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What do economic simulations tell us? Recent mergers in the iron ore industry

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Abstract

This paper investigates the European Commission's decision to allow a merger between two Brazilian iron ore mining companies, CVRD and Caemi, using data on the Direct Reduced Iron pellet market. By using a simulation model, we can directly simulate the total welfare effects from the merger and hence evaluate the merger from a new perspective. The results from our simulations suggest that the welfare effects are negative from the merger between CVRD and Caemi, which supports the conclusion drawn by the European Commission decision. By performing different simulations between hypothetical merger candidates, our results show that only mergers between small candidates have the potential to be welfare enhancing.

Keywords: Welfare; Iron ore; Merger; Simulation model; Cournot

JEL classification: D4; L4; Q3

Introduction

During 2001, 1562 million US dollars were spent on mergers and acquisitions in the global iron ore mining industry; in 2002 and 2003 the figures were 2861 and 3959 million US dollars, respectively.[2] From the global mining industry, the iron ore industry is one of the few industries that has experienced a continuous consolidation trend since the 1970s (Ericsson, 2001). Recent figures show that the iron ore industry is only moderately concentrated. The three largest firms control roughly 30% of the world production (Ericsson, 2004).

From society's perspective mergers can either have positive or negative effects. The direction of the effects depends on whether the predominant cause is to increase efficiency through cost reductions or alternatively increase market power. A combination of the two is also possible in which case the net effect is more difficult to foresee.

When assessing the economic impact, the public policy towards mergers—as embodied in case law—is primarily structural. The procedure commences with a discussion of how to delineate relevant markets. Market shares are then assigned and possible effects and the particular level of concentration are discussed. However, there is an obvious risk that the market definition 'generally determines the result of the case'.[3] In addition to the structural analysis, which concentrates on ownership and market shares, it is necessary to investigate the behavior and performance of the firms acting in the market. Typically, if one look at the performance the market needs to be modeled and some straightforward assumptions on behavior needs to be done.

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[1] The views expressed herein are those of the authors and do no purport to be those of the Swedish Energy Agency.

[2] We are grateful to have received these figures from Ericsson, Raw Materials Group, Stockholm, Sweden. www.rmg.se.

[3] Quote found in Werden (1997), it is a statement that the US Supreme court is making in the case Eastman Kodak versus Image Technical Services, Inc.

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It is then possible to discuss outcomes of the mergers on prices, quantities, and the welfare for society. For example, the analysis could be focused on investigating whether the merger will change the characteristics of the market and the involved firms such that the likelihood of cartels, or tacit collusion increases.[4]

There are several obstacles that must be overcome by authorities investigating mergers or acquisitions. Most important is how to foresee the welfare effects of mergers. Welfare is in this case defined as the combined effect of a merger on industry profits and consumer surplus. No predetermined weight is used between the two components of welfare. If the authority could somehow make a relevant prediction, this could be the first step in a process where the firms, confronted with this prediction, could defend their case.

Traditional analytical tools such as econometric modeling are ill suited to the task of analyzing large discrete changes such as mergers. In addition, structural analysis makes no attempt to explicitly estimate the price or welfare effects of mergers. This form of analysis can only be compared with arbitrarily set threshold values. Values, which are neither explicitly based on economic models of oligopoly nor based on empirical studies of the effects of mergers or on studies of the relationship between market structure and economic performance, are poor indicators for the enforcement authorities to rely on when assessing a merger case.

In this paper, we investigate the welfare effects of an acquisition of one Brazilian mining company (CVRD) of mainly Brazilian based mining operations (CAEMI), approved by the European Commission in October 2001 (European Commission, 2001a). The primary production of the two companies is iron ore. To get the merger cleared by the Commission, the companies offered to sell off one of the merged entities, a mine in Canada. We investigate the welfare effects of this merger, using a simulation model. Simulation allows us to consider different scenarios, among them the scenario with no divestiture. Furthermore, by using different elasticities of demand for iron ore, the model's sensitivity to market delineation (definition) can be analyzed.

