(R)EVOLUTION OF FINANCIAL THEORY

“The difficulty lies not in the new ideas, but in escaping from the old ones”

John Maynard Keynes

How can we explain that in 2008/2009 the global stock markets plummeted ~50% in nine months only to rebound by +60% over the following nine months? Why did investors price in the future earnings of the global stock market at 35 times the market price at the height of the TMT bubble, while the same multiple reached a low of 10 in March 2009? Can these swings be reconciled with the theory of the rational investor or are the global stock market and its participants irrational? Market participants and academics alike have struggled with finding answers to such questions. Over the years numerous potential explanations have been propagated. In this white paper we attempt to disentangle the most prevalent theories used to account for the ups and downs on the global stock market. Which theories (or maybe rather ideas) are most commonly brought forward, what is their core message, and which practical implications do they entail for the investment community? And last, but crucially, do any of these theories stand the test of reality?

EFFICIENT MARKET HYPOTHESIS

When discussing financial market theories the elephant in the room is of course the Efficient Market Hypothesis (EMH). In combination with modern portfolio theory it provides the foundation not only for most Finance 101 courses, but also for the supposedly more market-orientated CFA curriculum. What does the EMH state and how does it attempt to explain the behaviour of the global stock market?

Most credit in regard to the mathematical seeds of the EMH is usually given to the Chicago-school behemoth Professor Eugene Fama, who in his dissertation published in 1965 was the first to convincingly argue that the stock market follows a simple random walk. Were this assumption to hold, the prediction of stock market returns would be rendered into an endeavour destined for failure. Five years later Fama published his landmark work Efficient Capital Markets: A Review of Theory and Empirical Work in which he extended and refined the theory underlying the EMH. In this context one must also mention the work of the leading thinker of twentieth century US economics; in parallel and independent from Professor Fama’s research, Professor Paul Samuelson published the first rigorous mathematical proof for the EMH (1965).
In its purest form and in combination with the original work on Modern Portfolio Theory by Professor Harry Markowitz – like Samuelson, also a Nobel Laureate –, EMH states that the global stock market is informationally efficient in the sense that market prices rationally and instantaneously reflect all available information regarding a stock’s value. As a result, market participants cannot systematically achieve a risk-adjusted excess return by trading on publicly available information. These conclusions follow from the assumptions that all individual market participants base their actions on a set of rational preferences and that the stock market aggregates information efficiently. Put bluntly, in aggregate investors are always right. For a global equity investor the theory implies that one should not put effort into taking active investment decisions, but rather always invest in a portion of the entire, efficiently priced, market. In the case of the global stock market, the weighting of the individual positions should reflect their market value in proportion to the value of the total market.

One cannot deny that the EMH is based on a very solid and mathematically rigorous footing. However, when testing its assumptions and resulting implications empirically, the disconnect to the reality observed on the financial markets quickly becomes apparent. For instance, it has proven false to assume that investors possess perfect conditional foresight, a cornerstone assumption of the EMH. In reality, investors make mistakes. Realized volatility is roughly four times the predicted level. This high level cannot be explained within the EMH framework, where volatility only arises due to exogenous events, e.g. news about the fundamentals of a company. Perhaps most importantly, while mathematically elegant to handle, in reality stock markets do not really follow a random walk. This much seems evident even by a precursory glance at a performance chart of the global stock market over the past 40 years. Even the sternest believer in the EMH must have difficulties not to see the clear bull- and bear market cycles.

However, if one does not want to rely on the naked eye only, there is more than enough empirical data that backs up this observation. If stock markets were to follow a random walk, equity returns would be serially uncorrelated. The chart below depicts the rolling first-order autocorrelation coefficients for returns of the MSCI World Index. If the market were to follow a random walk, these coefficients would be close to zero. However, we can observe that – at times – the correlation is significantly different from zero. Thus future returns can – to an extent – be predicted simply by observing current/past return patterns. Furthermore, based on this data, the widely held belief that markets have become increasingly efficient over time, i.e. that they exhibit a more random pattern, can also be rebutted.

