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ROUNDTABLE ON THE ROLE OF EFFICIENCY CLAIMS IN ANTITRUST PROCEEDINGS

-- Note by Ms. Helen Jenkins --

This note is submitted by Ms. Helen Jenkins (Managing Director, Oxera, UK) to the Competition Committee FOR DISCUSSION under Item XII at its forthcoming meeting to be held on 24-25 October 2012.

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EFFICIENCY ASSESSMENTS IN EUROPEAN COMPETITION POLICY AND PRACTICAL TOOLS

-- Note by Ms. Helen Jenkins --

1. Introduction

1. Efficiency improvements are understood to be the heart of economic growth. Explaining that growth and supporting those improvements has been the subject of extensive economic research.¹ The link between efficiency gains and innovation has been explored through measures of R&D expenditure or intensity, human capital, management and organisational structure.²

2. The Lisbon Treaty identified that a strong competition policy for Europe would underpin the productivity growth necessary to continue to deliver good outcomes for European citizens and consumers. In general this is based on an assumption that more competitive outcomes lead to a more efficient, productive economy; however, the reality can be more subtle and competition policy should also embrace a good understanding of the efficiency implications of enforcement activity. Competition policy examines the impact of arrangements between, and practices of, firms to assess whether these are likely to distort competition in some manner. Where the rationale for the introduction of a new arrangement or practice may be to deliver a more efficient process, there may be a trade-off between enhancing rivalry and enhancing efficiency.

3. This paper discusses the issues that arise in considering the trade-off between efficiency gains and potential competitive distortions. In line with more effects-based analysis in many jurisdictions and for many aspects of competition policy, authorities are exploring the weight to give to efficiency assessments in judging the legality of an agreement, a merger or a practice. First, the current approach to efficiency assessment in Europe is set out, identifying that these considerations are relevant in most types of competition policy cases. Then the balance between these two important criteria is examined and how this differs depending on the area of competition law. Finally one of the standard techniques in efficiency analysis is described—data envelopment analysis (DEA)—and how it has been, or could be, used in competition assessments.

2. How are efficiency considerations incorporated into competition analysis?

4. There are three sources of efficiency used in economic welfare analysis—allocative, productive and dynamic efficiencies. Allocative efficiency relates to how well an economy's resources are allocated; that is, how close prices are to an appropriate (marginal) cost benchmark. Achieving allocative efficiency

¹ See the original work by Solow identifying the principle of total factor productivity. Solow, R.M. (1957), 'Technical change and the aggregate production function', *Review of Economics and Statistics*, 39:3, 312–320. Explanations of this change have been developed by many economists, both theoretically and empirically.

² For an overview of theoretical and empirical research into the drivers of growth, see Aghion, P. and Durlauf, S. (2005), *Handbook of Economic Growth*, Elsevier.

ensures that (scarce) resources are allocated to the areas where they are most valued. Productive efficiency relates to how close current resource use is to best practice; that is, whether there is scope to gain more output from existing inputs through adoption of existing technology. Dynamic efficiency relates to the speed at which underlying technology improves; that is, the speed of innovation. In this, technology refers not only to physical investment, but also to organisational practices, skill transfer, etc.

5. Productive and/or dynamic efficiency considerations are relevant in every aspect of competition assessments. In mergers, the underlying rationale for many transactions is the efficiency gains that will be realised; hence most merger assessments will discuss the evidence for productive and/or dynamic efficiency. Similarly to mergers, most (non-hardcore) agreements or other arrangements between market participants will have an efficiency rationale that requires examination. State aid cases in Europe, particularly cases relating to subsidies for services of general economic interest (SGEI), need to assess whether the underlying operation of the SGEI recipient is efficient. Here it is productive efficiency that is of interest. A number of practices scrutinised under abuse of dominance legislation, while potentially exclusionary, may also have such efficiency benefits (for example, tying or bundling practices).

6. The tension underlying competition policy is effectively between the first type of efficiency and the second and third types. Rivalry and competitive markets yield pricing closely related to underlying costs (allocative efficiency), to the benefit of consumer welfare. Much of the intervention by competition authorities is to ensure that allocative efficiency is achieved and that firms are not able to earn excessive returns through exclusionary practices or through agreements or mergers that hamper rivalry. However, new market arrangements may yield lower-cost or higher-quality outputs (productive or dynamic efficiency), to the benefit of total welfare. Competition assessment (in general) weights consumer welfare and allocative efficiency highly, and is reluctant to give weight to efficiency benefits where they lead (at least in the first instance) to producer welfare, usually in the form of higher profits.³ As we shall see below, the speed and certainty with which these latter benefits would filter through to consumers more generally has received little to no attention in competition analysis.

