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Financial time series as model system for earthquake prediction

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The statements of disappointed geophysicists about impossibility of the decision of a task of the forecast of earthquakes may be heard frequently. The typical argumentation is that for the forecast is necessary to take into account set of the factors, from movement of planets and atmospheric phenomena up to a geological, chemical structure of deep layers, and the most part of the information on these processes is inaccessible. If for the earthquake prediction it is necessary to write and to solve the equations of movement of the limited site terrestrial core, that task is really impracticable. However forecast is based on the principles, that do not formalized till now, but its are enough effective. The best way to be convinced of serviceability of methods of the earthquake prediction is to apply methods developed in seismology, to other, absolutely independent area.

That independent area is the financial markets. The signals generated by the share, futures or foreign exchange markets in their structure are similar to signals that observed in geophysics. The most distinct features of financial time series are the power form of power spectra (that is fractal structure) and seasonal variations (days, weeks etc.). And the collective movements of the shares prices in world share markets demonstrate "the financial analogue of earthquakes", the market crises. Thus, both on structure and on features of collective behavior the financial time series are ideal model system for verification and debugging of the methods for earthquake prediction.

The structural similarity of financial and geophysical time series allows studying the problem questions. For example, "*flickering or punctuated*" character of the earthquake precursors are discussed in seismology for the long time. The unlimited fi-

nancial data with any frequency and for any period allow to check up the effect of flickering precursors on model system.

Indeed if to apply the same prognostic indicator to an exchange index in the various periods of time, will appear, that the efficiency of the indicator is various for the different periods. For a quantitative estimation three exchange indexes (Russian RTS, Indian BSE30 and Austrian AEX) for the 10-year's period with 1997 on 2007 were considered. For each of three indexes prognostic structural indicators are calculated. All period of observation was broken on sites for 250 days (working year for fife day's week). Further for each site of time the cross correlation function between an index (without trend) and appropriate structural indicator were calculated. As a measure the cross correlation coefficient with zero time lag was used. The excess of a level of a standard error in 3-4 times as criterion of not random connection between two time series was accepted. For a case in 250 points it means, that the cross correlation function with value 0.3 and is higher (three-time excess of a standard mistake) allows to consider the indicator as effective. For all three indexes is received, that the periods of efficiency (two - three years) are followed by the periods of an inefficiency of the indicator, then again there comes the period of efficiency. Thus, on financial time series the effect of flickering precursors is obviously observed [1].

On the other hand, the methods that were advanced in seismology, allow to receive new results in the analysis of the financial markets. For example, application of a Lyubushin-Sobolev method of the aggregated signal [2] to financial temporary numbers(lines) has allowed to find out effect of synchronization of national exchange indexes and to use it(him) for forecasting time of a beginning of the international financial crises [3, 4].

As a funny thing I shall notice, the technical analysts of the financial market successfully used the seismic methods for a long time, but do not know about it. The indicator "moving averages convergence - divergence" MACD is popular in the financial market, is the digital analogue of the narrow-band seismoreceiver of a camerton type.

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