The iron ore industry

There are currently over 70 producers of iron ore in the world, none of which has reserves that are more than 15% of the known worldwide supply (Ericsson, 2004). The industry is present on all continents, although the more prominent producers are found in South America and in Australia. The Brazilian producers have, since the 1980s, increased their market share in Western Europe. The price trend for iron ore as a whole is decreasing. Hellmer (1997) claims that output for iron ore is relatively price inelastic in the short run. This is because the output is limited to existing capacity and investment in new facilities requires large amounts of capital. In addition, capital costs discourage output reductions in times of decreasing demand. The cost of investment in a mining facility should be regarded as a sunk cost. Thus, a mine may have an incentive to keep producing at capacity even when there may be price changes in either direction.

[4] See, for example, Nilsson (2004).

The Direct Reduced Iron (DRI) process is of particular interest in this article. The use of DRI is claimed to be more environmentally friendly, and it allows for the possibility of small-scale steel mills to operate profitably. In the year 2000, the production of steel using the DRI process increased by 12% from 1999 despite poor conditions overall for the steel industry (MIDREX, 2000).

The acquisition[5,6]

The merger, or more precisely the acquisition, that provides the case study for demonstrating the value of simulations is one between two Brazilian based companies, CVRD and Caemi. Caemi was partly owned by the large Japanese trading company Mitsui. The proposed acquisition combined the largest and the fourth largest global iron ore producers. The transaction met the thresholds for turnover within the European Economic Area (EU plus Iceland, Norway and Lichtenstein) and thus required approval from the European Commission. As the commission stated, this acquisition created the world's largest producer of seaborne iron ore. Furthermore, the transaction created particularly high market shares in the segment for iron ore pellets, which is one of the three forms in which iron ore is sold (the other two are fines and lump). When the acquisition was approved, the market for seaborne iron ore was reduced from four major actors to three (the other major actors are Rio Tinto and BHP). These three actors would all have large market shares in the seaborne iron ore market.

That the competitive assessment by the European Commission was built on the supply of seaborne iron ore is not remarkable since the Swedish producer LKAB is almost the only local competitor in Europe. There is some production in Eastern Europe, which, for various reasons, lacks demand from the EU. Iron ore transported by ship

[5] Information on the merger taken from the Commission press releases on the merger between CVRD and Caemi (European Commission July 3, 2001 and October 30, 2001) and an interrupted earlier proposal by BHP to buy Caemi (European Commission April 20, 2001).

[6] The terms merger and acquisition are used interchanged even though the actual case study is by definition an acquisition. Whether the case study is considered to be a merger or acquisition the welfare effects and simulation approach is the same.

represents about 45% of all iron ore trade. Participation in the seaborne trade requires access to specific infrastructure, such as railways that are able to handle large tonnage and deep-water harbors.

The Commission found that the merger would lead to the creation of a dominant position in the seaborne supply of iron ore pellets. The primary competitors, Rio Tinto, BHP and LKAB, would not be able to constrain the merged entity's possibility of exercising market power in the European market for iron ore pellets. The Commission also found that the merger would lead to the creation, or strengthening, of a dominant position in the seaborne market for DRI.

On October 5 2001, the parties offered to divest Caemi's 50% share in the Canadian pellet producer QCM. In the view of the Commission, this took care of the overlap in the production of pellets between the two companies. Thus, the merger was cleared.

Merger simulation

The basic approach in merger simulation studies is straightforward. Pre-merger price and quantities are usually easy to observe, and it may be possible to find some empirical evidence on elasticities of demand for DRI. Using this information, a numerical model is calibrated so that its solution equals the observed prices and quantities. This is the pre-merger equilibrium. A proposed merger would, if permitted by the enforcement agencies, imply that firms reconsider their price- or quantity-setting. Such a future situation is at present hypothetical, but the numerical model can be used to simulate the post-merger situation. After the simulation study has provided information about the possible price increase following a merger, the post-merger situation can be compared to the pre-merger situation.[7] A price increase following a merger is only expected if the merger results in a noticeable increase in market power, which is not always the case.

