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The Efficient Markets Hypothesis Dethroned

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ABSTRACT. Impending changes in social security as well as in corporate and government policies are making individuals more responsible for their retirement savings. As a result, knowledge of investing concepts and financial markets is more important than ever before. The efficient markets hypothesis, the dominant financial markets theory, is described and analyzed. In doing so assumptions are questioned and the three forms of market efficiency are evaluated in quantitative and qualitative fashion to determine whether the efficient markets hypothesis is an accurate view of financial markets. This paper concludes that the efficient markets hypothesis does not accurately describe U.S. stock market activity.

I. Introduction

In 1978 Michael Jensen, a graduate of the University of Chicago and one of the creators of the efficient markets hypothesis, stated that, "there is no other proposition in economics which has more solid empirical evidence supporting it than the Efficient Markets Hypothesis" [Jensen, 1978, 96]. This paper analyzes the accuracy and validity of the efficient markets hypothesis in the context of the U.S. stock market. The efficient markets hypothesis, the preeminent financial market theory for over thirty years, has implications on how individuals invest for retirement, what investments they choose in order to reach their goals, and how individuals view the stock market. This paper concludes that the efficient markets hypothesis does not accurately describe or predict U.S. stock market behavior.

II. Definition of the Efficient Markets Hypothesis

In 1970 Eugene Fama coined the term efficient markets hypothesis and introduced its three forms: weak, semi-strong, and strong. The efficient markets hypothesis states that, "prices fully reflect all available information" [Fama, 1991, 1575]. The efficient markets hypothesis assumes information is fully reflected in prices, price changes are continuous, investors are rational profit-maximizers sharing the same investment goals, expectations, and holding period, and security prices follow a submartingale [Mandelbrot, 2004, 83-87]. A process is a martingale if the present value of future cash flows is the current stock

price. In 1965 Paul Samuelson proclaimed that the stock market is one such process. Fama further specified that security prices follow a submartingale, a type of martingale with positive expected returns instead of zero. The submartingale condition assumes stock prices always equal the present value of future cash flows (also known as intrinsic value), are normally distributed, and are independent of one another [LeRoy, 1989, 1585-1595 & Mandelbrot, 2004, 87].

III. A House Built on Sand: Faulty Assumptions

Assumptions are a necessity in the fields of economics and finance. They are needed to isolate two variables in order to determine a relationship, to simplify reality so that concepts may be generalized and taught to others, and to develop theories that create important advances in knowledge. A close look at the vital assumptions underlying the efficient markets hypothesis follows.

A. CONTINUOUS PRICING EXISTS

Continuous pricing is the ability of stock prices to move about in uninterrupted succession [Merriam Webster's Online Dictionary]. The normal distribution, used to analyze changes in stock prices, requires that price changes are continuous. Normally distributed stock price changes are assumed so as to use statistical tools to validate the efficient markets hypothesis. If continuity is assumed, then financial economists may use the measurement tools developed by Harry Markowitz and William Sharpe as well as expected value and standard deviation. Without continuous pricing the statistical tools used by the efficient markets hypothesis are useless.

In the stock market, prices in fact jump by several points at a time instead of moving in a continuous fashion. In many circumstances these jumps are insignificant. For example, 80% of trades occur at prices ending in a zero or five. Brokers simply use zero and five by convention. Problems occur when the absence of continuous pricing causes an order imbalance, a situation when a buy (sell) order is placed without a corresponding sell (buy) order at a nearby price. Thus the spread between the bid and ask price is large.

When this occurs trading must either be delayed to wait for more buy/sell orders or the market specialist steps in and serves as the other

side of the trade. If the market specialist, the person in charge of maintaining a fair and organized market for a given stock, steps in, the sale price will be between the bid and ask price. A stock experiencing an order imbalance may jump in price as much as a couple of dollars. So, in as little as sixty seconds a firm may lose 5-10% of its market value because of an order imbalance [Mandelbrot, 2004, 85-86]. In stock market panics these price jumps add fuel to an already volatile environment, creating excess volatility. Instead of moving continuously over a range of values, an order imbalance corrected by the specialist will result in quick price jumps that aggravate investors. In these situations investors may panic and try to sell an imbalanced security, further magnifying the problem.

