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Observations on Samuelson’s Dictum

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The stock market in the form of the S&P 500 is estimated to be inefficient in 13% to 30% 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. 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. The model developed show expected results in terms of relative efficiency for Developed vs. Emerging Markets and for Dow Jones vs. Nasdaq. 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 contributed to 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

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 the stock market at an aggregate level. EMH is a cornerstone within financial theory, cf. Fama (1965, 1970, 1991, 1998). 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*

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[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.

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*", cf. Samuelson (1998). 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. 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 some degree of efficiency in the *relative* pricing of two large-cap stocks, which are not that different.[2] The stock market does not have any close substitutes, which makes arbitrage against the whole market more difficult. These observations support Samuelson's Dictum.[3]

According to another cornerstone within financial theory, 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 the ambition of this paper 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.

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), De la O *et al* (2022), Guzman *et al* (2022), Gârleanu and Pedersen (2022), and Glasserman and Mamaysky (2023), took the subject under consideration. The literature on EMH is vast and is not the focus in this paper.

Jung and Shiller (2005) looked 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.[4]

Easton and Kerin (2010) took 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

[2] Since most professional (long only) equity fund managers are rewarded on relative performance against a benchmark, this institutional setup in itself drive the market towards micro-level efficiency.
[3] Only when assuming a relative definition of efficiency at micro level. More about this later.
[4] 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.

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) found 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) analyzed 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) analyzed 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"* (p. 17). 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.

Mangee (2021) explained Samuelson's Dictum by referring to the term uncertainty, which in economic theory is not the same as risk.[5] Mangee argues 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.

De La O *et al* (2022) analyzed 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) concluded 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

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

(2022) results are close to the implications indicated by Samuelson's Dictum.

Glasserman and Mamaysky (2023) developed 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.

It serves no purpose to go through a review of the extensive literature on tests of 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) stated, "*Any alternative model has a daunting task.*"

This paper contributes to the scarce literature on Samuelson's Dictum in several ways. Firstly, a new ex-post fair value model is developed for the measurement of potential inefficiency at macro level. The model is constructed as an overlapping trend model, which uses share prices as input without the need for information about dividends or earnings. The model is therefore in principle is independent of corporate pay-out policy and does not assume a constant discount rate. Secondly, the paper decomposes potential share price inefficiency into two components, earnings expectations (EPS) and valuation/discount rate (P/E). Thirdly, the paper uses the overlapping trend model to demonstrate that Emerging Markets historically have been less efficiently priced than Developed Markets and that Nasdaq-like firms (young and high-tech firms) in general have been less efficiently priced than Dow-Jones-like firms (large, mature firms). Fourth, the paper questions Samuelson's claim of micro level efficiency and is critical of the consensus definition in the literature of a relative definition of efficiency at micro level and is also critical about on the most used metrics to measure micro level efficiency, the R^2 measure.

Model to Identify Potential Inefficiency at Macro Level

According to the EMH, share prices oscillate around an 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 constructed 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) commented 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 uses stock prices directly and create a trend function of stock prices. This approach is in principle independent of corporate pay-out policy. 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.

