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The Integrative Market Hypothesis for Stock Market Fluctuations

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THE INTEGRATIVE MARKET HYPOTHESIS FOR STOCK MARKET FLUCTUATIONS*

ABSTRACT

This article provides a new understanding of stock market price fluctuations, applying the concepts of quantum physics. This new approach challenges traditional theories of stock price movement, such as Random Walk, finding them antiquated and incomplete. The paper compares the stock price fluctuations to the quantum movement of particles. Specifically, the movement of stock prices on the NASDAQ index is fitted to a curve derived from Plank's equation for black body radiation. The market is ultimately found to be not totally reactive nor random, but taking on an emergent quality. This independent movement is not expected from the interaction of individual traders. These results are astonishing as they are contrary to the prevalent reactive view of market price movement and suggest a radically new understanding of the market. A parallel to human consciousness is drawn to help explain this new understanding. Ultimately, this article is meant to provide a new perspective on the stock market and not as an exhaustive theory of it.

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I. INTRODUCTION

Modern society is dependent on free market economics. Ever since Franklin D. Roosevelt took the U.S. off the gold system, monetary value has been subjectively defined by the people that use it. In essence, money, commodities and businesses are worth what we believe they are worth. Furthermore, markets are the barometer of our collective beliefs of worth. What controls the winds of change in market prices? Some think that it is as unpredictable as the weather.[1] This paper argues a new perspective is needed to understand these fluctuations, one drawing its understanding from quantum physics, the science of the microscopic world of particles, and consciousness.[2] Thus, this paper searches the possibility that our markets may behave more like the spooky world of subatomic particles and overall parallel the conscious mind of its individual members. This approach may shed light on our age old desire to understand how markets function and why prices move the way they do.

Traditionally, we have looked to the fundamental values of the companies that comprise the stock market, past trends of stock price movements and have even derived a statistical basis for stock movement from science in the Efficient Capital Market Hypothesis. Applying theses hypothesis we establish rules and regulations for how we interact with markets.

This leads to a very important question: is our reductionist approach sufficient to describe the complex system we call the stock market? Or, is the market more than just the sum of its parts? This paper argues that it is, and the key to understanding the market is to understand those parts that comprise it, us, and the fundamental laws of physics.

Others have equated the market to the neural networks of our brain, the ecological system of the earth and even genetics and evolution to understand it from the top down.[3] Those that advance these analogies to the development of conscious life on earth do so in hopes of understanding the market and why events like the 1987 crash occur. Currently, such drastic crashes are totally beyond the bounds of traditional market theories.[4]

Is there some fundamental connection either conceptually or actually between the laws of nature, from those that describe the most fundamental elements of our reality (particles), to the most complex and least understood systems of nature, the conscious mind? This paper, through the Integrative Market Hypothesis, provides it is and that this is the key to understanding the true

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[1] Chaos theory describes complex systems including the weather and recently has been applied to the stock market. *See generally* Kevin Assemi, *The Over Reliance on Efficient Capital Market Hypothesis in Understanding and Regulating the Stock Market: The Need for an Interdisciplinary Approach Appling Chaos Theory*, PEPPERDINE JOURNAL OF BUSINESS ENTREPRENEURSHIP AND THE LAW (2007), Online Edition, http://law.pepperdine.edu/organizations/jbel/assemi.pdf.

[2] "Quantum theory, chaos, and . . . complexity theory all concentrate on the emergent whole that cannot be reduced to the sum of its parts, on discontinuous, nonlinear change that leads abruptly to surprising new sets or forms, on indeterminacy and unpredictability." IAN MARSHALL & DANAH ZOHAR, WHO'S AFRAID OF SCHRODINGER'S CAT? AN A-TO-Z GUIDE TO ALL THE NEW SCIENCE IDEAS YOU NEED TO KEEP UP WITH THE NEW THINKING 255 (Quill William Morrow New York) (1997).

[3] On October 19th, 1987 the U.S. stock market fell 29%. *See* Assemi, *supra* note 2, at 7.

[4] When applying traditional theories of risk, the 1987 crash had a one in 50 billion chance of occurrence. *Id.*

movements of the stock market. This paper addresses these questions in three sections. In section one, the basic approach of this paper and the traditional approach to market analysis are explained. Then, in section two, the paper's approach is applied to actual movement of stock prices on the NASDAQ. Finally, section three addresses the possible ramification of section two's analysis and concludes this paper.

II. SECTION ONE

A. Our Approach

The focus of this paper is to analyze a set of stock market data and interpret its time-plotted price variations by applying what is designated as the Integrative Market Hypothesis. This paper attempts to isolate a market movement that is not fully explained by traditional market behavioral theories, such as the reactive movement analysis's or the random walk hypothesis.[5] Before we proceed, we will make an initial assumption: we will treat the stock market as a system that is capable of gaining and losing energy[6] over time. This energy is reflected by the change in price. Therefore, we will assume that the higher the price goes, the higher the energy in the system, whereas the lower the price, the lower the energy.[7]

In the simplest and most theoretical analysis of economic models, a market is a process by which people exchange goods (or money) so that buyers and sellers are able to acquire what they want.[8] A stock market is nothing more than such a system, set up for the sale and acquisition of ownership interests in a company. By this definition, the stock market, like all other markets, should follow the theory of supply and demand.[9]

Even a superficial look at actual historical data of the trade of stock shows that a linear relationship, like the one of simple supply and demand, is a dramatic oversimplification. There is obviously a much more complex movement. The nature of such movement has been the subject of countless papers and speculation over the years, from the simplistic to the overly complex, from the mechanical to the random and from the influence of humans to that of UFOs. Without delving into the quagmire of speculation and theory, there are two primary schools of thought which have emerged and have been accepted as plausible theories: the

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[5] Other theories include Efficient Capital Market Hypothesis, Random Walk Hypothesis, technical analysis, fundamental analysis, and Dow theory.

[6] This paper does not define the type of energy that is embodied in the market, but uses the term loosely to describe the driving force behind stock price movements. *See* Hazen, *infra* note 18 for further explanation of "energy."

[7] As systems in nature, the stock market would move toward a state of entropy. *See* Marshall, *supra* note 3. Therefore, to sustain higher stock prices more energy would have to be inputted into the market itself. *See id.* at 256. This is because all systems are inefficient and therefore, to maintain the status quo they need constant energy. *See id.* Here the market is an open system which allows the imputation of "energy" from outside investors, thus allowing ordered movement of stock prices and preventing total entropy of the system. *See id.*

[8] RUSSEL KIRK ECONOMICS: WORK AND PROSPERITY 11 (Intercollegiate Studies Institute 1989).

