and Akzo Nobel. The implementation of the proposed merger was likely to remove an effective competitor in the form of Powder-Lak. And without the countervailing power, customers of the merging parties (particularly small ones) could not counteract any attempt by the merged entity to exercise market power.

Having established that there are weak competitive constraints in the powder coating market in South Africa, the Commission concluded that the proposed transaction was likely to substantially prevent or lessen competition to the extent that users of the product in the construction, white goods, automotive, architectural and general metal finishing sectors would be adversely affected as prices were likely to increase significantly. Based on this finding, the Commission prohibited the merger. In arriving at this conclusion, the Commission had taken cognisance of concerns from customers who indicated that if prices were to increase post-merger, they would simply pass on such increases to end-users and for those customers that faced competition from imports the possibility of closing down factories could not be ruled out.

The Commission assessed average prices of Ferro, Powder-Lak and Akzo Nobel over a period of five years and found that the average prices of Ferro and Akzo Nobel's powder coating had been approximately 30 per cent above the prices of Powder-Lak's product. According to the Commission, this meant that the merged entity could increase the price of Powder-Lak's product by a small, significant and permanent amount of between 5 per cent and 10 per cent without losing any customer to any supplier, thus making it profitable.

Having found that the proposed transaction is likely to lead to a substantial prevention or lessening of competition in the powder coating market in South Africa, section 12A(a)(i) of the Competition Act requires the Commission to determine 'whether or not the merger is likely to result in any technological, efficiency or other pro-competitive gain which will greater than, and offset, the effects of any prevention or lessening of competition, that may result or is likely to result from the merger, and would not likely be obtained if the merger is prevented'.

In the case of *Trident Steel (Proprietary) Limited and Dorbyl Limited for the acquisition of three operations of Baldwins Steel, a division of Dorbyl Limited*[15] (Trident Steel/Dorbyl) the Tribunal proposed a test to assess efficiencies claimed as a result of the merger, which the parties also relied on[16].

The parties claimed that the transaction would result in real (production efficiencies) and pecuniary efficiencies (raw material cost efficiencies). However, the Commission's view was that although there will be efficiencies that could be attributed to raw material savings, these could not compensate the anti-competitive effect that the merger would have in the manufacture and sale of powder coating in South Africa.

Through this rudimentary assessment, the Commission validated its findings, which Ferro (the acquiring firm) had an option to appeal but opted not to exercise its right.

The paper intends to test the veracity of the Commission's finding using the merger simulation technique.

3 Methodology

The first step in merger simulation is estimating an oligopoly model, using assumptions about demand, cost and the equilibrium (see Verboven, 2008). The parameters of the models are then used to make counterfactual predictions on the likely effects of a merger. For clarification, consider the following simple example. Assume the existence of three firms, producing three differentiated products. Suppose we observe

from the market that there are constant and symmetric own and cross price elasticities of demand, the marginal costs are constant and identical and the equilibrium is akin to that of Bertrand price setting firms. If firm 1 and 2 want to merge, define the following for Firm 1 (and symmetric for Firm 2): a constant own price elasticity, ε_{11}; and the cross price elasticity with respect to Firm 2 to be, ε_{12}. We define a diversion ratio, δ, and the percentage of lost sales to Firm 1 after a price increase by Firm 1 that flows back to Firm 2.[17]

Before the merger, the profits of Firm 1 are, $\pi_1 = (p_1 - c)q_1(p_1, p_2, p_3)$ where q_1 is the market demand for Firm 1's product, p_1 is the price of Firm 1's product, p_2 and p_3 are the prices of Firm 2's and Firm 3's products, respectively, and c corresponds to the marginal cost. Assuming Firm 1 maximises profits with respect to price, we obtain the following first-order conditions:

$$q_1 + (p_1 - c)\frac{\partial q_1}{\partial p_1} = 0$$

This applies to both Firms 1 and 2, so that $p_1 = p_2 = p_3 = p$. Using a few algebra steps and the constant own price elasticity, price can be expressed as follows:

$$p = c\left(1 - \frac{1}{\varepsilon_{11}}\right)^{-1}$$

To simulate the price effects of a merger between the two firms, simply combine their profit functions so that after the merger the joint profits of Firm 1 and 2 are:

$$\pi_{1+2} = (p_1 - c)q_1(p_1, p_2, p_0) + (p_2 - c)q_2(p_1, p_2, p_0)$$

Taking the first derivatives with respect to price of product 1 requires:

$$q_1 + (p_1 - c)\frac{\partial q_1}{\partial p_1} + (p_2 - c)\frac{\partial q_2}{\partial p_1} = 0$$

