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MERGER REVIEWS AND POST-MERGER EVALUATION WITH DEA

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Abstract:
Merger reviews is a core business for competition authorities (CA). In this paper I employ linear programming methods to evaluate potential efficiency gains following a merger, against the background of market-side effects (e.g. price increases), which are usually relevant in a CA's merger assessment. Furthermore, I use an additive model to show that there are circumstances where a merger cannot induce technical efficiency gains, thus limiting the scope for potential welfare gains. I argue that when there is no potential for technical efficiency gains, the CA should consider an outright ban of the proposed merger, because there will be little room for positive effects on market competition and respectively, on consumer welfare.

Key words: merger review, DEA, competition, market-side effects

JEL classification: C61, D24, D40

INTRODUCTION

The literature accounts for a plethora of reasons behind the occurrence of horizontal mergers (2), but it is generally agreed that mergers have the potential to lessen competition, thus providing opportunities for price increases. Price increases are more likely to occur in particular instances e.g. 1) the merging entities have a substantial share of the market; 2) they are close competitors 3) the consumers' options for switching are limited 4) competitors are unable to increase the supply in the event of a price increase.
What is more concerning, however, is that empirical studies (3) concerned with the evaluation of the effectiveness of mergers find that most mergers fail to fulfill the expectations of the shareholders. In fact, most mergers seem to seriously affect the economic and the financial performance of the resulting undertakings.
It has been argued that competition authorities should not be concerned with the wellbeing of enterprises, but the consequences of a failed merger could affect both the market structure and the consumer welfare. In this regard, and considering the fact that only 0,05% of the mergers reviewed by the DG Competition were in fact forbidden, I argue that the evaluation of potential efficiency gains should become an essential step in mergers reviews and the burden of proof should not be left entirely with the notifying parties.
The EUMR (4) accepts efficiency gains as a valid argument in favor of a merger, only when three cumulative conditions are met:

i. Efficiencies should benefit consumers i.e. should be transferred into lower prices, steaming from cost reductions, new or improved products or services.

ii. Efficiencies should be merger specific i.e. there should be no other less anti-competitive alternatives to achieve such efficiency gains.

iii. Efficiencies should be verifiable, such that the Commission should be reasonably certain that such efficiencies would materialize.

In order to establish the link of the above three conditions with the efficiencies which are related to the technology, we undertake to analyze them in turn. First, we argue that the concept of technology is fully justified when analyzing anticompetitive effects of mergers. In competition policy, the

analysis is usually centered on the relevant market. In most situations, the anticompetitive effects of a merger are analyzed on a single market or, occasionally, on several markets where the activities of the merging entities overlap. In either situation it is reasonable to consider the concept of technological frontier, which incorporates the best practices in the production of a particular good (akin to the production function).

The first requirement of cost reductions would entail to a movement of the post-merger enterprise towards the efficiency frontier. It is not clear, however, how the passing of these costs savings into lower product prices should be assessed. It appears that this requirement can only be verified in a post-merger assessment. Not even a merger simulation strategy can reveal the possibility or the certitude of such a passing, since this decision rests with the management of the post-merger enterprise. This evaluation can only be performed in a post-merger evaluation.

The second requirement implies that, if there is to be an efficiency gain, it should be related to the coming into existence of the new enterprise, the result of the proposed merger. In turn, this clearly implies that the source of efficiencies should not steam from sources outside the proposed merger. It also implies that, considering our reference to the technological frontier, one should be able to identify potential for a movement towards the frontier i.e. there should be scope for technical improvements, following the merger (5).

The third requirement is concerned with the possibility of verifying the potential efficiency gains. It is a good argument in favor of representing the best practice technology in the industry associated with the relevant market, such that the potential for efficiency gains could be assessed at an early stage in the merger assessment.

The market developments following a merger have potential anticompetitive effects, but these effects could be countervailed by cost efficiencies and other synergies leading to **increases in efficiency**, which in turn could be reflected in lower prices, to the benefit of consumers. Although efficiency is recognized as one of the main goals of the competition policy, very seldom the regulators employ tools aimed at evaluating pre and post-merger efficiency gains in an industry.

Data Envelopment Analysis (DEA) is suitable for evaluating the economic efficiency of different production units (or decision making units - DMUs -) like companies, banks, bank branches, hospitals etc. DEA is particularly prone to conduct pre- and post-merger evaluations with regard to the distribution of efficiencies in the market on focus. At the same time, this tool allows for the simulation of a potential merger's effect and powerful visual tools have been developed to assist the decision-maker (Bogetoft and Lars, 2010).

