**Notes**

***From Benoit Mandelbrot***

Markets are Risky – Extreme price swings are the norm in financial markets. Price movements do not follow the well-mannered bell curve assumed in modern finance; they follow more violent curve that makes and investor’s ride much bumpier.

* Trouble runs in streaks – Market turbulence tends to cluster.
* Markets have a personality – Prices are not driven solely by real world events, news and people. When investors, speculators, industrialists, and bankers come together in a real marketplace, a special, new kind of dynamic emerges – greater than, and different from, the sum of the parts. Fundamental process by which prices react to news does not change. Mandelbrot analysis of cotton price over the past century shows the same broad pattern of price variability at the turn of last century when prices were unregulated, as there was in the 1930’s when prices were regulated as part of the New Deal.
* Markets mislead – Patterns are the fool’s gold of financial markets. The power of chance suffices to create spurious patterns and pseudo-cycles that, for the entire world, appear predictable and bankable. But a financial market is especially prone to such statistical mirages. Bubbles and crashes are inherent to markets. They are the inevitable consequence of the human need to find patterns in the pattern less.
* The size of price changes clearly clusters together. Big changes often come together in rapid succession, and then come long stretches of minor price changes. (Trouble runs in streaks)

Price levels/changes exhibit some kind of irregularity regularly. The charts sometimes rise or fall in long waves, or with small waves superimposed on bigger waves. But none of this phenomenon – clusters of volatility, or irregular trends – resembles any of the cycles, waves, or other patterns that characterize those aspects of nature controlled through well-established science. There are no familiar sine or cosine waves, with regular periods. These peculiar patterns cannot be predicted; and so humans who bet on them often lose. Yet there clearly is a system to them. It is as if the charts have a memory of past. If the price changes start to cluster, or the prices themselves start to rise, they have a slight tendency to keep doing so for a while – and then, without warning, the stop. They may even flip to opposite trend.

**Market “Timing” Matters Greatly. Big Gains and Losses Concentrate into Small Packages of Time**

Concentration is common across fields. Look at a map of gold deposits around the world: you see clusters of gold mines – in South Africa and Zimbabwe, in the far reaches of Siberia and elsewhere. This is not total chance; millennia of real tectonic forces gradually worked it that way. Understanding concentration is crucial to many businesses, especially insurance. A recent study of Texas, Louisiana, and Mississippi found 90% of the claims came from just 5% of the insured land area.

In a financial market, volatility is concentrated, too. The data demonstrates this. From 1986 to 2003, the dollar traced a long, bumpy descent against JPY. But nearly half of that decline occurred in just 10 out of 4695 trading days. Put another way, 46% of the damage to dollar investors happened on 0.21% of the days. Similar statistic applies in other markets. In the 1980s, fully 40% of the positive returns from S&P 500 index came during 10 days – about 0.5% of the time. Same can be applied to how most famous investors made big money….their earnings were concentrated on big bets!!

**Forecasting Prices May be Perilous, but one can estimate the odds of future volatility**

Markets are turbulent, deceptive, and prone to bubbles, infested by false trends. It may well be that you cannot forecast prices. But evaluating risk or profiting from it is another matter entirely.

Markets can exhibit dependence without correlation. The key to this paradox lies in the distinction between the size and the direction of price changes. Suppose that the direction is uncorrelated with the past: ***The fact that prices fell yesterday does not make them more likely to fall today. It remains possible for the absolute changes to be dependent. A 10% fall yesterday may well increase the odds of another 10% move today – but provide no advance way of telling whether it will be up or down. If so, correlation vanishes, in spite of the strong dependence. Large price changes tend to be followed by more large changes, positive or negative. Small changes tend to be followed by more small changes. Volatility clusters.***

**In Financial Markets, the Idea of “Value” has Limited Value**

Value is a single number that is a rational, solvable function of information. Given a certain set of information about an asset – a stock, a bond, or a commodity – everybody if equally well-placed to act will deduce it has a certain value, they will hang the same price tag on it. Prices can fluctuate around that value; and it can be hard to calculate. But value, there is. It is a mean, an average, something certain in a chaos of conflicting information. People like comfort of such thinking***. There is something in the human condition that abhors uncertainty, unevenness and unpredictability. People like an average to hold onto, a target to aim at – even if it is a moving target.***

***The prime mover in financial markets is not value or price, but price differences; not averaging, but arbitraging. People arbitrage between places and time. Full understanding of multifractal markets begins with the realization that mean is not golden.***