Comments on "Productivity Measurement in a Service Industry: Plant-Level Evidence from Gambling Establishments in the United Kingdom"

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June 26, 2004

Professors Paton, Siegel, and Vaughan-Williams take on a challenging task of measuring the productivity of a service sector. Furthermore, the conceptual issues are complicated by the uncertainty nature of the gambling business. The gambling industry, however, is gaining importance in the relative share of the service sector as a whole in countries like the U.K. and Canada. For example, per capita expenditure on gambling in Canada increases from \$130 in 1992 to \$447 in 2001 (Marshall, 2003). Therefore more accurate methods in measuring its output and productivity are desirable.

I once lived in Guildford, England for a year. But as a starving graduate student I did not have the luxury of exploring the gaming varieties there. The concise introduction to the U.K. gambling industry in Section III is really helpful. It echoes Baily and Zitzewitz's (2001, 452) insistence that 'the first step in correctly measuring the output of an industry is to understand that industry.'

1 Prices and Quantities

In measuring the output of a marketed good, in particular a commodity with homogeneous property in period t, we simply exploit the identity

$$\text{price } (p_t) \times \text{quantity } (q_t) = \text{observed value } (v_t). \quad (1)$$

For example, the price of light, sweet crude oil is \$37.45 per barrel on the New York Mercantile Exchange on June 25, 2004. Both p_t and q_t are well defined in Equation (1). With the observed value v_t, we only need either p_t or q_t to imply the other. In the service sector, however, both p_t and q_t are not easily defined. Moreover, for the gambling industry, the nature of the product itself is ambiguous.

The ambiguity in defining the product nature in the gambling industry arises from the different perspectives held by the consumers and the producers. All consumers who engage in gambling activities are by definition risk seeking agents. One way to estimate the output of gambling is to model directly the utility gain of the consumers.[1] On the other hand, the producers are either facing no risk at all, as in the case of government lottery; or being risk neutral, as in the case of a casino: the law of large numbers ensures that casino operators earn the expected profits.

Output measurement from the above two perspectives can yield very different results. Unlike the consumers, the lottery corporations do not care about who win the jackpots. They only care about sales volume and profit. In a way, we can view the consumers collectively pay the producers to redistribute their incomes based on some future uncertain events according to a certain set of rules. The probability

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[1] See Yu (2004) for this approach.

distribution of the random events can be objective as in lottery, or subjective as in horse racing. In fact, different rules, events, and probability distributions correspond to different product design. Consumers choose their favourite gambling activity based on their income, taste, degree of risk seeking, and the product prices.

The view that the producers are charging a fee for redistributing the gamblers' income implies that v_t in Equation (1) is simply the gross profit, or turnover, as defined by the authors. To get the quantity or real output q_t, we need to infer the price of each gaming product. Instead of using the consumer price index, my suggestion for p_t is the retention ratio, which is one minus the payout ratio r_t. The payout ratio is defined as the portion of the wager returned to the winners as prize money. For example, r_t ranges from 0.45 for Lotto 6/49 in Canada to 0.95 for some slot machines in Las Vegas. The low price ($p_t = 1 - r_t = 0.05$) charged by the latter is because of the local fierce competition, whereas the Canadian Interprovincial Lottery Corporation is effectively a monopoly.

Recall that a rational consumer allocates her spending to equalize the marginal utility of the last dollar (or pound) spent on each gaming activity. This implies that the marginal utility is proportional to the price, with the common factor of proportionality being the marginal utility of money. If we normalize the unit of consumption of each gaming product to one dollar (pound), then p_t becomes a dimensionless unit (dollar per dollar). Intuitively, p_t is the price charged by a producer to redistribute each dollar between the consumers. An important consequence of defining prices and quantities as above is that the tax reduction in 2001 can be simply translated into a price decrease, which triggered the increase in quantity demanded.

Once the prices and hence the quantities of all the different types of gaming activity are obtained, an aggregate output index can be calculated. Unfortunately the ARD data set used by the authors contains only firm level turnovers and payout ratios, but not those based on different products. It is nevertheless interesting to calculate firm level prices and quantities using this approach.