A similar condition applies for the price of the second product. Because of symmetry you obtain $p_1 = p_2 = p^*$, using the constant own price elasticity and the diversion ratio $\delta = \frac{\varepsilon_{21}}{\varepsilon_{11}}$ and you can easily calculate the percentage change in prices from their pre-merger levels. And so the predicted price is:

$$p^* = c\left(1 - \frac{1}{\varepsilon_{11} - \varepsilon_{21}}\right)^{-1} = c\left(1 - \frac{1}{\varepsilon_{11}(1 - \delta)}\right)^{-1}$$

We can now compute:

$$\frac{p^* - p}{p} = \frac{\delta/\varepsilon_{11}}{1 - \delta - 1/\varepsilon_{11}}$$

Shapiro (1996) expresses this formula differently. Using the mark up condition

$m = (p - c)/p = 1/\varepsilon_{11}$

before the merger he obtains:

$$\frac{p^* - p}{p} = \frac{\delta m}{1 - \delta - m}$$

This shows that all that is needed to predict the price effect of the merger is the diversion ratio and the prevailing mark up (or equivalently the own price elasticity).

In constructing the simulation model, we use a flat logit demand model based on Werden and Froeb (1994). The model assumes that consumers make discrete choices among the alternatives in the market or do not buy at all. Consumers select the alternative that gives them the greatest utility. Consumer *i*'s utility for buying and consuming product *j* consists of a function of observable characteristics (z_j) and an unobservable term: $U_{ij} = V(z_j, \gamma) + e_{ij}$.

Consumer *i* will buy good *j* rather than any of the other goods in some choice set C if and only if product *j* creates the most utility: $\pi_j \equiv \text{Prob}(i \text{ buys } j) = \text{Prob}(U_j > U_k)\,\forall k \in C \setminus j$.

McFadden (1974)shows that if the e_{ij}'s are independent and identically distributed according to the extreme value distribution, then:

$$\pi_j = Exp\left[V(z_j, \gamma)\right] / \sum_{k \in C} Exp\left[V(z_k, \gamma)\right]$$

The specification of V on which the flat logit model is based is given as $V(z_j, \gamma) = \alpha_j - \beta p_j$. The profit for a firm which owns all the brands in some set $f \subseteq C$ is $\sum_{k \in f} Q\pi_k (p_k - c_k)$ where Q is the total number of consumers.

Setting the derivative of profit with respect to the price of one of that firm's products, *j*, yields the first order condition:

$$\pi_j\left[1 - \beta(p_j - c_j)\right] + \sum_{k \in f} \beta\pi_k^2 (p_k - c_k) = 0$$

Using some algebra we obtain:

$$p_j - c_j = \frac{1}{\beta\left(1 - \sum_{k \in f} \pi_k\right)}$$

Note that π_k is a function of the prices and the parameters of the demand system, so we cannot solve directly for the equilibrium prices.

For the purposes of the proposed Ferro/Powder-Lak merger, we have prices and a calibrated demand system that is used to solve for the costs that would be consistent with the equilibrium. This is how pre-merger marginal costs are estimated. However, by using the flat logit demand it is assumed that a price rise on one product causes consumers to switch to the other products in relation to these products' market shares (the independence of irrelevant alternatives assumption (IIA)). If, for example, the price of Powder-Lak's powder coating increases, most consumers would turn to Ferro and fewer to Akzo Nobel. The assumption is reasonable on the powder coating market since products which sell a lot have more shelf space in the stores.

