Department of Economics
UNIVERSITY OF CANTERBURY
CHRISTCHURCH, NEW ZEALAND

PROVISIONAL DATA AND UNBIASED PREDICTION OF ECONOMIC TIME SERIES

By Karen Browning and David Giles

Discussion Paper

No. 8902

Department of Economics, University of Canterbury
Christchurch, New Zealand

Discussion Paper No. 8902

March 1989

PROVISIONAL DATA AND UNBIASED PREDICTION OF ECONOMIC TIME SERIES*

By Karen Browning and David Giles

---

* This paper is circulated for discussion and comments. It should not be quoted without the prior approval of the author.

I. INTRODUCTION

Provisional economic time-series data are important in policy-making, and their quality is of considerable interest. This note views preliminary data as predictors of their final counterparts, and considers the hypothesis of unbiased prediction. This hypothesis is tested in a simple regression framework and is illustrated with New Zealand Balance of Payments (B.O.P.) data.

This analysis is in the spirit of the recent resurgence of interest in the quality of preliminary economic data and the implications for policy-makers (e.g., Maravell and Pierce (1983), Mork (1987) and Milbourne and Smith (1988)). Related studies (e.g., Zarnowtiz (1985), Nordhaus (1987)) have analysed the quality of genuine economic forecasts. The method adopted here is based on regressions of the form

$$y_{ft} = \alpha_i + \beta_i y_{it} + u_{it} \quad , \qquad (1)$$

where y_{ft} is the "final" value for the t'th observation on y;

y_{it} is the i'th revised value for the t'th observation on y;

and $E(u_{it}) = 0; \quad i = 0,1,2,...; \quad t = 1,2,...,T.$

For any sample of preliminary and final data we can test the hypothesis that $\alpha_i = 0$ and $\beta_i = 1$. If this hypothesis is true then $E(y_{ft}) = y_{it}$ and the i'th revision of the data is an unbiased predictor of the final series for y. This analysis is common in the futures/financial markets literature (e.g., Leuthold (1974), Giles and Goss (1981)), but appears not to have been applied explicitly in the present context.

II. DATA

New Zealand B.O.P. data are subject to several quarterly revisions. We consider separate time-series for the values of exports (E), imports (I) and balance on merchandise trade (B). Each series is published quarterly, with a one-quarter delay, by the New Zealand Department of Statistics. In addition to a provisional value for the previous quarter, "revised"[1] values for the four quarters prior to that are published simultaneously. So, for example, Table 19 of the December 1986 issue of the Monthly Abstract of Statistics lists an initial release of B for 1986Q3, as well as revised values for 1985Q3 - 1986Q2.

Over time, five figures are published for each quarterly observation on E, I and B. We take the fourth revision to be the final value for the series. So, for each of E, I and B, five separate time-series can be constructed. For example, $\{B_{ft}\}$ and $\{B_{ot}\}$ comprise "final" (fourth revision) figures and initial releases, while $\{B_{it}\}$ (i = 1,2,3) comprise data relating to the i'th intermediate revisions of B over time.

Our data span the period[2] 1977Q1 - 1986Q3.

III. ESTIMATION AND TESTING

Ordinary least squares (OLS) estimation of (1) yields consistent estimates of α_i and β_i if y_{it} is uncorrelated with u_{it}. If the u_{it} are serially independent these estimates are best linear unbiased, and the unbiasedness hypothesis of interest can be tested legitimately with separate t-tests or a joint F-test. Given the nature of y_{it} here, its exogeneity is questionable, so we apply the Hausman (1978) test before proceeding further. The test is implemented by computing both OLS and instrumental variables (IV) estimates.[3] For the latter, $y_{(i-1)t}$ is used as an instrument for $y_{it}(i = 1,2,3)$ and y_{ot} is its own instrument (so OLS and IV coincide in this last case). For our problem, based on equation (1), the Hausman test statistics are asymptotically $\chi^2_{(2)}$ under the null hypothesis that y_{it} is uncorrelated with u_{it}. Of the twelve such statistics computed the largest had a value of 5.28 and all others were less than unity, so the null hypothesis cannot be rejected at the 5% level. IV estimation is unnecessary in this case.[4]

