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Insufficient Econometric Evidence - Comments on the Mackinac Study – "An Analysis of State-Funded Tourism Promotion"

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This note focuses on econometric aspects of the study in as much as they impact on the validity of the policy prescriptions inferred from the study. Based on close reading of the whole document, this note concludes that the Mackinac study does not provide enough treatment of the substantive and econometric complications of the system it seeks to model. Consequently, the econometric evidence in the study is inadequate for policy formulation.

The main objective of the Mackinac study is to measure the impact of state-funded tourism promotion on state incomes and employment in three sectors of interest: accommodations, amusement and recreation, and entertainment. Specifically, the study uses the following dynamic panel data model:

$$\delta(L)\, Y_{it} = \alpha + \alpha_i + \beta_1 X_{it} + \beta_2 X^2_{it} + \rho_1 [WX_{jt}] + \rho_2 [WX^2_{jt}] + \theta [WY_{it}] + \lambda \text{ Trend} + e_{it}$$

where

Y_{it} = gross state product, at time t, state i; in three sectors treated separately: accommodations, amusement and recreation, and arts and entertainment

X_{it} = state-funded tourism promotion spending, in real terms, at time t and state i

α_i = fixed effects for state i

W = spatial weight matrix, first order contiguity matrix of states

Trend = time trend, to account specially for changes in household consumption pattern over the sample period

$\delta(L)$ = polynomial lag operator.

Thus, attention focuses on the estimates of the parameters (β_1, β_2, ρ_1, ρ_2) and statistical tests of significance about them. (In general, a statistical test of a hypothesis is a procedure that determines whether an observed deviation from the hypothesis is due to chance or "statistically significant" enough to warrant rejection of the hypothesis.)

The analysis undertaken in the Mackinac study suffers from the following statistical inadequacies:

1. Omission of other important factors that affect the dependent variables,
2. Failure to adequately correct for the fact that state-funded tourism promotion is actually affected by state sector product or income,
3. Failure to account for potential changes in model parameter values over time – e.g., due to policy shocks at the state or federal level,
4. Possible nonstationarity and more complicated serial correlation patterns in the random disturbances in the model,
5. Data limitations due to the range of the magnitude of state expenditures on tourism promotion (relative to income) that is covered in the study.

For the most part, statistical tests of significance could have been performed to flag down these inadequacies, but little is done in the study along these lines, except for the partial effort regarding item 2 above.

Regarding item #1, there are many other factors that affect gross state product (Y) in the three sectors under study – e.g., policy changes at the state or federal level, external events, economic cycle, etc.. If such factors vary over time or across states and are correlated with X, it is well known in econometric literature that their exclusion from the model would introduce statistical bias in the coefficient estimates and invalidate the standard significance tests about parameter coefficients. (Note: An estimating procedure is said to be biased if, on average, it produces estimates that are off the mark, different from the true unknown parameter value.) The direction and magnitude of bias cannot be anticipated a priori, except in special cases. But tests can be applied to ascertain the statistical significance of this bias. Unfortunately, no such tests are reported in the study.

Item #2 refers to the so-called "endogeneity" of X in the model, which is another complication that will introduce bias in coefficient estimates. The authors discuss this issue in p 14 of the study, writing initially, "This is not likely a large concern given that every state in our sample has, at some time, engaged in tourism spending." A hypothesis of this type should be supported with statistical tests but none is provided in the study. The authors offer a solution and suggest that "natural features in each state may influence support for state-funded tourism-related development." They then regress X on elevation span (distance between tallest and lowest geographic point in each state) to calculate "adjusted values" for X, which are then used to obtain what I would interpret as a two-stage least squares estimate of the model – (See p. 14 of the study). As the term connotes, the two-stage least squares estimate of the model is obtained in two steps. First regress X on the "first-stage regressor" – in this case, on elevation span, and get the calculated values of X from this regression. In the second step, replace X with the calculated values to estimate the model. The numerical results with the estimated coefficients and tests of their significance are in Graphics 3, 4, and 5 on pp16-19. These include the adjusted estimates accounting for endogeneity of X but it is not clear that elevation span is an adequate "instrument" for X. Suitable tests should have been applied to check this.

The authors point out that one chief concern pertinent to their study is the choice of using fixed effects or random effects (p.14). They should have followed this up with statistical tests that would point to which choice is supported by the data. Another set of tests would be quite useful towards establishing the time dynamics in the model. For example, it was mentioned in the paper that the order of own lag for Y was determined with the Akaike Information Criterion (AIC) but this is not included in Graphics 3-5. It was also mentioned that there are no common unit roots in the system, without presenting any test results to support the claim. Ideally, there also should be a battery of tests for nonstationarity, causality, and serial correlation patterns.

Finally, we also note that the magnitude of state expenditures on tourism promotion, relative to state income may not be large enough or not have covered enough range to allow a more definitive measure of effects on state income. The modeling approach adopted in the Mackinac study is particularly vulnerable to this as lack of variability in the explanatory variable introduces higher variability in

coefficient estimates. And the range being not too far from the origin may even mask the correct direction of the relationship between state expenditures on tourism promotion and state income.

Given all these mitigating factors: bias from omitted variables, endogeneity bias, structural breaks over time, more complicated time dynamics in the model disturbances, and data limitations - alternative methods, such as Input-Output based methods for calculating returns on investment, should be considered. Another viable approach is survey-based research on advertising awareness and effectiveness in influencing actual travel behavior.

About the Author

Roberto S. Mariano received his PhD in Statistics from Stanford University and has been with the faculty of the University of Pennsylvania since 1971. He is currently Professor Emeritus of Economics at the University of Pennsylvania and Professor Emeritus of Economics at Singapore Management University. At Singapore Management University from 2002-2010, he was Founding Dean of the School of Economics, Vice Provost for Research, and Founding Director of the Sim Kee Boon Institute for Financial Economics. He is an elected Fellow of the Econometric Society and has served on the Executive Council of the Econometric Society, representing Southeast and South Asia.

He has published extensively on econometric methodology in academic journals in economics and statistics, including Econometrica, Econometric Theory, Journal of Econometrics, Journal of the American Statistical Association, and Journal of Business and Economic Statistics. He has been a consultant to multinational institutions, central banks, government agencies, and private companies in Asia and the United States with a focus on econometric methodology for forecasting and policy analysis.

His current research interests include statistical tests for multiple forecast comparison, high-mixed-frequency forecasting, and estimating the output gap for inflation forecasting in the Philippines.