www.rsepconferences.com CONFERENCE PROCEEDINGS/FULL PAPERS ISBN: 978-625-99063-1-7/May 2023

Clemens, M. pp.17-37

Observations on Samuelson's Dictum

Michael Clemens
Chief Portfolio Manager, BankInvest Group, Denmark
E-mail: michael.clemens@yahoo.dk.

DOI: https://doi.org/10.19275/RSEPCONFERENCES247

Abstract

The stock market in the form of the S&P 500 is estimated to be inefficient in 13% to 31% of the time since 1963. This is contrary to the theory of efficient capital markets, but in accordance with Samuelson's Dictum, which posits that the stock market is micro efficient, but macro inefficient. I develop a new model to measure potential inefficiency at macro level and question the assumption about efficiency at micro level. Inefficiency in price (P) is driven by earnings (EPS) and/or valuation (P/E). At the peak of the TMT-bubble in 1999/2000, both factors were in play, while only earnings assumptions were inefficient before the Great Financial Crisis in 2008/09. Parts of academia seems to accept a different definition of market efficiency at micro level compared to macro level. At macro level, a standard "price vs. fair value" definition seems to be generally accepted, while at micro level, a relative "price vs. price" definition seems to be broadly used. The latter way of thinking has historically led to significant price bubbles. Numerous examples of stock prices that deviate significantly from their fair value in days, weeks and months and doubtful methods for measuring efficiency at micro level cast doubt about the micro efficiency claim part of Samuelson's Dictum.

Keywords: Samuelson's Dictum, stock market inefficiency, overlapping trend model
Jel codes: G10, G14.

1. Introduction

The economist Paul Samuelson (1915-2009) put forward the hypothesis that the stock market is micro efficient, but macro inefficient. Hence, according to Samuelson, the efficient market hypothesis (EMH) is more valid for individual securities than for stock market at an aggregate level. EMH is a cornerstone within financial theory, cf. Fama (1965, 1970, 1991, 1998). In layman terms, the classical version of EMH suggest that stock prices are unpredictable and that stock prices reflect all available information and do not deviate from the theoretical fair values – at least not by much and not for long.[1] EMH is a theory for both micro and macro levels of the stock market.

Samuelson's Dictum was put forward as a side remark in 1998. He said: *"..we've come a long way .. toward micro efficiency of markets*" and *"..there is no persuasive evidence .. that macro market inefficiency is trending toward extinction*". In a private letter, here quoted from Jung and Shiller (2005), Samuelson elaborates "*modern markets show considerable micro efficiency*" and "*In no contradiction to the previous sentence, I had hypothesized considerable macro inefficiency, in the sense of long waves…in the time series of aggregate indexes of security prices below or above various definitions of fundamental values*". It should be clear that Samuelson with "micro" refers to individual securities and with "macro" refers to broad stock indices such as the S&P 500. It should also be clear that inefficiency is measured against an estimate of "fundamental value".

The EMH rests on several assumptions, which are not always met in practice. One such assumption is the existence of arbitrage. Even if arbitrage is not possible in some cases, most large-cap stocks have close substitutes where arbitrage is possible. It is therefore in theory and often also in practice possible to maintain efficiency in the *relative* pricing of two large-cap stocks, which are not that different. The stock market does not have any close substitutes,

[1] Fama (1970, p. 388) recognize that it is "*an extreme null hypothesis*" to expect stock prices always to reflect "*all available information*" and do not "*expect it to be literally true*". In Fama (1991, p. 1525) he writes "*Since there are surely positive information and trading costs, the extreme version of the efficient market hypothesis is surely false*". The assumption of unpredictable stock prices requires a constant discount rate. However, allowing for a time-varying discount rate, an "updated" EMH version does not require that returns are unpredictable, see fx. Engsted (2006). The "definition" of efficient markets has evolved over time from *prices reflect all information* and *random walks*, over *martingale process* assumptions to assumptions about *no excess risk adjusted returns*; the latter used by Malkiel (2003, p. 60). Statman (2019, p. 141) operates with two versions of the EMH: a "price-equals-value EMH" and a "hard-to-beat EMH". The former version is a strict "strong form" of efficiency, while in the latter some investors may beat the market consistently, but most cannot.

which makes arbitrage against the whole market more difficult. These observations support Samuelson's Dictum.[2] One reason arbitrage may not always bring stock prices back to efficiency levels is the relative size of the players in the market. The total size of the US equity market was around 50 trillion USD by mid-2022, while the total hedge fund industry had around 5 trillion USD in capital, all of which was not allocated to equities. Hence, it is at least a "1 against 10" fight for arbitrageurs to maintain market efficiency. No wonder it is not always possible.

Another cornerstone within financial theory is that an investor can reduce the total risk of the portfolio through diversification. Risk is assumed either company specific (unsystematic risk) or common to the whole market (systematic risk), cf. Sharpe (1964). The total risk (unsystematic risk *plus* systematic risk) is therefore lower for the market portfolio than for the average individual stock, as uncorrelated unsystematic risk "cancel out" as the number of stocks in the portfolio grow. Therefore, all-other-things-equal, it should be easier to make predictions about the whole market than for individual stocks – as posited by Samuelson's Dictum.

Samuelson's Dictum raise the question of whether the whole can act differently than the sum of its parts. The market is the sum of individual stocks and intuitively, the hypothesis is self-contradictory. It is not the ambition to prove or reject the hypothesis but to introduce a new method to measure potential inefficiency at macro level and to point to weaknesses in the claim of efficiency at micro level.

2. Literature review

Not much literature deals directly deals with Samuelson's Dictum, albeit among others Jung and Shiller (2005), Easton and Kerin (2010), Bernard and Verhofen (2011), Baker *et al* (2014), Singh *et al* (2015), Mangee (2021), Glaserman and Mamaysky (2021), De la O *et al* (2022), Guzman *et al* (2022) and Gârleanu and Pedersen (2022) take the subject under consideration. The literature on EMH is vast and I will only scratch in the surface of that in the following. Focus will be on the US stock market as the model developed later will be for the S&P 500 Index. The evidence and arguments presented may therefore not apply to other stock markets - emerging and frontier markets in particular.

Jung and Shiller (2005) look at 49 US companies with a long dividend history and analyze whether the dividend-price ratio can predict future dividend growth. They conclude that this is the case at the individual company level, but not for a portfolio made up of all 49 companies. They conclude that this supports Samuelson's Dictum.[3, 4]

Easton and Kerin (2010) take a closer look at the Great Financial Crisis (GFC) of 2008/09 and conclude that this event add evidence to the claim, that the stock market may, at times, be inefficient at macro level. They also make the important observation, that regulatory intervention against perceived inefficiency at macro level, such as short-selling ban, may hurt efficiency at micro level.

Bernard and Verhofen (2011) finds that a portfolio of different asset classes creates out-of-sample positive excess return when the portfolio is constructed with value and momentum weights, respectively. They therefore conclude that capital markets are inefficient at macro levels, in accordance with Samuelson's Dictum.

Baker *et al* (2014) analyze the low-risk anomaly from a Samuelson's Dictum perspective, dividing the anomaly into micro and macro effects. They conclude that the low-risk anomaly has both macro and micro level components of almost similar magnitudes. Hence, their conclusion supports the macro level inefficiency claim of Samuelson's Dictum but goes against the claim of micro level efficiency.

Singh *et al* (2015) analyzes seven developed and seven emerging stock markets for the period 2003 to 2014. They run a battery of tests and conclude that Samuelson's Dictum *"largely holds true in the present context"*. I see a couple of problems with their research design and conclusion, though. Firstly, at micro level they use broad common stock indices such as the S&P 500 and FTSE 100, which in the traditional view of Samuelson's Dictum are seen as macro level. Secondly, their conclusion about macro level inefficiency (all 14 countries) is solely driven by inefficiency in emerging markets, while large developed markets such as the US and the UK are seen as efficient and hence not in compliance with Samuelson's Dictum.

[2] Only when assuming a relative definition of efficiency at micro level. More about this later.
[3] In this context it is important to distinguish between whether D/P (dividend-price ratio) can predict changes in D (dividends), or changes in P (share prices). If D/P can predict changes in D, then the market is deemed efficient, but if D/P can predict changes in P, this goes against the random walk theory, and the market is deemed inefficient.
4 Goddard *et al* (2008) survey 103 non-financial UK firms over 34 years to 2003 and reports*:"…our empirical results, based on firm-level data, appear to be somewhat more supportive of the present value model than those of several previous studies that were based on aggregated stock price and dividend index data."* Hence, their analysis support Samuelson's Dictum at micro level.

www.rsepconferences.com CONFERENCE PROCEEDINGS/FULL PAPERS ISBN: 978-625-99063-1-7/May 2023

Mangee (2021) explain Samuelson's Dictum by referring to the term uncertainty, which in economic theory is not the same as risk.[5] Mangee argue that uncertainty in the form of unexpected news at macro level creates ambiguity and obfuscates investors formation of expectations, which broadens the possible range of outcomes and leads to greater inefficiency in stock prices at macro level. On the other hand, uncertainty (unexpected news) at micro level often has a more relevant information content, which narrows the possible outcomes and leads the greater efficiency in stock prices at micro level.

Glasserman and Mamaysky (2021) develop a model in which investors chose to specialize in either micro level information, macro level information or select to remain uninformed (noise traders). The model assumes asymmetric information costs, with higher costs for micro level information than for macro level information. Their conclusion is in line with Samuelson's Dictum, which might seem surprising given the higher costs of micro level information search. However, they argue that it is exactly those higher costs that in their model keeps noise traders away from this activity and leads to greater efficiency in stock prices at micro level. Casual observation of individual stock trading activity, however, cast doubt on that latter conclusion and the implied assumptions that noise traders do not operate at individual stock level.

De La O *et al* (2022) analyze all US common stocks in the period 1951 to 2020 and finds that in the cross-section, valuation ratios such as price-earnings or price-book ratios predict future returns better than future earnings growth in a ratio greater than 2:1. This goes against the claim of micro efficiency in Samuelson's Dictum.

