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CYCLES AND LONG-RANGE BEHAVIOUR

IN THE EUROPEAN STOCK MARKETS

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Abstract

This paper uses a modelling framework which includes two singularities (or poles) in the spectral density function, one corresponding to the long-run (zero) frequency and the other to the cyclical (non-zero) frequency. The adopted specification is very general, since it allows for fractional integration with stochastic patterns at the zero and cyclical frequencies and includes both long- and short-memory components. The cyclical patterns are modelled using Gegenbauer processes. This model is estimated using monthly data for five European stock market indices (DAX30, FTSE100, CAC40, FTSE MIB40, IBEX35) from January 2009 to January 2019. The results indicate that the series are highly persistent at the long-run frequency, but they are not supportive of the existence of cyclical stochastic structures in the European financial markets. The only clear evidence of a stochastic cycle is obtained in the case of France under the assumption of white noise disturbances; in all other cases, there is no evidence of cycles.

Keywords: European stock markets,

markets obtained by following this approach. The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 outlines the modelling business cycles: mos

extend credit to the real sector. Claessens et al. (2011) provide a wide-ranging analysis of financial cycles using a large database covering 21 advanced countries over the period 1960:1-2007:4. They study cycles in credit, house prices and equity prices. The main results are the following: 1) financial cycles tend to be long and severe, especially those in housing and equity markets; 2) financial cycles are highly synchronized within countries, especially with credit and house price cycles; and 3) financial cycles magnify each other, especially when the downturns in credit and housing markets coincide. DePenya and Gil-Alana (2006) propose a method for testing nonstationary cycles in financial time series data. They develop a procedure that enables the researcher to test unit root cycles in raw time series. The test has several distinguishing features compared with alternative ones. In particular, it has a standard null limit distribution and is the most efficient test against the fractional alternatives. In addition, it allows the researcher to test unit root cycles at each of the frequencies, and, thus, to approximate the number of periods per cycle. Finally, as already mentioned, Caporale and Gil-Alana (2014) propose a general framework including linear and segmented time trends, and stationary and nonstationary processes based on integer and/or fractional degrees of differentiation; moreover, the spectrum is allowed to contain more than a single pole or singularity, occurring at both zero but non-zero (cyclical) frequencies. They find that US dividends, earnings, interest rates and long-term government bond yields exhibit fractional integration with one or two poles in the spectrum; further, a model with a segmented trend and fractional integration outperforms rival specifications over long horizons in terms of its forecasting properties. A similar approach is taken in the present study (see the next section for details).

3. The Model

The adopted model is the following:

$$1 \quad 2\cos \qquad) \qquad , \qquad 1, 2, ..., $$

where we can define $C_{j,d_2}(P)$ recursively as follows:

$$C_{0,d_2}(P) \quad 1, \quad C_{1,d_2}(\;) \quad 2\,Pd_2,$$

function and can be used to obtain some preliminary evidence about the peaks in the spectrum of the series.

INSERT TABLE 1 ABOUT HERE

Table 1 displays the first five values of the periodogram for each series. It can be seen that for the stock markets of France, Germany and UK, the highest value corresponds to the smallest frequency, following by frequency 3; however, for France and Spain, it occurs at frequency 2, followed by frequency 1 and frequency 3 respectively.

In order to avoid deterministic terms, we use the demeaned series and estimate the model given by equation (1), testing the null hypothesis:

$$H_0 : d = d_0, \qquad (2)$$

where d = $(d_1, d_2)^T$, with both values ranging from -2.00 to 2.00 with 0.01 increments. Thus, the estimated model under the null is:

$$(1 - L)^{d_{1o}} (1 - 2\cos w_r L + L^2)^{d_{2o}} x_t = u_t, \quad t = 1, 2, \ldots, \qquad (3)$$

where u

For the sake of generality, we do not restrict the first polynomial to be constrained at the zero frequency, and therefore consider initially a model with 2 factors of the Gegenbauer polynomial of the form

