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The use of the logit competition index (LOCI) as a measure of hospital market power

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Abstract

This paper examines the use of the logit competition index (LOCI) as a measure of assessing the market power of hospitals. In the United Kingdom (UK) the Competition Commission has recently started to apply the LOCI in their Market Inquiry into the British healthcare sector. The South African (SA) Competition Commission commenced its own Market Inquiry into the SA private healthcare sector in September 2013, and the draft terms of reference¹ indicate the Commission will address the level of concentration and market power of the large private hospital groups in SA. It seems likely the Commission will make use of leading-edge techniques applied in other jurisdictions such as the UK, and this paper evaluates what the LOCI measure can add to the more traditional measures of concentration such as the Herfindahl-Hirschman Index (HHI). The advantage of the LOCI is that it does not require potentially arbitrary assumptions about the size of the relevant geographic markets (or catchment areas) around particular hospitals, whether these involve concentric rings drawn around these hospitals on a map, or so-called isochrones that account for the influence of features such as access roads to a hospital. The paper explains the calculation of the LOCI and the interpretation of the values it can take on, and then concludes with a preliminary assessment of the likely impact of the use of the LOCI on the Commission's analysis of hospital concentration in SA.

1. Introduction

The Competition Commission has dedicated part of its website to “Healthcare” and as of late August 2013 there were two papers posted under that heading –

¹ Competition Commission, November 2012. *Draft terms of reference for the market inquiry: private healthcare sector.*

both general reviews of the sector and potential competition concerns within it. One paper² is by Wits University Professor Alex van den Heever, and the other paper³ is by economics consultancy Genesis Analytics. Both papers refer to the high levels of concentration within the private hospital market. Van den Heever⁴ states the following in his review:

“Available information suggests that hospital concentration has increased costs with a possible related reduction in quality of care. As a growing empirical consensus exists internationally that market structure is central to the achievement of pro-competitive outcomes for private hospital markets, the continued approval of new hospital mergers in a concentrated market is a concern. In part, the equivocal response from government and public authorities results from uncertainty about the true facts on the ground. Despite the very substantial annual cost of private hospital care and expensive merger applications, competition studies are merger specific and extremely limited in scope and accuracy. There is nevertheless a strong basis for a definitive market review covering both structure and conduct.”

The Genesis report also mentions the importance of regional rather than national hospital concentration, and the report states the following (p 37):

“...in evaluating mergers, the Tribunal also considered regional market shares as regional competitive dynamics do matter. This is because patients prefer to travel to the nearest hospital that offers the treatment required. The regional market shares reveal that in some areas there is likely to be a higher level of concentration than the national market shares represent.”

The Genesis report also notes (p 38) that hospital services are heterogeneous rather than homogeneous:

“The market shares also do not reflect the degree of heterogeneity in the services provided by hospitals. Hospitals do not provide the same set of specialised services – adjacent hospitals may provide a different set of services, or a hospital may be dedicated to a specific specialisation. This is not picked up in the market shares presented above as they are based on total bed numbers and do not distinguish by bed type.”

Furthermore, the Commission indicated in its draft terms of reference (p 10) that the following aspects about hospitals would form part of the subject matter of its Inquiry:

² Alex van den Heever, 19 June 2012. *Review of competition in the South African health system.*

³ Genesis Analytics, 31 August 2012. *Healthcare market background paper.*

⁴ *Ibid.*, p 99.

- “An analysis of profitability of hospitals
- A review of the trends in consolidation and impact on profitability”

Therefore we can certainly expect the Commission to investigate the concentration of the private hospital market (or markets) in its Inquiry, and potentially seek out measures that provide more accurate measures of concentration at a regional or local level, and for more homogeneous groupings of hospital services.

The UK Competition Commission in its own healthcare market inquiry has employed the LOCI measure to get a better idea of private sector hospital concentration and market power. The Times newspaper reported recently⁵ that the UK Competition Commission found 98 out of 178 private hospitals outside London are “...insufficiently constrained by competition. This includes 30 in areas where there is no choice for private patients and 41 in local duopolies.”

The LOCI measure of concentration can certainly provide more accurate assessments of hospital concentration in the regions, without the need for the researcher to choose the size of the relevant geographic market. A further refinement of hospital concentration measures to reflect the heterogeneity of hospital services depends on defining the relevant product market correctly, and is not improved by the use of the LOCI measure. In the UK, the Competition Commission has included in its research all inpatients receiving treatment from a consultant (specialist) with a primary specialisation in one of the 17 identified “specialties of interest”.

In the next section, the calculation of the LOCI measure of concentration is explained.