**Not a random walk down Wall Street**

If one cannot use the efficient market hypothesis to explain how the global stock market behaves, why is it still such a dominant force in academia? Clearly, one reason lies in the compelling and easily understandable logic of the theory. One should also not discount the notion of so called career risk. Imagine having built a stellar academic career by publishing papers propagating the efficient market
hypothesis, only to switch sides and refute your previous findings. One would hope – perhaps a bit naively – that the academia’s ultimate goal is to objectively find solutions to problems, however, at the end of the day, most academics manage their careers in the same way that any profit-oriented market participant does. The renowned trader Victor Niederhoffer tells an insightful anecdote from his days as a Ph. D. Student at the University of Chicago (birthplace of the EMH) when he overheard two professors and a group of graduate students worryingly discuss what to do if their empirical results turned out to be inconsistent with the random walk model they had been propagating. “Don’t worry, we’ll cross that bridge in the unlikely event we come to it”. Even though the average market participant does not assume that the global stock market behaves as modelled in the EMH – a claim corroborated by the outcomes of numerous surveys – they still act according to the theory. Why otherwise would concepts such as tracking error and active share have such prominence? And why do market participants slavishly adhere to a market capitalization-weighted benchmark without really questioning the faulty underlying reasoning? Why is closet indexing so prevalent? We sum up our answer with a quote by the legendary John Maynard Keynes: “It is better to fail conventionally, than to succeed unconventionally”.

**BEHAVIOURAL FINANCE**

Behavioural finance (BF) is the study of the impact of psychology on the behaviour of market participants and the ensuing effect on financial markets. This discipline has gained increasing popularity over the past ten years as academics and investors have scrambled to find explanations for the inconsistencies between the EMH and the empirical data as vividly evidenced by the boom and bust nature of the global stock market. BF postulates the existence of cognitive biases that cloud an investor’s ability to judge an asset’s fair value and/or act on the information in a rational manner. According to behavioural finance, market prices are in large part determined by irrational investors affected by these biases – as opposed to rationally pricing in news about fundamentals as stated in the EMH framework. This implies that market participants can achieve – in EMH terminology – excess returns by taking active investment decisions.

Behavioural finance is founded on insights of psychology. As early as the 18th century, scholars were discussing how psychology explains individual economic decision making and behaviour. However, with the rise of neo-classical economics – a line of thought that sought to reshape economics from a soft and primarily descriptive discipline into a hard science – in the 20th century, the influence of psychological effects lost significance among theoretical economists. Thus it fell on two psychology professors, Amos Tversky and Daniel Kahnemann, to advance the languishing development of financial market theory by bringing behavioural arguments into the discourse. Prospect Theory, developed in the 1970ies, uses cognitive psychology to explain various divergences and inconsistencies in economic decision-making. However, it is the publication of the paper “Does the stock market overreact?” written by Professors Werner de Bondt and Richard Thaler that is often considered as the true starting point of behavioural finance. They apply the findings from Prospect Theory to the stock market and make a case for systematically irrational behaviour by market participants. Investors’ irrationality can best be explained by various cognitive biases; some of the most commonly mentioned are:

- **Loss aversion** – people have a tendency to prefer avoiding losses to posting gains. A loss of $100 generally hurts more than a gain of $100 satisfies. This leads to an increase in risk aversion.
- **Anchoring** – people have a tendency to rely too heavily on one piece of information when making a decision. In the investment world, this bias is best exemplified by equity research analysts, who are notoriously slow at adjusting their views.
- **Mental accounting** – people have a tendency to code, categorize and evaluate economic outcomes. An example of this is the tendency of investors to frame specific investments; these belong to for instance “my trading account” or “my retirement account”.


Money illusion – people tend to think of currency in nominal rather than real terms. Experiments have shown that people generally perceive a 1% pay cut in nominal terms as unfair, whereas they in general do not complain if they get a 1% nominal pay rise when inflation is 2%.

Informed market participants try to exploit the mispricings that arise due to market participants’ cognitive biases. The resulting strategies are summed up by various market anomalies such as the January effect, the calendar effect, the size effect and the announcement effect.

BF’s biggest drawback is that it is not based on and does not constitute a uniform theory, but rather an extensive body of observations on the behaviour of individual financial market participants. It thus cannot adequately be assessed and evaluated as a theoretical premise for explaining how the global stock market functions. Furthermore, the empirical evidence put forward to support behavioural finance concepts is based primarily on experimental studies carried out within the confines of a laboratory setting. Whether such a laboratory setting can replicate real-life decision making is a matter hotly contested by academics and practitioners alike. To sum up, while behavioural finance provides useful insights with regard to the decision-making process at the investor level, it does not put forward any coherent theory to explain the behaviour of the aggregate stock market.