[9] *Id.* at 96.

traditional approach[10] and the random walk theory.[11]

B. The Traditional Approach: The Stock Market as a Complex Machine

The Nineteenth Century was one of the most astonishing time periods in history. It was characterized by revolutionary changes in technology, social and medical sciences and physics. The system of physics that was developed during and prior to that time is referred to as Classical or Newtonian Physics.[12] Classical Physics[13] is deterministic. That means that if things are known with enough certainty, they will follow the immutable laws of nature and yield exact and predictable results.[14] Therefore, through the lens of classical physics, the universe is an interlaced, albeit very complicated, machine or system. But it is a machine nonetheless. Given enough information it can be analyzed and predicted with finite accuracy.[15] This is the mentality which permeated and drove the Nineteenth Century and the Industrial Revolution.

The stock market did not escape such analysis. Seeing how investors are seemingly given information and in return modify share prices, together with the fact that the market itself is fully manmade, it is no surprise that it has often been viewed under the light of such traditional mechanical approach. It, too, was viewed as being a large complex machine, and as such it was assumed that its parts and behavior could be isolated, broken down and explained.[16]

Over time, the theories of physics evolved and combined with philosophy into what is now referred to as Modern Physics,[17] greatly based on quantum

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[10] Including fundamental and technical analyses.

[11] The "random walk model is an outgrowth of ECMH; and holds that, though stock prices are based on their intrinsic values, their movement is random." SIMON M. KEANE, STOCK MARKET EFFICIENCY THEORY EVIDENCE AND IMPLICATIONS 12 (Philip Alan 1983).

[12] *See* STEVEN POLLOCK, PARTICLE PHYSICS FOR NON-PHYSICISTS- A TOUR OF THE MICROCOSMOS 12 (The Teaching Company Limited Partnership 2001).

[13] "The ideas of classical physics developed steadily, starting with Isaac Newton in the 1600s and progressing through the 1700s, 1800s, and 1900s. This development included the concepts of e.g. forces, gravity, electricity, magnetism, energy, temperature, thermal physics, light, and sound. *Id.*

[14] EUGENE HETCH, PHYSICS 3 (Cole Publishing Co.,1994). In comparison modern physics provides the understanding that reality is defined by uncertainty. This uncertainty is embodied in Heisenberg's Uncertainty Principle. ALAN LIGHTMAN, THE DISCOVERIES, 201 (Pantheon Books 2005). "In pre-quantum physics [classical physics], it was of course recognized that any practical measurement had uncertainties associated with it-the glass of the lens could have been ground more finely, the lab table might be shaking a little, and so on. But, *in principle*, one could build instruments that made these uncertainties as small as one wished. Heisenberg's uncertainties are different. No matter what instruments we ever build, there is a fundamental limitation on how small we can make the uncertainties. This fundamental limit is caused by the essential and unavoidable wave-particle duality of light. . . . Heisenberg's Uncertainty Principle means, among other things, that the future cannot be determined from the past. The future position of a particle can be determined only if its current position and velocity are known. The Uncertainty Principle decrees that this condition is possible only to within limits. The Uncertainty Principle decrees that the world of certainty envisioned by Galileo and Newton does not exist." *Id.* at 200.

[15] Classical physics was the pre-quantum mechanics area, where certainty and determinism through the laws of physics reigned supreme. *See* Pollock, *supra* note 13 at 12.

[16] This is the reductionistic approach which holds that "[t]he properties of any larger whole are reducible to the properties possessed by the parts." Marshall, *supra* note 3, at 41.

[17] Modern Physics revolves around and began with the quantum mechanic concept of quanta.

mechanics.[18] The view of the stock market has for the greater part remained based on its fundamentally arcane ideas.

Under such traditional view, if the stock market is nothing more than a large machine, it needs a supply of energy (or withdrawal of it) in order to change. This means that the market will vary in direct response to what it is given, and it will do so in a linearly responsive way.[19] Such energy[20] is said to be reflected in statistics like trade volume and stock prices. If the energy flux were to decrease, the market would also decline accordingly.[21]

A modern physics approach would utilize a more holistic method, combining physics and probability, while thinking in a less active-reactive way.[22] It, however, seems apparent that while the market does not produce energy of its own,[23] once perturbations are introduced in the system, the system itself does not necessarily respond in linear fashion.

C. The Random Walk Theory

If the response is not linear, what is it? In response to this question, some

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Pollock, *supra* note 13, at 12. A quantum is a finite energy level or discrete packet of energy. ROBERT M. HAZEN, THE JOY OF SCIENCE 18 (The Teaching Company Limited Partnership 2001). The natural world does not progress in a continuous spectrum, but rather it "jumps" from one energy level to the next. *Id.* This concept that energy is made up of discrete quanta, was presented by Max Planck in his study of black-body radiation. Pollock, *supra* note 13, at 12.

[18] "Quantum mechanics, along with relativity, is the cornerstone of all modern physics. The understanding of atoms and subatomic particles, lasers, silicon chips, and so much else in the world of today depends fundamentally on quantum mechanics." Lightman, *supra* note 15, at 200.

[19] *See* Marshall, *supra* note 3, at 103 (explaining that the traditional Newtonian view provided that the world was progressed linearly and was predictable).

[20] Because the stock market itself does not have a physical body, the word "energy" is used in a slightly looser term than in its physics meaning. It is used to analogize the complex machine model. The word "energy" is speculative and used throughout this paper to indicate the quality of action which results in perturbations in the price of stocks. "The (physics based) definition of energy depends on the familiar concept of work, which is the exertion of a force over a distance. Energy is the ability to do work-the property of a physical system that allows it to exert a force over a distance. Energy comes in a wide variety of forms. Objects in motion possess kinetic energy. Many systems store potential energy, which is poised to do work. Waves possess energy that can be transferred without significant movement of the medium. Benjamin Thompson (1752–1814) demonstrated that heat is a form of mechanical work and thus is equivalent to energy. Radiation, such as light from the Sun, is another energy form, which can travel through a vacuum at 186,000 miles per second. Finally, one of the defining discoveries of modern science is the equivalence of mass itself with energy-the energy released in nuclear reactions." Hazen, *supra* note 18, at 4.

[21] This is part of the Efficient Capital Hypothesis which provides that the market reacts efficiently to new information by adjusting stock prices up or down quickly. *See* Eugene F. Fama, *The Behavior of Stock-Market Prices*, 38 U. CHI. J. BUS. 34, 36 (1965).

[22] However, whichever approach is taken, the structure which is the market needs to operate within a system which contains energy. It is true that if the market closed it would zero out. That would be analogous to taking all energy away from atoms. They would stop vibrating and therefore they would stop radiating energy. This happens at a temperature of zero Kelvin, also known as absolute zero.