While the IIA is useful, it can also be restrictive (see Nevo, 2000 and Hausman & Leonard, 2005). In terms of substitution patterns, the consequence of the IIA property is that cross-price elasticities are totally driven by market shares. If for example, a logit model is used to estimate the demand for cars and the market share for a red Volvo is 5 per cent, for a blue Volvo the market share is 10 per cent and for a Bentley the market share is 10 per cent. The cross-price elasticities derived from the logit model will predict substitution patterns proportional to the product market shares, given a marginal price increase in blue Volvos. Consumers who choose to substitute away from blue Volvos are twice as likely to buy Bentleys instead of red Volvos[18]. Actual behaviour by customers in the real world setting may not follow this pattern of substitution.

The nested logit model is a flexible version of the flat logit demand model. This model begins with the partitioning of products into groups or *nests* containing similar products. This means that substitution patterns are stronger within groups than across groups. However, the IIA property still holds within groups (see Ivaldi & Verboven, 2005). With all their known weaknesses, logit and nested logit demand models have been used in merger simulation (see Werden & Froeb, 1994, Werden, 1997, Ivaldi & Verboven, 2005, among others).

The random coefficients or mixed logit model retains all the benefits of the standard logit and is highly flexible as well (see Berry, 1994 and Berry Levinsohn & Pakes BLP, 1995). The key idea behind the BLP model is to interact product and (observed and/or unobserved) consumer attributes. With the interaction, consumers will substitute toward similar products, not just products with the same mean utility. Flexibility in substitution is obtained by allowing model parameters to be random functions of consumer characteristics. Cross-price elasticities are no longer determined by shares but by product characteristics and variations in the sensitivity to those characteristics. The strength of the BLP model is its ability to account for consumer heterogeneity. Competition analysis relies on getting substitution patterns right and this is exactly where logit and nested logit are weakest, but this does not render them less useful. While the BLP model combines advantages of flexible substitution patterns with minimal data requirements of discrete choice approach, it is complex and much more time consuming to estimate, which might impact on its effectiveness in merger analysis as competition authorities have a limited time to review mergers.

In sum, a weakness of discrete choice models is that consumers are assumed to purchase one unit of one good, or nothing at all. Furthermore, while these techniques are now established in academic literature, they are still unfamiliar to courts and regulatory bodies.

4
Data

The merger was proposed to take place in late 2007. The prices, quantities and margins used in the simulation are 2006 averages. Ideally, we would have liked to have used the prices at the time of the merger, but these were not available. In addition, we would have liked to use consumer–level data (for example, from scanners) as it leads to more accurate estimates. However, consumer preferences are highly variable and scanner data results in sample selection problems because a small portion of consumers have store cards.

Ferro, Powder-Lak and Akzo Nobel submitted average factory gate or ex-works prices, including discounts, which their consumers paid. This is the information set by the firms; it does not point to which customer bought which product in the manner that information on a store card would indicate. One advantage of using a flat logit model is that it can be used when there is incomplete information on the elasticities. The best way is generally to estimate every cross-price elasticity one by one. By choosing the flat logit model, we only need two elasticities, the market elasticity which controls for substitutability between the products in the market and the outside good and a measure of the level of substitutability between the products in the market.

Powder coating has an inelastic demand. An increase in the price of all powder coating results in a decrease in the quantity sold by less than one per cent. The powder used in powder coating is made out of thermoplastics which include polypropylene and polyethylene. Fedderke and Simbanegavi (2008) estimate price elasticities of demand in four petrochemicals derived plastics markets. They find price elasticities for low density polyethylene and polypropylene to be -0.3 and -0.2 respectively. These low price elasticities imply the presence of pricing power. The price elasticity of a key input may be different from the price elasticity of the product. Ideally we would have liked to estimate a logit demand model to obtain more accurate estimates of elasticities. This involves estimating supply and demand functions using uniform prices and quantities across products to obtain a single industry-wide demand elasticity estimate.