In the standard Cournot framework each firm produces a single homogeneous product.[8] Since the goods are homogeneous there exists only one price. One of the essential features of the Cournot model is that the firms in the industry compete in quantities, i.e. makes choices about what quantity to supply. Once each firm has decided how much to supply, the market mechanism will find the market-clearing price. Equilibrium exists in this model when every firm is producing the level of output that maximizes its profits given the output levels of all the other firms. Once this equilibrium is established no individual firm has an incentive to unilaterally deviate from it, since each is doing as well as it can given the behavior of the others.

Let the market price be given by $p=p(Q)$ with $p'(Q)<0$, $Q=Q_{-i}+q_i$ is the aggregate output of all firms in the industry, c_i and q_i is the marginal cost and output of firm i, and ε is the price elasticity of market demand for DRI. Define firm i's market share as $s_i\equiv q_i/Q$. Denote firm i's cost function by $c(q_i)$. Firm i's profit can consequently be written as:

$$\pi_i \equiv p(Q_{-i}+q_i)q_i - c(q_i) \quad (1)$$

In the Cournot equilibrium, each firm picks its output in order to maximize its profit, where the first order condition, $\partial\pi_i/\partial q_i=0$, is

$$p(Q) + q_i\frac{\partial p(Q)}{\partial q_i} - \frac{\partial c(q_i)}{\partial q_i} = 0 \quad (2)$$

The third term on the left-hand side is firm i's marginal cost, mc_i. Comparing two firms i and j, the Cournot equilibrium conditions in Eq. (2) tell us that $q_i>q_j$ if and only if $\mathrm{mc}_i<\mathrm{mc}_j$. In equilibrium, larger firms have lower marginal costs. In any Cournot equilibrium in which different firms produce different quantities, marginal costs differ across firms, so that costs are not minimized given the aggregate output. Hence, aggregate output is not, in general, a sufficient statistic for welfare (Farrell and Shapiro, 1990). Moreover, in a Cournot equilibrium, the price-cost mark-up of any firm i is given by:

$$\frac{(p-c_i)}{p} = \frac{s_i}{|\varepsilon|} \quad (3)$$

From the basic Cournot equation, it is possible to derive a link between the share weighted price-cost mark-up across all firms in an industry and the Herfindahl index (HHI), which is defined as the sum of the squared market shares of all firms in the industry.

$$\frac{\left(p-\sum_i c_i s_i\right)}{p} = \frac{\mathrm{HHI}}{|\varepsilon|} \quad (4)$$

This basic Cournot result thus provides the first theoretical link between market concentration and higher average margins. Under Cournot assumptions, as market concentration rises—measured by the Herfindahl index—so do prices for a given level of costs. When the price elasticity of market demand for DRI increases, the price decreases.

[7] There may arise situations were the simulation procedure is not as straightforward as described. Mathiesen and Sorgard (2000) point out two such situations. *First*, if the merger is conducted on beliefs about future competition conditions, the present situation is irrelevant for calibration purposes. *Second*, as the model is presented, it is implicitly assumed that the firms are single-goods producers and does not account for the possibility of multi-goods producing firms.

[8] The assumption of a homogenous good, according to the Cournot model, might be a heroic assumption when applied to iron ore. It might be argued that raw iron ore is indeed not a homogenous good from one producer to another. Even pellets differ from one producer to another, for example, LKAB emphasizes the olivine-rich nature of its pellets. The rationale for assuming a homogenous good in our simulation is to simplify the modeling in the sole attempt to assess the usefulness of using simulations when evaluating mergers.

The simulation analysis is carried out in three separate steps.[9] The *first step* is to describe the nature of competitive interaction. By studying the products, the enforcement agency can, on qualitative grounds, conclude whether it is a homogeneous or heterogeneous product. If the latter is the case, the exact nature of differentiation needs to be investigated, i.e. is the competition symmetric across the industry or is competition localized between smaller subsets of products or firms. Furthermore, it is important to identify the cost conditions of the firms. Capacity constraints may restrict the competition, as may the manner in which prices (or quantities) are set. One of the great advantages of simulation analysis is that, regardless of conclusions drawn from the nature of competitive interaction, it can still be used. Structural models may only be valid for certain cases of competitive interaction. The *second step* is to substitute data on the products' current prices and market shares into the model, as well as the elasticity of demand for DRI of market demand. This makes it possible to calibrate the parameters of the model. The data needed for running the model are thus limited. The calibration allows the retrieval of firm specific parameters values for marginal costs and demand. The previous two steps fully quantify the model of competitive interaction through a mixture of specification assumptions and parameter calibration based on pre-merger equilibrium. By specifying the changes to the model, as implied by the merger, and computing the new prices and market shares it becomes possible to compute changes in prices, consumer surplus and total welfare following the merger.