7. We start with an assessment of the way in which efficiency considerations are balanced in Europe, focusing on mergers and agreements. We also examine any differences that arise as a result of whether there is a horizontal or vertical link.

2.1 *Efficiencies in mergers and agreements*

8. Competition authorities generally require that the claimed merger efficiencies meet a number of conditions before they are weighed against a potential lessening of competition. For example, the European Commission requires merger efficiencies to ‘benefit consumers, be merger specific and be verifiable’, with these three conditions being cumulative.⁴ The US agencies have a similar approach, namely to:

consider whether cognizable efficiencies likely would be sufficient to reverse the merger’s potential to harm customers ...

credit only those efficiencies likely to be accomplished with the proposed merger and unlikely to be accomplished in the absence of either the proposed merger or another means having comparable anticompetitive effects ...

³ An exception to this is the competition regime in Norway, which has a total welfare standard and therefore gives weight to both consumer and product welfare.

⁴ European Commission (2004), ‘Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings’, OJ 2004/C 31/03, para 78.

*verify by reasonable means the likelihood and magnitude of each asserted efficiency, how and when each would be achieved (and any costs of doing so), how each would enhance the merged firm's ability and incentive to compete, and why each would be merger-specific.*⁵

9. Under Article 101 TFEU, all agreements between undertakings, decisions by associations of undertakings and concerted practices that may affect trade between European Union (EU) countries and that have as their object or effect the prevention, restriction or distortion of competition are prohibited.⁶ In recognition of the efficiency rationale that may exist for certain agreements, there is the possibility to seek an exemption to this rule. Article 101(3) TFEU provides that the prohibition may be declared inapplicable in case of agreements that contribute to improving the production or distribution of goods or to promoting technical or economic progress, while allowing consumers a fair share of the resulting benefits, and that do not impose restrictions which are not indispensable to the attainment of these objectives. In addition, the arrangements must not afford such undertakings the possibility of eliminating competition in respect of a substantial part of the products concerned.

10. The treatment of efficiencies thus has similarities under mergers and agreements. Efficiencies must exist (ie, they must be verifiable under merger control and the agreement must contribute to technical progress); they must be passed on, at least in part, to consumers (ie, they must benefit consumers under merger control and any exemptible agreement must allow consumers a fair share); and they must be specific to the practice (ie, they must be merger-specific and the restriction must be indispensable to attaining the efficiencies).

11. There is, however, an important difference. Until relatively recently, European (and US) merger control did not give weight to efficiency considerations as a counterbalance to identified anti-competitive effects, whereas the analysis of agreements has had this feature (through Article 101(3) or a rule of reason approach in the USA). This difference in the weight given to efficiency considerations is still somewhat evident in terms of the burden in passing the identified hurdles.

12. European guidance sets out that efficiency claims can only tip the balance in favour of merger approval in the event of limited evidence of a lessening of competition.⁷ The verifiability condition requires significant evidence that efficiencies must be substantial and timely. This condition can be challenging to establish where the nature of the efficiency may be linked to management or innovation and therefore be inherently longer-term in focus. Such longer-term considerations may be given greater weight in assessment of agreements. The requirement that merger efficiencies must benefit consumers has led to a focus only on relatively short-term marginal cost efficiencies, and that they should be realised in the markets where there are competitive concerns. Fixed-cost efficiencies can be taken into account in assessing an agreement, where there is a fair share for consumers, as can benefits accruing in related markets. Given that many fixed-cost savings will be passed on over time (as the fixed costs become variable), mergers will be blocked that may have valuable contributions to economic performance from which consumers would benefit over the longer term.

13. In assessing both mergers and agreements, there is a strong burden of proof on the parties to show that the efficiencies could not be attained in a different way. This may give insufficient weight to whether the gains would be achieved absent the arrangement being scrutinised. An example is efficiencies

⁵ Department of Justice and the Federal Trade Commission (2010), 'Horizontal Merger Guidelines', August 19th, p. 30.

⁶ Article 101(1) of the Treaty on the Functioning of the European Union (TFEU) (ex-Article 81(1) of the Treaty Establishing the European Community).

