

THE FRACTAL MARKET HYPOTHESIS

FELICIA RAMONA BIRĂU*

Abstract

In this article, the concept of capital market is analysed using Fractal Market Hypothesis which is a modern, complex and unconventional alternative to classical finance methods. Fractal Market Hypothesis is in sharp opposition to Efficient Market Hypothesis and it explores the application of chaos theory and fractal geometry to finance. Fractal Market Hypothesis is based on certain assumption. Thus, it is emphasized that investors did not react immediately to the information they receive and of course, the manner in which they interpret that information may be different. Also, Fractal Market Hypothesis refers to the way that liquidity and investment horizons influence the behaviour of financial investors.

Keywords: *Fractal Market Hypothesis, chaos theory, fractals, capital market, Efficient Market Hypothesis.*

Introduction

Capital markets are extremely complex and unpredictable. Capital markets' chaotic behavior and non-linearities, complication and uncertainty, unexpected booms and crashes are some of the most challenging current issues.

Fractal Market Hypothesis is an alternative to Efficient Market Hypothesis and it is based on chaos theory. The antagonism between the two theories is more than evident. Actually, Fractal Market Hypothesis is a new and different approach which was developed to provide an alternative solution to the difficulties faced by the traditional theory in explaining certain financial phenomena.

Fractal Market Hypothesis is an alternative to Efficient Market Hypothesis and it is based on chaos theory. The antagonism between the two theories is more than evident. Actually, Fractal Market Hypothesis is a new and different approach which was developed to provide an alternative solution to the difficulties faced by the traditional theory in explaining certain financial phenomena.

Chaos theory has established a new level of understanding regarding the concept of capital market. In general, capital market is one of the most fertile and accessible areas to apply chaos theory. Through its fundamental characteristics, a capital market is even more appropriate. A chaotic system, as it is a capital market presents certain characteristics such as: unpredictability, instability, disorder, noise and lack of control.

Chaos represents a state of complex, unpredictable, nonlinear dynamics. Moreover, a chaotic system appears to be random when in fact is an evolved form of order. In other words, a chaotic system is a unconventional collage consists of a deterministic and a random process.

Chaos theory provides an explanation for the fact that complex and unpredictable results can and will occur in systems that are sensitive to their initial conditions. In addition, chaos theory is perceived as a qualitative study of complex and unstable irregular behavior regarding deterministic nonlinear systems such as capital markets.

Fractal Market Hypothesis - the boundary between traditional and unconventional finance

The analysis of capital market based on chaos theory provides a completely different perspective compared to the concept of Efficient Market Hypothesis. Under the terms of a globalized world, traditional finance paradigm can no longer be considered a panacea.

* Ph. D. candidate, Faculty of Economics and Business Administration, University of Craiova, Craiova, Romania, (email: birauramona@yahoo.com).

Eugene Fama suggested that : “The ideal is a market in which firms can make production-investment decisions and investors can choose among the securities that represent ownership of firms’ activities under the assumption that security prices at any time “fully reflect” all available information. A market in which prices always “fully reflect” available information is called efficient”.

The central idea of the efficient market theory is that any information is available to all investors or market participants, so capital prices always incorporate and reflect all relevant information. Due to this issue, the price of a capital should reflect the knowledge and expectations of all investors or market participants. Because of that, except for long-term investment trends, future capital prices are difficult, if not impossible, to predict. In other words, an investment strategy based on past capital prices cannot preview future prices, no matter how complex and deep would be.

Eugene Fama defined market efficiency in a very accessible manner: “In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future. In other words, in an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value.”

On the other hand, according to Mandelbrot, in finance, the concept of chaos is not a rootless abstraction but a theoretical reformulation of a down-to-earth bit of market folklore - namely, that movements of a capital or currency all look alike when a market chart is enlarged or reduced so that it fits the same time and price scale.

Consequently, it becomes impossible to identify price changes from one period to another, even if it's weeks, days or hours. This feature defines the charts as fractal curves and make available to users a wide range of mathematical and computer analysis methods.

According to Peters, through the Fractal Market Hypothesis, we can understand why self-similar statistical structures exist, as well as how risk is shared distributed among investors.