The methodology described above is based on two key assumptions. The *first* assumption concerns the shape of the marginal cost curves. Here, it is conveniently assumed that marginal costs do not vary over the relevant range. The *second* assumption concerns the demand system, or more precisely, the second and higher order properties of the functional form for the demand. This implies that different functional forms on the demand function might produce different results. For instance, if the demand function is assumed convex the second order properties would generate higher price effects from a merger than a liner demand function would. If a merger is significantly anti-competitive, prices and quantities change enough so that the shape of the demand curves matters. It is these higher order properties of the demand system that largely determine the size of the post-merger price increase (Crooke et al., 1997).

Model specification/calibration

Representing the pre-merger equilibrium involves making a choice of a particular set of market shares and prices to use in the model. This is needed for the calibration of the demand system. Theoretically, the correct sets are those that would have prevailed in the near future had the merger not taken place (Werden, 1997). However, this information is not available, thus, as used in the majority of cases, a proxy consisting of market shares and prices for some recent time period is used instead. It is important that the selected time period is of sufficient length so those seasonal and other transitory phenomenon are averaged out. Werden (1997) suggests that if pronounced trends, or some other solid basis for predicting changes in either market shares or prices, exist, that forecasts or qualified guesses may be used.

Demand systems that share the same first order characteristics can produce very different post-merger prices. This points out the importance of second and higher order properties of demand systems in determining the magnitude of the post-merger price and quantity changes. Crooke et al. (1997) systematically examine the implications that four different functional forms for demand have on post-merger equilibria. The demand specifications they examine are: (1) an almost ideal demand system (AIDS); (2) a logit form; (3) a linear form; (4) a log-linear or constant elasticity form. They show that the linear function provides the smallest changes in prices and quantities resulting from the merger. The difference between predictions from linear and the logit functions were rather small.

In the context of the purpose for this report, it is sufficient to employ a simple linear demand function. This can be motivated by the relative ease with which it can be analyzed, a factor that is of help in the following important contexts. *Firstly*, without a thorough analysis of the investigated industry it is unknown which of the demand specifications best represents the actual demand structure. *Secondly*, the linear demand function produces a conservative measure of the price change produced by the merger. *Thirdly*, logit demand is not suitable for homogenous goods since there is no probability ratio, which can be calculated between two goods (there is just one good in the model). *Fourthly*, it is helpful when deriving the first order conditions in order to find the optimal solution. Therefore, there is no way of saying which of the demand specification that represents the case market best.

The simulation model is based on a version of the Cournot model employed for merger policy analysis by Farrell and Shapiro (1990), McAfee and Williams (1992), and Werden (1991). By assuming a linear demand function, as motivated above, the following industry demand and cost equations may be derived:

$$p = a - bQ \tag{5}$$

$$C(q_i) = \frac{q_i^2}{k_i} \tag{6}$$

where k_i is the capital stock of firm i. Firm i chooses q_i to maximize profits

$$\pi_i = (a - bQ)q_i - \frac{q_i^2}{k_i} \tag{7}$$

[9] For a more detailed presentation of the steps, see Röller et al. (2000).

