

# Chapter 10

## Plasticity and Memory in the Financial Markets

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### ABSTRACT

*The chapter questions the applicability of the Efficient Market Hypothesis (EMH) for analysis of financial markets. The overall goal is to analyze methods of forecasting future prices of financial assets based on the concept of the fractal market structure and long-term memory of past prices. Fractals in the financial markets are interpreted either as investors with different investment horizons or as a configuration of the price movement on chart. This chapter examines the fractal structure of financial markets, nonlinear methods of analysis of financial markets, plasticity and long-term memory to long-term investment horizons of financial markets, fractal analysis of financial markets, new approaches to forecast prices of financial assets, which eliminate shortcomings of the linear paradigm.*

### INTRODUCTION

This chapter discusses applicability of the Efficient Market Hypothesis (EMH) for the analysis of financial markets. The overall goal is to analyze methods of forecasting future prices of financial assets based on the concept of the fractal market structure and long-term memory of past prices. Fractals in the financial markets can be interpreted either as investors with different investment horizons or as a configuration of the price movement on the chart.

The need to explore the EMH is initiated by the idea that traditional analytical methods used in practice and in academia are based on the linear paradigm and exclude the fractal structure of the market. This paradigm postulates that in the situation of external influences' absence, any system, including markets, seeks balance: demand equals supply, everything is stable, and trends do not appear accidentally. Linear theory is based on the proposition that markets have no memory: news is announced then markets react and forget immediately. However, this theory does not match our every-day reality of the financial markets.

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On the contrary, recent research confirms ineffectiveness of the financial markets. This inefficiency is verified by existence of the so-called market anomalies “calendar anomalies”, “price anomalies”, “effect size”, “effect of the news”, and so forth. Such anomalies indicate the long-term memory existing in the financial markets. In these circumstances, the hypothesis of the Fractal Market Hypothesis (FMH) has been reassessed and used as the background of the analysis for the chapter.

Interestingly, on the border between the conflicts of opposing forces, one can find not nascent chaotic, disordered structures, but instead a spontaneous rise of the higher level self-organization. Moreover, the structure of such self-organization is of new kind, irrelevant to the older Newton scheme. As soon as markets have a long-term memory at the long-term investment horizons, the past behavior of price influences its future value. The intrigue lies in the fact that if the assumption of random movement in prices in the capital markets is incorrect, most of the current theories, empirical research, and methodological approaches are rendered useless. New methods must displace older methods which do not involve independence of variables and normality distribution of variables. These new methods should include fractals and nonlinear dynamics which are being applicable to real data and demonstrate greater efficiency.

Within the theory of markets, the nonlinear paradigm includes the concept of long-term memory: events that may affect the markets for a long time, and perhaps infinitely. The modern linear paradigm allows only the possibility of short-term memory, in the best case, in submartingal form. Inability of a linear system is due to the fact that the statistical deterministic systems allow a small degree of freedom. This fact significantly limits their ability to adapt; they are forced to give way to competitors in the development.

This chapter will attempt to answer the following issues:

- Fractal structure of financial markets
- Nonlinear methods of analysis of financial markets
- Plasticity and long-term memory to long-term investment horizons of financial markets
- Fractal analysis of financial markets
- New approaches to forecast prices of financial assets which eliminate shortcomings of the linear paradigm

Therefore, the practical significance lies in the intention to equip academics and practitioners with new methods and tools for analysis and forecasting future development and dynamic of the financial markets.

## **THEORETICAL FRAMEWORK**

Analysis of the key theoretical concepts explaining financial market behavior should begin with the founding father of the traditional theory of market, Louis Bachelier (1964). In 1900 he attempted to defend his doctorate thesis titled, *Theory of Speculation*, in which the basic question of price development was articulated. Most approaches of that time centered on the simple cause-answer scheme: if an event happens, prices react with a definite and expected result. Such connection could be easily observed after an event, but could hardly be predicted in advance. Bachelier has chosen another way to explain this phenomenon by attempting to apply theory probability to financial market development and to estimate the probability of price instability via a set of factors. He discovered existing analogy between heat dispersion within a substance (or Brownian movement of molecules in water) and fluctuation of bonds costs.

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