Bearing in mind that X, I and B are closely related, it is natural to consider estimating <u>systems</u> of three equations, each equation being of the form (1), with y = X,I,B. Four such "seemingly unrelated regressions" (SUR) systems can be estimated, these corresponding to i = 0,1,2,3. The incentive for estimating SUR systems, rather than single equations, is a gain in estimation efficiency if the contemporaneous error covariance matrix is non-diagonal.[5] The diagonality of this matrix can be tested via the likelihood ratio test statistic, LRT = $T\,\ell n.\ (|\tilde{\Omega}_o|/|\tilde{\Omega}|)$, where T is the sample size; $|\tilde{\Omega}_o|$ is the determinant of the maximum likelihood estimator (MLE) of the error covariance matrix under the null hypothesis of diagonality; and $|\tilde{\Omega}|$ is its unconstrained counterpart.[6] Here, LRT is aysmptotically $\chi^2_{(3)}$ under the null hypothesis.

IV. RESULTS

The LRT results appear in Table 1, together with further Hausman test results, now applied in the context of joint systems estimation[7] as a cross-check on the results reported earlier. In this case the Hausman test statistic (H) is asymptotically $\chi^2_{(6)}$. In Table 1 we see that the null hypothesis is rejected in the first row but accepted in the second. Accordingly, the appropriate framework for testing the unbiasedness of our preliminary data is a three-equation SUR model (with equations of the form (1) to explain X, I and B), estimated jointly on the assumption that the regressors are uncorrelated with the disturbances.

The MLE results appear in Table 2. The "asymptotic t-values" below the coefficient estimates relate to the hypothesis $\alpha_i = 0$ and $\beta_i = 1$ respectively. These hypotheses cannot be rejected individually at any reasonable significance level. The same is true when they are tested jointly using the Wald test (W). The serial independence of the errors in the SUR model is considered informally with the Durbin-Watson (DW) test. This test is only approximate in SUR models, so an alternative asymptotic test is reported. Each SUR system was re-estimated with an allowance for AR(1) errors in each equation, and "asymptotic t-tests" (Z) were applied to test that each autocorrelation coefficient is zero. The results strongly support the serial independence hypothesis, which is necessary if our unbiasedness tests are to be legitimate. Finally, the R^2 values in Table 2 increase monotonically with the number of revisions, for each data series. The degrees of freedom are constant, so this decrease in the residual variance reflects the increasing efficiency with which the unbiased preliminary data predict the final series.

V. CONCLUSIONS

This paper suggests a simple method of assessing one aspect of the quality of preliminary economic time-series data. Whether such data are unbiased predictors of the final official figures can be tested formally in a regression framework. We have illustrated this with provisional New Zealand balance of payments data.

Our results indicate that, for the data set considered, the provisional figures (and their various revisions) are reliable predictors of the final data. The hypothesis of unbiased prediction is strongly supported. Of course, other data must be examined on their merits. Further, for any series of interest, the results may be sensitive to the choice of sample period - the quality of data gathering and reporting may vary over time. In our case, we have replicated the study over two sub-samples by splitting the data-set at 1981Q4. Broadly, the results obtained still favour the unbiased prediction hypothesis, especially in the latter sub-sample, though the outcomes of some of the intermediate tests are rather mixed. This is not surprising, given that they have only asymptotic justification, and our full sample comprises only 39 observations.

Preliminary releases of New Zealand B.O.P. data are used by policy-makers for a variety of purposes. The timeliness of their availability, coupled with the results of this study, suggest that they form a useful and reliable set of information.