Applying the first order condition, the choice of q_i can be obtained

$$p = \left(b + \frac{1}{k_i}\right)q_i \tag{8}$$

The demand parameters can be obtained by using the fact that $\partial p/\partial Q = b$ and the definition for elasticity $\varepsilon = \partial Qp/\partial pQ$. Rearranging terms and solving for b gives

$$b = \frac{\partial p}{\partial Q} = \frac{p}{Q}\frac{1}{\varepsilon} \tag{9}$$

this in turn gives

$$a = p\left(1 + \frac{1}{\varepsilon}\right) \tag{10}$$

Market equilibrium, i.e., market price and quantity, and for firm output are solved by first defining

$$\beta_i = \frac{bk_i}{bk_i + 1} \tag{11}$$

$$B = \sum_{i=1}^{n} \beta_i \tag{12}$$

and the market price and firm output becomes

$$p = \frac{a}{1 + B} \tag{13}$$

$$q_i = \frac{a}{b}\left(\frac{\beta_i}{1 + B}\right) \tag{14}$$

where industry output $Q = \sum q_i$. The determinants of this model are the industry price (p), the industry elasticity of demand for DRI (ε), and the firm market shares (s_j).

Results and discussion

In the merger between Rio Tinto and North,[10] the European Commission notes (in §18) that: "[…] a number of interested parties have submitted that fines, pellets and lump iron ore should be considered as three different product markets […] there is limited interchangeability between the different types of iron ore since the switching between them can significantly affect the efficiency of steel mills. […] It also appears that that there is only limited substitutability from a supply-side perspective […] production of pellets requires a pelletizing plant, which is a significant capital investment". That there are significant differences in production in the broader iron ore market is also supported by the results in Hellmer (1997). He found that LKAB, despite mining at relatively high cost underground mines, could be profitable by working in the right segment of the larger iron ore market.

[10] European Commission, merger procedure decision, 1st of August 2000.

Table 1
Production, and structural information on the DRI market segment

Company	Capacity (million tons)	Production (million tons)	HHI[a] (capacity based)	HHI[a] (production based)
CVRD samarco	11.2	11.2	570	1007
QCM	4	2	73	32
IOC	2.5	0.4	28	1
CMP	1.5	1.48	10	18
Hylsa	4.5	3	114	72
Imexsa	3.5	3.5	56	98
Shougang	1	0.7	5	4
LKAB	8.3	4.01	313	129
Ferrominer	9.9	8.99	446	649
Sum total	46.9	35.28	1614	2000

Source: MIDREX (2001). World Direct Reduction Statistics.
[a] Herfindahl index.

In the Rio Tinto/North decision, it is also mentioned that in reality only seaborne quantities are available for European steel mills, and that Russian, Chinese and Indian production are not available for intercontinental trade. It follows then that these producers accordingly ought to be treated as separate markets.

We have used data on the DRI pellet market and have tried to reconstruct the view of the commission in the CVRD/Caemi case. This means that in the simulations we have retained those producers that can be considered as acting in the seaborne market, and that have the potential for trading with the European Union. Table 1 presents the data.

As seen in Table 1, CVRD is the leading producer of DRI pellets followed by the Venezuelan company Ferrominer and LKAB. Market leadership is even more pronounced when we look at the column for production rather than capacity. On the other hand, capacity is what we normally assume will put a downward pressure on future prices. We perform simulations using both measures, but concentrate our analysis on the results from simulations where capacity is used as the limiting factor. The simulation results using the production data can be found in Appendix A. We simulate the effects of the merger by normalizing the price to unity. In our case, we are interested in the directions of the changes, not the magnitude.

The simulations estimate changes in HHI (industry concentration), marginal costs, pellet prices, and price elasticity of demand. These results, in turn, allow us to estimate changes industry profits, consumer surplus, and overall welfare (change in profits + change in consumer surplus). From society's perspective, the overall effect of a merger can be positive or negative, depending on the relative sizes of changes in prices, costs, and quantities (and their effects on profits and consumer surplus).

We have included the difference in marginal costs for the largest of the merging firms as these turns out when the model is calibrated and simulated. In equilibrium, by assumption in the oligopoly model, larger firms have lower marginal costs. It is necessary to pay particular attention to the change of these marginal costs since the model automatically assumes lower marginal costs as an effect of the merger. This is not particularly obvious in a merger between two mining companies, with mining operations not located in proximity to each other.[11] The possible lack of expected beneficial effects of the merger is further elaborated in the ongoing discussion of the failure of many merged firms in all kind of different industries to realize synergy effects from mergers (for an excellent discussion on this, see Mueller (1996)).