⁷ European Commission (2004), op. cit., paras 76–88.

arising from simple scale economies. Such efficiencies can, in principle, be achieved unilaterally through organic growth, and consumers are likely to benefit if companies compete to gain scale rather than buy it. These efficiencies may therefore not be merger-specific and consequently would not be included as part of the balance in determining whether the merger should go ahead.⁸ If the merger were to proceed, however, these benefits would arise and, where they affected marginal costs (for example, improved terms for procurement of inputs), would be likely to flow directly to consumers. In the absence of the transaction, neither firm may manage to grow organically to achieve the same scale, and the efficiencies would be lost.

14. One of the first cases in which the European Commission offered a review of efficiency analysis provided by the merging parties was Inco/Falconbridge.⁹ The merging parties claimed that the merger would generate efficiency gains since they could optimise mining and processing operations benefitting from the proximity of their mines and processing facilities in the Sudbury basin. While the Commission acknowledged the potential for substantial synergies and efficiency gains, it concluded that the synergies were not merger-specific because the parties would have been able to capture many of these by creating a mining and processing joint venture (JV).¹⁰

15. The Commission also considered that the efficiencies would not have benefitted end-customers in the relevant markets where competition concerns had been identified since the efficiencies would materialise upstream and the merged entity would have significant market power in the relevant market. Hence, the merged entity would have limited incentives to share the benefits of the efficiencies with its end-customers.¹¹

16. In contrast, there are two recent cases where the UK and Dutch competition authorities approved media mergers on the basis of substantial demand-side efficiencies. The UK case concerned a merger of two radio stations; the Dutch case concerned a merger of two door-to-door distributed directories.¹²

17. The Dutch case involved the merger of the only two national networks of door-to-door distributed directories, and was approved following an effects-based assessment which found that the merger would generate substantial efficiencies for the advertisers (customers of distributed directories). The Dutch competition authority, the NMa, found strong demand-side efficiencies for advertisers stemming from the integration of the two directories, as each advertiser would now need to advertise in only one directory and could access all households. This benefit was balanced against the loss of rivalry, given the constraints from other media (such as the Internet).

18. A similar efficiency defence was accepted in the clearance of a recent UK merger of two radio stations. The OFT found in this case that the demand-side efficiencies 'would tip the balance' in favour of clearing, as it would allow advertisers to reach consumers more effectively. The key benefits from the merger of the two radio stations were one-stop shopping transaction cost savings for advertisers (they could purchase bundles of advertising time across both stations); under common ownership, the stations would be able to differentiate their content offerings and thereby target different audiences. This meant a

⁸ See Farrell, J. and Shapiro C. (1990), 'Horizontal Mergers: An Equilibrium Analysis', *American Economic Review*, 80, 107–26.

⁹ Case No. COMP/M.4000, July 4th 2006. The case was cleared with remedies, but the parties did not complete the deal.

¹⁰ Ibid, paras 537–42.

¹¹ Ibid, paras 543–50.

¹² NMa (2008), 'Telefoongids/Gouden Gids', Decision by the NMa's board; and OFT (2008), 'Global Radio UK Limited/GCap Media plc', August 8th.

higher-quality, more convenient offering to advertisers. Again, the competitive constraints from other media options were important.

19. These two cases are in contrast to the European Commission's assessment in February 2012 of the Deutsche Bourse/NYSE case.¹³ The Commission prohibited the proposed merger, arguing that prohibition was warranted because the merging parties would have a combined market share exceeding 90% in the market for European financial derivatives and that entry was unlikely.¹⁴ The efficiency defence put forward by the merging parties—greater liquidity from combining the two pools and collateral savings through cross-margining opportunities—was not taken into account since the Commission concluded that it could not verify the liquidity claim, and that the collateral savings claim was not merger-specific and would not compensate for the significant loss of rivalry that would arise from the transaction.

2.2 *Horizontal versus vertical arrangements*

20. Agreements or mergers between horizontal competitors will always need to consider the incentive to reduce rivalry, as the parties will directly benefit from each other's decisions to exercise (exploitative) market power. Competitor firms have a shared incentive to enter into horizontal arrangements which have the effect of increasing prices to consumers, enhancing their margins without losing sales to each other, and hence distorting competition. As discussed above, such arrangements may also deliver productive or dynamic efficiencies which need to be balanced against any potential allocative inefficiency that arises because of the reduced rivalry.