Guzman *et al* (2022) conclude that innovations in ETFs have improved the transmission of macro level information to sector level and to individual stock level, and hence improved macro efficiency over the past 20 years. They use daily observations and the R^2 metric as a measure of information efficiency (more on R^2 later) and conclude that the increase in both stock level R^2 and sector level R^2 over the past 20 years is a sign of improved transmission of information from the "market level" to "sector level" and then to "stock level". Their conclusion about ETFs (passive investment) improving macro level efficiency stands in contrast to other authors, including DeLisle *et al* (2017) and Gârleanu and Pedersen's (2022). Their interpretation of higher R^2 on both individual stock level and sector level as a measure of improved market efficiency, also appear out of sync with the general assumption that low R^2 is a sign of price efficiency, while high R^2 is a sign of price inefficiency.

In Gârleanu and Pedersen's (2022) model, active investors will reduce potential micro level inefficiency at a greater extent than they will reduce macro level inefficiency. Their model also indicate that lower information costs reduce potential market inefficiency, but more so at macro level than at micro level. On the other hand, a larger number of passive investors increase inefficiency on macro level. All-in-all, Gârleanu and Pedersen's (2022) results are close to the implications indicated by Samuelson's Dictum.

2.1 Traditional tests of market efficiency

It serves no purpose to go through a review of the extensive literature on tests of EMH; see fx Lekovic (2018) for a good review of the testing arsenal and Degutis and Novickyte (2014) and Jovanovic (2018) for an excellent "history lesson" on the development of the EMH. Despite results pointing in many directions, fact remains that EMH is still the preferred benchmark as it is "operational", unlike alternatives such as The Adaptive Market Hypothesis (Lo, 2004) or various behavioral finance models of market behavior. As Fama (1998, p. 284) states, "*Any alternative model has a daunting task."* This is despite the built-in contradiction in the EMH as pointed out by Grossman and Stiglitz (1980): the market will only be efficient if it reflects all available information, but investors will only search and analyze that information if it is profitable. However, in an efficient market, there is no such thing as profitable trades and we end up in a catch-22 situation, which has inspired to much research in decades.

Fama (1991, pp. 1576-1577) divides test of EMH into three categories:

- Test for return predictability
- Event studies
- Test for private information

Test for return predictability analyze to what extent certain variables such as dividend-price ratio, P/E, etc. can predict future returns. Generally, valuation ratios such as P/E cannot predict short-term returns but works better on longer horizons. Cochrane (2011, p. 1048) shows this very clearly with much better statistical results for 5-year

[5] In economic theory, risk can be quantified (known probability distribution), while uncertainty cannot (unknown probability distribution).

regression of returns on D/P than for 1-year regressions. Campbell and Shiller (1998) is a seminal contribution in this genre, which stretches at least back to Nicholson (1960) and Basu (1977). Some evidence, however, suggest that return predictability might disappear after the academic publication, see among others Schwert (2002) and McLean and Pontiff (2016). While the original return prediction studies questioned the EMH, the results of McLean and Pontiff suggest that "market forces" erode the anomalies over time, which support the EMH. A large problem in this kind of studies is time variation in the discount of the market; see fx Cochrane (2011) on this subject. Changes in transaction costs, inflation, tax rates and other legislation may change the markets view of what constitute a "fair value" D/P or P/E (effectively discount rate), see Clemens (2015). However, even if there are fundamental (rational) explanations for some time-variation in the market's discount rate, variation outside a "reasonable bound" might be a sign of market irrationality. For studies involving D/P it is a problem that the dividend pay-out ratio may not be constant over time and hence influence long-term time series results. One important piece of legislation in this regard is the rule 10b-18 from 1982, which practically made share repurchases legal and changed corporate pay-out policy in the decades following. This regulatory change made D/P less dependable as a as a forecasting variable. Lettau and Van Nieuwerburgh (2008) concludes that the relation between return and price ratios (D/P or P/E) is unstable over time.

Testing for serial dependence of returns, a run tests may be used.[6] Sewell (2012) conduct run test for the Dow Jones Industrial Average over the period October 1928 to March 2012. Run tests are made for daily, weekly, monthly, and annual return. The results show that daily returns are not independent and hence, the EMH is rejected. As the measurement period lengthens, the more efficient the market appears to be.

Another way to test return independence is autocorrelation tests, which goes at least back to Fama (1970). Sewell (2012) provides a good summary of the literature and finds that the DJIA Index is inefficient for autocorrelation studies on monthly and annual basis, while not for daily and weekly returns. For the market to be efficient, autocorrelation, at any lag, should not be significantly different from zero. Seminal contributions such as De Bondt and Thaler (1985) and Jagadeesh and Titman (1993) show negative autocorrelation in returns on 3-5 years horizon and positive autocorrelation on 6-12 months horizon. On more shorter horizons, Lo and MacKinlay (1988, 1990) generally found negative autocorrelation for individual stocks and positive autocorrelation on index level on weekly holding periods, while on monthly holding periods, they find varying results, depending on the data. Generally, the autocorrelation studies points to weakness in the EMH at both micro and macro level.

Sewell (2012) conducts one autocorrelation and two run tests (simple run test and more sophisticated run test) on daily, weekly, monthly and annul basis for the DJIA Index; a total of twelve (12) tests (three tests each over four time horizons). Out of these twelve (12) tests, Sewell conclude that five (5) or 42%, show that the market is inefficient; autocorrelation on monthly and annual basis, while run tests suggest inefficiency on daily and weekly basis.

Variance bound and variance decomposition tests also look at the "predictability" of the stock market. Shiller (1981) demonstrated that the stock market (S&P 500) was much more volatile than what (subsequent) fundamentals (dividends) would suggest. This translates directly into inefficiency at macro level. However, Shiller assumed a constant discount rate and relaxing this assumption result in more mixed results regarding excess volatility and inefficiency, cf. Bollerslev and Hodrick (1992, p. 4). Campbell (1991) found that at an aggregate level, only between one third and half of the variance of future stock returns is explained by news about cash flows, while the remainder is explained by news about expected returns (i.e. discount rate). This also suggest inefficiency at macro level. Voulteenaho (2002) demonstrate that firm-level stock returns are mostly driven by news about cash flows, which supports the claim of efficiency at micro level.

Event studies looks at stock splits, ex-dividend day effect, index inclusions, etc. These studies are typically test of micro level efficiency. Event studies are typically done over short time periods (days, weeks), over which the expected return is close to zero, minimizing the issues of the joint-hypothesis problem, cf. Fama (2014, p. 1470). For ex-dividend day studies, the general conclusion is that stock prices fall less than suggested by the dividend and that this is not fully explained by fundamental factors such as taxes; see Clemens and Johnsen (2016) for a review of the literature.[7] Shleifer (1986) reports on index inclusions into the S&P 500 and found significant and

[6] Compared to autocorrelation tests, which test for linear dependence between returns, run tests can detect both linear and non-linear dependence, but loses the information of the size of the return as the test "only" look at whether the return is positive or negative, Sewell (2012, p. 167).

[7] Bali and Hite (1998) explain the less than dividend size drop in the share price with discrete "tick multiples", while dividends on the other hand are essentially continuous. Earlier studies, fx. Elton and Gruber (1970) focus on the unfavorable tax treatment of dividends over capital gains and claim that the tax burden was already discounted into the share price, which then should fall less on the ex-dividend day.

non-transitory excess return. A decade later, Beneish and Whaley (1996) found almost similar results. Barberis and Thaler (2002, p. 10) report that Yahoo jumped 24% in a single day, on news that the stock was added to the S&P 500 Index. This of course contradicts with the EMH and Samuelson's Dictum claim about micro level efficiency. Wilkens (2022) provide a summary of possible theoretical explanations of the index effect.

Test for private information includes surveys on whether company insiders (CEOs, board members, etc.) earn excess profits on their trading in company shares and whether professional active fund managers can outperform the market or not. The trading of insiders is a micro level test of efficiency, while the performance evaluation of professional fund managers may be seen as both a macro-, and a micro level test of efficiency.

Early studies by Jaffe (1974) and Finnerty (1976) show that insiders outperform the market in their trading of company stocks. This indicates that the market is not (or rather was not at that time) efficient (at micro level), at least not in the *strong form* of efficiency. More recently, Karadas (2019) report that powerful members of Congress earned high abnormal return over the period 2004-2010 using nonpublic information. These abnormal returns disappeared with the implementation of the "Stop Trading Congressional Knowledge" Act (STOCK Act) in 2012.

The literature about whether active managers can outperform the market is large. Most of the early literature from Jensen (1968) up to Carhart (1997) suggest that active managers cannot outperform the market. However, costs play a large role in these surveys. Fama and French (2010) finds that the return of the average mutual fund is in line with the market return before costs, but below when taking costs into consideration. The usual interpretation of this and similar findings is that the (stock) market is sufficiently efficient to prevent profit over and above the costs of finding and processing information.

All studies of this kind are however subject to the joint-hypothesis problem, which suggest that when testing the EMH by way of risk-adjusted returns, both the EMH and the asset pricing model (CAPM or multi-factor) are tested at the same time. In studies from the 1960s and 1970s, adjustment for risk was done according to the Capital Asset Pricing Model. Murphy (1977) refers to a study in which an active manager outperformed benchmark by 2.19% per annum over a 20-year period. Most active managers would be extremely satisfied with such a performance. Only problem though, the alpha (2.19% p.a.) was not significantly different from zero. In the survey Murphy refers to (Jensen, 1968), only one fund out of 115 had a significant positive outperformance, and that fund beat its benchmark by 5.82% per annum over a 14-year period. The problem according to Murphy is that risk-adjustments is itself uncertain, which is why the risk-adjusted returns becomes uncertain.

In the time between Jensen (1968) and Carhart (1997), the proponents of the EMH adhered to the old adages "If you can't beat them, join them" and "Keep your friends close, but your enemies closer". Several so-called anomalies such as size effect, value effect and momentum effect were at first evidence against EMH but have been "embraced" as risk factors, see Fama and French (1992) and Carhart (1997). Hence the standard against which excess performance and hence market efficiency is measured has been gradually raised, making it more difficult today to report risk-adjusted excess performance compared to early studies that had zero or one-factor risk-adjustments. This "embracement of disagreements" is one of the reasons that EMH is still very much the "gold standard" in financial theory, partly because it works well most of the time and partly because useful alternatives are lacking.[8]

As mentioned, the norm has now become to adjust for risks through a 3-facor or 4-factor model, see for example Harvey and Liu (2022). The return that cannot be ascribed to one of these risk factors is called alpha and should be significantly higher than zero to be classified as positive risk-adjusted return. However, using a factor-model that includes a small-cap factor on performance measurement for mutual funds that have the S&P 500 Index as a benchmark, may be a misrepresentation of the true benchmark.

