

No unit root in GNP: An Implication of Statistical Adequacy

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Abstract

Dickey and Fuller in the late 1970's provided methods by which the unit root hypothesis could be tested. Subsequent to this, Nelson and Plosser made a landmark application of these methods to macroeconomic time series, which has produced numerous other enquiries of this nature. One such application is Stock and Watson (1986). This study revisits Stock and Watson's results, with the main conclusion being that real per capita GNP is trend rather than difference stationary. This conclusion contradicts both, Stock and Watson as well as Nelson and Plosser, but is due to its application of the more robust method of ensuring statistical adequacy. This paper shows that real per capita GNP is a trend stationary rather than a difference stationary process. This conclusion is yet another in the series of more recent studies which have overturned the results of the seminal investigation by Nelson and Plosser. The paper's conclusion is also inconsistent with the results of the metric against which it is being measured; the results of Stock and Watson (1986). This comes as no surprise as these results are consistent with most studies which employ the more robust approach of establishing statistical adequacy before attempting to test for unit roots. The statistical adequacy approach is deemed to be more robust because it ensures that a set of internally consistent probabilistic assumptions is imposed upon the model. Without this kind of consistency no inferences should be drawn from a model's results, because at best such inferences are misleading, if not entirely false.

References

- [1] Agiakoglou, C. and P. Newbold (1992), "Empirical evidence on Dickey-Fuller type tests," *Journal of Time Series Analysis*, 13, 471-83.
- [2] Andreou, E. and A. Spanos (2003), "Statistical adequacy and the testing of trend versus difference stationarity," *Econometric Reviews*, 22, 3, 217-237.
- [3] Arellano, C., and S. G. Pantula (1995), "Testing for trend stationarity versus difference stationarity," *Journal of Time Series Analysis*, 16, 147-164.
- [4] Banerjee, A. J. Dolado, J. W. Galbraith, and D. F. Hendry (1993), *Co-integration, error-correction, and the econometric analysis of non-stationary data*, Oxford University Press, Oxford.
- [5] Bhargava, A. (1986), "On the Theory of Testing for Unit Roots in Observed Time Series," *Review of Economic Studies*, 52, 369-384.
- [6] Blough, S. R. (1992), "The relationship between power and level for generic unit root tests in finite samples," *Journal of Applied Econometrics*, 7, 295-308.
- [7] Campbell, J. Y. and P. Perron (1991), "Pitfalls and Opportunities What Macroeconomists Should Know About Unit Roots," Technical Working Paper (100) National Bureau of Economic Research Working Paper Series.
- [8] Chatfield, C. (1984), *The Analysis of Time Series*, Chapman and Hall, London and New York.
- [9] Choi, I. (1992), "Effects of data aggregation on the power of tests for a unit root," *Economic Letters*, 40, 397-401.
- [10] Cochrane, J. H. (1991), "A critique of the application of unit root tests," *Journal of Economic Dynamics and Control*, 15, 275-284
- [11] DeJong, D. N., J. C. Nankervis, N. E. Savin and C. H. Whiteman (1992), "The Power Problems of Unit Root Tests in Time Series with Autoregressive Errors," *Journal of Econometrics*, 53, 323-343.
- [12] Dhrymes, P. J. (1998) *Time series, unit roots, and cointegration*, Academic Press.
- [13] Dickey, D.A. (1976), "Estimation and hypothesis testing for nonstationary time series," Ph.D. dissertation, Iowa State University.
- [14] Dickey, D. A. (1984), "Powers of Unit Root Tests," *Proceedings of the American Statistical Association*, pp. 489-93.

- [15] Dickey, D. A. and W. A. Fuller (1979), "Distribution of the Estimators for Autoregressive Time Series with a Unit Root," *Journal of the American Statistical Association*, 74, 427-431.
- [16] Dickey, D. A. and W. A. Fuller (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root," *Econometrica*, 49, 1057-1072.
- [17] Dickey, D. A., H. P. Hasza, and W. A. Fuller (1984), "Testing for unit roots in seasonal time series," *JASA*, 79, 355-367.
- [18] Dickey, D. A., W. R. Bell, and R. B. Miller (1986), "Unit roots in time series models: tests and implications," *American Statistician*, 40, 12-26.
- [19] Dickey, D. A. and S. G. Pantula (1987), "Determining the order of differencing in autoregressive processes," *Journal of Business and Economic Statistics*, 5, 455-461.
- [20] Elliot, G., T. J. Rothenberg, and J. H. Stock (1996), "Efficient Tests for an Autoregressive Unit Root," *Econometrica*, 64, 813-36.
- [21] Enders, W. (1995), *Applied Econometric Time Series*, Wiley, New York.
- [22] Engle, R. F. and C. W. J. Granger (1987), "Cointegration and error correction: representation, estimation and testing," *Econometrica*, 55, 251-276.
- [23] Evans, G. B. A., and N. E. Savin (1981), "Testing for unit roots; 1," *Econometrica*, 49, 753-779.
- [24] Friedman, M. and A.J. Schwartz (1982), *Monetary trends in the United States and the United Kingdom*, University of Chicago Press, Chicago and London.
- [25] Hall, A. (1989), "Testing for a unit root in the presence of moving average errors," *Biometrika*, 76, 49-56.
- [26] Hall, A. (1995), "Residual autocorrelation and unit root tests based on instrumental variables estimators from time series regression models," *Journal of Time Series Analysis*, 16, 555-569.
- [27] Hamilton, J. D. (1994) *Time Series Analysis*, Princeton University Press, New Jersey.
- [28] Hwang, J. and P. Schmidt (1996), "Alternative methods of detrending and the power of unit root tests," *Journal of Econometrics*, 71, 227-248.
- [29] Kwiatkowski, D., P. C. B. Phillips, P. Schmidt and Y. Shin (1992), "Testing the null hypothesis of stationarity against the alternative of a unit root: How sure

