PROBLEMS IN ESTIMATING THE OPTIMAL-COST PRISON SIZE: A COMMENT

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Trumbell and Witte (p. 115) present an economic analysis that attempts to arrive at a specific figure for the optimal size prison in terms of the costs of prison operation and some of the other features of prisons commonly included in proposed standards for prison operation. The thrust of their findings is that the least expensive prison to operate is larger than small but smaller than gargantuan. Few people would challenge this finding, which is simply a reminder of the economies of scale and the diseconomies of excessive scale.

What is more problematic is their effort to arrive at a specific figure for the optimal size prison, which they report as a prison "which confines, on the average, 1371 inmates" (p. 129). The apparent precision of this figure may be a powerful signal to prison planners and lawmakers that new prisons should be designed to house about 1300 to 1500 inmates. It is clear that the authors expect such persons to be interested in their results ("we believe that our results will be of interest to prison administrators and other executive branch decision makers [p. 116]"). The point of this brief comment is to caution real-world decision makers about problems with the statistical basis of these conclusions.

There are two major problems with the analysis presented by Trumbull and Witte. First, their data were drawn from only six federal correctional institutions (FCI's). The six FCI's were not a random sample of all FCI's. Rather, the authors obtained data on 21 FCI's and proceeded to conduct a preliminary analysis to identify a subset "*which appeared to use broadly similar methods of operation*" (p. 122; emphasis added). Based on this preliminary analysis, they identified six FCI's "which appeared to use broadly similar methods of operation (p. 122)." In other words, the 15 FCI's *not* included in the analysis used significantly different methods of operation. It makes sense to assume that the relationship between cost and size would be

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influenced by the "method of operation." The specific figure (and the parameters that led to that figure) reported by the authors for cost-optimum size applies only to prisons that use a method of operation equivalent to that used by the six FCI's included in the statistical analysis. We are never told what that method of operation is. I doubt whether Trumbull and Witte could in fact describe the method of operation in a way that would meaningfully permit one to identify which prisons use it (other than the six in their sample); of course, one could simply repeat the preliminary analysis the authors carried out to originally identify the prisons to be included in their major analysis and compare the results to those of Trumbull and Witte. In any case, we know that Trumbull and Witte's major results probably apply to less than 30 percent of the federal correctional institutions, and it is likely that they would apply to even fewer state institutions. The authors hedge their findings by reporting difficulty in replicating their analysis using data from the California state prison system (". . . the disparate nature of California prisons . . ."). While the authors at that point say that their "results should be viewed as indicative only" (p. 135), the thrust of their discussion is built around the apparently precise figures they report. We have no way of knowing to what degree their results can be generalized beyond the six prisons. At the least, they should have repeated their analysis for all 21 FCI's, even though methods of operation varied among them; such an analysis would provide a better idea of the generalizability of the specific figures discussed in the paper.

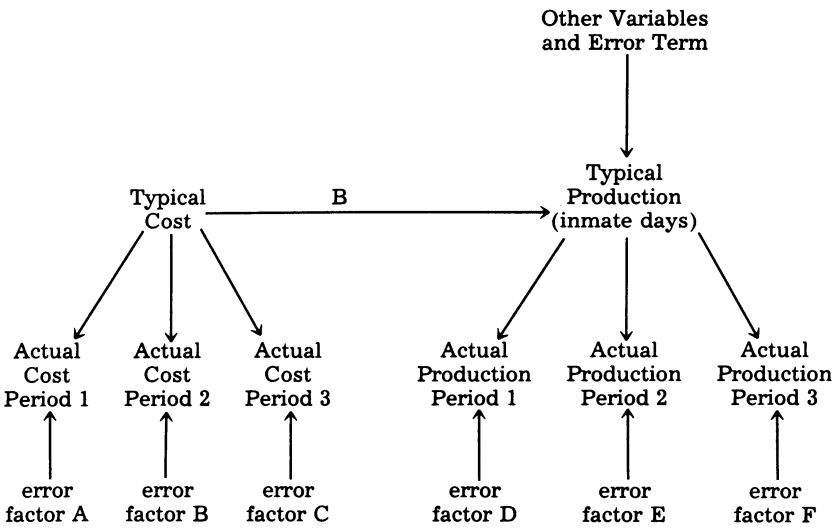
Even if the authors had looked at all 21 FCI's, there is a second data problem which raises questions about the validity of their findings regarding the six FCI's included in the analysis. Analysis of a data set that consisted of only six observations would be of limited use to policy makers. The authors, therefore, sought to stretch their data base by using a standard technique for pooling cross-sectional and time-series data (see Kmenta, 1971: 512-514). They took ten quarterly observations (i.e., they obtained all of the variables for each of ten three-month periods) for each of the six institutions; this yielded a total of 60 observations rather than just six. But what is the nature of the quarterly data? Do the variations among quarters for a given institution reflect "real" differences or just random fluctuations reflecting staff vacancies, food prices, utility costs, inmate population, and the like? The specific statistical technique the authors used is intended to correct for

the autoregressive effects frequently found in time-series data (since each set of ten quarterly observations is in fact a small time series), but is the relationship among the observations in each time series really autoregressive in nature? That is, should we really think of each set of quarterly observations as a time series?

I would answer this question in the negative. The nature of the variation, given the very short intervals involved, probably does not follow that of a classic time series. (It is not surprising that Trumbull and Witte should think of their data in this fashion, since economists customarily work with time-series data.) An alternate image of the data is more likely to reflect their true nature, given that the "parameters" of any given prison are fixed barring a major construction project or a major policy change (neither of which the authors suggest occurred during the period included in the analysis). Assuming constant dollars (i.e., correcting for inflation), we can posit that each institution is characterized by a "normal" or "typical" level of production (i.e., inmate days) and a "normal" or "typical" cost. These variables are in fact unmeasured; we instead observe the production level and cost for a particular period of time, or in this case, several periods of time.

The actual model of what we are seeing is shown in Figure 1; this figure suggests that each actual observation is a function of the unmeasured "typical" variables plus a unique error factor (or random fluctuation), and that the "true" underlying

Figure 1. A Measurement Model



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variables are related through the "structural parameter" B. Multiple indicator, unmeasured variable models such as this are commonly used by social scientists (see Joreskog and Sorbom, 1979) and do not present serious analytic difficulties. If one accepts the model of Figure 1 as an accurate reflection of the information Trumbull and Witte have, then one must conclude that they do not really have 60 observations. There are really only six observations, each with ten sets of measured indicators, and one should not try to draw the kinds of inferences the authors are making when there are only six data points.

In summary, Trumbull and Witte should be applauded for their efforts to bring an empirical analysis to bear on an important topic like prison size and cost. At the same time, other than the very general point regarding economies of scale, and diseconomies of excessive scale, their analysis really offers little, if any, guidance for policy planners and prison administrators. It is, in my judgment, no more than a suggestion of the type of analysis that needs to be done if we are going to understand the relationship between prison size and prison operation costs.

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