

# EC821: Time Series Econometrics

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### Notes Section 10 Part 3

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#### **1. Annotated bibliography of papers studying long range dependence**

The following list includes only those papers which I have authored or coauthored on the subject. Beyond the (somewhat dated) extensive bibliography in Baillie (1996), a search of the EconLit database for “long memory”, “fractional integration”, and “ARFIMA” will turn up many more recently published papers using these methods in economics and finance. All BC Economics Working Papers are accessible in Acrobat PDF format from the department homepage or my personal homepage on the department’s website.

- Boston College Economics Working Paper (BC WP) 492. John Barkoulas (University of Tennessee) and Christopher F Baum, “Dynamics of intra-EMS interest rate linkages” (rev. 02/2001)

Abstract: A number of previous studies have questioned the dominant role of Germany within the EMS. These conclusions are often based on empirical findings that interest rates of member countries of the EMS are not affected by German interest rates, even in the long run. In this study we establish evidence to the contrary by demonstrating that intra-EMS interest rate differentials (vis-a-vis Germany) exhibit mean-reverting behavior characterized by long-memory dynamics. Fractional error correction models’ estimates suggest the presence of

short-run intra-EMS monetary-policy interdependencies, but they validate the German Dominance Hypothesis in the long run.

- BC WP 472. Basma Bekdache (Wayne State University) and Christopher F Baum, "A re-evaluation of empirical tests of the Fisher hypothesis" (09/2000)

Abstract: This paper shows that the recent literature that tests for a long-run Fisher relationship using cointegration analysis is seriously flawed. Cointegration analysis assumes that the variables in question are  $I(1)$  or  $I(d)$  with the same  $d$ . Using monthly post-war U.S. data from 1959-1997, we show that this is not the case for nominal interest rates and inflation. While we cannot reject the hypothesis that nominal interest rates have a unit root, we find that inflation is a long-memory process. A direct test for the equality of the fractional differencing parameter for both series decisively rejects the hypothesis that the series share the same order of integration.

- BC WP 396. John T. Barkoulas (University of Tennessee), Christopher F. Baum and Atreya Chakraborty (Charles River Associates), "Waves and Persistence in Merger and Acquisition Activity" (rev. 12/1999; published, *Economics Letters*, 2001, 70, 237-243)

Abstract: Does merger and acquisition (M&A) activity occur in waves, that is, are there oscillations between low and high levels of M&A activity? The answer to this question is important in developing univariate as well as structural models of explaining and forecasting the stochastic behavior of M&A activity. There is evidence to suggest that aggregate U.S. time-series data on merger and acquisition (M&A) activity exhibit a "wave" behavior, which has been modeled by fitting either a two-state Markov switching-regime model or a sine-wave model to the data. This study provides an alternative characterization of the temporal patterns in M&A as a nonlinear process with strongly persistent or long-memory dynamics. The apparent level changes or partial cycles of differing magnitudes in aggregate M&A time series are consistent with an underlying data generating process exhibiting long memory. Time- and frequency-domain estimation methods are applied to a long M&A time series constructed by Town (1992), covering approximately a century of merger activity in the U.S. economy. We find significant evidence of long-term cyclical behavior, nonperiodic in nature, in the M&A time series, even after accounting for potential shifts in the

mean level of the series. A shock to M&A activity exhibits significant persistence as it is damped at the very slow hyperbolic rate, but it eventually dissipates. We provide both theoretical and empirical rationales for the presence of fractional dynamics with long-memory features in M&A activity. Theoretically, long-term dependence may be due to persistent differences in firm valuation between stockholders and nonstockholders following an "economic disturbance," as suggested by Gort (1969). Empirically, long-memory dynamics in M&A activity may reflect the statistical properties of fundamental factors underlying its behavior, as several of the proposed determinants of M&A activity have been shown to exhibit strong persistence.