21. In contrast, economic theory suggests that vertical arrangements are likely to be pro-competitive, as is reflected in the Commission's recent guidelines on vertical restraints:

*Vertical restraints are generally less harmful than horizontal restraints...In vertical relationships...the activities of the parties to the agreement are complementary to each other. The exercise of market power by either the upstream or downstream company would therefore normally hurt the demand for the product of the other.*¹⁵

22. This complementarity limits the incentive of two vertically related parties to enter into arrangements that enhance market power because, in so doing, the exercise of market power by one party to the agreement is likely to hurt the other. The aim of an upstream manufacturer is generally to encourage its retailers to sustain and increase sales of its product(s), and one of the main ways to do this is to sign agreements with retailers which provide for low retail prices. Vertical agreements can also be aimed at promoting a high quality of service; this is also consistent with promoting high volumes. Vertical mergers can resolve double-marginalisation or other coordination problems, thereby leading to incentives to lower prices. Thus, in general, the interests of buyers and sellers are aligned in expanding sales to end-customers rather than in seeking to restrict sales. There is less tension between allocative efficiency and productive or dynamic efficiency in the case of vertical arrangements, and, accordingly, competition authorities are more likely to give weight to the efficiency rationale for a practice.

¹³ European Commission (2012), 'Commission blocks proposed merger between Deutsche Börse and NYSE Euronext Brussels', press release, February 1st.

¹⁴ The European Commission defined distinct markets for trading on exchanges and over-the-counter (OTC) because of the differing product and customer characteristics.

¹⁵ European Commission (2010), 'Commission Notice – Guidelines on Vertical Restraints', May 19th, para 98.

In practice, this gives rise to a more lenient approach to vertical agreements and vertical mergers. While the tests and thresholds are similar, the presumption is different, as reflected, for example, in the 2010 European regulation on vertical agreements.¹⁶

2.3 *Assessment of treatment of efficiency gains*

23. The rationale for scepticism about efficiency gains is rooted in concerns over the verifiability of these future benefits against any identified clear competitive harm. We discuss in the next section how efficiency measurement techniques can be used to increase the comfort of competition authorities in relying on efficiency evidence.

24. In addition, where efficiencies may initially accrue to producers because they are fixed-cost savings, or where allocative efficiency is worsened because of market power, the weight given to consumer welfare means that these types of gains are not valued. In relation to the latter, this may reflect an overly short-term approach to such questions. Fixed-cost savings may take more than two years to filter through to customers (depending on asset lives), but may be significant when they do. Consideration of long-run incremental costs (LRIC) as well as marginal costs may be of interest. In a capital-intensive industry, or a software/digital content industry, short-run marginal costs have limited meaning. Benefits in reducing costs that are fixed over the standard assessment period of merger cases are likely to flow through over a longer timeframe. If there are limited marginal cost savings, but large merger-specific LRIC savings, ignoring these benefits may overall be harmful for consumer welfare. The fact that efficiency savings cannot be used where there is a substantial reduction in rivalry may also be to the detriment of consumers. Even monopolists (facing linear demand) will pass through 50% of efficiency savings, as the monopolist is willing to trade off the loss in margin against the gain in sales that arises. Ignoring efficiency benefits where they are longer-term in nature, or where there are significant concerns about the competition effects, may not serve the interests of consumers.

25. Out-of-market efficiencies are defined in US Horizontal Merger Guidelines as merger efficiencies that are ‘not strictly in the relevant market, but are so inextricably linked with it that a partial divestiture or other remedy could not feasibly eliminate the anticompetitive effect in the relevant market without sacrificing the efficiencies in the other market(s)’.¹⁷ In the presence of potential out-of-market efficiencies, competition authorities seek tailored remedies that preserve efficiencies while combating anti-competitive effects in the relevant market. In general, the motivation for requiring efficiency benefits to accrue in the same market where the harm to rivalry occurs is linked to a fairness concern and the welfare of specific consumers, as opposed to consumers overall. In terms of an overall consumer welfare standard, efficiencies that arise elsewhere are just as valuable as those that accrue within the relevant market. If there is a concern about fairness and a desire to make no one consumer worse off, this should perhaps be a separate requirement, rather than captured in the efficiency test.

26. Finally, requiring indispensability (or merger-specificity) may also harm consumer interests since this does not identify whether the gains would, in fact, be achieved absent the merger or new agreement. A comparison of the balance between the competitive harm and the efficiency benefits from the new arrangement against the counterfactual of the status quo would be more appropriate. That is, if a competition authority considers that a particular efficiency could be achieved through a JV arrangement rather than a full merger, it needs to assess how likely such a JV is to arise in the counterfactual of

¹⁶ European Commission (2010), ‘Commission Regulation (EU) No 330/2010 of 20 April 2010 on the application of Article 101(3) of the TFEU of the EU to categories of vertical agreements and concerted practices’, Regulation, OJ L102/1 23.4.2010.