However, most industries are characterised by multiproduct firms producing differentiated rather than uniform goods. This means that each product is likely to face a different demand elasticity. For instance, to use a single estimate of demand elasticity for a Bentley and a Volvo would be misleading, rather individual products' attributes and their market position should be used in demand elasticity estimation[19]. Absent any reliable estimates of aggregate elasticity of demand for powder coating from the literature and insufficient data, we adjust for this by simulating the unilateral effects of the proposed merger with market elasticities of -0.001 to -0.81 (see Table 3 in the Appendix on the sensitivity analysis).

5
Estimated results

In its assessment, the Commission noted that the implementation of the proposed merger would have reduced the number of firms in the powder coating market from three to two. One of the reasons why we chose this particular merger is that this was a market where one would expect a merger's effects to be most pronounced, and hence somewhat easier to disentangle from other changes influencing prices. Because of the high level of concentration, in practice, this was a market that would generally not escape legal or regulatory scrutiny.

Own-price elasticity can, in this context, be regarded as a measure of the degree of product differentiation between competing brands. If products are relatively highly differentiated then the market power of each brand is relatively high, and price response as measured by the own price elasticity is relatively small in absolute terms (ignoring the negative sign). Estimates of own-price elasticities are not available for powder coating brands. The model predicts these to be in the range of –3 to –5. Therefore the market is differentiated, but not to a high degree[20]. When calibrating the model we obtain the corresponding marginal costs from the first order condition. These were in line with the ones obtained from the submissions of the merging parties (see Table 1).

Table 1
Parameters based on pre-merger data

Product name	Demand alphas	Init. marg. costs	Init. gross margin	New marg. costs	Initial e ^ utility	MC change to offset price effect	% MC savings to offset price effect
Ferro	6.989	0.243	30.7%	0.243	8.076	–0.041	17.0%
Powder-Lak	5.412	0.192	31.3%	0.192	4.446	–0.061	31.8%
Akzo Nobel	7.360	0.257	30.5%	0.257	8.842	0.000	0.0%
PTL	4.195	0.277	20.8%	0.277	0.494	0.000	0.0%
Jotum	4.600	0.276	21.1%	0.276	0.741	0.000	0.0%
Rapid	4.195	0.277	20.8%	0.277	0.494	0.000	0.0%

Table 2 below shows the results of the simulation model before and after the proposed merger. The flat logit model assumes the aggregate elasticity to be –0.2 and beta is assumed to be 14. Results of the simulation model with the above inputs and assumptions suggest that the proposed merger might result in a weighted average price increase of about 9.2 per cent for merging parties. The prices of Ferro's powder coating would increase by about 6 per cent while Powder-Lak's powder coating would increase by approximately 15 per cent post-merger. In addition to the price changes, the model also calculates changes in shares that might result from the predicted price changes.

We conducted a series of additional results in order to test the sensitivity of our results to different assumptions of the aggregate elasticities of demand and betas. These results are shown in Table 3 in the appendix. These additional results consider the average predicted price increase from the merger for all products, the average predicted price increase from the merger for the merging firms' products and the pre-merger margin on product 1. The results show that product differentiation allows firms to exert market power, and that mergers between significant firms are likely to allow the merged entity (and to a lesser extent other firms) to raise prices because of the loss of competition between the merging brands. These results are not surprising since we used the logit demand model. The logit model gives conservative effects simply because of the small convexity of the logit demand function. In line with the Commission's findings, we have also assumed an absence of entry in response to any post-merger price increases.

Table 2
Predicted results of the simulation model

Before the merger							
Product name	**Product number**	**Initial quantity**	**Initial price**	**Initial owner**	**Final owner**	**Initial market share**	**Average initial price**
Ferro	1	0.327	0.350	Ferro	Ferro	35.0%	0.344
Powder-Lak	2	0.180	0.280	Powder-Lak	Ferro	19.3%	
Akzo Nobel	3	0.358	0.370	Akzo Nobel	Akzo Nobel	38.3%	
PTL	4	0.020	0.350	PTL	PTL	2.1%	