[23] This would invariably violate conservation of energy, one of the fundamental principles of physics. The law of conservation of energy is embodied in the first law of thermodynamics. Hazen, *supra* note 18, at 16. The first law states that the total amount of energy in a closed system is constant. *Id.* "[T]he total amount of energy obtained by adding up all the different sources is a constant." *Id.* "To many scientists, the first law carries a profound significance about the underlying symmetry of the natural order." *Id.*

people have theorized that the market is hardly reactive at all. Instead, it follows the theory of Random Walk.[24] The easiest way to describe Random Walk is to think of a game where a player randomly selects a number, +1 or -1, at a specified time interval (every second for example). This is very similar to tossing a coin in the air and assigning a value of +1 to one side and of -1 to the other. While we may expect that the average progress will be zero, this is not necessarily always the case.[25]

Louis Bachelier applied this mathematical theory to the economic system in 1900.[26] Bachelier's basic conclusion was that there is no useful information contained in historical price movements of securities.[27] Indeed, he drew the inference that the Random Walk Theory could explain the way stock prices changed unpredictably as a result of unexpected information appearing in the market.[28] This does not mean that the stock prices themselves change randomly, but, rather, that the news is random.[29] In reacting rationally to this new random information, stock prices seem to behave in a random manner themselves.

The application of the Random Walk Theory to the stock market is flawed because it suffers from the same type of omission that plagues the previously discussed theory. It is equivalent to an experiment where we were to throw a bucket filled with tiles in the air. Each tile has a letter of the alphabet written on it. When they fall down, we read the sequence which they form. While many times the resulting arrangement makes no sense, on occasion we may end up with a beautiful poem. After all, each letter has an equal possibility of falling in a certain sequence, so there is a finite probability that this could happen. From this we conclude that all poetry must have been composed using the method of tossing letter-tiles in the air.

Although the Random Walk Theory can produce results *similar* to the data that is being analyzed, it does not imply that similar results are produced by the same technique. While it is true that the theory as applied to the stock market states that the news is random, not the actual movement, it also assumes that the relationship to the news is predictable and non-speculative. This would remove any actual human input from the variables.

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[24] *See* Keane, *supra* note 12.

[25] RICHARD FEYNMAN ET AL., LECTURES ON PHYSICS 6-5 (California Institute of Technology, 1977).

[26] BENOIT B. MANDELBROT & RICHARD L. HUDSON, THE (MIS)BEHAVIOR OF MARKETS 44 (Basic Books 2004). Bachelier's professors and contemporaries did not appreciate his innovation. His thesis received humiliating marks from his professors, and he quickly dropped into the shadows of the academic underground. After a series of minor posts, he ended up teaching in an obscure French town for much of the rest of his life. His valuable work was largely ignored until the mid-1960's.

[27] *See id.; see also* CHARLES J. CORRADO AND BRADFORD D. JORDAN, FUNDAMENTALS OF INVESTMENTS, VALUATIONS AND MANAGEMENT, 5TH ED. 269 (Irwin/McGraw-Hill 2005).

[28] *See* Mandelbrot, *supra* note 27, at 52-53.

[29] *See* Keane, *supra* note 12.

III. SECTION TWO

A. A New Approach

One of the significant problems with the theories discussed above is the way in which they are conceived and tested. Instead of looking at the actual data and events that they try to describe, they attempt to set up another similar system, an experiment of sort. In this experiment, researchers claim success if they achieve results, in the isolation of their methods and mechanics, which resemble the original data. But this experimental system is at best only a parallel system devoid of any unknown variables. It is a model, and, as a model, it is unlikely that it appropriately matches the actual conditions or variations. Most importantly, it is highly unlikely that it properly reflects the complexities of the multitude of variables. Some of these variables, as a matter of fact, may not even be known, as will be discussed later.

Instead of designing a hypothesis and testing it, we will take the data and attempt to regress it down to its components. What if we were to look at the stock market curves by ignoring that they were actual changes of stock prices over time? Let us instead work our way backwards. We shall assume we are given the problem of recognizing and describing the behavior of a particle as a function of time within a system. The particle is given varying amounts of energy and we know that it is subjected to some major energy changes that are introduced from the outside. Can we describe its behavior?

The "particle" in our case is nothing more than the representation of a stock[30] and the "energy" is nothing but the representation of the price.[31] Therefore, the task will be to undo, to reverse-engineer,[32] the final curve. In order to do this, we will assume that the curve is composed of several different parts that are combined to form the final movement. Each of these events yields its own independent movement and hence can theoretically be separated and traced independently.

This paper proffers a simple procedure in order to analyze the curve. This procedure will: (a) consider a given curve of price vs. time of a certain stock; (b) try to identify separate parts of the curve; (c) attribute these parts to certain events or reactions which are known or have previously been hypothesized; (d) observe if any unaccounted perturbations remain and, if so; (e) try to fit the remaining curve to an equation.

Theoretically, there can be only three types of movements in any non-static system:[33] random, reactive and non-reactive (independent).[34]

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[30] In our case, the NASDAQ QQQ index has been chosen.

[31] Or at the very least, price can be defined as being directly proportional to the energy at any given time.

[32] Reverse-engineering is "to disassemble and examine or analyze in detail (as a product or device) to discover the concepts involved in manufacture usually in order to produce something similar." Merriam-Webster Dictionary, *available at* http://www.m-w.com/dictionary/reverse-engineer.

[33] For our purposes, a non-static system is simply a system in which there are variations.

[34] This independent movement can be described as emergent behavior of a complex system. In the simplest sense emergence is when the "whole is greater than the sum of its parts." *See* Marshall, *supra* note 3, at 138. More specifically, emergent behavior is: "A property of any entity or complex system

We will attempt to observe all three in the stock market, broken down in the following order:

a. Random Movements – random changes are typical in many energy filled systems. We are all familiar with the "snow" on a television set, or the background noise on a radio. For our purposes, random movements are nothing more than that noise. In more technical terms, they can be referred to as Brownian motion.[35] For our purposes, their amplitude is so small that it can be overlooked.

b. Reactive Movements – these occur in direct response to outside events (i.e. social or economic occurrences, social and economic trends). Reactive movements are correlated to several elements which are easily identifiable under traditional economic analysis. These include the concepts of Fundamental Analysis,[36] Tech Analysis,[37] Social Reactions,[38] and the like.

c. Non-Reactive or Independent Movements – these can be described in the general sense as movements that are not in direct response to an impetus, or everything that is not random and that is not in direct correlation to an outside influence. The traditional view of the stock market assumes such independent movements do not to exist.