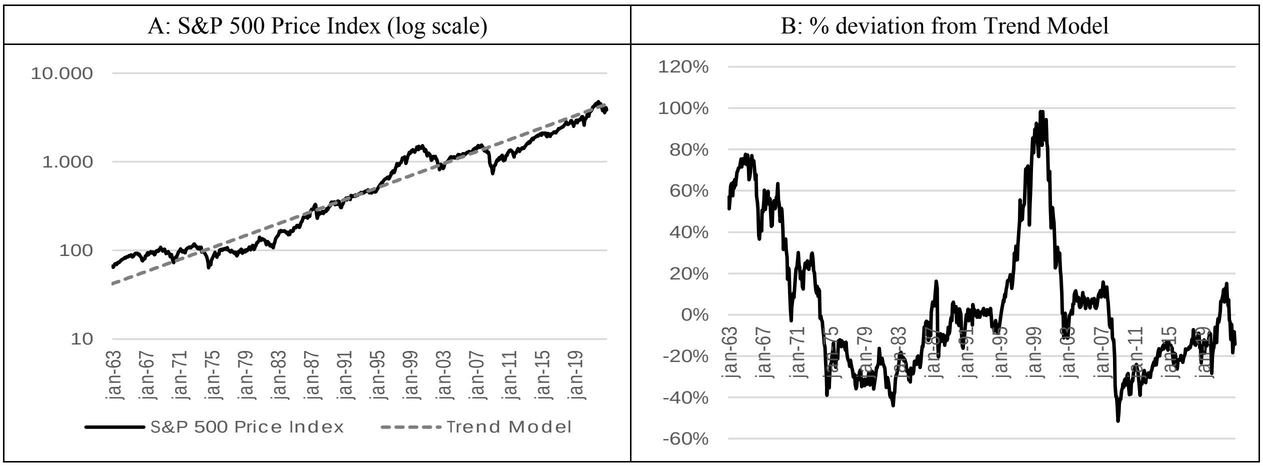

Figure 1. Model for inefficiency at macro level.

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 backward and 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 suggests that the market was vastly overvalued in large part of the 1960s (Nifty Fifty), undervalued in the latter part of the 1970s/early 1980s (inflation illusion?), again vastly overvalued around the millennium shift (TMT bubble), partly overvalued in 2007 (just before the GFC), vastly undervalued in 2009 (immediately after the GFC) and finally partly overvalued at the end of 2021 (ultra-low interest rates).[6] This pattern seems to fit well with consensus assumptions about when the market was “expensive” and “cheap”, respectively.[7]

Start	January 1963
End	December 2022
Number of observations (months)	720
Median deviation	3%
Average deviation	-4%
Standard deviation on deviation	33%
Maximum deviation	98% (March 2000)
Minimum deviation	-51% (February 2009)

Figure 2. Basic data on estimated share price model.

[6] 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.

[7] There is a close correlation between the deviation from trend as shown in Figure 1, Panel B and Shiller’s CAPE ratio.

Figure 2 shows 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 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) suggested 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	30%	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	7%	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 was 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% to 30% 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.

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.

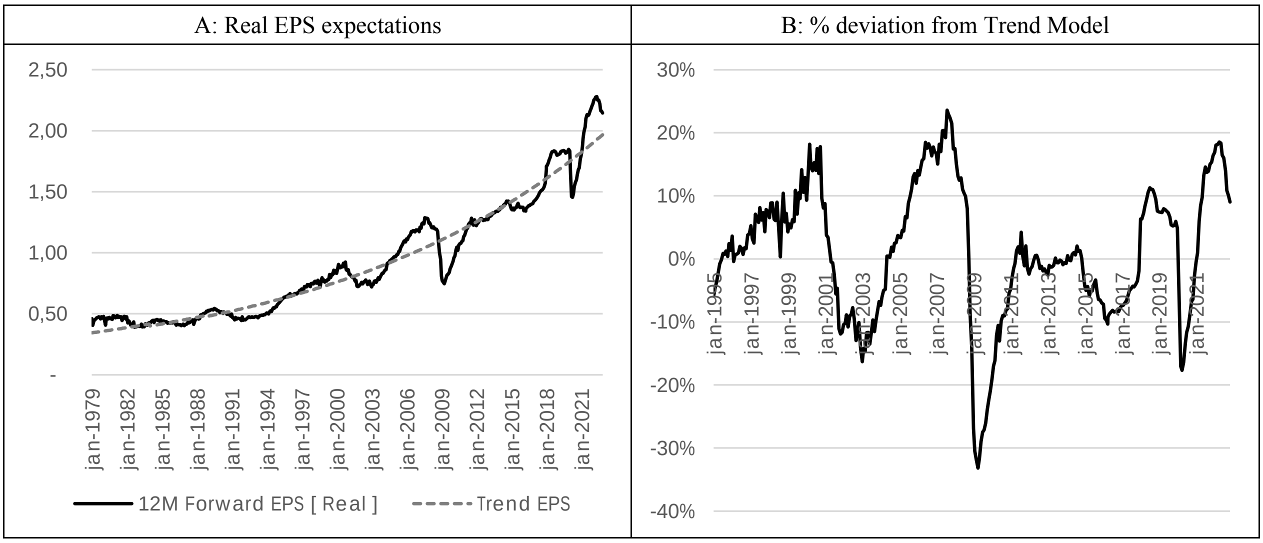

Figure 4. Real EPS and deviation from trend.