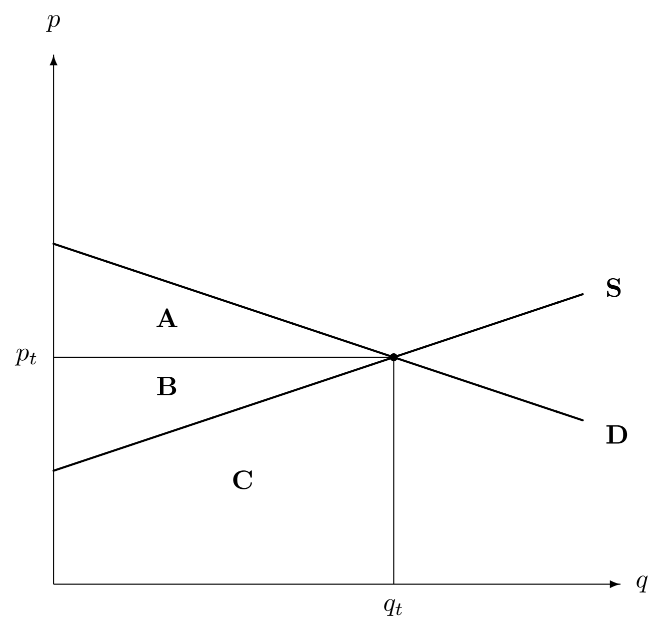

Figure 1: Welfare, market value, and total cost

Figure 1 depicts the partial equilibrium of the market for a particular gaming product. The consumer approach taken by Yu (2004) is a measurement of total consumer welfare, which is Area $A + B + C$ in the diagram. The producer approach suggested here includes $B + C$. The present cost approach in measuring lottery output by Statistics Canada measure Area C only.

2 Econometric Model and Data Problems

I am not familiar with the stochastic frontier analysis model but from what is described in the paper it is a very interesting method to compute productivity. I do have a few questions which may be interesting for the sake of discussion.

First, the variable COMP_i in Equation (7) of the paper may be a part of the capital stock K_{it} in Equation (5). If this is so, then there is a potential problem that U_{it} and K_{it} are correlated. Moreover, COMP_i

and TELEPHONE$_i$ in (7) may also be correlated. The multi-collinearity can influence the accuracy of the estimated coefficients.

Second, productions in the gambling sector are characterized by high fixed cost and low marginal cost. This implies that the production function should exhibit increasing return to scale. The estimated coefficients for the share variable S_{it}, however, are missing in Table 8.

Third, the capital stock reported by the firms in the survey may be the accounting values for tax purposes. These values may not coincide with the economic interpretation of capital.

Finally, it may be interesting to compare the SFA results with a traditional productivity index (Caves, Christensen, and Diewert, 1982). This is because the underlying distance function of the Malmquist input indices is the translog functional form, which is more flexible than the Cobb-Douglas function used in the SFA. Of course in order to calculate the input indices, we need the inferred prices of capital and materials.

3 Other Comments

The following is a list of minor comments on the paper:

- The variable m_t under Equation (1) is undefined. In Chinloy (1980) m_t is defined as $\sum_{i=1}^{I} h_{it}$.
- I could not derive Equation (2) from (1). It seems to me that the expression in the middle bracket should be $\log h_{it} - \log h_{i,t-1}$.
- On page 10, it is unclear what AWP and SWP mean. Also, delete 'Section 3.4 concludes.' at the end of the paragraph.
- On page 11, 'Table 2 provides a more detailed demographic breakdown of home/work/place of study Internet users.' I could not find any Internet data in Table 2.
- The word 'university' under Equation (3) should read 'firm' or 'product'.
- The distribution of the random variable μ_i in Equation (7) is not specified.

4 References

Baily, Martin Neil and Eric Zitzewitz (2001) 'Service Sector Productivity Comparisons: Lessons for Measurement,' in Charles R. Hulten, Edwin R. Dean, and Michael J. Harper, eds., *New Developments in Productivity Analysis*, The University of Chicago Press, 419-464.

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