Therefore, we can say that:

Overall Price Change = Δ *due to Random Movements* + Δ *due to Reactive Events* + Δ *due to Independent Movements*

. . . if it cannot be defined or explained in terms of the properties of its parts, or if it is not reducible to these properties and their relations. Many people have asked if life and consciousness are deducible to physiochemical processes in the body or brain, or if they are emergent phenomena- truly new phenomena displaying properties without a classical, physical antecedent." *Id.* at 137. Thus, emergent behavior raises the question "[c]an the properties and behavior of any group be wholly defined in terms of the properties and behavior of its individual members?" *Id.*

[35] Brownian motion is the noise inherent in many moving systems. For example, Einstein explained that the Brownian motion of pollen in liquids was caused by random collisions of atoms hitting the pollen from different angles. JAMES TREFIL, ROBERT M. HAZEN, THE SCIENCES: AN INTEGRATED APPROACH, 3RD ED. 174 (John Wiley & Sons, Inc. 2001).

[36] Fundamental Analysis correlates stock reactions to company performance and earnings. Cory Janssen & Ben McClure, *Fundamental Analysis: What Is It*, Investopedia ULC (2008), *available at* http://www.investopedia.com/university/fundamentalanalysis/fundanalysis1.asp. It takes into account a company's current performance, earnings and historical performance. *Id.* The traditional view of stock movement is that it is mostly related to such fundamental analysis. *Id.* The problem is that such correlation is not accurate. Therefore Fundamental Analysis is just one of the descriptors that needs to be added to others in order for a complete picture to emerge.

[37] "[Tech Analysis is a] method of evaluating securities by analyzing statistics generated by market activity, such as past prices and volume. Technical analysts do not attempt to measure a security's intrinsic value, but instead use charts and other tools to identify patterns that can suggest future activity. [Thus,] [t]echnical analysts believe that the historical performance of stocks and markets are indications of future performance." Technical Analysis, Investopedia ULC (2008), *available at* http://www.investopedia.com/terms/t/technicalanalysis.asp.

[38] Social Reactions are the changes in stock prices due to basic social events (*i.e.* war, political events, etc.).

B. A Model Study

For purposes of this paper, we will analyze a composite index[39] instead of a single stock. The use of an index instead of an individual stock is mainly done in order to filter out abrupt company-specific changes. In this paper, we will use the performance of the NASDAQ's index (QQQ).[40]

We shall apply the above analysis to a model set of data. The following graph (Graph 1[41]) represents the raw movement of the Index for the given time period.

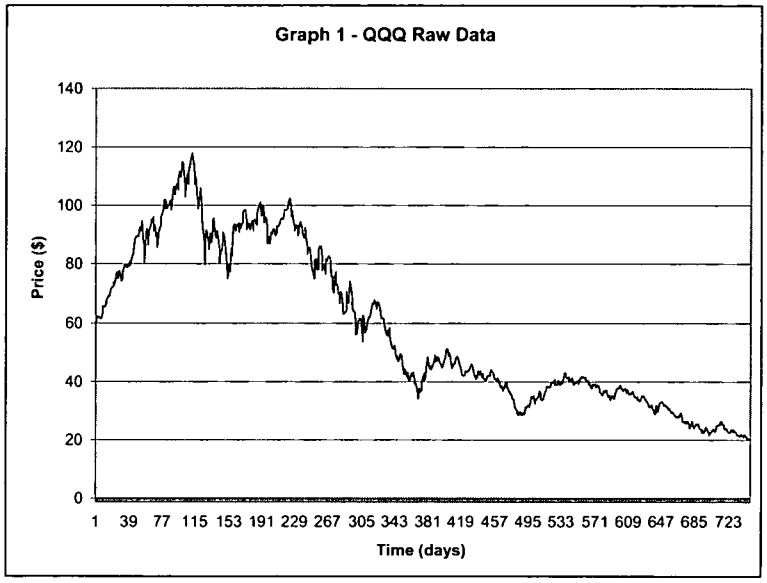


Figure 1

As we discussed above, we shall forget that this actually represents the graph of the change of price versus time[42] and let us look at it as the amount of energy of a particle in a system as a function of time. The x-axis would still represent the time intervals while the y-axis would then represent the amount of energy the particle has. We shall keep in mind that what we are trying to analyze is the actual path of the particle. That is to say that we are not interested in the *actual amount* of energy at any given time, but only in the relative motion (the change) of that energy. This paper is interested in the relative change from one specific moment

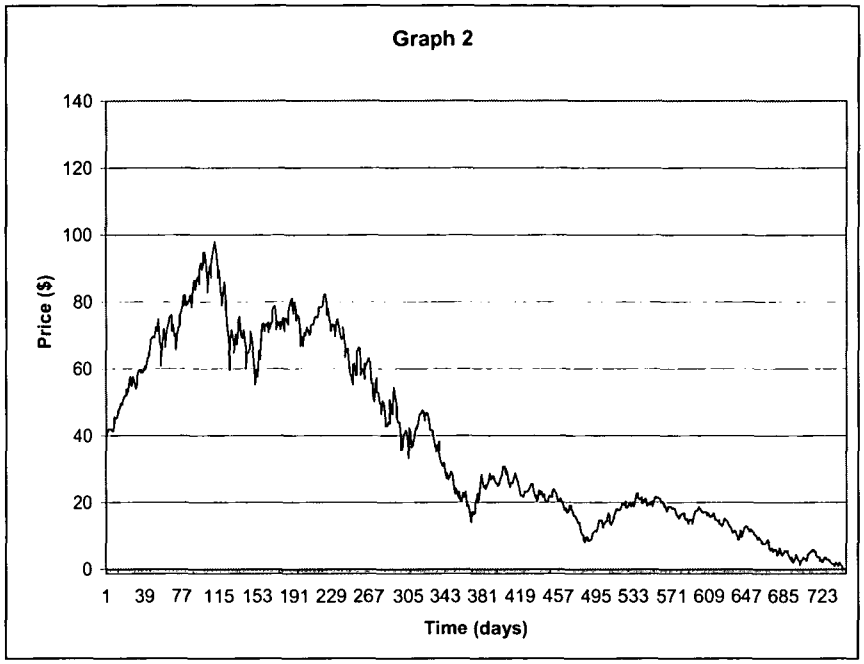
[39] In this paper we will utilize NASDAQ's composite index.

[40] QQQ is "[t]he NASDAQ-100 Index [which] includes 100 of the largest domestic and international non-financial securities listed on The NASDAQ Stock Market based on market capitalization. The Index reflects companies across major industry groups including computer hardware and software, telecommunications, retail/wholesale trade and biotechnology." NASDAQ Indexes, http://dynamic.nasdaq.com/services/indexes/ViewIndexes/Nasdaq_100.aspx?symbol=IXNDX.