Jotum	5	0.030	0.350	Jotum	Jotum	3.2%	
Rapid	6	0.020	0.350	Rapid	Rapid	2.1%	
After the merger							
Product name	**New prices**	**Price increase**	**Avg price increase**	**New quantities**	**Quantity decrease**	**Aggregate quantity decrease**	**Savings: new p = init p**
Ferro	0.371	6.1%	All prods	0.307	6.2%	1.1%	17.0%
Powder-Lak	0.321	14.7%	5.9%	0.128	29.0%		31.8%
Akzo Nobel	0.379	2.3%	merging	0.402	–12.2%		0.0%
PTL	0.350	0.1%	9.2%	0.025	–25.8%		0.0%
Jotum	0.351	0.2%		0.038	–25.5%		0.0%
Rapid	0.350	0.1%		0.025	–25.8%		0.0%

5.1 Market power tests

Ivaldi and Verboven (2005) suggest several tests to assess the merger effects. The hypothetical market power test requires no assumption about firm behaviour after the merger. The test computes the profitability of unilateral small but significant price increase by the merging firms. The test seeks to understand whether the two merging firms can profitably raise prices by 5 per cent and 10 per cent. The test is related to the SNNIP test and does not require assumptions about the conduct of the firm after the merger. For the proposed Ferro/Powder-Lak merger a hypothetical price increase of 5 per cent would have been profitable. While the hypothetical market power test is familiar to merger analysts, it underestimates the profitability of a price increase by the merged entity because it considers a percentage price increase that is the same for all products of the merging firms. In practice merging firms would increase the prices of their product by different amounts. However, the test ignores the responses of the competitors who may respond by also raising their prices.

The actual market power test uses more precise assumptions about firm behaviour after the merger to obtain predictions about the price effects and possible efficiencies. The test compares the post merger Nash equilibrium with the pre merger Nash equilibrium (see Table 2). The merging parties in the proposed Ferro/Powder-Lak highlighted several efficiency gains that would be realised as a result of the merger. We considered the possibility that the merger would create efficiencies in the form of savings in marginal cost. On one hand the proposed merger therefore has the effect of inducing the merging parties to set higher prices post-merger. For example, the point estimates for Ferro's powder coating increase after the merger was 6.1 per cent while Powder-Lak's point estimate of the induced increase was 14.7 per cent (see Table 2). On the other hand, the proposed merger would have led to cost savings which may have been partially passed on to the consumers. In support of the Commission's assessment and using the actual market power test it is clear that the proposed transaction would have resulted in a substantial prevention or lessening of competition in the South African powder coating market. The efficiency gains could not compensate the anti-competitive effect of the merger.

6 Conclusion

The Commission's assessment of the proposed merger led it to prohibit the transaction given the potential unilateral effects, a finding supported by our merger simulation exercise. The main thrust of this paper is to show how

merger simulation can be a useful tool to evaluate the unilateral effects of mergers. It can provide support to the Commission's analysis by focusing parties' attention on verifiable economic arguments, making transparent the values of the key parameters and assumptions in the Commission's analysis, producing quantitative estimates of the results of a given transaction, and indicating the amount of resources to allocate to proposed merger cases.

However, it is important to note that merger simulation does not attempt to produce proof of a substantial lessening of competition, nor to supplant the Commission's exercise of judgement, but rather the value to the Commission's merger inquiries will be in providing one piece of evidence in a case. In sum, the use of merger simulation can bring confidence to a merger analyst especially if together with the traditional analysis it points in the same direction and supports the documentary evidence and industry practices as was the case in the Ferro/Powder-Lak merger.

Endnotes

1 In addition, there remains no obvious and commonly accepted simulation approach which means that it remains important to continue thinking about carefully applying the market definition approach.

2 Without understanding the limitations of such models and the circumstances under which they can and should be usefully applied, they may not just be useless, but dangerous in the sense of providing possibly spurious results with spurious claimed accuracy (see Walker, 2005).

3 The Volvo experts criticised the study for the following reasons, namely, the use of list prices, IIA property of logit type models, common parameters across countries and heteroskedasticity. Despite these criticisms, the EC concluded that even though the merger evaluation will not be solely based on the findings of this study, the results of econometric work can be a valuable supplement and add insight into merger analysis.