A larger problem, perhaps, is the implied assumption of using for example the 4-factor model and perhaps even simulation-based return analysis in the assessment of "luck versus skill" is that performance achieved through factors such as beta, size, value and momentum over a long period (say 10 years) is more or less "a given thing" and does not require "skill". The problem with that view is that investing is made *ex ante*, while performance measurement is made *ex post*. Furthermore, the more variables (factors) that are included in the risk-adjustment, the higher becomes the "risk explained" part of the return and the lower the alpha.

Cremers *et al* (2019) takes a fresh look at the literature in the 20 years after Carhart (1997). Their conclusion is that the conventional wisdom that active managers do not add value paints a too negative picture of the mutual

[8] Pasricha and Dhanda (2022, p. 104) support this view as they conclude: "*Thus, the efficient market hypothesis will continue to be accepted as one of the finest theories in the literature of finance till behavioral economists present any such concrete theory*."

fund industry. In the years since Carhart, the mutual fund industry has undergone significant changes, including reduced cost of active management, reduced trading activity among active managers and reduced trading costs. Since 2000, the average cost of active mutual funds in the US have fallen by 38bp from 106bp to 68bp in 2021 (Investment Company Yearbook, 2022). All-other-things equal, this should improve active managers chances of producing positive alpha net of costs. Cremers *et al* (2019) provide a deep dive into the many issues of interpretating performance analysis of mutual funds, including the (alternative) costs of holding cash to support daily liquidity requirements and the reverse survivorship bias, which "*…occurs when funds close due to poor performance driven by bad luck rather than low skill*" (p. 12). Linnainmaa (2013) estimate this effect to add around 60bp to the average fund alpha in databases that included so-called dead funds to exclude survivorship bias. If we add 98bp (38+60) to the average fund performance in Carhart (1997), who knows what the conclusion would have been?

Even though some managers may exhibit skills and persistence, the average manager cannot escape the mathematical fact, that when the sample size becomes sufficiency large, the average of that sample will convert towards the population average. This is also the logic behind Sharpe's Arithmetic of Active Investing, cf. Sharpe (1991). Although private investors according to Barber and Odean (2013) and Pedersen (2018) might be a source of alpha to professional active managers, this may not be enough to change the overall conclusion.

3. Model to identify potential inefficiency at macro level

According to the EMH, share prices oscillate around the unknown fair value: $SP_t = FV_t + e_t$, where SP = Share Price, FV = Fair Value, and e = Random deviation of share price from fair value with a mean value of zero and constant variance. Only when e_t becomes too large (positive or negative) for too long, the market may be deemed inefficient. Hence, a model for estimating FV_t is needed to identify when the market may be inefficient.

The model developed here is for the S&P 500 Index as a proxy for "the market", since this is where the best data is available. Data is month-end prices for the S&P 500 Index from January 1963 to December 2022 - a period of 60 years. Regardless of the choice of "efficient market model", deviations between actual stock prices and the fair value estimate produced by the model should show large deviations at times of well-known peaks and troughs in the market, such as the peak of TMT bubble in 2000 or the bottom of the market in 2009 after the GFC. The model used here is a so-called ex-post model of the markets fair value. Shiller (1981, 2014) also construct ex-post models of the markets fair value, using real ex-post dividends and a constant discount rate as primary input variables. Shiller (2014, p. 1494) comment that the resulting present value curve of future dividends resemble an exponential function. Instead of going the "de-route" through dividends, the model developed here goes directly to stock prices and create a trend function of stock prices. This approach is independent of corporate pay-out policy (dividends vs. share buy-backs). The trend function then represents the fair value at any point in time. The model is constructed as an "overlapping trend function", which is the average of different trend functions (all exponential) starting and ending at different points in time during the investigated period. Using overlapping trend functions, the implied discount rate is not assumed constant. Significant deviations between this model and actual stock prices can thus be interpreted as inefficiency at macro level.

A: S&P 500 Price Index (log scale)	B: % deviation from Trend Model

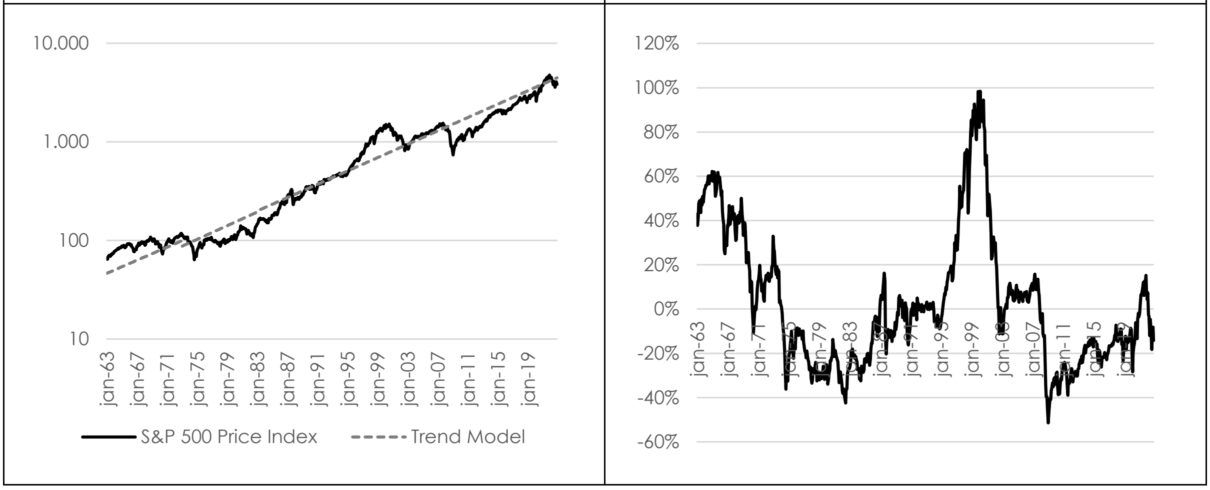


Figure 1: Model for inefficiency at macro level

Source: Datastream, Bloomberg, Shiller database and own estimation.

Note: The Overlapping Trend Model is constructed as the average of three exponential trend functions, each covering 40 years. First estimation period is from 1963 to 2002. The second period starts 10 years later in 1973 and runs to 2012, while the third period starts in 1983 and runs to 2022. Each estimated model is extended forward from their estimation period. The average of the three estimated models is the Overlapping Trend Model. Alternative designs do not change the results significantly. Hence, a simple model is applied here.

Panel B in Figure 1 suggest that the market was overvalued in large part of the 1960s (Nifty Fifty), undervalued in the latter part of the 1970s/early 1980s (inflation illusion?), significantly overvalued around the millennium shift (TMT bubble), partly overvalued in 2007 (just before the GFC), significantly undervalued in 2009 (immediately after the GFC) and finally partly overvalued at the end of 2021 (ultra-low interest rates).[9] This pattern seems to fit well with consensus assumptions about when the market was "expensive" and "cheap", respectively.[10]

Start	January 1963
End	December 2022
Number of observations (months)	720
Median deviation	3%
Average deviation	-4%
Standard deviation on deviation	30%
Maximum deviation	98% (March 2000)
Minimum deviation	-51% (February 2009)

Figure 2: Basic data on estimated share price model

Figure 2 show basic data about the deviations between the actual S&P 500 Index price and the fair value estimate from the model. As seen, the average and median deviation are close to zero. The maximum deviation is in March

[9] The term Nifty Fifty refers to a group of growth stocks in the 1960s, among others IBM, Pfizer, Coca-Cola, Walt Disney, Gillette, Polaroid, McDonald's, American Express, Walmart, Xerox and many more.
[10] There is a close correlation between the deviation from trend as shown in Figure 1, Panel B and Shiller's CAPE ratio.

www.rsepconferences.com CONFERENCE PROCEEDINGS/FULL PAPERS ISBN: 978-625-99063-1-7/May 2023

2000, close to the peak of the TMT-bubble, which would have been a likely a priori guess. The largest negative deviation is in February 2009, close to the bottom of the market after the GFC, which also would have been a likely a priori guess. I see these data as a validation of the method and the model.

The question about when the market is efficient or inefficient is a subjective matter. Black (1986, p. 533) suggest a factor 2 rule: i.e. anything between -50% and +100% of fair value may be seen as efficient. By this definition, Black suggest that the market is efficient in at least 90% of the time. Using these boundaries on this model, the market has been efficient during 99.9% of the period investigated. That is perhaps a stretch. I believe that the uncertainty in the model in form of the standard deviation of the estimates should be considered, when determining whether the market is efficient or not. Assuming for simplicity that the deviations are normally distributed, the question is then if 1.0, 1.5 or 2.0 standard deviations are appropriate.

No. of standard dev.	No. of months	% of total time	Periods with inefficiency
1.0	220	31%	• Most of 1960s • Parts of 1970s and early 1980s • Late 1990s until mid-2001 • Late 2008 until late 2010 • Periods in 2011 and 2012
1.5	92	13%	• Mid 1960s • TMT-bubble from late 1990s to 2000 • A few months in early 2009
2.0	46	6%	• Nifty Fifty in 1964-1966 • TMT-bubble in 1999 and 2000

Figure 3: Deviation between actual price and estimated price for S&P 500

Using a restrictive definition of 2.0 standard deviations, the market is only inefficient in the middle of the 1960s (Nifty Fifty) and during the TMT-bubble in 1999-2000. This might be a to narrow definition with the GFC, the Covid-19 pandemic, the crash of 1987 and other events in mind. It is therefore likely that the market was inefficient in 13-31% of the time since 1963. For comparison, the well-known investor Jeremy Grantham suggest that the market is irrational about 15% of the time, see Grantham (2022). Kenneth French estimate he is around index 87 on the "efficiency continuum" range from Index 100 (prices are exactly right) to Index 0 (prices are exactly wrong). This leaves Kenneth French allowing for around 13% of the time for inefficiency. French reckon Eugene Fama is around Index 91-92 and Jay Ritter as low as Index 79, see Doukast (2002). Hence, even supporters of behavioral finance (Jay Ritter) believe that the market is efficient about 80% of the time, while the "godfather" of EMH (Eugene Fama) allows for inefficiency 8-9% of the time.[11]

3.1 What drives periods of market inefficiency?

Additional insight may arise by decomposing potential price inefficiency into an earnings component and a valuation component. According to the identity P = EPS • P/E, where P is Price, EPS is Earnings Per Share and P/E is Price/Earnings, any inefficiency in P originate in either EPS or/and P/E.