[41] Data on all graphs was taken from a period within the last ten years.

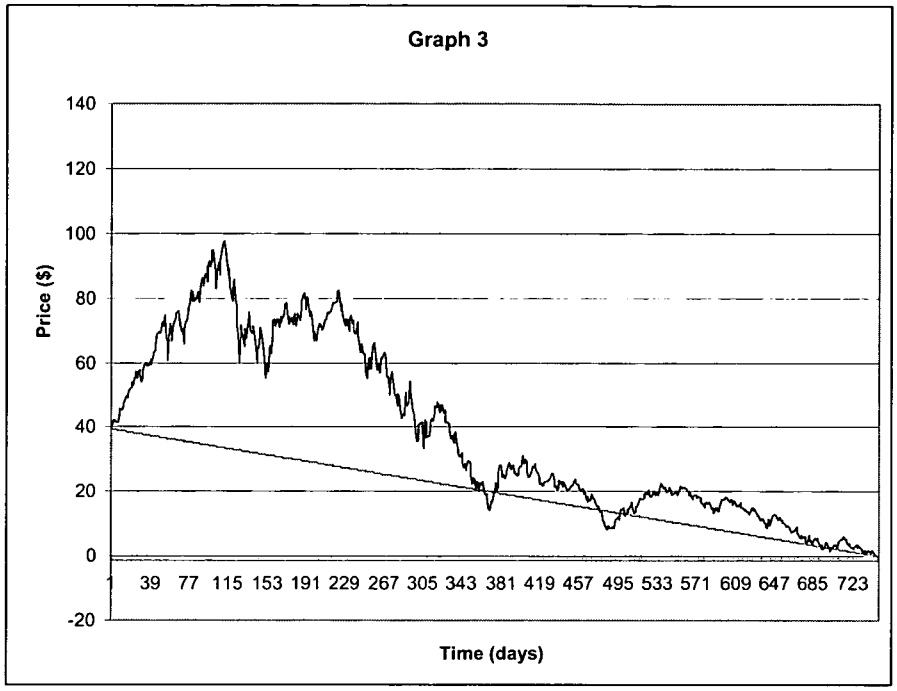
[42] This mental step of not describing it as price vs. time is mainly useful for discussion purposes. It mentally detaches the built-in assumptions about the stock market and allows the unbiased analysis of the data as if it were any other physical problem.

to the next.[43] Because of this, and also in order to ease analysis, we can safely get rid of amounts of energy which are constant throughout the time analyzed. That will have the effect of bringing the curve "down," as reflected in Graph 2.

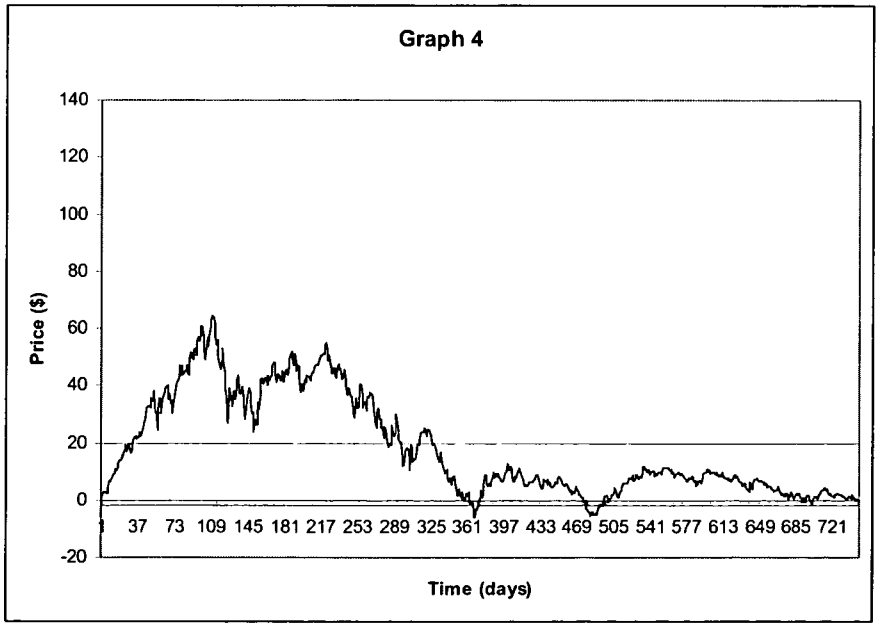


Also, we notice a downward trend. This trend is represented by the line in Graph 3.

[43] What determines the variations in our chart is the change between subsequent time intervals, not the total amount.



We can discard this "wedge" for the same reason as we discarded the constant above. It does not greatly affect the relative change between successive instants. Because it does not sufficiently impact the relative change, it is safe for us to remove it for purposes of our preliminary analysis. Graph 4 shows the curve once the area under the "wedge" is removed.



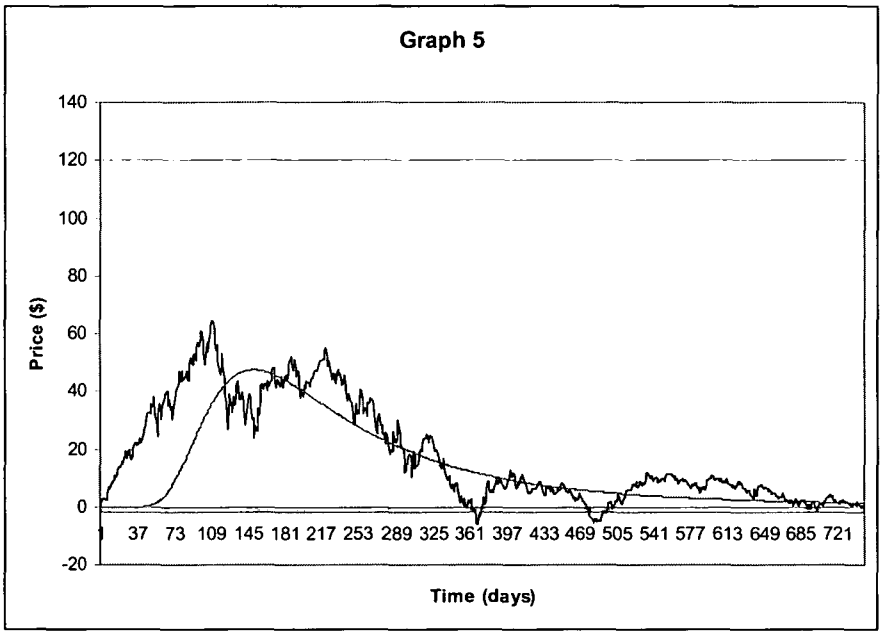
Let's now observe the relative motion of the particle once the constant amounts of

energy are removed. As earlier stated, certain market movements have been hypothesized by others.[44] These include reactive movements and random movements.[45] In this paper we believe both of these are present and account for some of the variations shown in Graph 4.