Fractal Market Hypothesis is based on certain assumption. Thus, is emphasized that investors did not react immediately to the information they receive and of course, the manner in which they interpret that information may be different.

A central concept in the framework of this theory is the capital market liquidity. The Efficient Market Hypothesis does not mention at all the concept of liquidity. This aspect is very important considering the fact that the most dramatic crashes were caused by the lack of liquidity. As a consequence, a lack of liquidity constrains investors to accept any price whether it is fair or not.

A liquid capital market is a stable market. However, a capital market is stable when it consists of a large number of investors which have different investment horizons. In contradiction with Efficient Market Hypothesis, the Fractal Market Hypothesis suggests that information is valued according to the investment horizon of the investor. Short-term price changes have a predisposition to be more volatile than long-term price trends.

The capital market is a complex and dynamic system with noisy, nonstationary and chaotic data series.¹ Some researchers are suggesting that such complexity is an intrinsic characteristic of such system. The interesting thing about the chaotic dynamics of capital markets is its great ability to generate dramatic movements which appear to be random, with higher frequency than linear models. Obviously, this chaotic behavior of capital markets in general, but especially of capital markets is a non-linear deterministic process. The non-linear models are much more complex and can generate a much more varied types of behavior.

Capital market modeling is an area of interest to capital traders, quantitative finance specialists, investment professionals and applied researchers. One of the most controversial issue in

¹Peters Edgar, “Fractal Market Analysis: Applying Chaos Theory to Investment and Economics”, New York: John Wiley & Sons, 1994

the recent past is probably whether the capital market can be predicted in a satisfactory manner or not. However, there is always some risk to investment in the capital market due to its unpredictable movements. Thus, an appropriate prediction model for capital market forecasting would be highly valued and useful, being an issue of a major interest.²

Human understanding of capital market is limited, because our capability in analyzing all the data has not been complete and empirical economic methods have not been satisfactory. The obvious complexity of the capital markets has been investigated by various researchers and a large amount of research papers has been published in recent times. Resolving such complexity has been for many long years just an utopia.

Capital market is characterized by complex nonlinear dynamics which does not converge to a known purpose, a result that may be anticipated or influenced, or at least to a limit cycle. In this context, even the concept of financial investment rationality reaches a completely different meaning. Thus, limited rationality replaces rational expectations.

At a certain level, on the capital markets is distinguished exclusively the human dimension of the financial events and, of course, the causes that led to the triggering of these particular phenomenon. Fractal Market Hypothesis and implicitly Chaos theory are applied to explain different categories of discontinuities. In recent past, this unconventional theory was applied in the financial field for modeling discontinuities based on complex and quite sophisticated mathematical models.

Conclusions

Fractal Market Hypothesis is an alternative to classical finance. Metaphorically speaking, there are many scientific boundaries in terms of market efficiency.

Chaos theory represents a significant progress in understanding a dynamic, complex, unpredictable, nonlinear systems such as the capital market. Assuming that capital market is a chaotic system and not just purely random, chaos theory is in sharp contradiction with Efficient Market Hypothesis. A market in which prices always “fully reflect” available information is called efficient. The most important issue regarding efficient market theory is that it is not possible to outperform the market over the long-term. Chaos theory contradicts deeply and argued this conventional principle of traditional finance.

Capital markets behavior is extremely chaotic and difficult to predict, so it is not an unusual or an impossible fact that seemingly minor events can cause major perturbations in the final outcome. In other words, very small and insignificant variations in initial conditions can generate extremely significant differences in the final event.