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

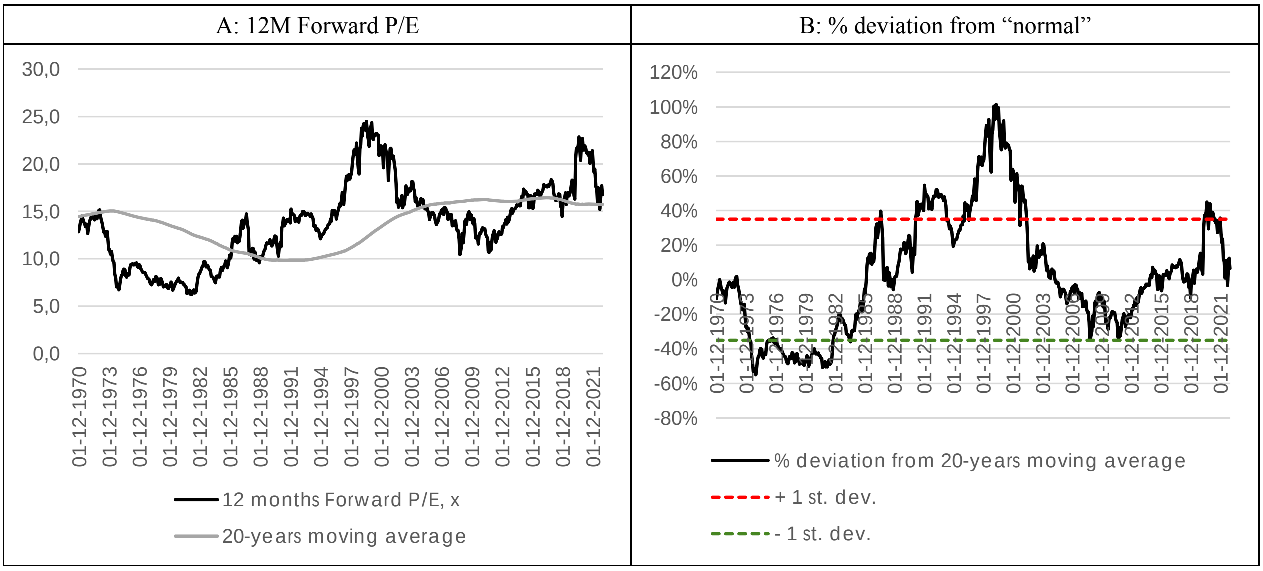

Figure 6. Changes in P/E and deviation from “normal”.

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.

Developed Markets vs. Emerging Markets

Singh *et al* (2015) demonstrated that Emerging Markets are more inefficient than Developed Markets. Griffin *et al* (2010) said that while conventional wisdom has it that emerging markets are less efficient than developed markets, their results show otherwise and suggest the same level of efficiency. Building overlapping trend models for standard indices for developed and emerging markets (MSCI World Index and MSCI Emerging Markets Index, respectively) may add to this unsettled debate.

Monthly price data is taken from Bloomberg as far back as possible, which is December 1987 for the MSCI Emerging Markets Index data. Hence, the analysis of both indices will begin at that date. In this analysis, the overlapping model is an average of four exponential functions, the first starting in December 1987, the second a year later, etc. All models run through April 2023. Models 2,3 and 4 are extended backwards 12 months from the starting point.

A: Deviation from trend, Developed Markets | B: Deviation from trend, Emerging Markets

