Reviewer's report

Title: Using Data Envelopment Analysis to Measure the extent of Technical Efficiency of Public Health Centres in Ghana

Version: 2 Date: 10 October 2008

Reviewer: Dan Friesner

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Referee Report (2nd Round)

Using Data Envelopment Analysis to Measure the Extent of Technical Efficiency of Public Health Centers in Ghana

General Overview

The authors should be commended for their efforts. Their revised manuscript is much improved and, after a few additional issues are addressed, is suitable for publication in BMC International Health and Human Rights. Most notably, the contribution of the paper to the literature – which is of great importance - has been refined and clarified. The manuscript now tells an interesting and compelling story.

Major, Compulsory Revisions

1. I do not buy the authors’ response that the use of the term economies of scope is appropriately used here. The authors have no information on input prices, and thus cannot reasonably assume they are fixed. Moreover, the authors use the correct language (“efficiencies of scale”) when discussing their results (second paragraph in this section), so the language should be consistently used throughout the paper. Finally, your argument that readers are more comfortable with the incorrect term “economies of scale” is contradictory. Even if one isn’t familiar with DEA, the level of rigor in the VRS and CRS model sections is sufficiently complex that one must assume that if a reader can make sense of those sections, it can most certainly understand the concept of scale efficiency. The concept isn’t that hard to grasp. As such, please replace the language “economies of scale” with “efficiencies of scale”.

2. Please add in a few sentences about the statistical limitations of DEA. The limitations of DEA are more severe than just the small sample bias. You simply can’t do much secondary statistical analysis of DEA scores (see my previous reviewer comments). To a large extent, this will help you further justify how you present and discuss your empirical results. The fact that you can’t do much secondary statistical analyses with DEA scores implies that the way you present and discuss your results are, in fact, exceedingly appropriate. Keeping the analysis simple and straightforward is paramount in making good policy recommendations based on your findings.
3. A third issue is that there is yet another limitation of DEA which must be addressed when comparing and contrasting DEA to SFA – the curse of dimensionality. To reduce the small sample bias, you need a large sample size relative to the total number of inputs and outputs employed in the model. A sample size of 1,000 is a large sample, but even in that case, the bias in DEA scores will still exist if you use, say, 100 inputs and 100 outputs. In your case, you have less than 90 observations and 9 inputs/outputs total. The ratio of observations to variables is not that large to assume this issue is nonexistent.

4. The middle fifty percent of the second paragraph in the Discussion section is redundant, especially now that you have fixed the literature review section of the paper. Please eliminate sentences 4-6 and the first part of sentence 7 and give the citation [20-25] at the end of sentence three. Leave in the remainder of the paragraph starting with “According to the paper…” . Finally, there are two typos here. It should state “According to this paper, the sample of…”

5. In the fifth paragraph of the discussion section, the fourth sentence is incomplete; it is a sentence fragment. An easy way to fix this is to combine the third and fourth sentences. “Because increasing the level of outputs requires an increase in the demand for health care which is beyond the control of the health centre’s management, a merger of two centres in close geographic proximity is an option worth considering.

6. In the final paragraph of the discussion section, be more careful about how you tie your ideas together. Explain clearly how using studies like this can be used to draw attention to the “forgotten” health centres. Did you find that most centres claiming to be forgotten were, in fact, more efficient than others in the data? Were they less efficient?

7. You mention that you used a correlation analysis to help you choose inputs and outputs. Why would you do this, and how exactly did this correlation analysis influence your variable selection process? I think this is appropriate as long as you explain more clearly what you did. But at the same time if you don’t explain it more clearly, I can’t see why it would have helped, since you argue that one of the benefits of DEA is that it isn’t subject to multicollinearity issues. That would imply that correlation isn’t an issue at all for DEA, and thus the use of correlation-based techniques to guide variable selection would be a moot exercise.

8. In your methods section, you state an a priori belief that the inefficiency rate should be around 20 percent. Did this come from the literature review? If so it should be stated at the end of that section as well. The literature review cites a number of studies, each of which has very different inefficiency levels. So an expectation of 20 percent implies that Ghana’s health centres are more similar to those in certain studies than in others. That’s fine; you just need to be more clear when stating that, and explaining why that assumption or expectation is appropriate. I think you’re basing your expectation off of study [26], but you never explicitly mention that study was also conducted in Ghana. Please be a little more transparent in your writing to this end.

9. In your variable selection section, you note that the choice of inputs and
outputs was guided by the literature, but you never add a citation to this end. I suggest adding a citation (or more than one) to the second to the last sentence of this paragraph.

10. Several of your footnotes are sentence fragments, and do not have periods at the end of the sentence. Please make all footnotes complete sentences (and also take out the = sign in footnote 1). I believe there is also a comma in Table 1 (the row describing input 1) where there should be a period.

11. Once the authors have addressed all relevant comments, they need to have the paper edited (or proof-read) by an independent party whose native language is consistent with that of the Journal to remove the typos and fix other grammatical errors. There are quite a few of them, and I don’t think it is worth the time to list them all. I advocate using someone that is not an author because (from my own experience) it is difficult for an author to catch typos in his/her manuscript. After one has worked on and read a manuscript 20 or more times many authors tend to lose perspective and miss these kinds of things. In my opinion, this isn’t a big deal (every writer makes typos), but it does need to be taken care of prior to publication.

**Level of interest:** An article of importance in its field

**Quality of written English:** Needs some language corrections before being published

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare that I have no competing interests.