Random movements tend to be of small amplitude.[46] While they can be theorized, they are extremely hard to isolate because, by definition, they are random.

Reactive movements are in direct response to outside influences. They are often responsible for the abrupt changes in price,[47] such as steep increases in price or sharp declines. Once we acknowledge both random and reactive influences, we are left with a much more "rounded" curve than when we started.

The first important conclusion is that we are not left with a horizontal line. A horizontal line would indicate that there were no fluctuations left, but just a constant amount of energy. Therefore there would be no changes left. This would imply that all causes of the changes had been accounted for. Were the traditional reactive approach of the market true, then, once we eliminated all of the reactive changes, we would be left with such a constant mount of energy. But this is not the case. Therefore, what kind of curve does the remainder approximate?



Graph 5 superimposes a curve which was empirically fitted to the data. It is

[44] *See* discussion, *supra*.

[45] *Id.*

[46] For purposes of our analysis at this time, we can completely neglect such small amplitude changes.

[47] For example, markets have crashed in response to major economic changes, such as difficulties in Asia, bust of the dotcom industry, and of course the recent burst of the mortgage bubble. *See Crashes: Introduction*, Investopedia ULC (2008), *available at* http://www.investopedia.com/features/crashes/.

notable for two separate reasons. First, the new curve approximates the path taken by our original data. Second, when the new curve's function is integrated,[48] we obtain approximately the same area as the original data. If we maintain the analogy that the graphs represent a particle's movement, then the areas under the curve would represent the energy of such particle.

Again, in our preliminary analysis, the importance is in recognizing the larger picture, instead of being bogged down in a minute analysis of tedious possibilities.

The formula used for the above curve, is of the form:

$$y = \frac{k}{x^a(e^{b/cx} - 1)}$$, where k, a, b and c are constants.

This formula was spawned directly from Max Planck's Blackbody radiation formula.[49]

Max Planck tackled the Blackbody radiation problem and thus helped spark the development of Quantum Mechanics.[50] More specifically, classical physics could not predict the color of light that would be emitted from a blackbody.[51] In fact, it predicted that a blackbody would emit an infinite amount of energy.[52] Planck applied the Second Law of Thermodynamics, showing that balance between the energy of the atoms verses light contained in the blackbody would move toward maximum entropy (or maximum disorder- energy would dissipate from higher to lower energy states).[53] Then, Planck realized that blackbodies required that atoms could only absorb or emit energy in discrete packets.[54] The idea that energy was emitted in discrete packets or quanta and not in a continuous fashion was a radical new idea and the basis of quantum physics.[55]

C. Reflections and Comments

At this point we need to make certain observations and disclaimers that ought to be already obvious. This paper in no way is meant to imply that the movement of every stock or index will, overall, follow a certain pattern. This sample data was used because it was a good example of the hypothesis used in this

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[48] Integration is a mathematical operation by which you find the total area under a curve.

[49] When an object is heated to high temperatures, it absorbs energy and it emits light. This is known as thermal radiation. By definition, a black body is an ideal system which absorbs all radiation which hits it. Traditional physics was unable to describe the behavior of a black body until Max Planck's derivation of his formula. RAYMOND SERWAY, PHYSICS FOR SCIENTISTS AND ENGINEERS 1147-48 (Saunders College Publishing, 1990).

[50] Hetch, *supra* note 15, at 1044.

[51] Lightman, *supra* note 15, at 5.

[52] *Id.*

[53] *Id.*

[54] *Id.* at 8.

[55] The Plank constant is used to as scale for the world of the microscopic, where quantum effects are observable. *See id.* at 14. Planck's Constant is equal to 6.55×10^{-27} erg seconds. *Id.* Further, because Planck's Constant is the scale for all quantum physics it is also the scale for all our reality. *Id.* The Constant determines the size of all particles, atom, and it even defines the smallest structure of time. *Id.*

paper.

This paper also in no way claims to be able to predict the future of certain stock performance. This paper is fully aware of the argument that states that if we can fit a formula to the data, than certain points of the formula can be predicted. For example, we can predict the maximum of the curve. That is theoretically true but, again, we need not oversimplify. A large change as observed in QQQ is odd and many other changes are superimposed. Further, this is not the purpose of an introductory study as put forth in this paper.

What we are saying is that, given the assumption that the market does not follow an exclusively reactive or random pattern, certain movements must be the result of other behaviors. Such behaviors must necessarily be independent and, as isolated in this paper, are describable by the same type of relationships as certain fundamental quantum physics events.

It is important to stress again that this paper does not speculate on the physical "meaning" of the results. It so far simply acknowledges certain results and compares them to known facts.

D. A Jump In Our Way of Thinking

Quantum physics brought together the duality of waves and particles.[56] Some philosophers speculate on the duality of body and soul.[57] Could this be the economic equivalent?

To obtain the curve we fitted to the data, we utilized an equation very similar to the one used in a basic problem of Modern Physics. We can easily infer that if two events can be described by similar mathematical functions, there is a

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[56] Albert Einstein theorized that light came in particle form, to explain the photoelectric effect. Lightman, *supra* note 15, at 49. The photoelectric effect is when a piece of metal is illuminated by ultraviolet light and thus emits electricity. *Id.* What is astonishing is that it was the latter discovered that "light behaves *both* as a wave and as a particle." *Id.* The most common experiment to show this duality is the double slit test. *Id.* In which single particles of light (photons) are shone at a screen. *Id.* Between the screen and the light source is a shade with two slits. *Id.* If light is only a particle you would expect to see only two bans of light, from the summation of individually emitted photons. Lightman, *supra* note 15, at 49. However, in actuality there are multiple bans of light in an interference pattern. *Id.* at 50-51. This suggests that individual photons of light "passes through both slits simultaneously and interferes with itself in route to the screen." *Id.* at 51. "The wave-particle duality evidently applies to all matter and energy." *Id.*