$$\prod_{j=1}^{2}\left(1 - 2\cos w_r^{(j)} L + L^2\right)^{d_o^{(j)}} x_t = u_t, \quad t = 1, 2, \ldots, \qquad (5)$$

where $d_o^{(1)}$ becomes $d_{1o}/2$ if $w_r^{(1)} = 0$ (or $j_1 = 1$). The estimated value of j is equal to 1 in all cases, which supports the existence of a pole or singularity in the spectrum at the zero frequency. Thus, in what follows we focus exclusively on the model given (3), estimating simultaneously d_{1o} (the order of integration at the long-run or zero frequency, d_{2o} (the order of integration at the cyclical frequency) and j_2 (the frequency in the spectrum that goes to infinity and that is related to the number of periods per cycle in the cyclical structure, i.e. $r_2 = j_2/T$).

Table 2 focuses on the case of white noise errors. It can be seen that that the frequency j_2 is equal to 2 for France, Italy and Spain, and to 3 for the UK and Germany. This implies that the number of periods per cycle is approximately 60 (5 years) for the stock markets in the former three countries and 40 months (3.3 years) for the latter two. Concerning the estimates of the differencing parameters, d_1 is smaller than 1 in the case of France, though the unit root null hypothesis cannot be rejected, while for the other countries the I(1) hypothesis is rejected in favor of values of d_1 above 1. As for the estimates of d_2, the highest is for France (0.33) and only for this country and Germany (0.08) the values are significantly positive. In the other three cases, they are positive but very close to zero and the I(0) null cannot be rejected.

INSERT TABLES 2 AND 3 ABOUT HERE

Table 3 displays the results for the case of weak autocorrelation using the model of Bloomfield (1973). The values of j_2 are now 2 for Italy and Spain and 3 for the other three countries, d_1 is substantially smaller than in the previous table, its estimate ranging between 0.58 (UK) and 0.71 (Spain), and evidence of mean reversion with respect to this frequency is only obtained in the UK case. In all other cases, the intervals indicate that the unit root null cannot be rejected. Finally, the estimates of d_2 are all positive but the null $d_2 = 0$ cannot be rejected in any country.

On the whole, our results indicate high persistence at the long-run frequency but they are not very supportive of the existence of cyclical stochastic structures in the European financial markets. The only clear evidence of a stochastic cycle is obtained in the case of France under the assumption of white noise disturbances; in all other cases, although d_2 is found to be positive, the confidence intervals are such that the null $d_2 = 0$ cannot be rejected, and therefore there is no evidence of cycles.

5. Conclusions

In this paper we have examined the possible presence of stochastic cycles in financial series. For this purpose, we have proposed a model that allows simultaneously for both long-run and cyclical patterns in the data using a method based on long-memory processes. For the zero frequency the standard I(d) approach is followed, whilst for the cyclical structure a Gegenbauer polynomial is used which also allows for fractional degrees of differentiation. Therefore, the chosen specification contains two singularities in the spectrum corresponding to the long-run (zero) and the cyclical (non-zero) frequencies respectively.

Using monthly data for five European stock market indices (namely, DAX30 (Germany), FTSE100 (UK), CAC40 (France), FTSE MIB40 (Italy) and IBEX35 (Spain)) over the period from January 2009 to January 2019 we find that the order of integration at the long-run or zero frequency is significantly higher than the one at the cyclical frequency, the latter being insignificantly different from zero in the majority of cases. The cycles seem to have a periodicity between 3 and 5 years.

However, these results should be taken with a degree of caution given the relatively short sample period. Specifically, with 121 monthly observations as in our case the smallest possible frequency apart from $j_1 = 1$ (that corresponds to the long-run frequency) is 2, which implies cycles of T/ 2 at most, i.e. 60 months or 5 years. Analysing much longer series, possibly spanning decades, would be much more informative about the possible existence of stochastic cycles. This is left for further research.

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Table 1: First five values in the periodogram of the series

Country	1	2	3	4	5
FRANCE	0.17205	0.00407	0.04472	0.02301	0.00021
GERMANY	0.55260	0.06697	0.10928	0.04837	0.00627