¹⁷ Federal Trade Commission and Department of Justice (2006), ‘Commentary on the Horizontal Merger Guidelines’, joint commentary, March.

blocking the merger. If it is unlikely then ignoring these efficiencies in the merger assessment may not give the correct weighting to the consumer welfare benefits likely to be achieved from the merger.

3. Practical tools for assessing efficiency gains

27. All of the above gives an overview of how efficiency considerations are currently factored into analysis of competition infringements. It also opens a debate about whether there is scope for more attention to, and balancing of, efficiency gains.

28. Merging parties and competition authorities do increasingly recognise that efficiency claims need to be evidence-based and quantifiable. Techniques that have been applied to assess firms' efficiency may offer some promise for understanding the likely benefits from new corporate arrangements.¹⁸ Here we focus on data envelopment analysis (DEA), one of the best-developed, easily explained and well-understood efficiency assessment techniques.

29. DEA has a number of technical advantages but also some practical advantages, which mean that it can be considered for use in merger analysis (and indeed, other competition applications).¹⁹

- DEA can handle multiple inputs and multiple outputs in their natural units (even where these are not directly commensurate). It does not require data on prices, which may be missing in some service industries.
- DEA is also favoured where the assumptions of standard production theory are in question (for example, hospital behaviour may not be characterised as either profit maximisation or cost minimisation).²⁰

30. In merger analysis, DEA can be used as a planning tool—ie, to assess the efficiencies to be realised by merging different-sized units within a firm or by merging two firms within a sector. It can also be used by competition authorities and merging parties to predict potential gains from a merger. For example, Lozano and Villa (2010)²¹ developed a DEA-based pre-merger planning tool for estimating the likely cost and profit gains from a merger. Their tool has been developed to model the closure of existing firms, replicating a horizontal merger, and, as such, could be applied to proposed horizontal mergers. The model has not yet been applied to real-world data, but it is designed to decompose efficiency gains into technical, allocative and pure merger efficiencies. All may be merger-specific: pure merger efficiencies

¹⁸ These techniques have been often applied in regulated sectors. For insights into efficiency assessment in regulated industries See Oxera (2011), 'Encouraging efficiency in regulated sectors: Lessons from 20 years of RPI-X', report for BT, December.

¹⁹ For example, DEA has been applied to estimate potential gains from mergers in the US hospital sector, the US banking sector and the Norwegian electricity distribution industry. See, Ferrier, G.D. and Valdmanis, V.G. (2004), 'Do Mergers Improve Hospital Productivity?', *Journal of the Operational Research Society*, 55:10; Bogetoft, P. and Gammeltvedt, T.E. (2006), 'Mergers in Norwegian electricity distribution : a cost saving exercise?', working paper, NVE, Norway; Sherman, H.D. and Rupert, T.J. (2006), 'Do bank mergers have hidden or foregone value? Realized and unrealized operating synergies in one bank merger', *European Journal of Operational Research*, 168, 253–68.

²⁰ For example, Gong and Sickles (1992) report that 'as mis-specification of functional form becomes more serious, DEA's appeal (vis-à-vis Stochastic Frontier Analysis) becomes more compelling.' See, Gong, B.H. and Sickles, R.C. (1992), 'Finite Sample Evidence on the Performance of Stochastic Frontiers and Data Envelopment Analysis Using Panel Data', *Journal of Econometrics*, 51, 259–84.

²¹ Lozano, S. and Villa, G. (2010), 'DEA-based pre merger planning tool', *Journal of the Operational Research Society*, 61, 1485–97.

would include, for example, procurement gains, while the merger-specific technical efficiency gains could arise from the additional best-practice opportunities that emerge from the consolidation. To identify profit gains, a good estimate of future output prices is necessary; this is generally not available prior to the merger. The Lozano and Villa tool may be useful for assessing mergers ex post.

31. We now describe the intuition of a DEA approach, both in cross-section and where data may be available over time. There is a significant literature available on these techniques. Potential application of DEA is discussed here in determining the potential gains of proposed mergers in the Danish hospital sector.

