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Reprise and Clarification

S.J. Kamath, K.C. Jensen and R.E. Bennett*

We find Professor Benzing's comment on our application of the Bennett Test to the money-in-the-production-function debate contained in our 1987 paper in this journal a commendable one since it applies the test to a new and improved data set over the 1959-85 period. As discussed in our paper in this journal and our 1988 I.E.J. paper, the Bennett Test represents a logical and more rigorous extension of existing econometric test procedures and its application in a variety of contexts is likely to help in the process of attempting to empirically falsify economic hypotheses.

A few points need to be addressed with regard to Professor Benzing's update, however. These points pertain to both substantive methodological issues not discussed in detail in our original 1987 paper in this journal as well as with regard to the interpretation of the results in the preceding update.

The first point pertains to the fundamental methodological issue underlying the logic of the alternative test procedute proposed in our 1987 paper. Conventional econometric tests of economic theories of the type used by Sinai and Stokes in their seminal 1972 paper are fundamentally inadequate because they are cast in a "confirmationist" mold and suffer from all the logical problems associated with "logical positivism" and the underlying Problem of Induction.[1] This bedevils the enterprise of empirically testing economic theories in a number of significant ways.

The problem is as follows. Due to the existence of the Problem of Induction, whereby there is no general method of providing an inductive proof of the truth of any general statement (theory) on the basis of positive evidence, "confirmations" of economic theories provided by econometric tests cannot be used to argue for the truth of the theory (in this case the original SS hypothesis). The Neyman-Pearson framework of hypothesis testing attempts to circumvent this problem by using empirical data to reject ('falsify') the null hypothesis and thus provide provisional support for the alternative hypothesis. Besides the well-known problems associated with using this framework (see Bakan 1961, Cooley and Leroy 1981, Leamer 1983, Mayer 1980, McCloskey 1985 and Swamy et. al. 1985), a major problem is that of the Ambiguity of Refutations and difficulties raised by the Duhem-Quine Thesis.[2] Since the test of any economic theory involves three levels of assumptions as discussed in our original JKB paper, those of the "core" behavioral assumptions, the "simplifying" assumptions and the "procedural" specifications of a theory being tested respectively, evidence in favor of the null hypothesis cannot be interpreted as evidence in favor of the rejection of the maintained hypothesis since the failure to "confirm" may be due to any one of the assumptions at the other two levels being false rather than at the "core" theory level.[3] Since all tests of economic theories are tests of joint hypotheses at the three distinct levels identified, it is not possible to ascertain conclusively the falsity of a behavioral hypothesis. This is the Duhem-Quine Problem. The Problem of the Ambiguity of Refutations arises because in order to falsify a behavioral hypothesis at Part (A) (see JKB, 1987), all possible assumptions at Part (B) and (C) need to be falsified, clearly an impossible task since there are an infinity of such assumptions.

We proposed the Bennett Test as a more rigorous test procedure to attenuate (but not solve) the problems with conventional test procedures. By proposing that counterexamples for a maintained theory be developed and tested using identical assumptions at Part (B) and (C) using identical data, we hoped to provide a procedure that would put the maintained behavioral hypothesis "at stake," since confirmation of the theory as well as its counterexample would provide logical grounds for "rejecting" the maintained hypothesis since the effects of Parts (B) and (C) would be immunized by such a procedure and the logical problems associated with econometric tests would be partially circumvented.

Consequently, our adoption of the "GOOD FIT: BAD FIT" terminology of conventional econometr-

*Dept. of Economics, California State University, Hayward; Dept. of Management Science, National University, San Diego; and Govt. of British Columbia, Victoria, B.C., Canada.

ric testing was predicated on the econometrician's interest in obtaining 'good' parameter estimates where 'good' was not defined purely in terms of R^2. While Professor Benzing's footnote 1 is essentially correct in principle, correct use of the Bennett Test implies that the *very same* procedural criteria (e.g. $R^2 \geq .90$, t-values ≥ 2 etc.) and simplifying assumptions (e.g. Cobb-Douglas functional firm, exclusion (or inclusion) of time-trend variable T etc.) be used in applying the test. Professor Benzing therefore is remiss in Section III (p. 5) when she appears to argue for the sustainability of the SS Hypothesis as compared to the JKB Unrestricted Counterexample by comparing R^2, especially in the light of her own footnote 1.[4]

With regard to the second issue regarding the inclusion/exclusion of the time-trend variable T and of considerations of multicollinearity in the estimates of SS and JKB, while the search for better procedures at the level of Part (C) is laudable, this issue is essentially irrelevant from the point of view of the argument of the JKB paper. Since SS had not tested for multicollinearily and the time-trend variable included in their regressions claimed to account for the success of the SS Hypothesis, proper application of the Bennett Test required that the JKB counterexamples be tested *with* the time-trend variable in order to isolate the truth-staus of the "core" hypothesis at Part (A) and immunize the assumptions at Part (B) and (C). Extensions of the Bennett Test to include tests for multicollinearity at the Part (C) level may indeed be informative and econometrically laudable but not in the context of the original SS paper.[5]

Finally, the results reported in Professor Benzing's paper would seem to raise *more* doubt regarding the tenability of the SS hypothesis. We agree that the fact that money enters the Cobb-Douglas production function with a significant *negative* coefficient as pointed out by the author would seem to raise grave doubts about including money in the neoclassical aggregate production function.

In conclusion, it may be pointed out that the Bennett Test Procedure provides a means of attenuating the 'advocacy bias' underlying econometric tests of theories identified by many theoretical econometricians and practioners (see especially Cooley and Leroy 1981, Feige 1975, Hendry 1980 and Leamer 1983). Its application in the context of the SS hypothesis points towards its usefulness in raising questions regarding the inclusion of real money balances in the aggregate production function as the preceding update by Professor Benzing demonstrates.

FOOTNOTES

1. See Boland (1982) and Caldwell (1982) for discussions of the features and limitations of logical positivism. Boland (1977, 1982), Jensen and Kamath (1987) and Swamy et. al. (1985) contain careful critiques of conventional econometric testing using the Neyman-Pearson framework.
2. See Boland (1977, 1982) and Roll for a discussion. The Duhem-Quine, Problem arises from the 'modus rollens' mode of argument used in Aristotelian logic whereby the falsity of one of the conclusions of a theory implies that *one* of the assumptions of the theory is false, without it being possible to identify *which specific* assumption is false. For a discussion of the implications of the Duhem-Quine Problem for economic theories see Cross (1982).
3. See Jensen and Kamath (1987) and Roll (1977).
4. The comparison of R^2 when the dependent variable is not the same is problematic as discussed by Kennedy (1985, p. 27, 85) and Mayer (1975). As Kennedy points out, the measure of R^2 is not of much importance in econometrics even though practioners act as if it is important.
5. We did discuss the issue of multicollinearity in our 1988 paper but did not pursue the issue in the context of the original SS hypothesis because of the nature of the Bennett Test Procedure. With regard to the estimation of Cobb-Douglas production functions, it is important to note that it is conventional to ignore multicollinearity. As Kennedy (1985, p. 150) notes:

> "The existence of multicollinearity in a data set does not necessarily mean that the coefficient estimates in which the researcher is interested have unacceptable high variances. The classic example of this is the estimation of the Cobb-Douglas production function: the inputs capital and labor are highly collinear, but none the less good estimates are obtained."

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