ADAPTIVE MARKET HYPOTHESIS

The adaptive market hypothesis is the newest addition to the body of financial market theories. It stems from research conducted at MIT by Professor Andrew Lo and tries to build a bridge between the efficient market hypothesis and behavioural finance. The first paper on this topic was published in 2004, however, subsequent publications have been sparse. Lo applies an evolutionary argument to fit irrational behaviour into a model of bounded rationality. In contrast to the EMH, the AMH postulates that the level of market efficiency is a time-varying variable and a function of the so-called market ecology. The concept of market ecology among others entails the number of competitors in a market, the scale of available profit opportunities and the adaptability of the market participants. Information therein is used to measure the level of efficiency in a market. As an example, the market for 10-year German government bonds is highly competitive and with an almost unlimited number of market participants also likely to be highly efficient and is therefore expected to reflect most relevant information very swiftly, i.e. there are no real market inefficiencies to exploit. However, a much less crowded market such as emerging market small caps is expected to exhibit a lower level of market efficiency that from to time to time offers mis-pricings that market participants should be able to systematically exploit.

A point of critique of the AMH is that it is still very abstract and qualitative in nature, and no formal framework has (yet) been proposed. At present, AMH is a theoretical concept rather than a fully-fledged theory. There are no quantifiable implications that are testable on real data. Much work still needs to be done for this to change. Furthermore, one could also argue that combining two wrongs does not make a right (on the contrary, maybe rather even squares the wrong…). As neither the efficient market hypothesis nor behavioural finance offer a plausible theoretical footing to explain the behaviour of the global stock market, it is hard to state the case that a combination thereof should provide a solid and convincing alternative solution. Furthermore, as the assumption about rationality or irrationality is of utmost importance, it should be noted that while the AMH makes the distinction between rational and irrational, it is only with the luxury of hindsight that the behaviour of market participants can be deemed to belong to one or the other category.

Although the AMH lacks formal rigour – something its founding father Professor A. Lo readily acknowledges –, its proponents highlight several useful practical implications. As the relation between risk and return is dependent on market ecology, which in itself is a dynamic mechanism, the much debated equity risk premium is considered to be time-varying. Furthermore, the equity risk premium is path dependent as the aggregate risk pre-
ferences of market participants vary through time. As an example, with the composition of market participants experiencing significant changes during the bear market in 2008, aggregate risk preferences are more than likely to have altered during this period. Many of the investors that suffered heavy losses in 2008 probably had exited the global stock market by 2010, leaving a markedly different population of investors today compared to before 2008. For market participants, this means that active decision making in specific market segments can from time to time generate systematic excess returns. To sum up, the adaptive market hypothesis generally considers the global stock market to be efficient, but occasionally, exploitable arbitrage opportunities – related to for instance valuation divergences – do arise.

**THEORY OF RATIONAL BELIEFS**

Rather than bridging the EMH and behavioural finance via an evolutionary mechanism that – at the present – lacks formal rigour and falsifiable implications, Professor Mordecai Kurz from Stanford University has proposed an alternative theory. Kurz has developed a framework in which investors exhibit so-called rational beliefs, i.e. investors are neither irrational as stipulated by behavioural finance, nor dynamically altering between being rational and irrational as assumed by the adaptive market hypothesis. Instead, investors act rationally on beliefs that may turn out to be mistaken. Crucially, Kurz does away with a central assumption of the EMH, that a stationary data generating process underlies the economy. Rather, in the Theory of Rational Beliefs (RB) – developed in a series of papers starting in the mid-nineties – the world evolves in a non-stationary manner over time. In contrast to the EMH paradigm, investors cannot deduce the true structural probability laws governing the economy. Investors bridge the resulting uncertainty by forming beliefs (i.e. a collection of conditional probabilities) over future states. While the true probability distribution of the states of the economy will always remain unknown, the empirical distribution based on the available past is common knowledge. This distribution captures the long term frequencies prevalent in an economy, and a rational investor must form his belief structure in such a way that it can be reconciled with the past empirical data. The RB framework allows for the investor to be both rational (his belief structure does not contradict the past) and wrong (it ultimately turns out to be inaccurate due to structural shifts in the economy) at the same time. Importantly, the beliefs investors form are correlated and fluctuate over time. The resulting endogenous volatility – i.e. the fluctuations that are not driven by exogenous news about fundamental data but rather by swings in investors’ optimism and pessimism regarding future stock market returns – manifests itself in bull- and bear market cycles in the global stock market. Accompanying empirical research carried out at Stanford University documents that roughly 80% of market volatility is explained by the evolution and dynamics of the investors’ correlated (rational) beliefs. By accounting for both endogenous and exogenous volatility, the theory of rational beliefs manages to explain the overall volatility levels as observed in the financial markets. This is in contrast to the EMH, which assumes that 100% of market volatility arises due to exogenous events, as no endogenous volatility exists. By adopting more realistic assumptions about the market and its participants, the Theory of RB achieves a far better fit with the reality observed on financial markets. In EMH parlance, the occurrences of excess volatility, varying equity risk premia or high trading volume are all referred to as “puzzles” as they cannot be reconciled with the EMH theory of rational expectations. By contrast, within the RB framework, these phenomena are no longer “puzzles”, rather they are consequences of the economy’s non-stationarity, the correlated rational beliefs of the market participants and the correction of mistakes.