By using an overlapping trend model much like the one above, it is possible to calculate "Trend EPS" and compare this estimate to the actual expected EPS. Periods with large deviations should indicate periods with potential inefficiency in the formation of earnings expectations; see Figure 4.

[11] While Fama may be the one who formalized the idea of the EMH and therefore can be considered the "godfather" of the theory, Jovannovic (2018) calls Cootner's (1962) article the "birth certificate" of the EMH.

www.rsepconferences.com CONFERENCE PROCEEDINGS/FULL PAPERS ISBN: 978-625-99063-1-7/May 2023

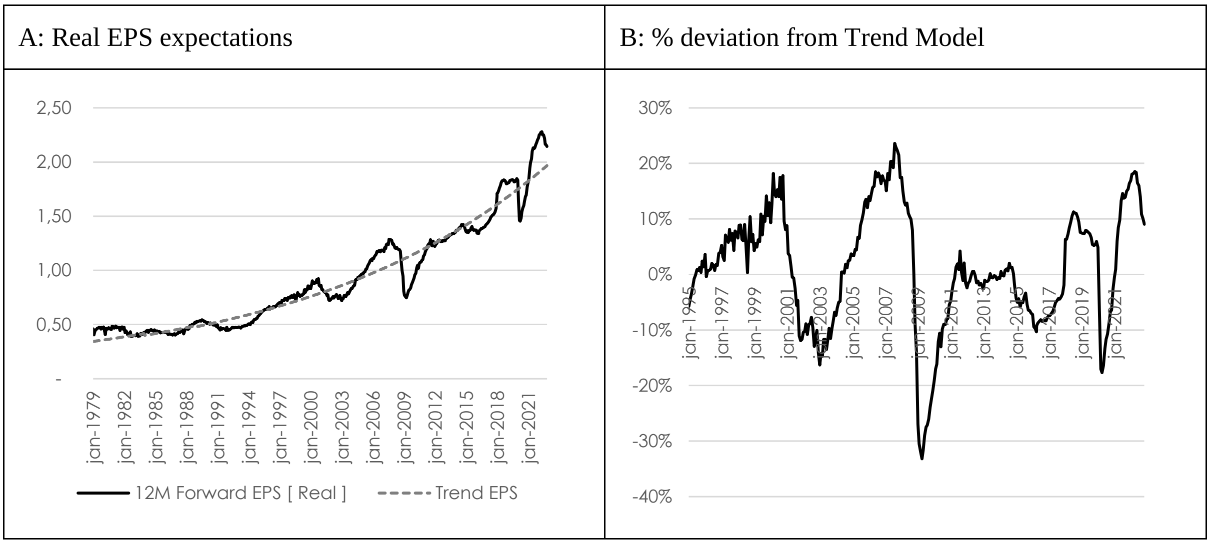


Figure 4: Real EPS and deviation from trend

Source: Datastream, Bloomberg and own estimation.

Note: 12 months forward EPS is deflated by the Core CPI Index as Real EPS is believed to provide a better understanding of the underlying trend in earnings. There are, however, only small differences between peaks and troughs in the real and nominal model. The model presented here is an average of five exponential trend models starting with five-year intervals from 1979. All models are extended forward to 2022. The reason deviation data is only shown from 1995 and not 1979 is to allow for a few exponential models before calculating the average and hence the deviation from trend.

Figure 5 report basic data about deviations between expected Real EPS and the estimated trend (fair) value. Average and median deviations are not far from zero. The maximum deviation is 24% in August 2007, just before the GFC, which together with the TMT-bubble around the millennium change would be likely a priori guesses. The largest negative deviation is in April 2009, just after the GFC, which also would have been a likely a priori guess. Again, I see this as a validation of the method and model used.

Start	January 1995
End	December 2022
Number of observations (months)	336
Median deviation	1%
Average deviation	1%
Standard deviation on deviation	11%
Maximum deviation	24% (August 2007)
Minimum deviation	-33% (April 2009)

Figure 5: Basic data on estimated real EPS model

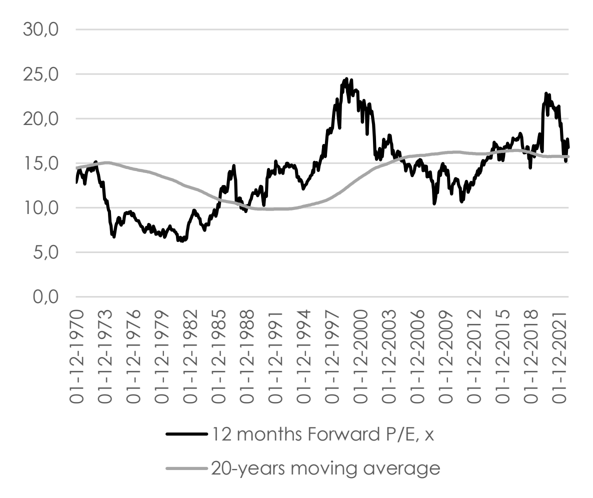
Since the standard deviation of the deviations is 11%, that would suggest that all observations within +/- 11% from the estimated value should be considered periods of efficient expectations. Earnings expectations were least efficient at the start of 2000, start of 2003, summer of 2007, late summer 2009, spring of 2020 and early spring of 2022. This pattern suggest that the model can identify known market peaks and throughs. The full answer to why

www.rsepconferences.com CONFERENCE PROCEEDINGS/FULL PAPERS ISBN: 978-625-99063-1-7/May 2023

expectations become overoptimistic or overly pessimistic should probably be found in the literature on behavioral finance, although the subject is briefly touched on below.

While it is relatively easy to construct trend models for share prices and EPS expectations, it is quite another thing to determine what is "normal" for P/E. This is because changes in investor tax rates, inflation, transaction costs etc. will influence the level of "fair P/E" and potentially cause a structural break in the "normal" level. Therefore, it makes little sense to use very long-term averages (fx 50 or 100 years) to determine "fair P/E". Instead, a 20-year moving average is used here as a proxy for when P/E is normal.

A: 12M Forward P/E



B: % deviation from "normal"

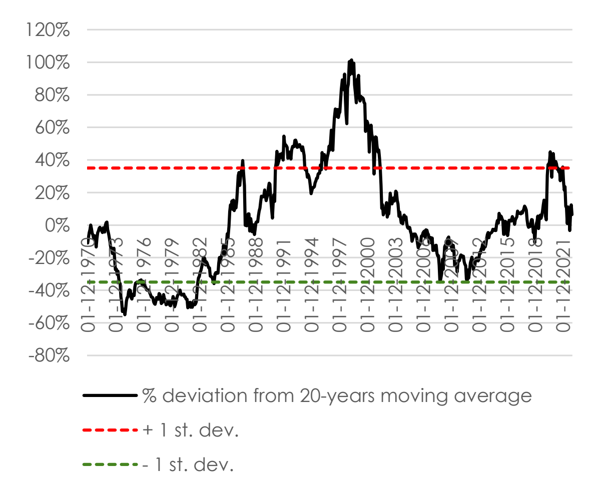


Figure 6: Changes in P/E and deviation from "normal"

Source: Datastream, Bloomberg, Shiller database and own estimation.

Note: Forward P/E is calculated backwards from 1979 (first available data from IBES) to 1950 via correlation analysis between IBES data and Shiller data.

From Figure 6, Panel B, it seems evident that in 1999/2000, P/E was much above what could be expected, given the history of the prior 20 years. Furthermore, it seems that in the latter part of the 1970s and early part of 1980s, P/E was below what was the norm at that time. Interestingly, given the crash of October 1987, P/E in August 1987 just ticks above one standard deviation from the norm. Around the changing of the year from 2020 to 2021, P/E seems to be above the norm for a short while. Another interesting observation is that before the GFC, P/E was around "normal", while the trend model for share prices suggests an overvaluation at that time. Since this overvaluation does not stem from high P/E, it must stem from overoptimistic earnings expectations, which Figure 4, Panel B also suggests.

4. Does academia use another yardstick for efficiency at micro level?

The EMH assumes that price deviations from the true (but unknown) fair value are random and short-lived. This applies to both single stocks as well as the market in aggregate. Different surveys on macro level efficiency seem to adhere to this definition. Surveys on micro level efficiency seems to be another matter though. Easton and Kerin (2010, p. 464), clearly define micro level efficiency as relative efficiency: "*At the micro level, market efficiency is the extent to which the prices of financial securities reflect information relative to other securities within the same asset class; for example, whether BHP Billiton shares are fairly priced when compared with RIO shares..*".[12] Baker *et al* (2014) also point to a relative definition of efficiency at micro level. Gârleanu and Pedersen (2022, p. 392) suggest that efficiency at micro level may be defined as the relative pricing differences between two similar

[12] Easton and Kerin (2010) also "operationalize" market efficiency at macro level to whether the market is priced fairly compared to a less risky asset class such as government bonds. Hence, they suggest either a CAPM-like derived fair value and/or a FED-model approach to valuation at macro level.

companies, and not as absolute price difference between the stock price and its (unknown) fair value. Mangee (2021) also seems to accept a relative definition of efficiency at micro level.

By assuming a relative definition of market efficiency at micro level, the majority of stocks may be pairwise efficiently priced, while at the same time, the whole market may be inefficiently priced. Already Graham and Dodd (1934, p. 359) warned about this line of thinking: *"Instead of judging the market price by established standards of value, the new era based its standards of value upon the market price. Hence, all upper limits disappeared not only upon the price at which a stock could sell but even upon the price at which it would deserve to sell."* We saw the same thing happen during the TMT-bubble in 1999-2000. Among equity analysts and investors, this is called "peer group comparison", which is a useful tool in a relative world, in which beating the benchmark is the goal, but certainly not optimal if the goal is a broader efficient allocation of scarce capital in society at large, in which case absolute efficiency is preferred (defined as share price ≈ fair value).