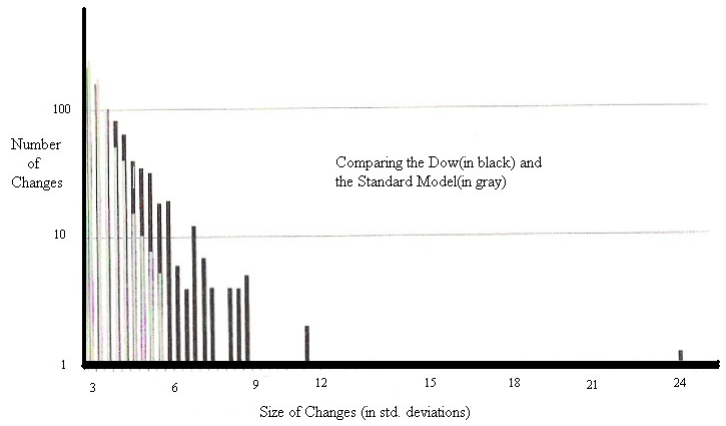
Price jumps are typically meaningless and unimportant. On special occasions when these price jumps do matter excess volatility is the result. While the continuous pricing assumption may be dangerous on occasion, it is not inaccurate most of the time.

B. STOCK PRICES CHANGES ARE NORMALLY DISTRIBUTED

Harry Markowitz kick-started the intellectual movement toward the efficient markets hypothesis in the 1950s. His PhD dissertation at the University of Chicago created the efficient frontier that would lead to the capital asset pricing model and the theory of efficient markets. In doing so he assumed that stock price changes follow the normal distribution because it was the easiest way to measure risk. It allowed the use of standard deviation and the normal distribution, tools that people were familiar with. Markowitz wrote that he did not know if stock prices were normally distributed, just that the normal distribution was easy to use [Mandelbrot, 2004, 66]. Since we still use standard deviation and the normal distribution to measure stock market risk, an analysis of whether stock price changes do in fact follow the normal distribution is in order.

When Eugene Fama was searching for a thesis topic at the University of Chicago he took a detailed look at the distribution of stock prices. Fama found that stock prices do not follow anything close to the normal distribution. Stock prices have far greater probability in the tails than does the normal distribution. Changes in stock prices of five standard deviations or more are two thousand times more likely to occur than the normal curve predicts. Similar trends were found by researchers for stock indices as well [Mandelbrot, 2004, 13]. The following graph shows the

stark differences between the distribution of stock prices and the normal curve.



- Reproduced from Mandelbrot, 2004, 94.

In August 1998 a series of steep stock price declines occurred. On August 4 the Dow fell 3.5% followed by drops of 4.4% and 6.8% in the same month. The odds of these three events occurring as they did, assuming stock prices follow the normal distribution, are one in five hundred billion. The odds of the final 6.8% drop alone are one in twenty million, indicating that such an event would occur once every 100,000 years. In 1999 the Dow fell 7.7% in one day. The probability of that was one in fifty billion. In 2002 the Dow plummeted for three consecutive days which had a probability of one in four trillion. The granddaddy of them all occurred when the Dow fell 29.2% in a single day on October 19, 1987. The odds of such a drop are one in 10^{50} [Mandelbrot, 2004, 4]. Low probability events happen far more often than suggested by the model.