January, 1989

TABLE 1. - SPECIFICATION TEST RESULTS

	Revision of Data (i)			
	0	1	2	3
LRT($\chi^2_{(3)}$)	30.9	22.0	19.3	146.1
H ($\chi^2_{(6)}$)	-	3.3	0.8	0.8

Notes: The Hausman test is redundant when i = 0. 5% critical values for χ^2 with 3 and 6 degrees of freedom are 7.82 and 12.59.

TABLE 2. - SUR ESTIMATION RESULTS

y_f	y_i	$\hat{\alpha}_i$	$\hat{\beta}_i$	W($\chi^2_{(2)}$)	DW (Z)	R^2
X	X_0	5.561	0.994	0.241	2.062	0.998
		(0.45)	(-0.60)		(0.00)	
I	I_0	16.045	1.009	0.062	2.031	0.955
		(0.59)	(1.29)		(-0.05)	
B	B_0	-15.011	1.009	3.998	1.439	0.950
		(-1.64)	(0.17)		(1.11)	
X	X_1	13.244	0.991	2.421	1.617	0.999
		(1.71)	(-1.46)		(0.66)	
I	I_1	24.677	1.001	0.150	2.036	0.956
		(0.95)	(0.18)		(-0.58)	
B	B_1	-9.318	0.984	2.106	1.898	0.964
		(-1.37)	(-0.41)		(0.16)	
X	X_2	7.574	0.994	0.864	2.151	0.999
		(1.056)	(-0.99)		(-1.54)	
I	I_2	22.254	1.002	0.122	2.036	0.956
		(0.86)	(0.31)		(-0.56)	
B	B_2	-4.590	1.001	0.609	2.452	0.970
		(-0.73)	(0.02)		(-1.89)	
X	X_3	-4.474	1.000	1.456	2.047	0.999
		(-0.67)	(0.04)		(-0.03)	
I	I_3	19.565	1.003	0.094	2.038	0.956
		(0.76)	(0.56)		(-0.94)	
B	B_3	-3.808	1.000	1.456	2.048	0.992
		(-0.87)	(0.00)		(-0.04)	

Notes: Figures in parentheses are "asymptotic t-values", and are Standard Normally distributed. White's (1980) heteroskedasticity - consistent estimator of the asymptotic covariance matrix is used to calculate all standard errors and "t-values". 5% critical value for χ^2 with 2 degrees of freedom is 5.99.

REFERENCES

Giles D.E.A., and B.A. Goss, "Futures Prices as Forecasts of Commodity Spot Prices: Live Cattle and Wool", Australian Journal of Agricultural Economics 25 (1981), 1-13.

Hall, B.H., R. Schnake and C. Cummins, Time Series Processor Version 4.1 User's Manual (Stanford: TSP International, 1988).

Hausman, J.A., "Specification Tests in Econometrics", Econometrica 46 (1978), 1251-1271.

Leuthold, R.M., "The Price Performance of the Futures Market of a Nonstorable Commodity: Live Beef Cattle", American Journal of Agricultural Economics 56 (1974), 313-324.

Maravell, A. and D.A. Pierce, "Preliminary-Data Error and Monetary Aggregate Targetting", Journal of Business and Economic Statistics 1 (1983), 179-186.

Milbourne, R.D. and G.W. Smith, "How Informative Are Preliminary Announcements of the Money Stock in Canada?", Discussion Paper #723, Institute for Economic Research, Queen's University (1988).

Morey, M.J., "The Statistical Implications of Preliminary Specification Error Testing", Journal of Econometrics 25 (1984), 63-72.

Mork, K.A., "Ain't Behavin': Forecast Errors and Measurement Errors in Early GNP Estimates", Journal of Business and Economic Statistics 5 (1987), 165-175.

Nordhaus, W.D., "Forecasting Efficiency; Concepts and Applications", Review of Economics and Statistics LXIX (1987), 667-674.