4.1 Observations about inefficiency at micro level

Inefficiency at micro level manifest itself in several forms. The typology here is my own, as I have not found any in the literature:

- Limits-to-arbitrage and short squeeze
- Twin stocks listed in different countries
- Sentiment "contagion"
- Irrational expectation formation
- Trading on old news
- Event studies

4.1.1 Limits-to-arbitrage and short squeeze

The existing of arbitrage is one of the essential assumptions behind the EMH. In case of limitations, situations can arise in which EMH is put on hold, at least for a while. Short squeeze is closely related and describes a situation, in which an investor must cover a short position but finds that due to low liquidity, the stock price is pushed to unsustainable levels as investors buy stocks to cover their short positions.

A classic example is the spin-off of the Palm Pilot stock from the parent company 3Com; In March 2000, 3Com sold 5% of the stocks in Palm Pilot and kept the remaining 95%. At the end of the first trading day, Palm Pilot had a market value of USD 54bn. The parent company 3Com ended the same day with a market value of USD 28bn. Since 3Com still owned 95% of Palm Pilot, this stake alone had a market value of USD 51bn, which indicated a negative value of the remaining part of 3Com of minus USD 23bn – for a profitable company with a billion in cash. Due to the low free float in Palm Pilot, a likely explanation for this violation of the EMH is limits-to-arbitrage. In the literature, limits-to-arbitrage is seen as one of the most important causes of violations of the EMH, see for example Shleifer and Vishny (1997). Limits-to-arbitrage causes an optimistic bias in the pricing of a given stock as the most pessimistic market participants are prevented from shorting the stock.

Two other well-known examples are the VW (Volkswagen) stock in October-November 2008 and the GameStop stock in January 2021. The VW-stock was at its peak 200%+ above its pre-level, while the GameStop-stock at its peak was 1200%+ above its pre-level. The VW-stock was back to its pre-level after approx. 20 trading days, while the GameStop-stock was (almost) down to its pre-level after 8-10 trading days. Both cases witness significant but short-lived inefficiency in the pricing of the stocks. Both stocks, which had a low liquidity, saw a sudden increase in demand. A reasonable hypothesis therefore is that short squeeze caused the push up in share prices to unsustainable levels. The GameStop case has attracted a reasonable level of academic and regulatory interest, see for example Security Exchange Commission (2021). Evangelos (2022) conduct a run test on the share price of GameStop and conclude that evidence points to a violation of the EMH. Neither in the VW or GameStop case was the financial condition of the companies in such as bad shape that it could justify a near-bankruptcy approach to valuation. Only in highly indebted companies will small changes in firm value cause large changes in equity value (stock price), which may be rational. This was not the case in either VW or GameStop.

4.1.2 Twin-stocks in different countries

For historical reasons and due to ownership structure, Royal Dutch Shell and Unilever, upheld listings in both London and Amsterdam. Rosenthal and Young (1990) document persistent mispricing between the Dutch and UK versions of the twin-stocks. Despite this finding, they conclude that the mispricing cannot be exploited for profitable trading strategies. In contrast, De Jong *et al* (2009, p. 518) fund "…*statistically significant and economically large deviations from theoretical parity"* in their analysis of 12 pair of twin stocks. Hence, different opinions exist on whether the price deviation from parity are significant enough to be deemed a deviation from the EMH. Both Royal Dutch Shell and Unilever have since these articles were published streamlined their group- and ownership structure to eliminate any such mispricing.

4.1.3 Sentiment contagion

Following up on twin-stocks, Froot and Dabora (1999) conclude that beyond transaction costs, sentiment in the local stock market may influence mispricing between twin-stocks listed in different countries. In theory, twin-stocks should be subject to the same sentiment, regardless of country of listing. On a more aggregate level, country specific mutual funds listed in the US seems to correlate more with the US stock market, than with the stock market of the country of origin, while NAV (naturally) varies more with the stock market in the country of origin. Boudurtha Jr, *et al* (1995) conclude that this is caused by sentiment contagion from the US stock market, even though all stocks in the fund are foreign.

4.1.4 Irrational expectations formation

In an efficient market, stock prices are determined by the available information (and a random fluctuating element with a mean of zero and a constant variance). However, in financial theory, we also learn that the stock price today is the present value of all the expected future dividends (or cash flows if that term is preferred), discounted by an appropriate discount rate and growth factor. Expectations about future dividends are formed by the information available today. Hence, expectations are not the same as information.

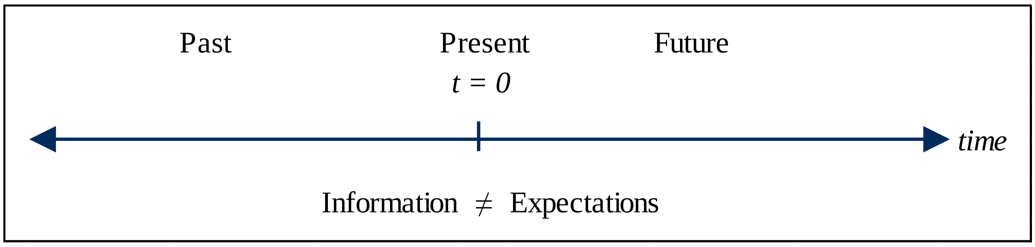


Figure 7: Expectations ≠ Information

Hence, instead of an "EMH formula" of stock prices like $P_t = f(I_t) + e_t$, where P_t (stock price today) is a function of I_t (all the available information today) and e_t is the standard error term, perhaps a more useful presentation would be $P_t = f(E_t) + e_t$, where $E_t = g(I_t) + e_t$; the letters *f* and *g* representing mathematical functions and E_t represent expectations today about future earnings. Combining the two functions, we get $P_t = f(g(I_t) + e_t) + e_t$.

The latter function (g) can be interpretated as the analytical process from gathering (all) available information and making inferences about the future from them. In a world of fake news, social media, etc., not all information is relevant, and in a world populated by people with bounded rationality, the expectation formation process may not always be fully rational. Given this setup, it is hardly surprising that expectations nor stock prices are not always "rational and correct".

Regarding expectation formation, Cornell and Damodaran (2022) use the term "The Big Market Delusion" to describe the process in which expectation formation for young firms goes rouge. Analyzing e-commerce stocks in the 1990s, online advertising stocks in the mid-2010s and cannabis stocks in 2018, they identify three commonalities about the boom and bust of this type of stocks. Firstly, a big market opportunity must exist, either perceived or real – maybe not for current products of the firm, but for imagined future products of the firm. "Real life problems" such as competition is often ignored at this stage. Secondly, overconfidence plays a big role at the owner-entrepreneurs level of many of these companies; an overconfidence that up until their public market IPO only has been supported by their survival (ie. beating the odds of new company failure). This overconfidence is subsequently communicated to the public market during and immediately after the IPO process. The third element is pricing, where analyst and investors often adapt Venture Capitalist type valuation ratios, of which *user or revenue growth* are often the most important variables, regardless of other fundamental variables such as profits and cash flows. In these examples, it was not the information available that caused the boom and bust but it was the process of expectation formation that failed. The Big Market Delusion is by no means only a small firm issue. During the TMT-bubble in 1999-2000, large cap stocks like Ericsson, Nokia, Corning, AT&T and Cisco (just to name a few) reached price levels, which more than 20 years later they have not yet caught up to. Robert Shiller uses the term "new era theories" about the story-telling which purpose is to rationalize "price-to-price feedback" mechanisms that has gone rouge and create a price bubble.

In continuation of the discussion of the TMT-bubble, it is interesting to take a closer look at the so-called dotcom-companies. Besides stocks that went public as a dotcom company, the real interest is to look at "ordinary" companies, which changed their name from XYZ Inc. to XYZ.com. Cooper *et al* (2001) found that companies which changed their name to include dotcom saw an abnormal return of +74% over 10 trading days and that this return was not transitory. Earlier studies of name changes did not show any significant price effects from the name change, see fx Karpoff and Rankine (1994). Either this reaction was caused by market ignorance of the business model before the name change and thereby also ignorance of the online business, while the name changes magically "revealed" this. Or, the name change, *in itself* (to include dotcom), changed the long-term expectations of investors. Either way, the price reaction seems to a violation of the assumption about market efficiency at micro level.

In times of great uncertainty, investors and analysts' expectation formation at micro level may create earnings expectations, that at least ex post, prove irrational. Two recent examples (out of many) may illustrate this: Norwegian company Kahoot ASA and German company Global Fashion Group. At the peak in 2021, both stocks were respectively 500%+ and 600%+ above pre-levels. Due to lockdowns during the height of the pandemic, both companies (both on-line based) showed temporary progress, which did not prove sustainable.[13,14] Hardcore followers of Samuelson's Dictum would argue that this was part of a general "online factor" during lockdowns, and hence the underlying cause was a macro inefficiency and not a micro inefficiency. In fact, an "online macro inefficiency" was probably at play during lockdowns as online giants such as Amazon and Netflix at the peak was some 100-120% above pre-levels, more than double the increase in the S&P 500 Index. In contrast to the examples of inefficiency due to short squeeze, the duration of the inefficiency in these two cases lasted somewhat longer, 9-10 month in the "up phase" and 12-16 months in the "down phase". This is because it takes time to build irrational expectations, just as it takes time for these to phase out.

4.1.5 Trading on old news

Statman (2001) refer to two examples of significant market moves in individual securities on so-called "old news". One example is the biotech company EntreMed, which saw a story about its new cancer drug appear in the New York Times on Sunday, 3rd 1998. The price soared as the result when the market opened on Monday. However, the news was not new, as the information was already published in the scientific magazine *Nature* about five months earlier. Another example is the resurface of the 2002 bankruptcy of United Airlines in the news in September 2008. Statman report that intraday, the stock was down 76% and NASDAQ stock exchange had to halt trading in the stock. Eventually, the trade was reopened, and the stock recovered somewhat. Both examples are probably the result of noise trader activity. Since new noise traders (and new informed traders) are introduced into the market every year and since experienced informed traders leave the market every year, the market has little memory and is bound from time to time to trade on old news.

4.1.6 Event studies

Event studies were discussed above.

4.2 Test of market efficiency at micro level

Test of market efficiency at micro level is often performed though so-called R^2-tests, where the return on one stock is analyzed against the return of the market. Sometimes with risk adjustments according to CAPM or multi-factor model, sometimes without. According to the test method, the size of R^2 is used to judge how much the market and standard factors influence the return of the stock. The lower R^2, the more efficient the stock is priced – according to this line of thinking. The logic is that given a high R^2, it is the systematic risk, which dominated the pricing innovation of the stock, while in an efficient market, it should be the unsystematic risk, cf. among others Morck *et*

[13] Around the beginning of the pandemic on February 28th, 2020, Norwegian investment bank ABG Sundal Collier expected EBIT of +8m and +30m USD for Kahoot in 2021 and 2022, respectively. By November 3rd, 2022, those expectations were reduced to 0m and -1m USD, respectively.