In many merger cases, the delineation of the market clearly becomes important, among other things because it should take into consideration substitution possibilities. In this case, there is probably no doubt that the Commission's delineation of the market into pellets, lump and fines, and further between 'normal' and DR iron ore, met some resistance from the merging parties. Controlling for substitution possibilities between iron ore products is done by allowing different values on the parameter for the elasticity of demand for DRI. The lower elasticity, among other things, would then be a reasonable reflection of how hard it is to substitute DRI pellets for another input.

When taking a decision on whether or not to approve a merger, the authorities need to consider the long run effects, and the possibilities for consumers to substitute between firms. In addition, future competitive effects of the merger become more dependent on the interaction between firms when the price increases. If there is a lot of idle capacity at competitors' mills, this will probably hamper any negative effects that could arise due to the merger. Taking this into account, we have chosen to use capacity as a measure of the market share.[12]

Tables 1 and 2, taken together, indicates both that the market is concentrated and that the merger would increase this concentration, as defined in the 1982 US merger guidelines.[13] These guidelines stated that the US Department of Justice would challenge any merger that increases HHI by more than 100 points. This criterion is met in our simulations. In addition, the marginal costs go down by approximately 3.5–5.5%, which indicates that there should be some synergy effects.[14] The price increase is 0.6–5%. Elasticity of demand for DRI increases, which is important since this makes the simulation of the effects of the merger more realistic.[15]

Table 2
Simulation results: CVRD/Caemi keeps QCM (using capacity data and three different estimates of elasticity)

Parameter/elasticity of demand for DRI	0.4	1	2
ΔHerfindahl index	256	327	362
ΔMarginal cost of the merged firm	−0.02	−0.04	−0.03
%ΔPrice	5.218	1.773	0.6311
ΔElasticity of demand	0.02984	0.03611	0.03835
ΔIndustry profits	3.749	1.276	0.4631
ΔConsumer surplus	−5.163	−1.758	−0.6271
ΔTotal welfare	−1.414	−0.4815	−0.164

When prices increase, we expect the elasticity of demand for DRI to increase, thus dampening the losses in consumer surplus. Finally, our simulation supports the conclusion that the welfare effect of the merger is negative in the DRI market when Caemi keeps QCM. Industry profits increase less than consumer surplus losses.

Now, the question remains whether these welfare effects would differ if QCM is divested to a competitor firm. It remains to be tested whether there is any combination of mergers that would produce a positive welfare effect using our simulations. We tried using different combinations of buyers and show part of the results of these simulations in Table 3. The results from the simulations, shown in Table 3, are using the same parameters and the same elasticities of demand for DRI as in the former case.

As seen in Table 3, the crucial parameter is the elasticity of demand for the DRI pellets. If the elasticity of demand for DRI is 0.4, the welfare effects are positive except for QCM-Hylsa and QCM-LKAB.

As in the case where we let CVRD/Caemi keep QCM, the case of LKAB buying QCM has a considerable effect on the HHI. Both the HHI threshold of 1800 and a change of more than 100 points are passed. The difference in HHI between the two cases is as small as 14 when the elasticity of demand for DRI is assumed to be 0.4, and 79 when the elasticity of demand for DRI is 2. While the price increases are smaller, the negative welfare effects found in the former simulation are also found in this case, although here they are only around half the size.

Apart from the other results of the simulations, the result in the latter case must be put into some broader perspective.

Table 3
The effect on welfare of different combinations of buyers of the QCM mine

Merger	Elasticities of demand					
	ΔQuantity HHI			%ΔTotal welfare		
	0.4	1	2	0.4	1	2
QCM-IOC	107	97	94	0.1	−0.01	−0.01
QCM-CMP	68	60	57	0.1	−0.002	−0.004
QCM-Hylsa	184	180	180	−0.06	−0.09	−0.04
QCM-Imexsa	141	132	129	0.08	−0.04	−0.02
QCM-Shougang	46	40	38	0.08	0.001	−0.002
QCM-LKAB	242	268	283	−0.67	−0.26	−0.093

[11] Ericsson (2001) points out that efficiency gains are difficult to obtain unless the merging mines are geographically close.