2. Calculation of the LOCI

2.1. The HHI

The LOCI measure is closely related to the most widely used measure of market concentration, the Herfindahl-Hirschman Index (HHI). Therefore, to start with, the HHI is explained briefly. The HHI gives more weight to firms with high market shares than those with lower market shares. The HHI is calculated as the sum of the squared percentage market shares of all firms in the market, and ranges from almost zero (in the case of perfect competition) to 10 000 (in the case of monopoly). For example, in conditions approaching perfect competition, a million firms might each have a very small but positive market share of one-millionth of the market, or one ten-thousandth of a percent (0.0001 per cent). The HHI is then the

⁵ The Times Newspaper, 28 May 2013. *Private healthcare fights inquiry's rip-off claim*. Website page: <http://www.thetimes.co.uk/tto/business/industries/health/article3776390.ece>

sum of one million squared market shares of one ten-thousandth of a per cent:

$$\begin{aligned} \text{HHI} &= 1\,000\,000 \times (0.0001)^2 \\ &= 1\,000\,000 \times 0.00000001 \\ &= 0.01 \end{aligned}$$

At the other end of the scale, if there is a monopolist in the market, its market share is 100 per cent, and the square of 100 is 10 000, which is the maximum value that the HHI can take on.

In between these extremes, there are values of the HHI that are regarded by convention as signifying unconcentrated, moderately concentrated, and highly concentrated markets. The US Department of Justice (Antitrust Division) and the US Federal Trade Commission have jointly issued their revised horizontal merger guidelines⁶ that set these thresholds as follows, based on their experience in merger review:

Unconcentrated markets:	HHI below 1 500
Moderately concentrated markets:	1 500 < HHI < 2 500
Highly concentrated markets:	HHI above 2 500

2.2 The LOCI

The LOCI is related to the HHI and can be seen as one minus a weighted average market share. As such, the LOCI will take on values from zero to almost one, where a value of zero indicates a monopoly market structure, and a value approaching one indicates conditions of perfect competition.

With the HHI measure, a prior step is defining the extent of the geographic market, whether by means of drawing catchment areas as concentric circles around a hospital representing a certain number of kilometres that patients would be prepared to travel, or a certain time they would be prepared to spend travelling, or by means of drawing slightly more sophisticated isochrones, which are also centred on a hospital but are shaped to take some account of access roads to and from a hospital. Alternatively, the relevant geographic market might be determined more crudely, for example to include all hospitals in the province of KwaZulu-Natal.

⁶ US Department of Justice and the Federal Trade Commission, August 19 2010. *Horizontal Merger Guidelines*.

There are some problems associated with relying on these methods of determining the relevant geographic market or catchment area, and these have been set out by the UK Competition Commission in its report⁷ on the LOCI methodology:

- (a) Concentration measures based on catchment areas may not identify pockets of local market power that are located within subareas of the catchment areas;
- (b) Catchment areas for nearby firms can overlap, which can lead to measures of concentration that are counterintuitive or misleading;
- (c) Catchment areas are often based on a fixed and symmetric radius of distance or time travelled by the 80th percentile of customers, and this can misstate the true catchment area if the surrounding geography is not uniform (e.g. if large cities are located on one side of the catchment area);
- (d) Catchment areas may be sensitive to the chosen threshold – this is typically based on 80 per cent of patients, but can vary; and
- (e) Catchment areas may be sensitive to the chosen measure of distance – this is typically based on straight-line distance or time travelled, but can vary, particularly with regard to assumptions about travel time.

The LOCI measure by contrast, does not rely on a predetermined catchment area. Rather, the LOCI measure uses an average market share of a hospital group (share of patients, or revenue, etc) across all submarkets, where – depending on the availability of data – a submarket may be as narrow as a residential suburb or postal code, and where the average market share is weighted according to the importance of each submarket to a hospital group.

2.3 Calculation of the LOCI for a “focal” hospital

The LOCI is calculated using data on the number of patients who visited a particular hospital of interest (or “focal” hospital, in the terminology adopted by the UK Competition Commission) in a particular period of time (say, two years) or the revenue from each patient. The LOCI depends on data being available on each patient’s residential address, either a postal code (as used in the UK by the Competition Commission) or a suburb, which would be more likely in South Africa. These postal codes or suburbs would then form the submarkets within which hospital groups would have market shares. A two-year period rather than a one-year

⁷ UK Competition Commission, February 2013. Private Healthcare Market Investigation. Annotated Issues Statement. 28 February 2013. Appendix B. Annex 2: Measuring local concentration using a market-share-based measure. Paragraph 8. Website page: http://www.competition-commission.org.uk/assets/competitioncommission/docs/2012/private-healthcare-market-investigation/ais_app_b_toh_1_annex_2_loci_note_housestyled.pdf

period is preferable as it is likely to provide more data points in each suburb or postal code, which would increase the statistical significance of the results.