Acknowledgement

This work was supported by the strategic grant POSDRU/CPP107/ DMI1.5/S/78421, Project ID 78421 (2010), co-financed by the European Social Fund – Investing in People, within the Sectoral Operational Programme Human Resources Development 2007 – 2013

References

- Aizenman, J. and Pinto, B., “*Managing Volatility and Crises: Overview, Draft chapter for Managing Volatility and Crises: A Practitioner’s Guide*”, Washington, The World Bank, 2004 <http://economics.ucsc.edu/faculty/aizenman/ManagingVolatility.pdf>

² Birău Ramona, “Box-Jenkins Methodology vs. Fuzzy Logic in capital market modeling”, The International Scientific Conference „Advancements in the theory of economic decisions under risk and uncertainty conditions. Fuzzy systems in economics”, 26th edition, Iași, 16 september 2011, vol. XIII, Tehnopress, Iași, ISBN 978-973-702-863-1, pp. 124-133

- Aizenman, J. and Powell, A., “*Volatility and Financial Intermediation*”, Journal of International Money and Finance, 2003, vol.22 (5)
- Barberis, N. and Thaler, R., “*A survey of behavioral finance*”, Handbook of the Economics of Finance, Elsevier Science B.V., 2003
- Birău Felicia Ramona – “*Behavioral Finance Paradigm And Its Implications On Investment Decisions*”, International Scientific Conference „ECO-TREND 2011 - Exit From The Crisis And Revival Of Sustainable Growth”, 8th edition, November 25-26, 2011, Tg – Jiu, Romania
- Birău Ramona, “*Box-Jenkins Methodology vs. Fuzzy Logic in capital market modeling*”, The International Scientific Conference „Advancements in the theory of economic decisions under risk and uncertainty conditions. Fuzzy systems in economics”, 26th edition, Iași, 16 september 2011, vol. XIII, Tehnopress, Iași, ISBN 978-973-702-863-1, pp. 124-133
- Birău Felicia Ramona, “*The meanings of efficient market paradigm in the context of capital markets. An analysis of weak-form efficiency on the Bucharest Capital Exchange*”, The International Conference, „Competitiveness And Stability In The Knowledge Based Economy”, The Faculty of Economics and Business Administration, University of Craiova, Romania, 4 - 5 November 2011
- Blackledge, J. and Murphy, K., “*Currency Trading Using the Fractal Market Hypothesis*”, Risk Management Trends, InTech, 2011
- Chang, R. and Velasco, A., “*Liquidity Crises in Markets: Theory and Policy*”, Federal Reserve Bank of Atlanta, Working Paper 99-15, October 1999
- Chorafas, D., “*Chaos theory in the financial markets: applying fractals, fuzzy logic, genetic algorithms, swarm simulation & the Monte Carlo method to manage market chaos & volatility*”, McGraw-Hill Professional, 1994
- Eichengreen, B. and Mody, A., “*What explains changing spreads on -market debt : fundamentals or market sentiment?*”, National Bureau Of Economic Research, Cambridge, 1998, <http://www.nber.org/papers/w6408>
- Fama Eugene, “*Market efficiency, long-term returns, and behavioral finance*”, Journal of Financial Economics 49, 1998, pp.283-306
- Fama Eugene, “*Random Walks in Capital Market Prices*”, Financial Analysts Journal , 1965
- Malkiel, B., “*The Efficient Market Hypothesis and Its Critics*”, Princeton University, CEPS Working Paper No. 91, 2003
- Mandelbrot, B. and Hudson, R., “*The (Mis)behavior of Markets, A Fractal View of Risk, Ruin and Reward*”, Profile Books LTD, 2005
- Mandelbrot, B., “*How Fractals Can Explain What's Wrong with Wall Street. The geometry that describes the shape of coastlines and the patterns of galaxies also elucidates how capital prices soar and plummet*”, Scientific American, 2008
- Kellert, S., “*In the Wake of Chaos: Unpredictable Order in Dynamical Systems*”, (Chicago, University of Chicago Press, 1993), cited in Crayton Bedford, The Case of Chaos, in Mathematics Teacher Magazine, April 1998.
- Peters Edgar, “*Fractal Market Analysis: Applying Chaos Theory to Investment and Economics*”, New York: John Wiley & Sons, 1994
- Sharpe, W. and Alexander, G., “*Investments*”, 4th Edition. Englewood Cliffs, NJ: Prentice Hall, 1990
- Torre, A. and Schmukler, S., “*Capital Markets and Globalization - The latin american experience*”, A Copublication Of Stanford Economics And Finance, An Imprint Of Stanford University Press, And The World Bank, 2007