Kurtosis is a statistic that measures how closely data fits the normal distribution. If a data series is normally distributed its kurtosis is three. If the data are more (less) volatile, kurtosis will be greater (less) than three. From 1970 to 2001 the S&P 500 Index had a kurtosis of 43.36, indicating that stock price changes do not at all correspond with the normal curve. If the 1987 crash is excluded, kurtosis is 7.17, still an alarmingly high number. Similar results have been found with other stock indices as well [Mandelbrot, 2004, 96].

Stock price movements do not follow the normal distribution because stock prices exhibit far too much volatility. The stock market is much riskier than standard deviation and beta, two orthodox measures of risk that will be looked at later in this paper, would lead one to believe. Proof lies in kurtosis measurements and low probability events that occur two thousand times more often than the normal distribution predicts. The assumption that stock price changes are normally distributed is inaccurate.

C. ARBITRAGE IS UNLIMITED

The efficient markets hypothesis assumes that stock prices follow the submartingale model. The submartingale model assumes that stock price always equals intrinsic value because arbitragers offset the influence of irrational agents. Rational agents in the market will buy (sell) when irrational agents sell (buy), negating any effect of irrational agents on stock prices. If rational agents are unable to outweigh the influence of irrational agents, then price might not equal value [Shiller, 2003, 96].

Irrational is defined as lacking usual mental clarity or understanding [Merriam Webster's Online Dictionary]. This lack of mental clarity is manifested in the decisions investors make. Individuals are dependant on their savings for retirement, education, and security. Despite the importance of investing, people repeatedly make costly mistakes without altering their investment style or philosophy. While mistakes manifest themselves in subpar results, investors continue to repeat the same mistakes.

So who are the irrational agents in the stock market? Well, most individuals in the market are irrational. Many financial economists claim that individuals overreact to recent news, under react to news that contradicts their current beliefs, and are overconfident in their ability to choose stocks [Hagstrom, 2000, 103-105]. Technical analysts base their buy and sell decisions on past price patterns and know next to nothing about the companies whose stock they buy. Equity pension funds underperform the market consistently over time [Malkiel, 1990, 177]. University endowment funds investing in equities are known for underperformance and some famously bad stock picks [Malkiel, 1990, 69]. All of these investors are irrational.

The only investors that have not been labeled irrational are mutual fund managers and professional arbitragers. Security analysts, who do

much of the research for equity mutual funds, overreact much like individual investors do. A study completed in 1990 shows that the actual earnings per share changes for U.S. companies were only 64% of what analyst's estimated one year prior to the earnings announcement. Earnings per share estimates made two years ahead were even less accurate, indicating that security analysts consistently overestimate the prospects of companies they analyze [De Bondt & Thaler, 1990, 55]. The rationality of mutual fund managers must be questioned as well because they make investment decisions based on security analysts' research.

Irrational agents in the market challenge the ability of arbitragers to keep markets efficient. When price and value diverge due to irrational investor behavior, arbitrage becomes inherently risky because price can move further from value just as easily as it can move toward value. The following real world example shows that even when value and price are known to be different arbitrage is not powerful enough to bring price back to value.

Royal Dutch and Shell are separate companies that agreed in 1907 to merge all of their interests, including profits, in a 60-40 ratio, a fact widely known among investors [Schleifer, 2000, A.10]. In the capital markets Royal Dutch should always sell for 1.5 times more than Shell. From 1990-1999 the ratio of their stock prices deviated significantly from the 1.5 ratio. In the early 1990's Royal Dutch was trading quite a bit below the 1.5 ratio; Royal Dutch shares sold at a discount of up to 7% from the correct ratio. A pure arbitrage opportunity and guaranteed profit for any investor who bought Royal Dutch and sold Shell existed. Buying Royal Dutch will increase its stock price while selling Shell will cause its stock price to fall, bringing the two stocks back into equilibrium. Instead, the shares of Royal Dutch went from a 7% discount to a 20% premium [Shleifer, 2000, A.10]. How can rational agents in the market allow such things to happen?

