Financial Indicators and the Business Cycle: The Contribution of Recurrence Plot Analysis

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Abstract

The particular characteristics of the latest persistent episode of financial distress revived the interest in investigating the power of financial indicators to predict peaks and troughs of the business cycle. Among the best candidate variables are the stock of money, as measured by the monetary aggregate M2, and the stock market as represented, in the case of US, by the S&P500 index.

Since the relationship between the financial and economic sectors is quite complex the need to adopt appropriate techniques which do not suffer from well-documented estimation errors and computational biases becomes more than ever relevant. There are four main groups of methodologies employed in the leading indicators literature. The first and most widely used category employs linear regression or limited dependent variable probit/logit techniques (Frankel and Rose, 1996; Sachs et al., 1996). The second approach was developed by Bruggemann and Linne (2000), Edison (2003). It is considered to be non-parametric since a number of variables are selected as leading indicators of a crisis and then threshold values are estimated, beyond which a crisis signal is considered to have been given. In the third approach the sample of countries is split into a crisis and non-crisis control group and then the behavior of variables are examined around the time of the crisis (Edwards and Santaella, 1993). Finally the fourth category includes all the alternative non-parametric techniques such as binary recursive trees (Ghosh and Ghosh, 2003; Frankel and Wei, 2004), artificial neural networks and genetic algorithms indicators (Apoteker and Barthelemy, 2001) and Markov switching models (Cerra and Saxen, 2001; Peria, 2002).

With the aim of making both an empirical and theoretical contribution, we propose an alternative line of research based on the recurrence plot (RP) analysis. The multivariate extension of RPs is also employed (Marwan and Kurths, 2002). Besides the simple and cross-recurrence plots investigation, we focus on the nonlinear bivariate measure of entropy, which is able to capture synergistic dynamics between the variables being analysed. The data set consists of monthly time series (the longest available) for the US money supply and the S&P500, and we use monthly US industrial production as a proxy of the business cycle. The first data coupling (real M2-Industrial Production) spans the period from January 1959 to February 2014 while the second (S&P500-Industrial Production) expands the analysis from January 1919 to March 2014.

The results reveal a clear lead behavior of 12 months for the SP&500 index over the cycle starting at the post-1999 regime, marked by the financial deregulation in the US market. The respective cross-RP between the S&P500 and the Industrial Production does not present

any distinguishable pattern, which is a strong sign of the absence of coincident phases. In the case of M2 a distinct regime starts at early 2009. Prior to this point we do not observe any remarkable change in the RP structure. It appears that the money supply during this highly volatile period performs poorly as a leading indicator. Our finding confirms recent reports of the Conference Board according to which the M2 has missed the 2001 and 2007 recessions, exerting a negative pressure on the Composite Leading Index. Most interesting is the performance of the time-varying entropy measure between the S&P500 and the Industrial Production. It is consistently high after mid-2006, providing valuable information about the ongoing complexity of the relationship which coincides with the onset of the recession in 2007.