[57] Dualism is the idea that the mind or soul is separate from the body, though both making up individual people. *Dualism*, Stanford Encyclopedia of Philosophy, *available at* http://plato.stanford.edu/archives/fall2003/entries/dualism/. This idea originates, at least, from the time of Plato and Aristotle. In his work, *Phaedo,* Plato argues that the soul is trapped within the material body and is eternal. *Id.* Further, he states that intellect, an element of the soul, is immaterial. *Id.* Plato couched this idea in his belief that everything in the material world, including our bodies, are copies of eternal and perfect Forms. *Id.* Aristotle, though not believing in Plato's eternal Forms also argued for the duality of the soul and body. *Id.* Aristotle suggested that intellect is immaterial because, if it was embodied in a physical organ, it would be limited to perceiving only certain kinds of material objects, just as our eyes can only see light waves and not sound waves. *Id.* Modernly, the body/soul duality controversy continues. Interestingly, quantum physics has shown us an unexpected link between our conscious mind and the physical world. Specifically, "particles occupy multiple states and multiple locations at the same time [in a state of superposition]. DANIEL N. ROBINSON, CONSCIOUSNESS AND ITS IMPLICATIONS 23 (The Teaching Company Limited Partnership 2007). The very act of measurement [observation] 'collapses' these to a single state, namely, a now specifiable single location and state." *Id* (citation in original).

possibility that the two events share some underlying characteristics. Quantum Physics has become more and more linked to everyday events,[58] because many events in Nature share similar traits.[59] The stock market is not such a natural object because it lacks physical materiality. But could it be that it is not the materiality that makes objects natural, but the interaction of them with the rest of the Universe?[60] The amalgam resulting from the interplay of all things links everything into an inter-related whole, each part of which shares some similar characteristics. Then, anything that comes into contact with something else can assimilate some distinctive quality. The stock market is in constant contact with people, reflecting their inherent conditions. Therefore, there is the possibility that the stock market follows the curve we described because it too is a natural object, and all natural objects follow the same path. Our theory tends to be encompassing, instead of separating. It is unifying instead of divisive. It is inclusive, instead of selective. But with such wholeness comes an equal amount of uncertainty.

But in that event, is the distinction between an object behaving like a conscious organism and that object being a conscious organism actually relevant? After all, analogizing the market to a conscious being or a conscious being to the market has the same result, for both are natural objects and both follow the same path. The difference lies in our ethical dilemma in interacting with it, but not in the behavior of the system itself.

This dilemma may even be more complex than at first thought. For comparative purposes, we like to give the example of a two-dimensional stick figure. He lives in a two dimensional world defined by an eight by ten piece of paper. His reality is defined by such piece of paper. He can move up, he can move down and he can move sideways, but there is no concept of depth and of a three-dimensional world. Suddenly, we come along and draw with a pen a mark on the paper. All he sees, all he is able to see, is the appearance of the mark. He can theorize why and how that mark appeared. He can make a very plausible theory, something which in his world works and makes sense. However, from our perspective, we know that his theory was not the case. The problem is both that he is unaware of a third dimension, because he has no personal experience of it, and also that he has no intellectual ability to imagine a third dimension, because it is outside the realm of what is physically possible.[61] Just try to imagine a fourth

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[58] "Quantum mechanics . . . govern[s] all physical systems." SETH LLOYD, PROGRAMMING THE UNIVERSE (First Vintage Books Edition 2007). In fact Dr. Seth Lloyd, professor of quantum mechanics at MIT, believes that the whole universe can be explained through quantum mechanics. *Id.* at 3. He argues that the universe is like a giant computer, which started with the big bang and whose computations has lead to life, consciousness, society and thus even the stock market. *See generally id.* Thus, by better understanding quantum physics we can better understand the emergent characteristics of complex systems like the stock market. *See id.* at 9.

[59] In fact, some scientists are attempting to develop quantum models of the mind to understand how "higher mental facilitates, like artistic ability, morality, and spirituality" arise as emergent phenomena from the interaction of individual neurons. Marshall, *supra* note 3, at 300.

[60] At the very least, Einstein's famous equation $E=MC^2$, provides the equivalence of matter energy, and superstring theory theorizes that everything in the universe is made up of vibrating strings of energy. *Id.* at 339-40.

[61] This example is analogous to the twenty-six dimensions theorized by superstring theory. Superstring theory hopes to unify Einstein's laws of the macroscopic- people, planets etc- with the quantum mechanical laws of the microscopic. Marshall, *supra* note 3, at 339-41. However, this theory requires there exist at least eleven spatial dimensions, which we cannot understand, outside of

material dimension[62] in our world. What would it be? Where would it be?

This paper does not advocate that there is a fourth material dimension, or an outside conscious being running the stock market. What we are trying to get across is that our understanding is limited by our experience and our knowledge. Our physicality limits us. We are part of the system we are trying to analyze. Because of this, we are part of the error. In order to fully look at the market,[63] we must remove ourselves from it. But once we remove ourselves, the system changes or disappears all together. It is this paradox that makes the prediction of systems in which we are included impossible.[64] Even with all possible variables accounted for and sufficient computing power, a prediction assumes a fixed pattern. This necessarily implies the voidance of a self and of consciousness. That is a step we are not willing to take.

When we analyze a system like the stock market, we must realize that we are also looking at ourselves in the process. Gone are the days of mechanical prediction and certainty in the world of physics. Why should other aspects of our lives be different? All we can produce are possibilities. As Professor Feynman said: "Much of our knowledge must always remain uncertain. The most we can know is in terms of probabilities."[65] The analogy is that the stock market is a product of ourselves, but more in the sense of it being a child instead of a machine.

E. A Step Beyond: From Physics to Philosophy

If we are part of the market, then it is a feasible conclusion that the market itself may display certain characteristics of us. There are only two possible conclusions for the results we have obtained in our analysis: coincidence or some type of underlying non-reactive movement. Coincidence is really the conclusion of randomness.[66] As we already accounted for that possibility, we shall exclude that conclusion all together.

If the movement is non-reactive, it means that it is not influenced by events from outside its own system. This necessarily implies that it must come from within the system. If it comes from within, the question is whether it is the representation of something "absorbed" by the system, an infusion of sort, or if it is

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mathematics, because we have never experienced more than three dimensions. *See id.*

[62] Here we intend an actual fourth physical dimension, like length, width or height, and not a conceptually constructed dimension like time.

[63] Or any other system in our society, as a matter of fact.

[64] A mathematician, Kurt Godel, proved that we cannot describe all truths of any system from within it. Marshall, *supra* note 3, at 176. In other words, we cannot use any formal system - i.e. any form of math or language - to describe all ultimate truths, because we cannot objectively test the accuracy of the system from within it. *Id.* Quantum physics is a good analogy. This is because, it is theorized that the world exists in a state of superposition of all possibilities and the act of "conscious" observation collapses the world into our reality. *Id.* at 258. Moreover, the type of measurement we take may determine what reality will be manifested. *Id.* Thus, to truly, understand our tangible universe we must be present. *Id.; see also* ROBERT M. HAXEN AND JAMES TREFIL, SCIENCE MATTERS: ACHIEVING SCIENTIFIC LITERACY 69-70 (Anchor Books 1991).