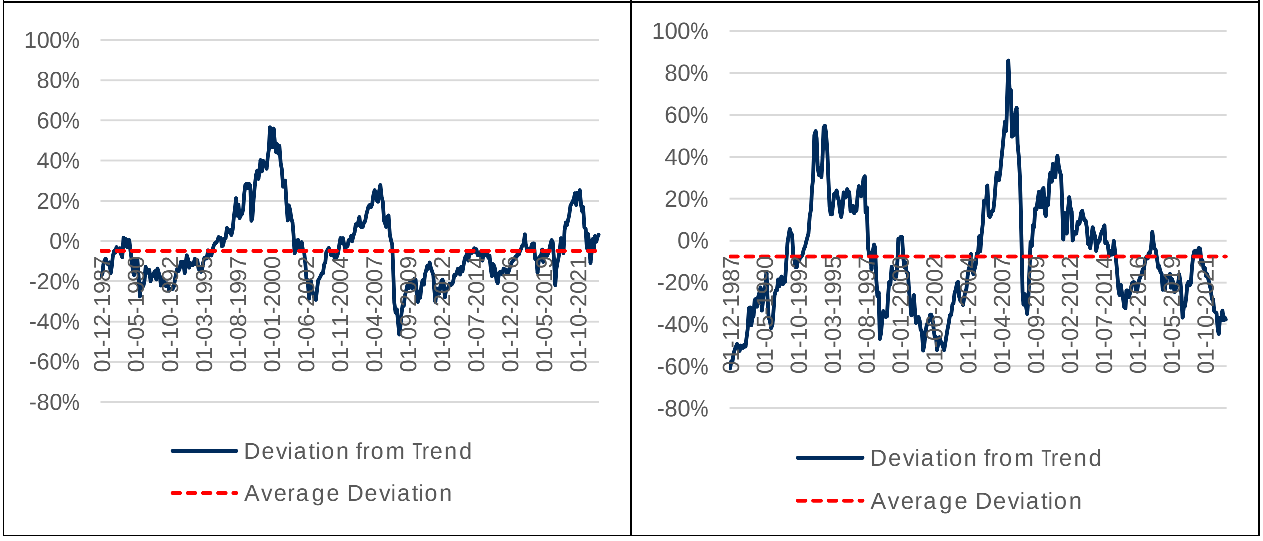

Figure 7. Deviation from trend, Developed vs. Emerging Markets.

Source: Bloomberg, and own estimation.

Note: Developed Markets are represented by the MSCI World Index (Bloomberg Ticker: MXWO Index) while Emerging Markets are represented by the MSCI Emerging Markets Index (Bloomberg Ticker: MXEF Index).

Casual observation from Figure 7 suggests that deviation from the "norm" is larger in both direction for Emerging Markets. This is supported by the general stats in Figure 8:

	Developed Markets	Emerging Markets
Start	December 1987	December 1987
End	April 2023	April 2023
Number of observations (months)	425	425
Median deviation	-4%	-6%
Average deviation	-6%	-9%
Standard deviation on deviation	18%	27%
Maximum deviation	57% (March 2000)	86% (October 2007)
Minimum deviation	-46% (February 2009)	-61% (December 1987)

Figure 8. Basic data on Developed vs. Emerging Markets trend models.

While Figure 8 display the average over the four models, each individual model also shows higher standard deviation and larger ranges between maximum and minimum deviations. The logic conclusion is that since 1987, Emerging Markets has on average been less efficient that Developed Markets, as represented by standard stock market indices.[8]

[8] Asked about the difference between stock market efficiency in developed markets and emerging markets, ChatGPT concluded: *"In conclusion, stock market efficiency differs between developed and emerging markets. Developed markets tend to exhibit higher levels of efficiency, reflecting well-established institutions, robust regulatory frameworks, and efficient information dissemination. Emerging markets, on the other hand, face challenges due to developing financial systems, information asymmetry, and limited liquidity." Date of query: May 24th, 2023.*

Nasdaq Composite vs. Dow Jones

Stocks without an "anchor" are often difficult to value.[9] That anchor could be cash flows, dividends, tangible assets or liquid financial assets. Without such anchor, valuation assumptions often have wide ranges resulting in large swings in share prices. Stocks without such anchor are usually young firms and/or firms in industries with rapidly changing "norms of production", such as technology and biotech. The Nasdaq Composite Index is a good representation of such stocks, while stocks with valuation anchors are well represented by the Down Jones Index (large stable and mature firms with long operating history).

Monthly price data is taken from Bloomberg since January 1979. In this analysis, the overlapping model is an average of four exponential functions, the first starting in December 1987, the second a year later, etc. All models run through June 2023. Models 2,3 and 4 are extended backwards 12 months from the starting point.