are we that economic time series have a unit root?," *Journal of Econometrics*, 54, 159-178.

[30] Lee, J. and P. Schmidt (1994), "Unit root tests based on instrumental variables estimation," *International Economic Reviews*, 35, 449-462.

[31] Leybourne, S. J. (1995), "Testing for unit roots using forward and reverse Dickey-Fuller regressions," *Oxford Bulletin of Economics and Statistics*, 57, 559-571.

[32] Lu, M. and J.M. Podivinsky (2003), "The Robustness of Trend Stationarity: An Illustration with the extended Nelson-Plosser Dataset," *Econometric Reviews*, 22, 261-267.

[33] Mcnown, R. and T. Puttitanun (2002), "New unit root tests of the Nelson-Plosser data," *Applied Economics Letters*, 9, 9-11.

[34] Pantula, S. G. (1991), "Asymptotic distributions of unit root tests when the process is nearly stationary," *Journal of Business and Economic Statistics*, 9, 63-71.

[35] Pantula, S. G. and A. Hall (1991), "Testing for unit roots in autoregressive moving average models," *Journal of Econometrics*, 48, 325-353.

[36] Park, H. J. and W. A. Fuller (1995), "Alternative estimators and unit root tests for the autoregressive process," *Journal of Time Series Analysis*, 16, 415-429.

[37] Perron, P. (1989), "The Great Crash, the oil price shock and the unit root hypothesis," *Econometrica*, 57, 1361-1401.

[38] Phillips, P. C. B. (1987), "Time series regressions with a unit root," *Econometrica*, 55, 227-301.

[39] Phillips, P.C.B. and P. Perron, (1988), "Testing for a unit root in a time series regression," *Biometrika*, 75, 335-346.

[40] Phillips, P. C. B. and Z. Xiao (1998), "A primer on unit root testing," *Journal of Economic Surveys*, pp. 7-54.

[41] Said, S. E. and D. A. Dickey (1984), "Testing for unit roots in autoregressive-moving average models with unknown order," *Biometrika*, 71, 599-608.

[42] Schwert, G. W. (1989), "Tests for Unit roots: A Monte Carlo Investigation," *Journal of Business and Economic Statistics*, 7, 147-59.

[43] Schmidt, P. and P. C. B. Phillips (1992), "LM test for a Unit Root in the Presence of Deterministic Trends," *Oxford Bulletin of Economics and Statistics*, 54, 257-287.

[44] Spanos, A. (1990) "Unit Roots and their dependence on the conditioning information set", *Advances in Econometrics*, 8, 271–292.

[45] Spanos, A. and A. McGuirk (2001/ forthcoming), "Revisiting the foundations of unit root testing: statistical parameterizations and non-nested testing."

[46] Stock, J.H. (1995), "Unit roots, structural breaks and trends," in R. F. Engle and D. L. McFadden (eds.), *Handbook of Econometrics*, IV, Ch. 46, 2739-2841, vol. IV, Elsevier, Amsterdam.

[47] Stock, J.H. and M.W. Watson (1986), "Does GNP Have A Unit Root?," *Economics Letters*, 22, 147-151.

[48] Tanaka, K. (1990), "Testing for a moving average unit root," *Econometric Theory*, 6, 433-444.

[49] Tanaka, K. (1996) *Time Series Analysis*, John Wiley & Sons, New York.

[50] Vougas, D.V. (2002), "Application of the Dickey-Fuller test to the Nelson and Plosser (1982) data," *Applied Economics Letters*, 9, 511-514.

[51] Williams, D. (1991) *Probability with Martingales*, Cambridge University Press, Cambridge.

[52] Zivot, E. and D. W. K. Andrews (1992), "Further evidence on the Great Crash, the oil-price shock, and the unit root hypothesis," *Journal of Business and Economic Statistics*, 10, 251-270.