To explain table 1 we assume that of 1 250 patients from suburbs 1, 2 and 3 who visited hospitals in a period of time, a certain number from each suburb visited hospital A (third column) and so hospital A's market share of hospital patients from each suburb is shown in the fourth column – e.g. hospital A's market share of patients from suburb 1 is 350 patients who visited hospital A as a percentage of the 500 total patients from suburb 1 who visited all hospitals, or $(350 / 500) = 75\%$ (fourth column). The final column shows the number of patients from a suburb visiting hospital A as a percentage of all patients seen by hospital A – e.g. the number of patients from suburb 1 who visited hospital A (350) as a percentage of all patients that visited hospital A (800) was 43.75%. This final column represents the market share weighting for hospital A.

Table 1. Hypothetical example of the focal hospital LOCI

Submarket	Total Patients	Visiting Hospital A	Mkt Share A	Percentage of patients visiting Hospital A
Suburb 1	500	350	75%	43.75%
Suburb 2	400	350	87.5%	43.75%
Suburb 3	350	100	28.6%	12.50%
All suburbs	1 250	800	64%	100.00%

The next step is to calculate the LOCI, as the weighted market share of hospital A and this is equal to:

$$\begin{aligned}
 \text{LOCI} &= 1 - [(0.75 \times 0.4375) + (0.875 \times 0.4375) + (0.286 \times 0.125)] \\
 &= 1 - [0.328125 + 0.3828125 + 0.03575] \\
 &= 1 - [0.7466875] \\
 &= 0.2533125
 \end{aligned}$$

The answer of approximately 0.25 indicates a highly concentrated average market share for hospital A.

2.4 The LOCI for a hospital group

If the focal hospital, hospital A in our example, is part of a hospital network such as MediClinic, Netcare or Life Healthcare, then not all hospitals drawing patients from the same submarkets will necessarily be competitors. Therefore the focal hospital's LOCI might understate its true market power if there are other hospitals from the same network drawing patients from one or more of the same suburbs as the focal hospital. Therefore the LOCI measure for the focal hospital must be adjusted to account for the effect of patients visiting hospitals from the same group as the focal hospital.

Table 2 below shows two additional columns, one of which shows the total number of patients visiting all hospitals in the same network as hospital A, and the adjacent column shows the revised market share of the network that owns hospital A. Note the market shares of the network are all higher than the market shares for hospital A alone; and the total market share across all suburbs / submarkets has also risen, from 64% to 79%. Note however that the final column, showing the weighting for the revised resultant market shares, remains the same.

Table 2. Hypothetical example of hospital network LOCI

LOCI Submarket	Total Patients	Visiting A	Mkt Share A	Visiting network	Network mkt share	% patients visiting A
Suburb 1	500	350	75%	430	86%	43.75%
Suburb 2	400	350	87.5%	360	90%	43.75%
Suburb 3	350	100	28.6%	200	57%	12.50%
All suburbs	1 250	800	64%	990	79%	100.00%

The revised LOCI for hospital A, modified to reflect its ownership by a network of hospitals, is as follows:

$$\begin{aligned}
 \text{LOCI} &= 1 - [(0.86 \times 0.4375) + (0.90 \times 0.4375) + (0.57 \times 0.125)] \\
 &= 1 - [0.37625 + 0.39375 + 0.07125] \\
 &= 1 - [0.84125] \\
 &= 0.15875
 \end{aligned}$$

Clearly, the revised “network LOCI” is even smaller, at about 0.16, than the hospital LOCI of 0.25, indicating higher concentration and augmented market power for hospital A in suburbs 1, 2 and 3.

2.5 LOCI measures for the national private hospital sector

The extension of the hypothetical examples presented above is a matter of compiling data on patient visits from all relevant submarkets, and once this is done, the relevant geographic markets define themselves, for each hospital will have a LOCI measure that is one minus its weighted market share in all suburbs from which it draws any patients. Contrast this with the necessarily arbitrary assumptions one must make when guessing how far patients will travel to a hospital, or the maximum time they are prepared to spend travelling to a hospital.

The market shares for the LOCI calculation, as mentioned earlier, can be determined on the basis of a simple count of the number of inpatient visits, or on the basis of invoiced amounts, or “episode prices” (the UK Competition Commission term) charged for hospital services to inpatients.

2.6 Data considerations

In the UK, the use of outward postal codes is evidently a reliable way to pinpoint the geographical location of a household from which a patient would travel to visit a hospital. In South Africa however, postal codes are for larger areas that would not be very useful for LOCI calculations. There may however be suburb-level data that would be more useful, and these could be requested from the records of hospitals in order to calculate the LOCI for focal hospitals in the South African private hospital sector.

3. Conclusion

The Panel appointed by the Competition Commission to conduct its Healthcare Market Inquiry might well decide to request the requisite information in order to perform LOCI calculations, which would assist greatly in providing more exact measures of hospital market concentration that are not biased by arbitrary assumptions about the size of the relevant geographic markets.