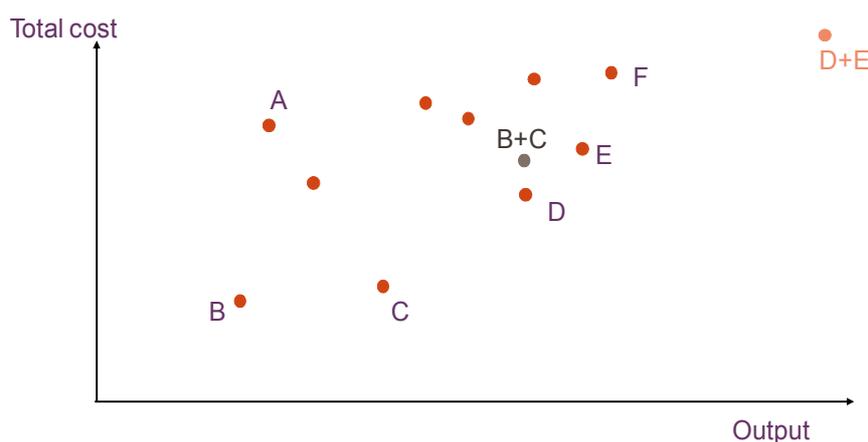
3.1 Data envelopment analysis

32. DEA is a frontier-based method²² that is commonly used for measuring comparative efficiency and productivity when there are multiple inputs and outputs that cannot be readily reduced to a single input or a single output measure. It is widely used by regulators and academics, providing useful performance measurement information in a variety of application areas.²³ Its major advantage is that the efficiency estimates are based on realised performance observed in other, similar companies, implying that it is a relatively robust and transparent approach.

33. DEA measures efficiency by reference to an efficiency frontier, which is constructed as linear combinations of efficient (best-practice) companies—that is, companies producing the most output at the lowest cost. DEA assumes that two or more companies can be ‘combined’ to form a composite producer with composite costs and outputs—a ‘virtual company’. The actual companies are then compared with these virtual and actual companies. If another actual or a virtual company or their combination achieves the same output as the actual company at a lower cost, the actual company is judged to be inefficient.

34. Figure 1 is a graphical representation of ten units (for example, hospitals), with the y axis representing the total cost of service, and the x axis the total outputs produced (for example, patients satisfactorily discharged). Units (B+C) and (D+E) represent the merger of units B and C, and D and E respectively, where their total costs and total output are simply added together initially.

Figure 1 Graphical example of data envelopment analysis (I)



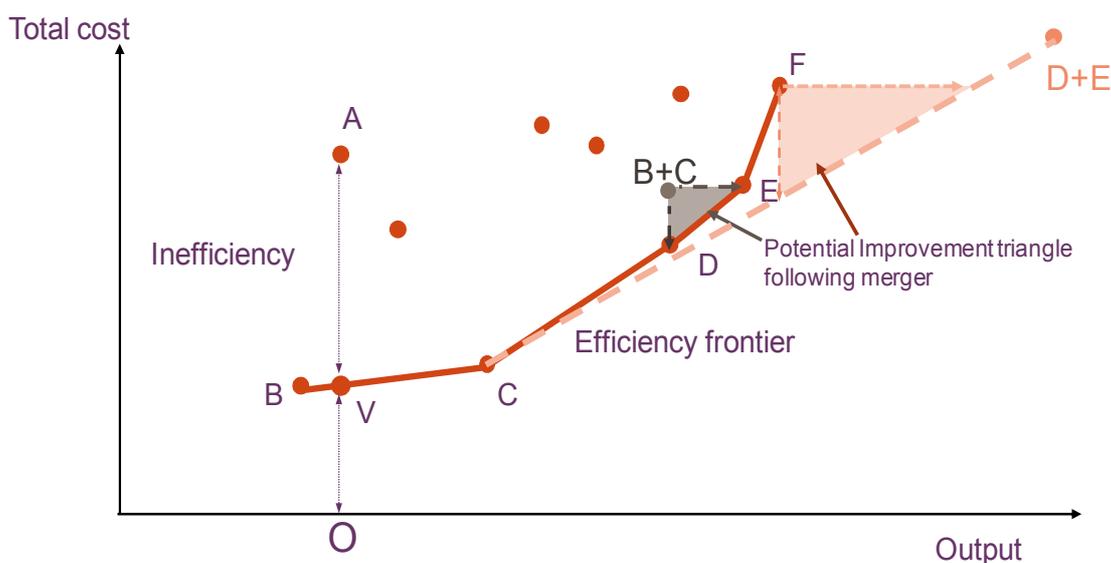
Source: Oxera.

²² Frontier-based approaches attempt to estimate a minimum cost frontier for the industry. These approaches could use econometric analysis, as in the case of corrected ordinary least squares (COLS) and stochastic frontier analysis (SFA), mathematical optimisation, as in the case of data envelopment analysis (DEA).