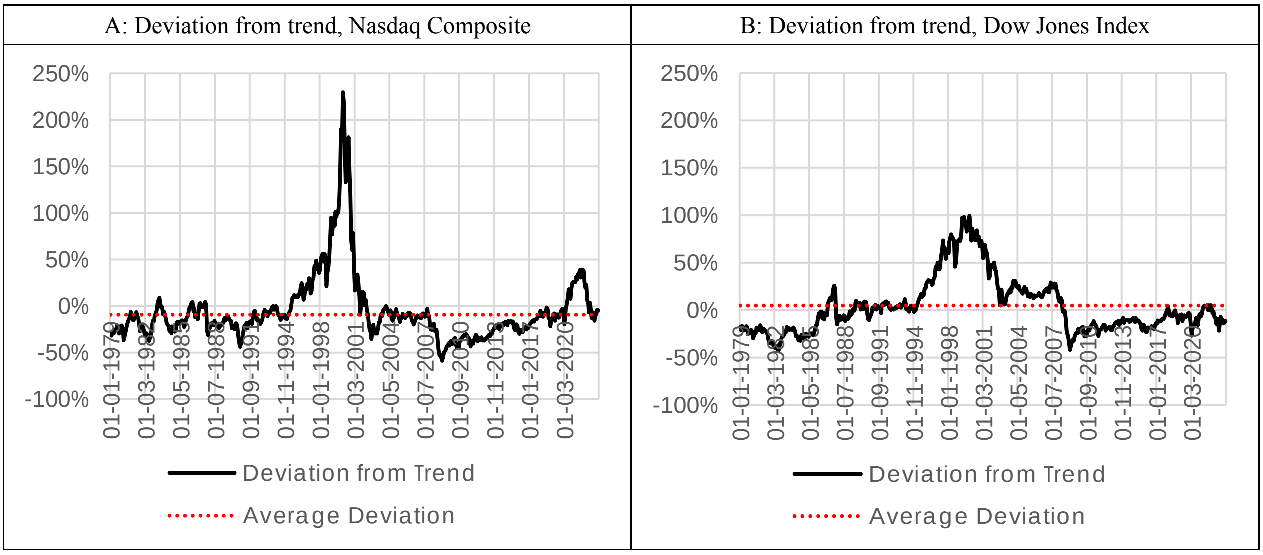

Figure 9. Deviation from trend, Nasdaq vs. Dow Jones.

Source: Bloomberg, and own estimation.

Note: Nasdaq Composite Index (Bloomberg Ticker: CCMP Index) and Dow Jones Index (Bloomberg Ticker: INDU Index).

Casual observation from Figure 9 suggests that deviation from the "norm" is larger in both direction for Nasdaq. This is supported by the general stats in Figure 10:

	Nasdaq	Dow Jones
Start	January 1979	January 1979
End	June 2023	June 2023
Number of observations (months)	532	532
Median deviation	-13%	7%
Average deviation	-5%	12%
Standard deviation on deviation	37%	32%
Maximum deviation	230% (February 2000)	99% (December 1999)
Minimum deviation	-59% (February 2009)	-42% (February 2009)

Figure 10. Basic data on Nasdaq vs. Dow Jones trend models.

[9] *Anchor in this respect should not be confused with the psychological bias of anchoring, which is a well-known concept from Behavioral Finance.*

While Figure 10 display the average over the four models, each individual model also shows higher standard deviation and larger ranges between maximum and minimum deviations. The logic conclusion is that since 1979, Nasdaq stocks have on average been less efficiently priced than Dow Jones stocks.

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 defined 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..".*[10] Baker *et al* (2014) also pointed to a relative definition of efficiency at micro level. Gârleanu and Pedersen (2022, p. 392) suggested that efficiency at micro level may be defined as the relative pricing differences between two similar companies, and not as would have been expected, the difference between the stock price and its (unknown) fair value. Mangee (2021) also seemed 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. However, relative valuation is 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).

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

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

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[10] 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. However, using the "FED-model" as "asset pricing model" also runs into a "joint-hypothesis problem" as the government yield in itself may not be fully rational and efficiently priced.

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) conducted 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.

Twin-stocks in different countries. For historical reasons and due to ownership structure, Royal Dutch Shell and Unilever, upheld listings in both Amsterdam and London. 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.

Sentiment contagion. Following up on twin-stocks, Froot and Dabora (1999) concluded 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 *et al* (1995) concluded that this is caused by sentiment contagion from the US stock market, even though all stocks in the fund are foreign.

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, 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) used 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. Cornell and Damodaran conclude that 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 have gone rouge and created 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.[11] [12] 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 were 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.

Trading on old news. Statman (2019) referred 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 May 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 the 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.

Event studies. 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.[13] Shleifer (1986) reports on index inclusions into the S&P 500 and found significant and non-transitory excess return. A decade later, Beneish and Whaley (1996) found almost similar results. Barberis and Thaler (2002, p. 10) reported 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.

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

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[11] 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.

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

[13] Bali and Hite (1998) explained 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) focused 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. Both arguments are likely less likely in today's market environment.

multi-factor model, sometimes without. According to this 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 al* (2013). 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) decomposed 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) found 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) provided 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* (2010) were likewise critical towards using R^2 as a measure of market efficiency.