What are then the practical implications for investors? As markets evolve in a non-stationary manner, informed investors should dynamically adjust their allocation in order to systematically exploit inefficiencies caused by endogenous volatility, i.e. investors’ correlated mistakes. The magnitude – and therefore the potential to achieve supe-
rior returns – of these correlated mistakes is a function of the so called Pricing Model Uncertainty (PMU), a concept developed by US economist Woody Brock. Investors are not only ignorant of the true stochastic process governing the economy, they also cannot be certain about the pricing function that maps prices to the outcomes of the stochastic process. The larger this PMU, the larger the average mistakes made by investors. This in turn results in greater volatility and mis-pricings on the financial markets. The global stock market, which exhibits pronounced bull- and bear market cycles, displays a high degree of PMU. If investors dynamically adjust the allocation to countries and sectors within their global equity portfolio based on the knowledge that the distribution of equity returns is state dependent, they have a high probability of achieving a superior return relative to simple capital weighting as postulated by the EMH. Simply put, instead of investing in the entire market as described by market capitalization, an investor should invest in markets that are in a bull cycle, and avoids investments in markets that are in bear cycles. Furthermore, as changes in the return distribution and the belief structures bear ramifications for the global as well as individual stock markets, this dynamic allocation procedure could be looked upon as a “dynamic passive” strategy.

Taken one step further, the implication of this groundbreaking research is that the concept of active and passive management has to be fully rethought. According to the Theory of Rational Beliefs, a passive investment is not the static allocation as stipulated by the EMH, but actually the “dynamic passive” investment strategy mentioned above. This also implies that in order to generate true alpha, an investor must achieve a superior return to the new “dynamic passive” investment strategy, which is deemed to be the new benchmark.

CONCLUSION

Numerous propositions have been brought forward over the years that attempt to explain the behaviour of the global stock market, but when put under scrutiny nearly all of them (be that EMH, BF or the AMH) do not stand the test of reality. Most of them are quite literally what they imply; namely, theories that work only in a theoretical setting and rely on a plethora of more or less realistic underlying assumptions.

The lion’s share of investor attention has been devoted to the efficient market hypothesis and its various spin-offs. These theories have heavily shaped the financial industry and fostered the emergence of concepts such as value-at-risk, optimal portfolio construction and market capitalization-weighted benchmarking. However, on closer inspection, the EMH does a poor job of explaining how the financial markets behave. The global stock market does not follow a random walk, the equity risk premium is time-varying and realized volatility is significantly higher than predicted by the efficient market hypothesis. Newer approaches such as behavioural finance and the adaptive market hypothesis provide useful insights, but lack formal rigour and can therefore in their current state at best be described as interesting ideas. In our view, the most convincing attempt brought forward so far at explaining the behaviour of the global stock market is the theory of rational beliefs (RB) from Stanford University.

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<tr>
<th>Formal rigour</th>
<th>Empirical validation</th>
<th>Implications for investors</th>
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<tbody>
<tr>
<td>EMH</td>
<td>Yes</td>
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<tr>
<td>BF</td>
<td>No</td>
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<td>AMH</td>
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<td>RB</td>
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Not only does RB tick the boxes in terms of theoretical rigour and the reliance on realistic assumptions, it has also been empirically validated. Compared to the efficient market hypothesis, the theory of rational beliefs (and the implications it holds for investors) is still young, but it is gaining more and more traction within academic circles. This trend is likely to accelerate in the future and will eventually lead market participants to increasingly incorporate the theory’s ideas into their decision making process. However, paradigm changes take their time. For the foreseeable future, suboptimal EMH decision making and EMH based financial products will remain widespread. Ultimately, it is up to
the investor to exploit the so arising opportunities and adjust his behaviour accordingly. In most walks of life it tends to be the early bird that catches the worm – we believe the early movers embracing the theory of rational beliefs stand to benefit.

“Science advances one funeral at a time”

Max Planck

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