A standard DEA requires information about factors of production (inputs) and about the quantities produced (outputs). Several other types of analyses can be conducted, when factor and output prices are available. Although vertical mergers can be subject to a DEA, horizontal mergers are particularly prone to a data envelopment analysis.

DEA basically constructs a sector-wise technological frontier, which represents the best-practice technology in an industry, and then it calculates the distance from the frontier to each individual DMU. By doing so, DEA provides a measure for the efficiency of individual units, as well as an overall sector measure of efficiency. Both indicators are relevant for evaluating the potential gains in efficiency following a merger. The DEA measures are relative, meaning that they are depended on the sample available to analyze, but if the sample covers the scrutinized market to a considerable extent, they provide a satisfactory image of the resulting market outcome, following a merger.

When conducting merger reviews, competition authorities have or can obtain data from the companies directly involved in a merger, but usually there little data available on other market participants. In order to assess the technological frontier for the relevant industry i.e. the industry related to the market analyzed, data from most market participants is required. While most CA do not have legal ground for asking data from other companies in the affected market/s, oftentimes databases covering the whole industry or sector can be found to exist.

DEA can also assist in decomposing efficiency gains in scale, scope (harmony) and even the potential for **synergies,** which are those efficiency gains pertaining to the "intimate integration of

the parties' unique, hard-to-trade assets" (Farrel and Shapiro, 2001). The actual evaluation of synergy effect could only take place in a post-merger evaluation.

DEA has already been used in merger analysis. Ferrier and Valdmanis (2004) analyzed hospital mergers in the USA, including the construction of pseudo-hospitals (the outcome of potential mergers). Sherman and Rupert (2006) apply DEA to bank mergers, in an analysis involving bank-branches as well. Bogetoft and Wang (2005) discuss in great detail the decomposition of efficiency gains following a merger into technical, scale and scope (harmony), and provide an empirical example on Danish offices for agricultural advisory services.

Figure 1 below (Bogetoft and Lars, 2010) shows in a stylized manner the potential for efficiency improvement following a merger involving two technically efficient companies (located on the production frontier). One can see that the potential for improvement lies to the north-east of a hypothetical company, which is simply the result of combining the inputs/outputs used before the pre-merger enterprises. In a post-merger assessment, the competition authority should be concerned if the actual enterprise arising from the merger lies outside the PI area.

Several concerns (outliers, sample size etc.) have been raised in connection with a data envelopment analysis, and remedies (e.g. bootstrapping) have been proposed to deal with these issues. In mergers, data requirement might be of particular concern, because it is desirable to analyze data from most players on a particular market, and this data might not be available in some cases.

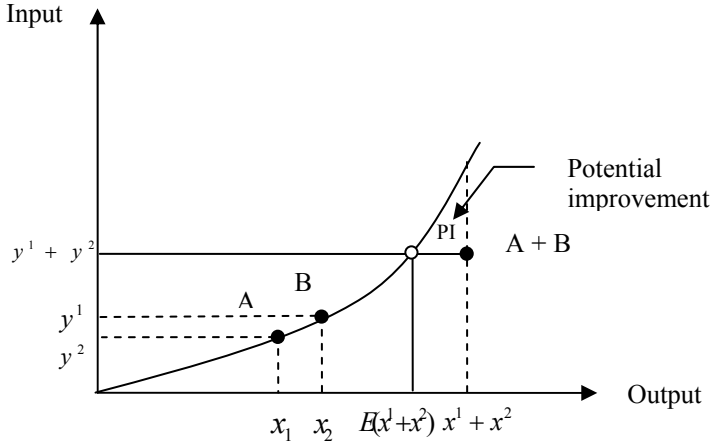

Figure 1

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When reviewing a merger, the competition authority is interested to identify those efficiencies that can be achieved with a merger, but they cannot be reasonable obtained, absent the proposed merger. This means that in a pre-merger assessment, the companies to-be-merged are located on the efficiency frontier, or even if only one company is located on the efficiency frontier, that it is a reasonable assumption that higher efficiency can be obtained through a potential merger, within the same input-output mix.

The competition regulator is interested in two broad classes of effects: *unilateral effects*, concerned with the ability of the newly emerged entity to raise the product's price, and *coordinated effects*, concerned with the ability of the post-merger firms in the market to coordinate their actions, given that the number of competitors is reduced.

