Volume Working Title: Price Index Concepts and Measurement

Volume Editor / Conference Organizer: Erwin Diewert, John Greenlees and Charles Hulten, editors

Volume Publisher: University of Chicago Press

Volume URL: http://www.nber.org/books/diew08-1

Conference Date: June 28-29, 2004

Title: Comment on "Measuring the Output and Prices of the Lottery Sector: An Application of Implicit Expected Utility Theory"

Author: Alan G. White

Date Received: December 31, 1969

URL: http://www.nber.org/chapters/c5087

OVERVIEW: METHODS, DATA, AND RESULTS

In his paper "Measuring the Output and Prices of the Lottery Sector: An Application of Implicit Expected Utility Theory," Yu presents an economic approach to measuring the output and prices of a hard-to-measure sector – that of the lottery sector. Yu applies implicit expected utility theory by developing a money metric of utility of playing the Canadian 6/49 Lottery game.

Yu argues that the lottery is becoming an increasingly important component of GDP in Canada. He notes that according to the 1997 Survey of Household Spending (SHS), over two-thirds of families in Canada purchased lottery tickets and that average expenditure on lottery tickets was approximately $238. Given that expenditure on gambling is likely underreported in the SHS, the lottery industry may be a more important and significant component of GDP than currently measured, necessitating a more accurate method for measuring its output.

In the theory of consumption under uncertainty, a risk-averse consumer maximizes an expected utility function, in which risk averseness is often assumed to be decreasing in wealth. Although this theory has been applied to problems in insurance and investment decisions, it predicts that a risk-averse expected utility maximizer would never purchase a lottery ticket unless the payout is extremely large. This, however, is not consistent with reality where the purchase of lottery tickets and gambling among consumers is common place. Yu notes that "in order to model a small gamble like the Lotto 6/49, we need a preference structure more flexible than the EUH [Expected Utility Hypothesis]."

Yu notes that under non-expected utility theory, first order risk aversion implies that the risk premium of a small gamble is proportional to the standard deviation of the gamble, whereas under standard expected utility theory the risk premium is proportional to the variance of the gamble. In the case of N=2 (i.e., a world with two possible outcomes) the non-expected utility theory allows for kinks around the 45 degree certainty line. I would like Yu to give a little more intuition to the reader (in section 2.2) on what non-expected

utility theory is and give an explanation of the distinction between the risk premium being proportional to the standard deviation/variance of the gamble so it is easier to better understand differences between expected and non-expected utility theories. This might be aided by a clearer description of such things as the independence axiom and recursivity axiom that Yu refers to in the paper but does not fully explain.

In the non-expected utility theory as applied in this paper, the output of the lottery sector is defined as the difference in utility levels between a situation involving gambling and one not involving gambling, once the optimal wager has been solved for from the first order conditions for the utility maximization problem. Yu extends the two-outcome model developed by Diewert (1993) to model a six-outcome result for the Lotto 6/49.

Yu uses data on winning numbers, payouts, and sales volume provided by Lottery Canada for November 1997 through November 2001, covering a total of 419 draws. Yu combines this with Statistics Canada data on the CPI and annual data on the number of households, personal disposable income, and participation rates in government lotteries. He uses these data to calculate the average wager per household and the average personal disposable income per household.

Yu notes that sales of Lotto 6/49 have declined over the period he examines, perhaps because of a shift to Video Lottery Terminals (VLTs) and casinos. Yu does not account for these in this paper, and it would be interesting for Yu to speculate on the potential methods of measuring the output of these two other components, and how (if at all) Statistics Canada is currently measuring them. He notes that approximately 13.3 percent of the sales revenue for Lotto 6/49 is used for administrative and retailing costs and it is this number that is used by Statistics Canada as the output of this lottery.

The first order condition for the optimal wager is estimated using maximum likelihood methods. The final results show that the average monthly output using the economic approach is $57.7 million, compared to the official total factor cost approach which is $19.4 million.

FUTURE RESEARCH/SPECIFIC COMMENTS

1. Yu compares the lottery output under both the economic approach and that used by Statistics Canada. It is clear that the statistical agency method understates the true output of the lottery sector as measured by the non-expected utility approach. What is somewhat surprising is the differences in trends between the two different methods. Specifically, the economic approach yields a sharper downward trend than that of the method used by Statistics Canada. I would like to see some speculation or explanation for the possible divergence between the two trends. Was there a change in administrative costs of the lottery during this period that could have caused this?
2. Given that Statistics Canada uses the administrative costs for its estimate of output, is it appropriate to use some variation of sales to measure output? It might not be practical for Statistics Canada to estimate a function of the type proposed in the paper and I would like to see a discussion of alternative measures that might be more feasible and how they might compare with the results presented in this paper.
3. I would like to see a very brief discussion of how lotteries and gambling etc., are handled by other statistical agencies (if at all). For example, how does the approach adopted by Statistics Canada compare with that of the Bureau of Labor Statistics or Statistics Netherlands?
4. Yu has not addressed VLTs or casinos in this paper – at least as they relate to the measurement of output. How does Statistics Canada handle these and what does Yu think the likely implications are for measuring these particular items?
5. Although Yu computes an implicit price index for the Lotto 6/49, I would like to see some intuition for how to interpret it. Should it be properly viewed as a cost-of-living subindex for those families who play the Lottery 6/49 or is there some other interpretation? How does one would interpret the price elasticity of demand? Does the price index or elasticity have any implications for the pricing of lottery tickets?

REFERENCES

Diewert, W. E. (1993), "Symmetric Means and Choice under Uncertainty," in W. E. Diewert and A. O. Nakamura, eds., *Essays in Index Number Theory*, Vol. 1, Amsterdam: North-Holland, 355-433.