Srivastava, V.K. and D.E.A. Giles, Seemingly Unrelated Regression Equations Models : Estimation and Inference (New York: Marcel Dekker, 1987).

White, H., "A Heteroskedasticity - Consistent Covariance Matrix Estimator and a Direct Test of Heteroskedasticity", Econometrica 48 (1980), 817-838.

Zarnowtiz, V., "Rational Expectations and Macroeconomic Forecasts", Journal of Business and Economic Statistics 3 (1985), 293-311.

FOOTNOTES

1. Of course, a "revised" value may be the same as that reported for this data point one quarter previously - a zero revision, though this is unusual in our sample.
2. The data were reported on a consistent basis during this period.
3. All computations in this study were undertaken using the TSP package (Hall *et al.* (1988)).
4. Morey (1984) provides evidence that, in terms of asymptotic risk, it may be preferable to use IV estimation rather than pre-test as we have described. However, as will be discussed, our final estimator is more complex and there are no known risk results for pre-test strategies of this type.
5. If the covariance matrix is diagonal, single-equation OLS estimation will be efficient.
6. See Srivastava and Giles (1987, p.283).
7. Joint MLE of the models was undertaken using the LSQ command in TSP, with and without the INST option.

LIST OF DISCUSSION PAPERS*

No. 8401	Optimal Search, by Peter B. Morgan and Richard Manning.
No. 8402	Regional Production Relationships During the Industrialization of New Zealand, 1935-1948, by David E. A. Giles and Peter Hampton.
No. 8403	Pricing Strategies for a Non-Replenishable Item Under Variable Demand and Inflation, by John A. George.
No. 8404	Alienation Rights in Traditional Maori Society, by Brent Layton.
No. 8405	An Engel Curve Analysis of Household Expenditure in New Zealand, by David E. A. Giles and Peter Hampton.
No. 8406	Paying for Public Inputs, by Richard Manning, James R. Markusen, and John McMillan.
No. 8501	Perfectly Discriminatory Policies in International Trade, by Richard Manning and Koon-Lam Shea.
No. 8502	Perfectly Discriminatory Policy Towards International Capital Movements in a Dynamic World, by Richard Manning and Koon-Lam Shea.
No. 8503	A Regional Consumer Demand Model for New Zealand, by David E. A. Giles and Peter Hampton.
No. 8504	Optimal Human and Physical Capital Accumulation in a Fixed-Coefficients Economy, by R. Manning.
No. 8601	Estimating the Error Variance in Regression After a Preliminary Test of Restrictions on the Coefficients, by David E. A. Giles, Judith A. Mikolajczyk and T. Dudley Wallace.
No. 8602	Search While Consuming, by Richard Manning.
No. 8603	Implementing Computable General Equilibrium Models: Data Preparation, Calibration, and Replication, by K. R. Henry, R. Manning, E. McCann and A. E. Woodfield.
No. 8604	Credit Rationing: A Further Remark, by John G. Riley.
No. 8605	Preliminary-Test Estimation in Mis-Specified Regressions, by David E. A. Giles.
No. 8606	The Positive-Part Stein-Rule Estimator and Tests of Linear Hypotheses, by Aman Ullah and David E. A. Giles.
No. 8607	Production Functions that are Consistent with an Arbitrary Production-Possibility Frontier, by Richard Manning.
No. 8608	Preliminary-Test Estimation of the Error Variance in Linear Regression, by Judith A. Clarke, David E. A. Giles and T. Dudley Wallace.
No. 8609	Dual Dynamic Programming for Linear Production/Inventory Systems, by E. Grant Read and John A. George.
No. 8610	Ownership Concentration and the Efficiency of Monopoly, by R. Manning.
No. 8701	Stochastic Simulation of the Reserve Bank's Model of the New Zealand Economy, by J. N. Lye.
No. 8702	Urban Expenditure Patterns in New Zealand, by Peter Hampton and David E. A. Giles.
No. 8703	Preliminary-Test Estimation of Mis-Specified Regression Models, by David E. A. Giles.
No. 8704	Instrumental Variables Regression Without an Intercept, by David E. A. Giles and Robin W. Harrison.