[12] For easy comparison, simulation results using 2001 years production data instead of capacity data are presented in Appendix A.

[13] Any market with an HHI over 1800 is considered highly concentrated. These guidelines have been revised twice since then, by the 1984 and 1992 year guidelines. However, while the emphasis on the HHI is less strong, in the revised guidelines the numbers still remain as benchmarks.

[14] The marginal costs for the larger Brazilian firm as calibrated in our model were approximately 0.4, 0.76 and 0.88 for the elasticities 0.4, 1 and 2.

[15] As is noted in Froeb and Werden (1996) in a model like the one used by Hausman et al. (1994) where elasticities are kept constant, the welfare effect of the merger will be overstated.

In this segment, LKAB may be a major actor, but in the overall seaborne iron ore market, LKAB has a fairly small market share. We also expect that competition between the market segments is possible, that is, that there are long run substitution possibilities between pellets, lump and fines, and that the DRI and blast furnace alternatives will also bring some competitive pressure even into the DRI market. On the other hand, if one company dominates all three markets, this competitive pressure will fail to exist.

Our results raise a few questions. *First*, are there any welfare gains in allowing mergers in the iron ore industry? As pointed out earlier, the welfare effects from mergers and acquisitions are not automatically positive (Mueller, 1996). We believe that the results in for example Hellmer (1997), where the Brazilian firms are found to act as Stackelberg leaders, should be taken as a first warning that any strengthening of their market power will have adverse effects on welfare. In that sense, our results are realistic and we would not expect any welfare gains accruing from this merger.

Second, if and what kind of synergy effects could be pointed out in this particular industry that would prove our simulations wrong? In equilibrium, by assumption in the oligopoly model, larger firms have lower marginal costs. It is necessary to pay particular attention to the change of these marginal costs since the model automatically assumes lower marginal costs as an effect of the merger. This is not particularly obvious in a merger between two iron ore mines, as they are not located in proximity to each other.[16] We may have expected it if one of the firms were in bad need of updating of production processes, or a radical change in management, etc. We lack the empirical data to answer this question.

Third, given the impact of the elasticity of demand for DRI on the results, it would be of interest to estimate the actual elasticity of demand. Unfortunately, we lack the data to do this. In the overall iron ore market, Hellmer (1997) and Chang (1994) report fairly low elasticities of demand for iron ore.[17] This supports the use of a low value for the elasticity of demand for DRI, thus from the simulations performed almost any merger among the smaller actors in this market would be acceptable from an economic view. However, it is important to point out that positive welfare effects are still small and that these results partly rest upon the assumption that the merger will lead to cost savings for the merging firms.

Our modeling efforts are but simple indications of the effects that the described merger will have on the iron ore market. Despite this, it seems reasonable to suggest that the acquisition of CAEMI by CVRD will be welfare decreasing, even if the effects are small.

[16] A similar conclusion is reached by Ericsson (2001).

[17] Hellmer (1997) reports an estimate of 0.18 and Chang (1994) estimated the elasticity for Brazilian ore shipped to Japan to 0.15.

Table A1
Simulation results: CVRD/Caemi keeps QCM in their control (using production data and three different estimates of elasticity)

Results/elasticity of demand for DRI	0.4	1	2
ΔHerfindahl index	220	280	315
%ΔPrice	4.011	1.513	0.5494
ΔElasticity of demand	0.02283	0.03072	0.0333
ΔIndustry profits	3.029	1.047	0.3845
ΔConsumer surplus	−3.978	−1.501	−0.5464
ΔTotal welfare	−0.9497	−0.4545	−0.1619

Thus, our analysis suggests that further concentration in the international iron ore market should only be allowed under the restrictive requirement that the firms can show that a merger will lower production costs substantially. Further, not only could competition authorities require that the merger should lead to lower production costs. The requirements on the merging firms should be to also make it plausible that some of the cost savings benefits the consumers. If this is not shown, the result of the merger may be an undesirable re-distribution of wealth from customers to large and strong companies, due to market power inefficiencies.

Appendix A

Table A1.

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