There is a vast amount of literature concerned with the measurement of efficiency of productive units, but the issue of efficiency distribution following a merger is less studied, although there are a

few notable studies concerned with this issue. For an extended review of literature, see Bogetoft and Wang (2005).
From a purely technological point of view, a merger is subjected to the following effects:

- Economies of scale
- Economies of scope
- Pure technical efficiency gains

Economies of scale describe the technology under which the merger takes place and they need to be increasing or constant for the merger to increase the performance of the newly established unit.
Economies of scope concerned the mix of inputs used or the outputs produced by the merging companies, and the associated efficiency derived from the optimization of this mix, with respect to the factors' market prices.
Let us start with the much touted BCC (Banker et. al,1984) model, assuming at this stage the VRS framework.

$$P_B = \{(x, y) \mid x \geq X\lambda, y \leq Y\lambda, e\lambda = 1, \lambda \geq 0\} \tag{1.1}$$

Using notations as in Cooper et al. (2000), the input oriented version of the BCC will write as follows:

$$\begin{aligned} &\min \theta_B \\ &\textit{subject to} \\ &\theta_B x_0 - X\lambda \geq 0 \\ &Y\lambda \geq y_0 \\ &e\lambda = 1 \\ &\lambda \geq 0 \end{aligned} \tag{1.2}$$

where θ_B is a scalar value.

The following proposition can be proven:
Proposition (Tone, 1999): When two locally (in the BCC set-up) efficient DMUs merge to form a new DMU whose inputs and outputs equal the sum of inputs and respectively outputs of the two original DMUs, the new DMU is neither locally (BCC), nor globally (CCR) efficient when increasing returns-to-scale prevails at all three DMUs.
A conclusion that can be drawn from the above proposition is that a first line of analysis when analyzing the merger is to evaluate the properties of the technological frontier around the merging firms, and if both or all the merging firms are located on IRTS, the no technical efficiency is possible. The only solution for the merger to create potential for efficiency and respectively welfare gains is to resort to some reduction with respect to their inputs i.e. divestiture of some assets.
Carlton (2009) argues that evaluating the appropriateness of merger policy requires more data than the pre and post-merger market developments (price levels, entry/exits etc.). The reason for this requirement is a potential selection bias arising from the fact that mergers that passed through the "second-stage" of the CA's merger evaluation procedure are only a subset of all potential mergers, alongside both approved and rejected sets of mergers. He then proceeds to argue that it is useful to analyze data describing the CA's predictions related to the outcome of a potential merger.
In this regard, employing DEA in the manner described in the preceding sections provides the CA with a handy, fast and easy-to-employ tool related to the distribution of efficiency in both the pre and the post-merger environment, coupled with the simulated post-merger environment, resulting from constructing the technological frontier supported by the unit resulted from the simple aggregation of the inputs/outputs of the undertakings proposed for merging.

2. Employing DEA when information about prices and costs are available

In the evaluation of a merger, it is fairly common to have access to product prices on the relevant markets as well as input prices. Although input prices are not normally included in the CA's *request for merger notification* these are fairly easy to gather and can, in any circumstance, be satisfactorily approximated (labor and capital costs, financing costs and various raw materials' prices).

When this type of information is available, one can proceed to evaluate whether there has been any improvement in the allocative efficiency of the resulting undertaking following the merger.

We will start with the model proposed in Färe, Grosskopf and Lovell (1985):

$$\max \sum_{r=1}^{s} p_r y_r - \sum_{i=1}^{m} c_i x_i$$

sjt.to

$$y_{ro} = \sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+, r = 1,..,s$$

$$x_{io} = \sum_{j=1}^{n} x_{ij}\lambda_j + s_i^-, i = 1,..,m \qquad (1.3)$$

where

y_{rj} are outputs (products), assumed all positive

x_{ij} are inputs (factors), assumed all positive

$p_r > 0,$ unit prices

$c_i < 0,$ unit costs

and

$$y_r = \sum_{j=1}^{n} y_{rj}\lambda_j, r = 1,..,s$$

$$x_i = \sum_{j=1}^{n} x_{ij}\lambda_j, i = 1,..,m \qquad (1.4)$$

It can be shown (Cooper *et al.,* 2000) that this model is equivalent with:

$$\max \sum_{r=1}^{s} p_r s_r^+ + \sum_{i=1}^{m} c_i s_i^-$$

subject to

$$y_{ro} = \sum_{i=1}^{n} y_{rj}\lambda_j - s_r^+, r = 1,..,s \qquad (1.5)$$

$$x_{io} = \sum_{j=1}^{n} x_{ij}\lambda_j + s_i^-, i = 1,..,m$$

$$\lambda j \geq 0, s_r^+, s_i^- \geq 0 \forall i, j, r$$

with

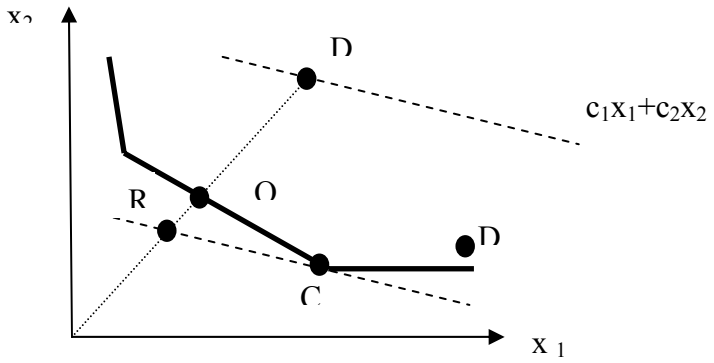
$$s_r^+ = y_r - y_{ro}, r = 1,..,s$$

$$s_i^- = x_{io} - x_i, i = 1,..m \qquad (1.6)$$

The optimal solution to this programme is obtained when:

$$\sum_{r=1}^{s} p_r s_r^{+*} + \sum_{i=1}^{m} c_i s_i^{-*} = 0 \qquad (1.7)$$

The above condition implies that all slacks are zero.
Employing the additive model underlined above allows one to distinguish between technical and allocative efficiency, as illustrated in the section below (Cooper et al., 2000, pp 223-224):



We can represent technical efficiency by the ratio of the distance measures from O to R and from O to P, as follows:

$$0 \le \theta_o^* = \frac{d(O,R)}{d(O,P)} \le 1$$

The θ_o* represents total efficiency and it can be decomposed into technical and allocative efficiency, as follows:

$$\frac{d(O,R)}{d(O,P)} = \frac{d(O,R)}{d(O,Q)} \cdot \frac{d(O,Q)}{d(O,P)}$$

allocative efficiency *technical efficiency*

It is reasonable to assume that, following an approved merger, in the post-merger evaluation, a significant increase should noted in the allocative efficiency of the newly formed undertaking, as compared with the best of the pre-merger entities. Should this not be the case, it is a sign that the merger has not had positive effects in the reallocation of resources. This leads naturally to the conclusion that it is very unlikely that and price reduction will be passed on to consumers, and that the merger should not have been cleared by the CA.

CONCLUSIONS

Merger reviews is a core business of Competition Authorities (CAs). While the focus is on market-side effects, such as the ability of the newly formed company to raise prices or the lessening of competition due to the decrease in the number of market players, the issue of assessing efficiency gains in the presence of a merger has been less considered in the merger reviews. In this paper I use an additive model to show that there are circumstances where a merger cannot induce technical efficiency gains, thus limiting the scope for potential welfare gains. I argue that in the presence of such a scenario, the CA should strongly consider banning the proposed merger.
In order to properly asses the efficiency gains brought about by a proposed merger, a reference to the best practice in the field has to be performed. DEA is a versatile tool, and has been used extensively in assessing technical efficiencies, both at the individual firm level and sector wise. To date, several attempts have been made to model the potential efficiency gains following a merger. The European Union Merger Regulation and the Horizontal Merger Guidelines make a clear reference to the existence of efficiency gains as an argument in favor a merger, as long as these

gains can offset potential anticompetitive effects of the merger. There seems to be a gap between the types of efficiencies that the CAs aim to identify in merger reviews and the evaluation of efficiency gains from the management literature and this paper is an attempt to bridge that gap.

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ENDNOTES:

(1) The views expressed in this paper are author's own and do not necessarily represent the views of his employer(s).
(2) In this paper, I use the term "merger" to refer to all types of corporate transactions which are referred to as "concentrations" under the EU competition regulations.
(3) Amihud et al. (2002) on cross-border bank mergers; Agrawal and Jaffe (2001) provide a comprehensive review on the literature concerned with the long-run financial performance following mergers and acquisitions.
(4) Council Regulation (EC) No 139/2004 on the control of concentrations between undertakings [2004] OJ L 24/1
(5) Basically, this means that at least one of the merging parties should not be located on the efficiency frontier. It is true that, in the unlikely scenario that all the merging parties are fully efficient, once can consider the possibility of a frontier shift (technical progress) associated with the merger.

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