[14] Since both companies were online based, most likely a "Big Market Delusion" effect were at play.

al (2013), who also gives a very good introduction and description about using the R^2 as a measure of market efficiency. The logic *a priory* assumption is therefore that low R^2 is associated with large companies with good research coverage (fast spreading of information) and few limitations to short selling. Campbell *et al* (2001) decompose total firm-level volatility into market, industry, and idiosyncratic volatility. They found that idiosyncratic volatility has increased over the period 1962 to 1997, while this was not the case for either industry-level or market-level volatility. Hence, R^2 for the typical firm has declined over the period, suggesting an improved efficiency at micro level in the spirit of Samuelson's Dictum. That was then. DeLisle *et al* (2017) finds that the increase in passive investments has increased the trading in individual stocks not related to firm-specific news and hence find an increase in R^2 since the early 1990's, pointing to a reduction in micro level efficiency. Bramante *et al* (2015) provide a good summary of the debate of R^2 as a measure of efficiency.

Contrary to what financial theory would suggest, Kelly (2014) found that low R^2-stocks were often young and small companies with low research coverage, high bid-ask spreads, low trading volume and limitations to short-selling. Kelly concludes that these results question the use of R^2 as a measure of efficiency at micro level. Alves *et al* (2021) and Hou *et al* (2013) are likewise critical towards using R^2 as a measure of market efficiency.

4.2.1 Small cap paradox

Roll (1988) analyzed US stocks for the period 1982-1987 and found that both single- and multi-factor adjusted R^2 is lower for small-cap stocks than for large-cap stocks. This would suggest, according to the proponents of the R^2 method, that small-cap stocks are more efficiently priced than large-cap stocks. Kelly (2014) also finds lower R^2 for small-cap stocks than for large-cap stocks.

However, small-cap stocks are different from large-cap stocks (which in effect is *the market*) in many ways, which all violates the assumptions behind the EMH:

- High(er) transaction costs
- Slow, and poor distribution of new information to investors
- Positive risk adjusted excess return for small-cap mutual funds

Roll (1984) found an inverse relationship between market value and trading costs in the form of bid-ask spread. Lesmond *et al* (1999) estimate all-in transaction costs to 10.3% for small-cap stocks vs. 1.2% for large-cap stocks. Griffin *et al* (2010) find the same results regarding analyst coverage and transaction costs.[15]

Research coverage is an important route for spreading of information. Not surprisingly, large-cap stocks have much better research coverage than small-cap stocks, cf. among others Kelly (2014). Media coverage is also more intense for large-cap stocks than small-cap stocks. According to the EMH, these facts should imply, that large-cap stocks are more efficiently priced than small-cap stocks. Based on arguments about efficient information spreading, one should expect that large-cap managers on average have lower excess returns than small-cap managers.

Banz (1981) is the classical article on small-cap outperformance. Stoll and Whaley (1983) questions whether the small-cap effect as reported by Banz is due to the exclusion of transaction costs. This relevant observation only applies to surveys based on market prices, but not for surveys of mutual funds, where returns are calculated after all costs, including transaction costs. Otten and Bams (2002) finds that among European mutual funds, small-cap funds perform better relative to benchmark compared to other funds. This pattern is found in several markets, among others Australia and the UK, cf. Chen *et al*, 2010) and Otten and Reijnders (2012). In the US, the same pattern is found in the annual SPIVA U.S. Scorecard report, issued each year by S&P Global, who owns the right to the S&P and Dow Jones indices, see Figure 8.

[15] Griffin *et al* (2010) call the combination of transaction costs and information production the "building blocks of efficiency".

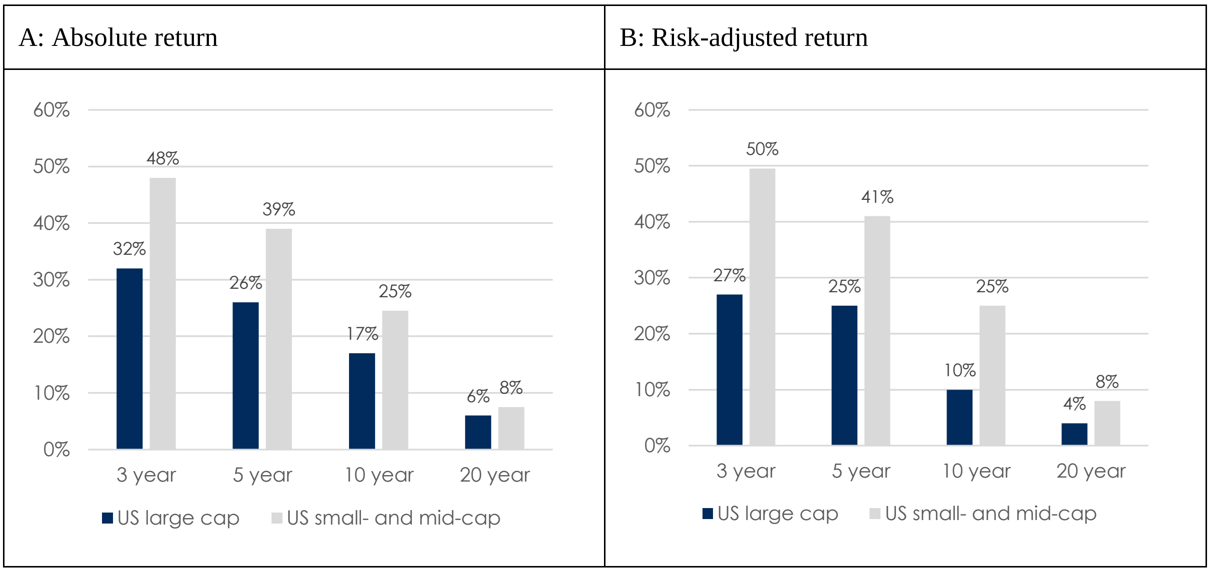


Figure 8: Share of US funds which outperform their benchmark

Source: SPIVA U.S. Scorecard 2021, S&P Global.

Compared to the general picture that mutual funds on average do not perform better than benchmark after costs, these studies suggest that small caps are less efficiently priced than large caps. Of course, there are surveys which suggest that small-cap funds to not create a positive relative return, see among others Ennis and Sebastian (2002). Some surveys suggest certain methodological problems in the measurement of risk (low liquidity, which could impact the estimation of CAPM-beta for example), see fx Roll (1981). Add to this the joint hypothesis problem, and results become indeed difficult to interpret.

In conclusion, the evidence seems very supportive for the claim that small-cap stocks are less efficiently priced than large-cap stocks.

4.2.2 Mini analysis of R^2 problem

A simple analysis of the problems with R^2 as a measurement of market efficiency show that the choice of measurement frequency (day, week, month, quarter) have large influence on the size of R^2 and on the difference of R^2 between large-cap and small-cap stocks, see Figure 8. To calculate R^2, the period 2015-2019 has been chosen as a normal period (pre-pandemic). Eight large-cap and eight small-cap stocks were selected. Correlations are calculated against the S&P 500 Index. No adjustment for risk is made.

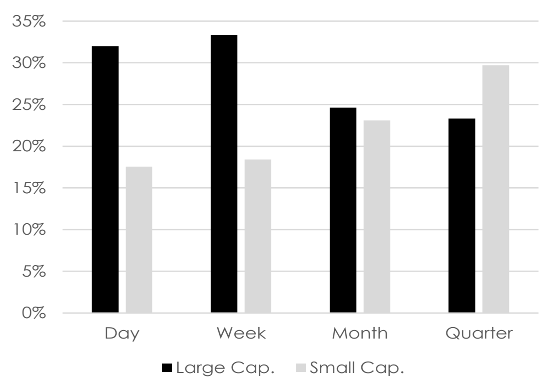


Figure 9: R^2 vs. measurement frequency

Source: Bloomberg and own calculations.

Note: The eight large cap stocks are (Bloomberg tickers): CSCO US, ED US, VZ US, PG US, MSFT US, UNH US, HD US and PEP US. The eight small-cap stocks are: WEN US, AEO US, POOL US, ABM US, OSK US, UNFI US, BIG US and PDCO US.

Regarding small-cap stocks, R^2 increase as the frequency of measurement is reduced. This is most likely due to the fact mentioned by Kelly (2014) that due to higher transaction costs (bid-ask spread, commission and "market impact"), trading small-cap stocks requires more significant news before a trade is deemed profitable. Hence, small-cap stocks see more days with zero returns than large-cap stocks, which results in a lower R^2, when measurements are made daily. Lesmond *et al* (1999) and Griffin *et al* (2010) also found that small-cap stocks have more days with zero return, which they ascribe to higher transaction costs. For large-cap stocks, the reverse picture seems to emerge: At high frequencies (day, week), the correlation with the market is high, as the probability of significant idiosyncratic news impacting the share price is low on such short horizons.[16] At lower frequencies (month, quarter), the probability of significant idiosyncratic news is higher, and hence the correlation with the overall market is reduced and R^2 falls. This small analysis questions R^2 as a reliable metric for market efficiency at micro level.

5. Summary and conclusion

There are multiple indications in the literature that on an aggregate basis, the stock market is from time to time inefficient as the deviation between the actual stock price and an estimate of "fair value" is too large and too long lasting to be incidental. This supports one half of Samuelson's Dictum.

The overlapping trend model and analysis presented here suggest that in the period 1963 to 2022, the aggregate stock market in the form of the S&P 500 Index was inefficiently priced in 13-31% of the time, which also supports one part of Samuelson's Dictum. Decomposing price inefficiency into P/E and/or EPS inefficiency give investors a better chance to identify peaks and troughs in the market. Using an overlapping trend model derived directly from share prices has advantages of not assuming a constant discount rate and also being independent of corporate pay-out policy (dividends vs. share buy-backs).

It seems that the literature does not define "market efficiency" the same way at micro and macro level. Micro level efficiency is often defined by way of relative prices ("peer group comparison"), which compares price to price, and not price to value. Graham and Dodd suggest that this was how the market behaved up to the crash of 1929 and from personal experience, I know, that this was also the way the market behaved in the run-up to the peak of the TMT-bubble in 2000. If the overall goal with an efficient stock market is effective allocation of society's scarce resources, a relative definition of market efficiency is a dangerous way to go.