²³ For empirical applications of DEA in transport, energy, finance and healthcare, see Cooper, W.W., Seiford, L, and Zhu, J. (2011), *Handbook on Data Envelopment Analysis*, second edition, Springer Science,.

35. Prior to the merger of units B and C or D and E, the DEA frontier is shown in Figure 2 by joining points B, C, D, E and F. These units expend the least cost to produce a given level of output; alternatively, they produce the maximum output, given the level of cost spent. Companies B, C, D, E and F are thus deemed efficient, as they are on the frontier. Under a cost-minimisation objective, the efficiency of company A is given by the distance from point A to point V.²⁴ Point V is a virtual company, made up of a weighted average of frontier companies B and C, such that V has the same quality as A.²⁵ Companies B and C are referred to as A's 'peers', with B having a higher weighting than C. DEA gives the following insight to the owners or managers of A: A could improve its productive efficiency by adopting best practice as exemplified by B and C.

Figure 2 Graphical example of data envelopment analysis (II)



Source: Oxera.

36. Suppose that efficient units B and C then decide to merge. DEA gives insight into the expected levels of synergy. If the businesses integrate without exploiting the potential new synergies (for example, the additional economies of scale from the increase in size), the outcome would be the point (B+C), shown to be inefficient under DEA. DEA could be used to estimate the additional cost savings (or improvement in output) that should be possible by the merger of two *already* efficient points B and C. The possibilities for improvement are shown in the shaded triangle, with the benchmark being determined by the efficient frontier connecting units D and E. If the merging parties are indicating efficiencies of this magnitude, DEA would confirm that this is consistent with two efficient firms remaining on the frontier. If the merging parties are suggesting significantly higher efficiency gains, this would take them beyond current best practice. A competition authority might require additional evidence to accept the verifiability of these savings, as this would be a shift in the industry efficiency frontier.

37. In an alternative scenario, suppose that efficient units D and E decide to merge, but again integrate without exploiting new merger synergies; this would be represented by point (D+E) which, owing to a lack of suitable comparators, could still be judged to be an efficient combination under a simple DEA

²⁴ 'A' will have a different efficiency challenge under an output-maximisation objective.

²⁵ For a more detailed discussion on DEA, see Thanassoulis, E. (2001), *Introduction to the Theory and Application of Data Envelopment Analysis: A Foundation Text with Integrated Software*, Springer.

approach.²⁶ However, in this instance, the industry frontier is shifted downwards as a result of the increased scale economies, and it could open up an efficiency challenge for other players in the industry. The unit F, previously judged to be efficient, now has a peer that provides it with a challenge that additional output growth can be achieved at lower unit cost (represented by the lightly shaded triangle). An impact of the merger here could be argued to arise through flagging the possibility of an improvement in the productivity of the industry as a whole.

3.1.1 *Performance over time*

38. Assessing performance over time using DEA is usually done by constructing a productivity index, commonly known as the Malmquist index. *Productivity indices* need to be constructed since productivity is an absolute measure, in contrast to the relative measures applied when measuring distance from an efficient boundary. The Malmquist index can capture the effects of changes in external conditions and the relative performance of the assessed unit in a way that is not possible by simply comparing the cross-sectional efficiency scores between two macro-periods. The Malmquist index can be computed using only measures of efficiency (estimated using DEA) without the need for functional assumptions or prices.

39. The productivity change over time can be broken down into two components. The first reflects the productivity gain or loss, attributable to a unit catching up or slipping behind in performance, compared with its contemporaneous benchmark units. The second reflects the extent to which benchmark performance has improved or worsened over time, known as ‘technology change’.²⁷ Productivity growth as measured by the Malmquist index is thus the product of efficiency change and frontier shift.

40. Where data is available to examine productivity changes over time, this allows for more detailed understanding of the drivers of efficiency benefits and the link to a merger or an agreement. Such an approach would be particularly valuable in assessing the outcomes after an enforcement decision has been taken, whether to prohibit or to allow a merger or agreement.

3.2 *Examples of applying DEA in competition assessments*

41. DEA can be usefully applied to predict the potential for efficiency improvements. It is suited to situations where the market comprises different units of varying size and scope. It has been used to analyse performance in a wide range of sectors (eg, insurance, banking, healthcare, energy, police forces), including in identifying opportunities where implementation of best-practice techniques could yield benefits.