Mini analysis of R^2 problem. A simple analysis illustrates the problems with R^2 as a measurement of market efficiency and show that the choice of measurement frequency (day, week, month, quarter) has large influence on the size of R^2 and on the difference of R^2 between large-cap and small-cap stocks, see Figure 11. 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.

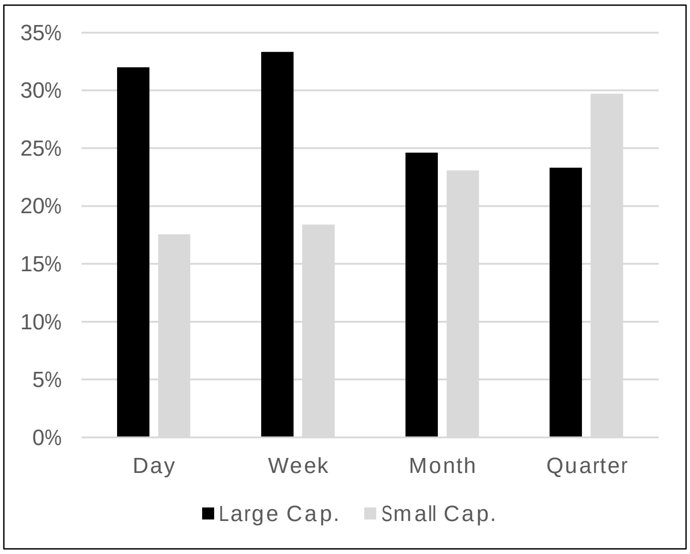

Figure 11. R^2 vs. measurement frequency.

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.[14] 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 as results change according to measurement frequency.

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%-30% 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.

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.

In conclusion, I believe that Samuelson was wrong in claiming micro level efficiency but right in assuming (from time to time) macro level inefficiency.

References

Alves, P., Ken V. P., & Paul T. (2010). The use of the R^2 as a measure of firm-specific information: A cross-country critique.

[14] Roll (1988) offered 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. An alternative explanation today would be trading flows in Index Funds and Index ETF's.

Journal of Business Finance and Accounting, 37(1/2), 1-26.

Baker, M., Brendan B., & Ryan T. (2014). The low-risk anomaly: A decomposition into micro and macro effects. *Financial Analyst Journal, 70*(2), 43-58.

Bali, R., & Hite G. L. (1998). Ex dividend day stock price behavior: discreteness or tax-induced clienteles? *Journal of Financial Economics, 47*(2), 127-159.

Barberis, N., & Thaler R. (2002). A survey of behavioral finance. *NBER Working Paper 9222*, http://www.nber.org/papers/w9222

Beneish, M. D., & Whaley R. E. (1996). An anatomy of the "S&P Game": The effects of changing the rules. *The Journal of Finance, 51*(5), 1909-1930.

Bernard, J., & Verhofen M. (2011). Are capital markets inefficient on a macro level?*, Working Paper,* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1959798

Black, F. (1986). Noise. *The Journal of Finance, 41*(3), 529-543.

Boudurtha J., James N., Kim D. S., & Lee C. M. C. (1995). Closed-end country funds and U.S. market sentiment. *Review of Financial Studies, 8*(3), 879-918.

Bramante, R., Giovanni P., & Diego Z. (2015). On the ruse of market model R-square as a measure of stock price efficiency. *Review of Quantitative Finance and Accounting, 44*(2), 379-391.

Campbell, J. Y., Martin L., Burton G. M., & Xu Y. X. (2001). Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk. *The Journal of Finance, 56*(1), 1-43.

Clemens, M., & Johnsen K. (2016). Udbytteinvestering: Empiri og teori. *Finans/Invest*, 4, 13-20.

Cooper, M. J., Orlin D., & Rau P. R. (2001). A Rose.com by any other name. *Journal of Finance, 56*(6) 2371-2388.

Cornell, B., & Aswath D. (2022). The big market delusion: Valuation and investment implications. *Financial Analyst Journal, 76* (2), 15-25.

De la O, R., Han X., & Meyers S. (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, A., Rosenthal L., & Mathijs A. V. D. (2009). The risk and return of arbitrage in dual-listed companies. *Review of Finance, 13*(3), 495-520.

DeLisle, R. J., Dan W. F., & Maria G. S. (2017). Passive institutional ownership, R^2 trends, and price informativeness. *The Financial Review, 52*(4), 627-659.