The examples of market inefficiency at micro level are numerous and often very extreme. Limits-to-arbitrage and short squeeze are most often to blame. Both small- and large-cap stocks can be subject to irrational expectation formation, which rocket the stock price to unsustainable levels. These observations and empirical issues with certain tests of micro-efficiency (R^2), cast doubt about the part of Samuelson's Dictum, that claims efficiency at micro level.

Observing the examples of inefficiency at micro level and the lessons learned from the analysis of inefficiency at macro level, a certain pattern emerges; periods of inefficiency at micro level are often very extreme, but short-lived (days, weeks, months), while inefficiency at macro level is less extreme, but often of longer duration (years). The following chart is a plausible graphical illustration of how market inefficiency manifest itself:

[16] Roll (1988) offers the explanation that large firms often have many divisions and operate in more than a single industry and therefore superficially resemble a well-diversified portfolio more than small firms.

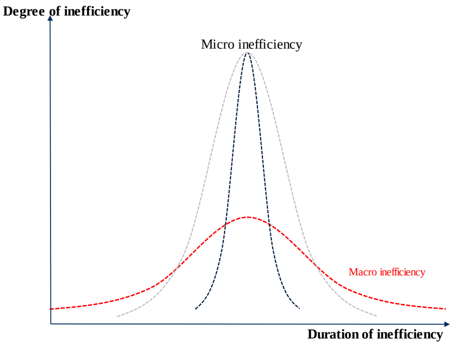


Figure 10: Illustrating micro- and macro inefficiency

Source: Own construction.

Another conclusion, which is more related to EMH than Samuelson's Dictum seems to be that it is not necessarily the EMH that sets the performance limitations for active investing as the market is not always efficient, regardless of micro- or macro-perspective. The underlying cause of lack of outperformance of active managers in the academic studies may be due to other factors, such as costs, agent-principal issues ("It is better to fail conventionally than to succeed unconventionally", John Maynard Keynes) and the mere fact of statistical sampling, as elegantly formulated in Sharpe's Arithmetic of Active Management.

References

Alves, Paulo, Ken V. Peasnell and Paul Taylor, 2010: *The Use of the R^2 as a Measure of Firm-Specific Information: A Cross-Country Critique,* Journal of Business Finance and Accounting, Vol. 37, No. 1/2, pp. 1-26.

Baker, Malcolm, Brendan Bradley and Ryan Taliafferro, 2014: The Low-Risk Anomaly: A Decomposition into Micro and Macro Effects, *Financial Analyst Journal*, Vol. 70, No. 2, pp. 43-58.

Bali, Rakesh and Gailen L. Hite, 1998: Ex dividend day stock price behavior: discreteness or tax-induced clienteles?, *Journal of Financial Economics*, Vol. 47, Issue 2, pp. 127-159.

Banz, Rolf W.,1981: The Relationship Between Return and Market Value of Common Stocks, *Journal of Financial Economics*, Vol. 9, Issue 1, pp. 3-18.

Barber, Brad M. and Terrance Odean, 2013: The Behavior of Individual Investors, in *Handbook of Economics in Finance*, ed. G.M. Constandinides, M. Harris and R.M. Stulz, Vol. 2, Part B, 2013, (chapter 22), pp. 1533-1570.

Barberis, Nicholas and Richard Thaler, 2002: A Survery of Behavioral Finance, *NBER Working Paper 9222*, http://www.nber.org/papers/w9222.

Basu, S., 1977: Investment Performance of Common Stocks in Relation to Their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis, *The Journal of Finance*, Vol. 32, No. 3, pp. 663-682.

Beneish, Messod D. and Robert E. Whaley, 1996: An Anatomy of the "S&P Game": The Effects of Changing the Rules, *The Journal of Finance*, Vol. 51, No. 5, pp. 1909-1930.

Bernard, Jan and Michael Verhofen, 2011: Are Capital Markets Inefficient on a Macro Level*?, Working Paper*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1959798.

Black, Fischer, 1986: Noise, *The Journal of Finance*, Vol. 41, No. 3, pp. 529-543.

Bollerslev, Tim and Robert J. Hodrick, 1992: Financial Market Efficiency Tests, *NBER Working Paper No. 4308*.

Boudurtha Jr., James N., Dong-Soon Kim and Charles M. C. Lee, 1995: Closed-End Country Funds and U.S. Market Sentiment, *Review of Financial Studies*, Vol. 8, No. 3, pp. 879-918.

Bramante, Riccardo, Giovanni Petrella and Diego Zappa, 2015: On the ruse of market model R-square as a measure of stock price efficiency, *Review of Quantitative Finance and Accounting*, Vol. 44, No. 2, pp. 379-391.

Campbell, John Y. and Robert J. Shiller, 1998: Valuation Ratios and the Long-run Stock Market Outlook, *The Journal of Portfolio Management*, Vol. 24, Issue 2, pp. 11-26.

Campbell, John Y., 1991: A Variance Decomposition for Stock Returns, *The Economic Journal*, Vol. 101, No. 405, pp. 157-179.

Campbell, John Y., Martin Lettau, Burton G. Malkien and Yexiao Xu, 2001: Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic Risk, *The Journal of Finance*, Vol. 56, No. 1, pp. 1-43.

Carhart, Mark M., 1997: On Persistence in Mutual Fund Performance, *The Journal of Finance*, Vol. 52, Issue 1, pp. 57-82.

Chen, Cong, Carole Comerton-Forde, David R. Gallagher and Terry S. Water, 2010: Investment manager skill in small-cap equities, *Australian Journal of Management*, Vol. 35, No. 1, pp. 23-49.

Clemens, Michael, 2015: Asset Pricing: Trends and Changes in Discount Rates and P/E Ratios, *Working Paper*, *SSRN*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2605027.

Clemens, Michael and Kresten Johnsen: 2016: Udbytteinvestering: Empiri og teori; *Finans/Invest*, No. 4, pp. 13-20.

Cochrane, John H., 2011: Presidential Address: Discount Rates, *The Journal of Finance*, Vol. LXVI, No. 4, pp. 1047-1108.

Cooper, Michael J., Orlin Dimitrov and P. Raghavendra Rau, 2001: A Rose.com by Any Other Name, *Journal of Finance*, Vol. 56, No. 6, pp. 2371-2388.

Cootner, Paul H., 1962: Stock Prices: Random vs. Systematic Changes, *Industrial Management Review*, Vol. 3, No. 2, pp. 24-45.

Cornell, Bradford and Aswath Damodaran, 2022: The Big Market Delusion: Valuation and Investment Implications, *Financial Analyst Journal*, Vol. 76, No. 2, pp. 15-25.

Cremers, K.J. Martijn, Jon A. Fulkerson and Timothy B. Riley, 2019: Challenging the Conventional Wisdom on Active Management: A Review of the Past 20 Years of Academic Literature on Actively Managed Mutual Funds, *Financial Analyst Journal*, Vol. 75, Issue 4, pp. 8-35.

De Bondt, Werner and Richard Thaler, 1985: Does the Stock Market Overreact?, *Journal of Finance*, Vol. 40, No. 3 pp. 793-805.

De la O, Ricardo, Xiao Han and Sean Meyers, 2022: The Return of Return Dominance: Decomposing the Cross-Section of Prices, *Working Paper*, *November 2022*, *SSRN*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4206091.

De Jong, Abe, Leonard Rosenthal and Mathijs A. Van Dijk, 2009: The Risk and Return of Arbitrage in Dual-Listed Companies, *Review of Finance*, Vol. 13, Issue 3, pp. 495-520.

Degutis, Augustas and Lina Novickyte, 2014: The Efficient Market Hypothesis: A Critical Review of Literature and Methodology, *Ekonomika*, Vol. 93, No. 2, pp. 7-23.

DeLisle, R. Jared, Dan W. French and Maria Gabriela Schutte, 2017: Passive Institutional Ownership, R^2 Trends, and Price Informativeness, *The Financial Review*, Vol. 52, issue 4, pp. 627-659.

Doukast, John A., 2002: Rationality of Capital Markets – 2001 European Financial Management Association: Roundtable Discussion with Ray Ball, Kent Daniel, Kenneth French, Stephen Ross and Jay Ritter, *European Financial Management*, Vol. 8, No. 7, pp. 229-247.

Easton, Steve and Paul Kerin, 2010: Market Efficiency and the Global Financial Crisis, *The Australian Economic Review*, Vol. 43, No. 4, pp. 464-468.

Elton, Edwin J. and Martin J. Gruber, 1970: Marginal stockholder tax rates and the clientele effect, *Review of Economics and Statistics*, Vol. 52, No. 1, pp. 68-74.

Engsted, Tom, 2006: Kan afkast forudsiges i et efficient marked?, *Finans/Invest*, No. 06, pp. 4-8.

Ennis, Richard M. and Michael D. Sebastian, 2002: The Small-Cap Alpha Myth, *Journal of Portfolio Management*, Vol. 28, Issue 3, pp. 11-16.

Evangelos, Vasileiou, 2022: Does the short squeeze lead to market abnormality and antileverage effect? Evidence from the Gamestop case, *Journal of Economic Studies*, Vol. 49, Issue 8, pp. 1360-1373.

Fama, Eugene F., 1965: The Behavior of Stock-Market Prices; *The Journal of Business*, Vol. 38, No. 1, pp. 34-105.

Fama, Eugene F., 1970: Efficient Capital Markets: A Review of Theory and Empirical Work; *The Journal of Finance*, Vol. 25, No. 2, pp. 383-417.

Fama, Eugene F., 1991: Capital Markets II; *The Journal of Finance*, Vol. 46, No. 5, pp. 1575-1617.

Fama, Eugene F., 1998: Market efficiency, long-term returns, and behavioral finance; *Journal of Financial Economics*, Vol. 49, Issue 3, pp. 283-306.

Fama, Eugene F., 2014: Two Pillars of Asset Pricing, *American Economic Review*, Vol. 104, Issue 6, pp. 1467-1485.

Fama, Eugene F. and Kenneth F. French, 1992: The Cross-Section of Expected Stock Returns, *The Journal of Finance*, Vol. 47, No. 2, pp. 427-465.