[65] Feynman, *supra* note 26, at 6-11.

[66] By definition, coincidence is "the occurrence of events that happen at the same time by accident but seem to have some connection." Merriam-Webster Dictionary Online, *available at* http://www.m-w.com/dictionary/coincidence.

truly from an independent internal source.

The first argument would imply that some sort of *knowledge* is somehow made part of the system, the stock market in this case. However, the system does not respond to it in a reactive manner. Instead it assimilates it and later releases it. What could this knowledge be? Could it be some type of projection of social consciousness or simply of global information?[67] Is it possible that the more information is freely disseminated and quickly integrated, the more the market will tend to follow the patterns we observed?

The second argument would stretch these questions even further, speculating on whether this release of energy[68] is not even assimilated from the outside, but inherent in the system. Would this mark some form of lower level of self and of consciousness?[69] Would this imply that internal reactions are able to be sustained on their own, even in such an artificial, non-physical and man-made system such as the stock market? This would by far be the most radical conclusion, and also

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[67] One commentator has described collective consciousness as an "infectious or epidemic state of feeling . . . where common functions are being experienced." The authors split the conscious into conscious when acting alone and that when acting with society. Edward Bradford, AM. J. OF PSYCHOL. (Titchener, Granville Stanley Hall 1918). Thus, the struggle to understand market movement as a societal change may be an extension of our own consciousness or a new consciousness we had not before considered. This complex view is starting to dominate our perspective of the world as Newton's linear and reductionist view once did. Marshall, *supra* note 3, at 103. Society no longer views the components of the world and society in isolation but as pieces of a whole with its own character and nature. *Id.* We now realize that complex things like, our brain, society, and as this paper argues, the stock market is more than the elements that comprises it. *Id.*

[68] Again, energy is used very loosely to represent the driving force for unknown market variations. One commentator explains that: "The first law [of Thermodynamics] establishes that the internal energy of a system is equal to the heat added to the system minus the work done by the system. To insist that the term energy is reserved solely to physical forms is simply to assert physicalism, not to establish its adequacy; there could be some sort of mental energy. The first law of thermodynamics is neutral as regards the form of energy." DANIEL N. ROBINSON, CONSCIOUSNESS AND ITS IMPLICATIONS 224 (The Teaching Company Limited Partnership 2007).

[69] Merriam Webster's Dictionary defines consciousness in three parts "a: the quality or state of being aware especially of something within oneself b: the state or fact of being conscious of an external object, state, or fact c: awareness; especially: concern for some social or political cause." Merriam-Webster Dictionary Online, *available at* http://www.m-w.com/dictionary/Consciousness. Though it seems radical, one of the fathers of Chaos theory has stated: "Within fifty to a hundred years, a new class of organism is likely to emerge. These organisms will be artificial in the sense that they will originally be designed by humans. However, they will reproduce, and will "evolve" into something other than their original form; they will be "alive" under any reasonable definition of the word." MICHAEL CRICHTON, PREY (Avon Books 2002) (quoting Doyne Farmer and Alletta Belin). This quote, by Doyne Farmer, explains how life may not be restricted to the organic life forms. Instead, to truly understand what life is, we may have to take a broader look and even realize that life may stem from our creations. For example, some multi-celled organisms are composed of cells that could survive on their own (such as sponges), however, we classify these organisms as one living being. Hazen, *supra* note 20. Thus, just because the stock market is composed of living organisms that can survive on their own (us) this does not mean that it itself is not a living being or at least acts like one. Doyne Farmer and others have used this idea to better model the behavior of the market: One of the most promising directions is to view financial markets from a biological perspective and, specifically, within an evolutionary framework in which markets, instruments, institutions, and investors interact and evolve dynamically according to the "law" of economic selection. Under this view, financial agents compete and adapt, but they do not necessarily do so in an optimal fashion. Evolutionary and ecological models of financial markets is truly a new frontier whose exploration has just begun. J. Doyne Farmer & Andrew W. Lo, *Frontiers of Finance: Evolution and Efficient Markets*, PROC. NATL. ACAD. SCI. USA, Vol. 96, 1991–92 (August 1999).

the one with the most varied consequences. However, the ultimate question remains. If the events we have analyzed in this paper come from within the system, does it mean that the system has its own internal "force" or its own internal "consciousness?"

F. Conclusion: More Questions Than Answers

Our analysis may have begun to peak inside a phenomenon that could have incredible consequences. At this point, we are left with more questions than answers. No matter which one of the above theories are correct, we may be dealing with some type of collective consciousness, which is "projected" onto (or into) a system (the market) or, at the very extreme, we could be looking at another form of consciousness which is not even defined.

What would be the consequences on society? How would society as a whole react if there were to be different forms of existence, even if they were to be simple ones? Is the market "alive"? If so, is anything displaying the same characteristics "alive"? Could this be the case even if there is no material body (as is the case for the market)?

Could this mean that something which lacks a physical body can display behavior which is traditionally tied to humans? Is behavior non- physical? What is more important: that the stock market behaves like a human, or that a human behaves like a material object?

These are important questions that are beyond the reach of this introductory paper. Ultimately, it is clear that the whole of the market is greater than the sum of the parts (complex emergence).[70] Thus, this paper's Integrative Market Hypothesis reveals the importance of appreciating the market as a complex system. A system that mirrors the characteristics of quantum mechanics and our own consciousness more than the linear analysis's we currently apply. Thus, we must step back and realize that when we view the price fluctuations of the market we may actually be peering into ourselves as a manifestation of the fundamental laws of physics.

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[70] A recent book delves into this emergence: "Instead of the usual interpretation of the efficient market hypothesis in which traders extract and consciously incorporate (by their action) all information contained in the market prices, we propose that the market as a whole can exhibit 'emergent' behavior not shared by any of its constituents. In other words, we have in mind the process of the emergence of intelligent behaviors at a macroscopic scale that individual . . . [traders] at the microscopic scale cannot perceive. This process has been discussed in biology, for instance in animal populations such as ant colonies or in connection with the emergence of consciousness." DIDIER SORNETTE, WHY STOCK MARKETS CRASH: CRITICAL EVENTS IN COMPLEX FINANCIAL SYSTEMS 279 (Princeton University Press 2003), *available at* http://books.google.com/books?id=D_pyXKbIhmIC&pg=PA279&lpg=PA279&dq=emergent+behavior+stock+market&source=web&ots=i4WAUhEgUs&sig=cE7Xte1xJanl3W89ezum3PX_ZZE#PPA279, M1.