Doukast, J. 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, 8*(7), 229-247.

Easton, S., & Kerin P. (2010). Market efficiency and the global financial crisis. *The Australian Economic Review, 43*(4), 464-468.

Elton, E. J., & Gruber M. J. (1970). Marginal stockholder tax rates and the clientele effect. *Review of Economics and Statistics, 52* (1), 68-74.

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

Evangelos, V. (2022). Does the short squeeze lead to market abnormality and antileverage effect? Evidence from the Games top case. *Journal of Economic Studies, 49*(8), 1360-1373.

Fama, E. F. (1965). The behavior of stock-market prices. *The Journal of Business, 38*(1), 34-105.

Fama, E. F. (1970). Efficient capital markets: A Review of theory and empirical work. *The Journal of Finance, 25*(2), 383-417.

Fama, E. F. (1991). Capital markets II. *The Journal of Finance, 46*(5), 1575-1617.

Fama, E. F. (1998). Market efficiency, long-term returns, and behavioral finance. *Journal of Financial Economics, 49*(3), 283-306.

Fama, E. F. (2014). Two pillars of asset pricing. *American Economic Review, 104*(6), 1467-1485.

Froot, K. A., & Dabora E. A. (1999). How are stock prices affected by location of trade? *Journal of Financial Economics, 53*(2), 189-216.

Gârleanu, N., & Pedersen L. H. (2022). Active and passive investing: Understanding Samuelson's dictum. *The Review of Asset Pricing Studies, 12*(2), 389-446.

Glasserman, P., & Mamaysky H. (2023). Investor information choice with macro and micro information. *The Review of Asset Pricing Studies, 23*(1), *1-52*.

Graham, B., & Dodd D. L. (1934). *Security Analysis*, Sixth Edition, eBook, McGraw-Hill.

Grantham, J. (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, J. M., Patrick J. K., & Nardari F. (2010). Do market efficiency measures yield correct inferences? A comparison of developed and emerging markets. *The Review of Financial Studies, 23*(8), 3225-3277.

Guzman, S., Peteul J., & Rezaee A. (2022). How have ETFs changed market macro efficiency and risk structure? *The Journal of Portfolio Management, 48*(7), 156-174.

Jung, J., & Shiller R. J. (2005). Samuelson's dictum and the stock market. *Economic Inquiry, 43*(2),221-228.

Karpoff, J. M., & Rankine G. (1994). In search of a signaling effect: The wealth effects of corporate name changes. *Journal of Banking & Finance, 18*(6), 1027-1045.

Kelly, P. J. (2014). Information efficiency and firm-specific return variation. *CEFIR / NES Working Paper, September 2014.*

Lesmond, D. A., Ogden J. P., & Trzcinka C. A. (1999). A new estimate of transaction costs. *The Review of Financial Studies, 12*(5), 1113-1141.

Lo, A. W. (2004). The adaptive markets hypothesis. *Journal of Portfolio Management, 30*(5), 15-29.

Malkiel, B. G. (2003). The efficient market hypothesis and its critics. *Journal of Economic Perspectives, 17*(1), 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.

Morck, R., Yeung B., & Yu W. (2013). R^2 and the economy. *Annual Review of Financial Economics, 5*, 143-166.

Roll, R. (1988). R^2. *The Journal of Finance, 43*(3), 541-566.

Rosenthal, L., & Young C. (1990). The Seeming anomalous price behavior of Royal Dutch Shell and Unilever NV/PLC. *Journal of Financial Economics, 26*(1), 123-141.

Samuelson, P. (1998). Summing upon Business Cycles: Opening Address. *Federal Reserve Bank of Boston*.

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

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance, 19*(3), 425-442.

Shiller, R. J. (1981). Do stock prices move too much to be justified by subsequent changes in dividends? *The American Economic Review, 71*(3), 421-436.

Shiller, R. J. (2014). Speculative asset prices. *The American Economic Review, 104*(6), 1486-1517.

Shleifer, A. (1986). Do demand curves for stocks slope down? *The Journal of Finance, 41*(3), 579-590.

Shleifer, A., & Vishny R. W. (1997). The limits to arbitrage. *The Journal of Finance, 52*(1), 35-55.

Singh, P., Deepak C. A., & Kumar A. (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, 3*(1), 17-44.

Statman, M. (2019). Behavioral finance—The second generation. *CFA Institute Research Foundation.*