4 For a brief review of the Oracle/People Soft merger and the Volvo/Scania merger see Budzinski and Ruhmer (2008)

5 This was an intermediate merger transaction, which in terms of section 14(1)(b) of the Competition Act No. 89 of 1998 (as amended) the Commission takes the ultimate decision, unlike for large mergers.

6 Courtlauds was founded in the UK in 1816 and was involved in the powder coatings business through International Paint & Pinchin Johnson.

7 Case No IV/M.1363.

8 See case number IV/M.1182 (1998).

9 Case No IV/M.1363.

10 See Case No 62/LM/Jul05.

11 See Motta, M. 2004. Competition policy: Theory and practice, p: 105. Church & Ware. Industrial Organisation, p: 617.

12 The pre-merger Herfinfindal-Hirschman Index (HHI) was 3094 points while post merger it was going to be 4424 points thus yielding a change in HHI of 1330.

13 Imports are mainly from companies such as Jotun (based in Dubai), PTL and Colour Blast (based in China), Rapid Powder Coating and Nice Coatings (based in India) and Oxyplast (based in Canada)

14 For instance, one major white goods manufacturer had switched to imports but immediately switched back to the local product due to quality problems.

15 Case number: 89/LM/Oct00

16 See page 20. '*where efficiencies constitute "real" efficiencies and there is evidence to verify them of a quantitative or qualitative nature, evidence that the efficiencies will benefit consumers, is less compelling. On the other hand, where efficiencies demonstrate less compelling economies, evidence of a pass through to consumers should be demonstrated and although no threshold for this is suggested, they need to be more than trivial, but neither is it necessary that they are wholly passed on... When we talk of real economies we would, without proposing an exhaustive list, include dynamic efficiencies, production efficiencies ranging from plant economies of scope and scale to research and development efficiencies that might not be achieved short of merger. Pecuniary efficiencies would not constitute real economies nor would those that result in a mere redistribution of income from the customers, suppliers or employees to the merged entity.*'

17 Put differently, some customers will stop buying product 1 if its price increases, the diversion ratio from Firm 1 to Firm 2 is the percentage of those displaced customers who end up buying product 2. This is roughly the percentage of Firm 1's marginal customers who view Firm 2 as the next best alternative.

18 Table 4 in the Appendix shows diversion ratios in the proposed Ferro/Powder-Lak merger. Mathematically, the diversion ratio is shown below;

$$\delta = -\frac{\partial q_2 / \partial p_1}{\partial q_1 / \partial p_1} = \frac{\partial q_2 / \partial p_1}{\partial q_1 / \partial p_1} \frac{q_1 / p_1}{q_2 / p_1} \frac{q_2}{q_1} = \frac{\varepsilon_{12}}{\varepsilon_{11}}$$

19 The establishment of basic merger simulation procedures by Werden and Froeb (1994) and Hausman, Leonard, and Zona (1994) has led to the growth of many studies exploring the strengths and weaknesses of simulation models to merger analysis.

20 For example as cited in Stavins (1995) 'economists have employed various means of estimating demand and supply for differentiated products or individual attributes, There is still no agreement as to the best way to estimate demand elasticities for products differentiated in several attributes. ...A large number of products forces the analysts to place strong restrictions on demand to avoid estimating thousands of elasticities. In most of the studies, models are assumed to compete only with their two nearest competitors. However, a sufficient drop in price could presumably make consumers move to a different market segment, making the assumption too stringent. Cross-elasticities are often estimated only after the market is aggregated to two general types of products.'

21 It is noted that products are differentiated because consumers perceive differences in the products. Included are instances where two products may be physically identical, and yet significant numbers of consumers are prepared to pay more for one than for the other. This scenario can arise where products are strongly branded, possibly through advertising, and consumers form preferences for one product over another, perhaps for intangible product characteristics such as image or reputation. Another product characteristic that can be varied, and hence can cause differentiation, is the geographical location of outlets.