42. As an example, the productivity impact of mergers over time has been examined. Ferrier and Valdmanis (2004) used the DEA-based Malmquist index approach to ascertain whether hospital mergers result in performance gains, at least in the short run. The authors concluded that hospital mergers in the USA in the late 1990s did result in an improvement in terms of technical (and scale) efficiency measures, although the merged hospitals did not sustain their performance; and, over time, performed poorly compared with others.²⁸ Cuesta and Orea (2002) used a panel data econometric approach to study the

²⁶ Under the additivity assumption maintained in Bogetoft and Wang (2005), the merger of units D and E would result in an infeasibly large unit for the reference technology, and the merger would not be considered advantageous.

²⁷ Indeed, if the units being assessed do not operate under constant returns to scale, but rather under variable returns to scale, then a third component can also be identified which captures the impact on productivity change attributable to changes in scale size.

²⁸ Ferrier, G.D. and Valdmanis, V.G. (2004), ‘Do Mergers Improve Hospital Productivity?’, *Journal of the Operational Research Society*, 55:10.

technical efficiency of Spanish savings banks over time and to test the differences in technical efficiency between merged and non-merged firms.²⁹ They found that merged firms had improved their technical efficiency.

43. The hospital sector offers good opportunities for performance assessment since there are units of varying size and scope, but often input and output prices are similar, as a result of regulation. Below we discuss in more detail the application of DEA by Kristensen, Bogetoft and Pedersen (2010) to assess both potential and realised efficiencies in advance of merger activity in the Danish hospital market.³⁰

3.2.1 *Application of DEA to proposed consolidation in the Danish hospital market*

44. In 2007 the Danish government rolled out a substantial building programme centralising medical services in fewer hospitals, claiming that consolidation of hospitals would increase hospitals' efficiency.³¹ By applying DEA, Kristensen et al. (2010) assessed ex ante the government's claim that the consolidations would deliver efficiency gains in the Danish hospital sector. The authors examined potential consolidations that would be consistent with the government's announced aims for the restructuring programme, and highlighted that this type of analysis can be used to plan such acquisitions and assess the likelihood of any stated benefits arising from a given consolidation.

45. The analysis followed a two-step approach: the cost frontier was identified using DEA analysis, and the efficiencies of existing and virtual hospitals were assessed, allowing potential efficiency gains to be established; and the estimated efficiency gains were then decomposed into the following sources:

- the **learning effect**, which measures the reduction in costs that arises where hospitals adopt best practice from the most efficient hospitals;
- the **scope effect**, which allows hospitals to focus on the services that they deliver most efficiently (ie, the ability to optimally exploit the mix of resources used and services provided by the merging hospitals);
- the **scale effect**, identifying the decline in the average cost of providing healthcare as the number of services delivered falls (ie, the additional gains that could come from the larger size of any merged hospitals).

46. As some of these potential gains could be realised absent a merger, decomposing the effects as above allowed identification of those efficiency gains that could only be realised through a merger. The results showed that sizeable cost reductions could be realised through learning effects and through improved economies of scope. Economies of scale could arise when smaller hospitals were merging, yet the evidence indicated that diseconomies of scale were likely to arise if larger hospitals were merged. This means that any consolidation programme would need to be assessed carefully if overall efficiency gains are a key rationale.

²⁹ Cuesta, R.A. and Orea, L. (2002), 'Mergers and technical efficiency in Spanish savings banks: A stochastic distance function approach', *Journal of Banking & Finance*, 26, 2231–47.

³⁰ Kristensen, T., Bogetoft, P. and Moeller Pedersen, K. (2010), 'Potential Gains from Hospital Mergers in Denmark', *Health Care Management Science*, 13:4, 334–45.

³¹ The Danish government did not substantiate its claim. The international literature suggests that the performance of merged hospitals falls below expectations owing to higher-than-expected costs stemming from the integration of the merging hospitals.

4. Conclusions

47. Competition assessment already recognises the need to give weight to efficiency considerations when determining whether a new arrangement can go ahead. While rivalry is seen as a long-term driver of economic welfare, there are cases where a new approach could drive significant efficiencies, to the overall benefit of consumers in the medium to longer term. Without doubt, authorities need to be convinced that such efficiencies are genuine and likely to occur. In this regard, cross-sectional and panel modelling of performance analysis using techniques such as DEA can be helpful in order to identify and quantify efficiency gains. While much of the extant application has been in terms of understanding the scope for mergers to generate efficiency gains, the principles can be applied more widely. As competition authorities become more familiar with measuring and verifying these gains (including with ex post assessments), the more comfortable they are likely to be in giving weight to these. There lies a challenge for practitioners and competition authorities to explore the extent to which performance analysis can be usefully applied to substantiate efficiency gains.