(continued on back cover)

No. 8705 Household Expenditure in Sri Lanka: An Engel Curve Analysis, by Mallika Dissanayake and David E. A Giles.

No. 8706 Preliminary-Test Estimation of the Standard Error of Estimate in Linear Regression, by Judith A. Clarke.

No. 8707 Invariance Results for FIML Estimation of an Integrated Model of Expenditure and Portfolio Behaviour, by P. Dorian Owen.

No. 8708 Social Cost and Benefit as a Basis for Industry Regulation with Special Reference to the Tobacco Industry, by Alan E. Woodfield.

No. 8709 The Estimation of Allocation Models With Autocorrelated Disturbances, by David E. A. Giles.

No. 8710 Aggregate Demand Curves in General-Equilibrium Macroeconomic Models: Comparisons with Partial-Equilibrium Microeconomic Demand Curves, by P. Dorian Owen.

No. 8711 Alternative Aggregate Demand Functions in Macro-economics: A Comment, by P. Dorian Owen.

No. 8712 Evaluation of the Two-Stage Least Squares Distribution Function by Imhof's Procedure by P. Cribbett, J. N. Lye and A. Ullah.

No. 8713 The Size of the Underground Economy: Problems and Evidence, by Michael Carter.

No. 8714 A Computable General Equilibrium Model of a Fisherine Method to Close the Foreign Sector, by Ewen McCann and Keith Mclaren.

No. 8715 Preliminary-Test Estimation of the Scale Parameter in a Mis-Specified Regression Model, by David E. A. Giles and Judith A. Clarke.

No. 8716 A Simple Graphical Proof of Arrow's Impossibility Theorem, by John Fountain.

No. 8717 Rational Choice and Implementation of Social Decision Functions, by Manimay Sen.

No. 8718 Divisia Monetary Aggregates for New Zealand, by Ewen McCann and David E. A. Giles.

No. 8719 Telecommunications in New Zealand: The Case for Reform, by John Fountain.

No. 8801 Workers' Compensation Rates and the Demand for Apprentices and Non-Apprentices in Victoria, by Pasquale M. Sgro and David E. A. Giles.

No. 8802 The Adventures of Sherlock Holmes, the 48% Solution, by Michael Carter.

No. 8803 The Exact Distribution of a Simple Pre-Test Estimator, by David E. A. Giles.

No. 8804 Pre-testing for Linear Restrictions in a Regression Model With Student-t Errors, by Judith A. Clarke.

No. 8805 Divisia Monetary Aggregates and the Real User Cost of Money, by Ewen McCann and David Giles.

No. 8806 The Management of New Zealand's Lobster Fishery, by Alan Woodfield and Pim Borren.

No. 8807 Poverty Measurement: A Generalization of Sen's Result, by Prasanta K. Pattanaik and Manimay Sen.

No. 8808 A Note on Sen's Normalization Axiom for a Poverty Measure, by Prasanta K. Pattanaik and Manimay Sen.

No. 8809 Budget Deficits and Asset Sales, by Ewen McCann.

No. 8810 Unorganized Money Markets and 'Unproductive' Assets in the New Structuralist Critique of Financial Liberalization, by P. Dorian Owen and Otton Solis-Fallas.

No. 8901 Testing for Financial Buffer Stocks in Sectoral Portfolio Models, by P. Dorian Owen.

No. 8902 Provisional Data and Unbiased Prediction of Economic Time Series by Karen Browning and David Giles.

* Copies of these Discussion Papers may be obtained for $4 (including postage, price changes occasionally) each by writing to the Secretary, Department of Economics, University of Canterbury, Christchurch, New Zealand.