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Appendix

Table 3
Sensitivity analysis

Average predicted price increase from the merger for all products								
		beta						
		6.11	9.16	12.21	15.26	18.32	21.37	24.42
	–0.81	5.8%	5.2%	4.6%	4.0%	3.6%	3.2%	2.9%
	–0.74	6.3%	5.5%	4.8%	4.2%	3.7%	3.3%	3.0%
agg elast	–0.66	6.9%	5.8%	5.0%	4.3%	3.8%	3.4%	3.0%
	–0.59	7.5%	6.2%	5.2%	4.5%	3.9%	3.5%	3.1%
	–0.52	8.1%	6.5%	5.4%	4.6%	4.0%	3.6%	3.2%
	–0.44	8.8%	6.9%	5.7%	4.8%	4.1%	3.7%	3.3%
	–0.37	9.5%	7.3%	5.9%	5.0%	4.3%	3.8%	3.3%
	–0.29	10.4%	7.8%	6.2%	5.2%	4.4%	3.9%	3.4%
	–0.22	11.3%	8.3%	6.5%	5.4%	4.6%	4.0%	3.5%
	–0.15	12.4%	8.8%	6.9%	5.6%	4.7%	4.1%	3.6%
	–0.07	13.7%	9.5%	7.2%	5.8%	4.9%	4.2%	3.7%
	0.0	15.2%	10.2%	7.6%	6.1%	5.1%	4.4%	3.8%
Average predicted price increase from the merger for merging firms' products								
		beta						
		6.11	9.16	12.21	15.26	18.32	21.37	24.42
	–0.81	10.1%	8.9%	7.6%	6.6%	5.8%	5.1%	4.6%
	–0.74	10.9%	9.3%	7.9%	6.8%	5.9%	5.3%	4.7%
agg elast	–0.66	11.8%	9.7%	8.1%	7.0%	6.1%	5.4%	4.8%
	–0.59	12.7%	10.2%	8.4%	7.2%	6.2%	5.5%	4.9%
	–0.52	13.6%	10.7%	8.8%	7.4%	6.4%	5.6%	5.0%
	–0.44	14.6%	11.3%	9.1%	7.6%	6.6%	5.8%	5.1%
	–0.37	15.7%	11.8%	9.5%	7.9%	6.7%	5.9%	5.2%
	–0.29	16.9%	12.4%	9.8%	8.1%	6.9%	6.0%	5.3%
	–0.22	18.2%	13.1%	10.2%	8.4%	7.1%	6.2%	5.5%
	–0.15	19.7%	13.8%	10.7%	8.7%	7.3%	6.3%	5.6%
	–0.07	21.3%	14.6%	11.1%	9.0%	7.5%	6.5%	5.7%
	0.0	23.3%	15.5%	11.7%	9.3%	7.8%	6.7%	5.8%

Pre-merger margin on product 1								
		beta						
		6.11	9.16	12.21	15.26	18.32	21.37	24.42
	–0.81	60%	42%	33%	27%	22%	19%	17%
	–0.74	61%	43%	33%	27%	23%	20%	17%
agg elast	–0.66	62%	43%	33%	27%	23%	20%	17%
	–0.59	63%	44%	33%	27%	23%	20%	17%
	–0.52	64%	44%	34%	27%	23%	20%	17%
	–0.44	65%	45%	34%	28%	23%	20%	17%
	–0.37	66%	45%	34%	28%	23%	19%	17%
	–0.29	67%	46%	35%	28%	23%	20%	17%
	–0.22	68%	46%	35%	28%	24%	20%	17%
	–0.15	69%	47%	35%	28%	24%	20%	18%
	–0.07	71%	47%	36%	29%	24%	20%	18%
	0.0	72%	48%	36%	29%	24%	21%	18%

Table 4
Diversion ratios at initial prices

		Product losing quantity					
		1	2	3	4	5	6
Product gaining quantity	1		41%	53%	34.2%	34.6%	34.2%
	2	27.8%		29.2%	18.8%	19.0%	18.8%
	3	55.2%	45.0%		37.5%	37.9%	37.5%
	4	31%	2.5%	3.2%		2.1%	2.1%
	5	4.6%	3.8%	4.9%	3.1%		3.1%
	6	3.1%	2.5%	3.2%	2.1%	2.1%	