Fama, Eugene F. and Kenneth F. French, 2010: Luck versus Skill in the Cross-Section of Mutual Fund Performance, *The Journal of Finance*, Vol. 65, No. 5, pp. 1915-1947.

Finnerty, Joseph E., 1976: Insiders and Market Efficiency, *The Journal of Finance*, Vol. 31, No. 4, pp. 1141-1148.

Froot, Kenneth A. and Emil A. Dabora, 1999: How are stock prices affected by location of trade?, *Journal of Financial Economics*, Vol. 53, Issue 2, pp. 189-216.

Gârneau, Nicolae and Lasse H. Pedersen, 2022: Active and Passive Investing: Understanding Samuelson's Dictum, *The Review of Asset Pricing Studies*, Vol. 12, Issue 2, pp. 389-446.

Glasserman, Paul and Harry Mamaysky, 2021: Investor Information Choice with Macro and Micro Information, *Columbia Business School Research Paper No. 16-45*.

Goddard, John, David G. McMillan and John O. S. Wilson, 2008: Dividends, prices and the present value model: firm-level evidence, *European Journal of Finance*, Vol. 14, No. 3, pp.195-210.

Graham, Benjamin and David L. Dodd, 1934: *Security Analysis*, Sixth Edition, eBook, McGraw-Hill.

Grantham, Jeremy, 2022: *Entering the Superbubble's Final Act*, GMO Viewpoints, August 31, 2022, https://www.gmo.com/americas/research-library/entering-the-superbubbles-final-act/.

Griffin, John M., Patrick J. Kelly and Federico Nardari, 2010: Do Market Efficiency Measures Yield Correct Inferences? A Comparison of Developed and Emerging Markets, *The Review of Financial Studies*, Vol. 23, No. 8, pp. 3225-3277.

Grossman, Sanford J. and Joseph E. Stiglitz, 1980: On the Impossibility of Informationally Efficient Markets, *The American Economic Review*, Vol- 70, No. 3, pp. 393-408.

Guzman, Santiago, Jospeh Peteul and Amir Rezaee, 2022: How Have ETFs Changed Market Macro Efficiency and Risk Structure?, *The Journal of Portfolio Management*, Vol. 48, No. 7, pp. 156-174.

Harvey, Campbell R. and Yan Liu, 2022: Luck versus Skill in the Cross Section of Mutual Fund Returns: Reexamining the Evidence; *The Journal of Finance*, Vol. 77, No. 3, pp. 1921-1966.

Hou, Kewei, Lin Peng and Wei Xiong, 2013: Is R-Squared a Measure of Market Efficiency?, *Working Paper, Princeton University*, Economics Department.

Investment Company Institute, 2022: *Investment Company Fact Book*, https://www.icifactbook.org/pdf/2022_factbook.pdf.

Jaffe, Jeffrey F., 1974: Special Information and Insider Trading, *The Journal of Business*, Vol. 47, No. 3, pp. 410-428.

Jagadeesh, Narasimhan and Sheridan Titman, 1993: Return to Buying Winner and Selling Losers: Implications for Stock Market Efficiency, *Journal of Finance*, Vol. 48, No. 1, pp. 65-91.

Jensen, Michael C., 1968: The Performance of Mutual Funds in the Period 1945-1964, *The Journal of Finance*, Vol. 23, Issue 2, pp. 389-416.

Jovanovic, Franck, 2018: A comparison between qualitative and quantitative histories: the example of the efficient market hypothesis, *Journal of Economic Methodology,* Vol. 25, No.4, pp. 291-310.

Jung, Jeeman and Robert J. Shiller, 2005: Samuelson's Dictum and the Stock Market, *Economic Inquiry*, Vol. 43, No. 2, pp. 221-228.

Karadas, Serkan, 2019: Trading on Private Information: Evidence from Members of Congress, *The Financial Review,* Vol. 54, No. 1, pp. 85-91.

Karpoff, Jonathan M. and Graeme Rankine, 1994: In search of a signaling effect: The wealth effects of corporate name changes, *Journal of Banking & Finance,* Vol. 18, Issue 6, pp. 1027-1045.

Kelly, Patrick J., 2014: "Information Efficiency and Firm-Specific Return Variation"; *CEFIR / NES Working Paper, September 2014.*

Lekovic, Miljan, 2018: Evidence For and Against the Validity of Efficient Market Hypothesis; *Economic Themes*, Vol. 56, No. 3, pp. 369-387.

Lesmond, David A., Joseph P. Ogden and Charles A. Trzcinka, 1999: A New Estimate of Transaction Costs, *The Review of Financial Studies*, Vol. 12, No. 5, pp. 1113-1141.

Lettau, Martin and Stijn Van Nieuwerburgh, 2008: Reconciling the Return Predictability Evidence, *The Review of Financial Studies*, Vol. 21, No. 4, pp. 1607-1652.

Linnainmaa, Juhani T., 2013: Reverse Survivorship Bias, *The Journal of Finance*, Vol. 68, No. 3, pp. 789-813.

Lo, Andrew W., 2004: The Adaptive Markets Hypothesis; *Journal of Portfolio Management*, Vol. 30, Issue 5, pp. 15-29.

Lo, Andrew W. and & MacKinlay, A. C., 1988: Stock market prices do not follow random walks: Evidence from a simple specification test. *The Review of Financial Studie*s, 1(1), pp. 41-66.

Lo, Andrew W. and MacKinlay, A. C., 1990: When are contrarian profits due to stock market overreaction? *The Review of Financial Studies*, 3(2), 175-205.

Malkiel, Burton G., 2003: The Efficient Market Hypothesis and Its Critics, *Journal of Economic Perspectives*, Vol. 17, No. 1, pp. 59-82.

Mangee, N., 2021: A New Explanation for Samuelson's Dictum and the Stock Market: Novel Events and Knightian Uncertainty; *Working Paper,* Parker College of Business, Georgia Southern University.

McLean, R. David and Jeffrey Pontiff, 2016: Does Academic Research Destroy Stock Return Predictability?; *The Journal of Finance,* Vol. 71, No. 1, pp. 5-31.

Morck, Randall, Bernard Yeung and Wayne Yu, 2013: R^2 and the Economy; *Annual Review of Financial Economics*, Vol 5, pp. 143-166.

Murphy, J. Michael, 1977: Efficient markets, index funds, illusion and reality, *The Journal of Portfolio Management*, Vol. 4, Issue 1, pp. 5-20.

Nicholson, S. Francis, 1960: Price-Earnings Ratios, *Financial Analyst Journal*, Vol. 16, No. 4, pp. 43-45.

Otten, Roger and Dennis Bams, 2002: European mutual fund performance; *European Financial Management*, Vol. 8, Issue 1, pp. 75-101.

Otten, Roger and Martin Reijnders, 2012: The Performance of Small Cap Mutal Funds: Evidence from the UK, Maastricht University, *Working Paper*.

Pasricha, Laurel and Neelam Dhanda, 2022: The past, the present and the prospective future of efficient market hypothesis: a theoretical and empirical investigation of international stock markets, *Theoretical and Applied Economics*, Volume XXIX, No. 2, pp. 89-106.

Pedersen, Lasse H., 2018: Sharpening the Arithmetic of Active Management, *Financial Analyst Journal*, Vol. 74, Issue 1, pp. 21-36.

Roll, Richard, 1981: A Possible Explanation for the Small Cap Effect, *The Journal of Finance*, Vol. 34, No. 4, pp. 879-888.

Roll, Richard, 1984: A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market, *The Journal of Finance*, Vol. 39, No. 4, pp. 1127-1139.

Roll, Richard, 1988: R^2; *The Journal of Finance*, Vol. 43, No. 3, pp. 541-566.

Rosenthal, Leonard and Colin Young, 1990: The Seeming anomalous price behavior of Royal Dutch Shell and Unilever NV/PLC, *Journal of Financial Economics*, Vol. 26, Issue 1, pp. 123-141.

Samuelson, Paul, 1998: Summing upon Business Cycles: Opening Address; *Federal Reserve Bank of Boston*.

Schwert, G. William, 2002: Anomalies and Market Efficiency, *Working Paper No. FR 02-13*, *University of Rochester*.

Security Exchange Commission: Equity and Options Market Structure Conditions in Early 2021, October 14, 2021, www.sec.gov.

Sewell, Martin, 2012: The Efficient Market Hypothesis: Empirical Evidence, *International Journal of Statistics and Probability*, Vol. 1, No. 2, pp. 164-178.

Sharpe, William F., 1964: Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *The Journal of Finance*, Vol. 19, No. 3, pp. 425-442.

Sharpe, William F., 1991: The Arithmetic of Active Investing, *Financial Analysts Journal*, Vo. 47, No. 1, pp. 7-9.

Shiller, Robert J., 1981: Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?, *The American Economic Review*, Vol. 71, No. 3, pp. 421-436.

Shiller, Robert J., 2014: Speculative Asset Prices, *The American Economic Review*, Vol. 104, No. 6, pp. 1486-1517.

Shleifer, Andrei, 1986: Do Demand Curves for Stocks Slope Down?, *The Journal of Finance*, Vol. 41, No. 3, pp. 579-590.

Shleifer, Andrei. and Robert W. Vishny, 1997: The Limits to Arbitrage, *The Journal of Finance*, Vol. 52, Issue 1, pp. 35-55.

Singh, Pardeep, C.A. Deepak and Arnav Kumar, 2015: Revisiting Weak Form Efficiency of Major Equity Markets in light of Global Financial Crisis: A Panel Data Approach, *Asia-Pacific Finance and Accounting Review*, Vol. 3, No. 1, pp. 17-44.

S&P Global, 2021: *SPIVA® U.S. Scorecard*. https://www.spglobal.com/spdji/en/documents/spiva/spiva-us-year-end-2021.pdf.

Statmen, Meir, 2019: Behavioral Finance – The Second Generation, *CFA Institute Research Foundation.*

Stoll, Hans R. and Roberg E. Whaley, 1983: Transaction Costs and the Small Firm Effect, *Journal of Financial Economics*, Vol. 12, Issue 1, pp. 57-79.

Voulteenaho, Tuomo, 2002: What Drives Firm-Level Stock Returns?, *The Journal of Finance*, Vol. 57, No. 1, pp. 233-264.

Wilkens, Sascha, 2022: Predicting Stock Index Change, *The Journal of Portfolio Management*, Vol. 48, No. 7, pp. 175-194.