- BC WP 380. Christopher F. Baum, John T. Barkoulas, and Mustafa Caglayan (University of Liverpool), "Long memory or structural breaks: Can either explain nonstationary real exchange rates under the current float?" (rev. 01/99; published, *Journal of International Financial Markets, Institutions, and Money*, 1999, 9, 359-376)

Abstract: This paper considers two potential rationales for the apparent absence of mean reversion in real exchange rates in the post-Bretton Woods era. We allow for (i) fractional integration and (ii) a double mean shift in the real exchange rate process. These methods, applied to CPI-based rates for 17 countries and WPI-based rates for 12 countries, demonstrate that the unit-root hypothesis is robust against both fractional alternatives and structural breaks. This evidence suggests rejection of the doctrine of absolute long-run purchasing power parity during the post-Bretton Woods era.

- BC WP 377. John T. Barkoulas, Christopher F. Baum, Mustafa Caglayan and Atreya Chakraborty, "Persistent Dependence in Foreign Exchange Rates? A Reexamination" (rev. 04/2000; forthcoming 2002 in *Global Financial Markets: Issues and Policies*)

Abstract: We test for stochastic long-memory behavior in the returns series of currency rates for eighteen industrial countries using a semiparametric fractional estimation method. A sensitivity analysis is also carried out to analyze the temporal stability of the long-memory parameter. Contrary to the findings of some previous studies alluding to the presence of long memory in major currency rates, our evidence provides wide support to the martingale model (and therefore for foreign exchange market efficiency) for our broader sample of foreign currency rates. Any inference of long-range dependence is fragile, especially

for the major currency rates. However, long-memory dynamics are found in a small number of secondary (nonmajor) currency rates.

- BC WP 361. John Barkoulas and Christopher F. Baum, "Long Memory and Forecasting in Euroyen Deposit Rates" (2/97; published in *Financial Engineering and the Japanese Markets*, 1997, 4:189-201)

Abstract: We test for long memory in 3- and 6-month daily returns series on Eurocurrency deposits denominated in Japanese yen (Euroyen). The fractional differencing parameter is estimated using the spectral regression method. The conflicting evidence obtained from the application of tests against a unit root as well as tests against stationarity provides the motivation for testing for fractional roots. Significant evidence of positive long-range dependence is found in the Euroyen returns series. The estimated fractional models result in dramatic out-of-sample forecasting improvements over longer horizons compared to benchmark linear models, thus providing strong evidence against the martingale model.

- BC WP 356. John T. Barkoulas, Christopher F. Baum and Nickolaos Travlos, "Long Memory in the Greek Stock Market" (12/96; published in *Applied Financial Economics*, 2000, 10:2, 177-184)

Abstract: We test for stochastic long memory in the Greek stock market, an emerging capital market. The fractional differencing parameter is estimated using the spectral regression method. Contrary to findings for major capital markets, significant and robust evidence of positive long-term persistence is found in the Greek stock market. As compared to benchmark linear models, the estimated fractional models provide improved out-of-sample forecasting accuracy for the Greek stock returns series over longer forecasting horizons.

- BC WP 349. John T. Barkoulas, Christopher F. Baum and Gurkan S. Oguz (Tufts University), "Stochastic Long Memory in Traded Goods Prices" (10/96; published, *Applied Economics Letters*, 1998, 5:135-138).

Abstract: Using spectral regression and exact maximum likelihood methods, we test for long memory dynamics in the traded goods prices for the G7 countries, as measured in their import and export price indices. Significant and robust evidence of fractional dynamics with long memory features is found in both import and export price inflation rates.

- BC WP 334. John Barkoulas and Christopher F. Baum, “Fractional Dynamics in Japanese Financial Time Series” (rev. 7/97; published, *Pacific-Basin Finance Journal*, 6:1-2, 115-124)

Abstract: Using the spectral regression and Gaussian semiparametric methods of estimating the long-memory parameter, we test for fractional dynamic behavior in a number of important Japanese financial time series: spot exchange rates, forward exchange rates, stock prices, currency forward premia, Euroyen deposit rates, and the Euroyen term premium. Stochastic long memory is established as a feature of the currency forward premia, Euroyen deposit rates, and Euroyen term premium series. The martingale model cannot be rejected for the spot, forward, and stock price series.

- BC WP 333. Christopher F. Baum, John Barkoulas and Mustafa Caglayan, “Persistence in International Inflation Rates” (rev. 04/98; published, *Southern Economic Journal*, 65:4 (1999), 900-913)

Abstract: We test for fractional dynamics in CPI-based inflation rates for twenty-seven countries and WPI-based inflation rates for twenty-two countries. The fractional differencing parameter is estimated using semiparametric and approximate maximum likelihood methods. Significant evidence of fractional dynamics with long-memory features is found in both CPI- and WPI-based inflation rates for industrial as well as developing countries. Implications of the findings are considered and sources of long memory are hypothesized.

- BC WP 321. John Barkoulas, Christopher F. Baum, and Mustafa Caglayan, “Fractional Monetary Dynamics” (revised 01/98; published, *Applied Economics*, 1999, 31, 1393-1400.)

Abstract: We test for fractional dynamics in U.S. monetary series, their various formulations and components, and velocity series. Using the spectral regression method, we find evidence of a fractional exponent in the differencing process of the monetary series (both simple-sum and Divisia indices), in their components (with the exception of demand deposits, savings deposits, overnight repurchase agreements, and term repurchase agreements), and the monetary base and money multipliers. No evidence of fractional behavior is found in the velocity series. Granger’s (1980) aggregation hypothesis is evaluated and implications of the presence of fractional monetary dynamics are drawn.

- BC WP 317. John Barkoulas, Christopher F. Baum, “Fractional Differencing Modeling and Forecasting of Eurocurrency Deposit Rates” (rev. 10/96; published, *Journal of Financial Research*, Fall 1997, 20:3, 355-372).

Abstract: We investigate the low frequency properties of three- and six-month rates for Eurocurrency deposits denominated in eight major currencies with specific emphasis on fractional dynamics. Using the fractional integration testing procedure suggested by Geweke and Porter-Hudak (1983), we find that several of the Eurocurrency deposit rates are fractionally integrated processes with long memory. These findings have important implications for econometric modeling, forecasting, and cointegration testing of Eurocurrency rates.

- BC WP 315. John Barkoulas, Christopher F. Baum and Gurkan S. Oguz, “Fractional Cointegration Analysis of Long Term International Interest Rates” (rev. 10/96; published, *International Journal of Finance*, 1997, 9:2, 586-606).

Abstract: DeGennaro, Kunkel, and Lee (1994) studied the long run dynamics of a system of long term interest rates of five industrialized countries by means of sophisticated cointegration methods. They found little evidence in support of the cointegration hypothesis, thus concluding that a separate set of fundamentals drives the dynamics of each of the individual long term interest rate series. In this study, we extend their analysis by exploring the possibility of very slow mean reverting dynamics (fractional cointegration) in the system of the five long term interest rates. We use the GPH test as our testing methodology for fractional integration and cointegration. Through rigorous investigation of the full system of the five long term interest rate series and its various subsystems, we provide evidence that the error correction term follows a fractionally integrated process with long memory, that is, it is mean reverting, though not covariance stationary. Despite significant persistence in the short run, a shock to the system of long term interest rates eventually dissipates so that an equilibrium relationship prevails in the long run.

- BC WP 314. John Barkoulas and Christopher F. Baum, “Long Term Dependence in Stock Returns” (4/96; published, *Economics Letters*, 1996, 53:3, 253-259).

Abstract: This paper investigates the presence of fractal dynamics in stock returns. We improve upon existing literature in two ways: i) instead of rescaled-range analysis, we use the more efficient semi-nonparametric procedure suggested by Geweke and Porter-Hudak (GPH, 1983), and ii) to ensure robustness, we apply the GPH test to a variety of aggregate and sectoral stock indices and individual companies' stock returns series at both daily and monthly frequencies. Our results indicate that fractal structure is not exhibited by stock indices, but it may characterize the behavior of some individual stock returns series.

## References

- [1] Baillie, R. 1996. Long Memory Processes and Fractional Integration in Econometrics, *Journal of Econometrics*, 73, 5-59.