To answer that question imagine an arbitrager who decided to sell Royal Dutch and buy Shell when Royal Dutch was selling at an 8% premium in 1997. A year later Royal Dutch was selling at a 20% premium to the 1.5 ratio. The arbitrager would have incurred steep losses because price deviated further from value instead of returning to the proper price. If markets are inefficient in this near textbook example, then how can we expect markets to efficiently price biotechnology firms trading at sixty times earnings? Stock prices often do not equal intrinsic value. Instead, prices wander away from value for long periods of time with no guarantee

that they will return [Shleifer, 2000, A.11].

Because rational agents are just that, they may realize that it's in their best interests to use a different approach. Instead of trading against irrational agents assuming that prices will soon return to value, rational investors recognize that just the opposite is equally likely to occur. Rational investors may then buy an overvalued stock anticipating a further price increase. If this occurs, rational investors would increase the level of inefficiency in the market instead of ensuring efficiency. In a model that simulated a marketplace with rational and irrational investors the rational investors did in fact push prices further from value as predicted [Shiller, 2003, 96]. It pays for rational investors to jump on the bandwagon and ride out the irrational price increase instead of betting against irrationality [The Economist, 1992, 24].

Some rational agents in the market have stopped practicing arbitrage on the difference between price and value and have started to invest based on the future actions of irrational agents, indicating a distinct change in philosophy. Rational agents may no longer base decisions on a fundamental analysis and valuation of corporations; instead they invest by observing other market participants in order to anticipate changes in stock prices [Keynes, 1936, 154-155]. Rational investors shift from a fundamental approach to a more speculative approach.

Several important points have been established. Rational agents, who the efficient markets hypothesis relies on to keep price equal to value, are outnumbered in the market place. Rational agents cannot outweigh the influence of irrational investors on stock prices, allowing value and price to separate. The inability of rational agents to unite price and value is a violation of the efficient markets hypothesis. Arbitrage becomes risky because price may depart further from value instead of quickly reverting to equilibrium. Steep losses become a distinct possibility for arbitragers, who typically have short investment horizons. Rational investors may choose to profit from an irrational increase in price instead of trying to profit off a stock's return to value by shorting an overvalued stock. Because of the uncertainty and riskiness that are inherent in stock markets, arbitrage is limited and risky, allowing stock price and intrinsic value to diverge from one another for long periods of time. Arbitrage does not occur often in the stock markets because they are risky and full of uncertainty. The lack of short selling in the U.S. stock market supports the hypothesis that arbitrage is infrequently used [Shiller, 2003, 101]. Even some proponents of the efficient markets hypothesis recognize that stocks

do not always sell at intrinsic value [Malkiel, 1990, 184 & Hilsenrath, 2004, A.1].

The submartingale condition of the efficient markets hypothesis requires complete and unlimited arbitrage by rational investors. In reality rational investors take on risk when arbitraging, decreasing the amount of arbitrage that occurs. The rational arbitrager may find easier profits by anticipating irrational price changes, increasing the difference between value and price and making the market more volatile and inefficient. It is incorrect to assume that arbitrage is unlimited and effective in uniting price and value. Another of the efficient markets hypothesis's assumptions is invalid.

D. SHORT SELLING IS COMPLETE

According to the efficient markets hypothesis, when stocks are underpriced relative to intrinsic value, rational agents in the market will buy the stock and profit off the price appreciation when it rises. If a stock is selling at a price greater than its intrinsic value rational agents will short the stock. To short a stock, investors borrow the overvalued stock's shares and sell them. When the stock's price falls back to intrinsic value the investor will buy back the stock and return it to the lender. The short seller would profit off the transaction by selling the shares at a price greater than the purchase price plus borrowing costs incurred. Shorting stocks brings price back in line with intrinsic value. The efficient markets hypothesis requires complete short selling by rational agents to bring overpriced stocks back to value.

In March 2000 3Com, a network equipment maker out of Massachusetts, sold 5% of its ownership stake in Palm, the personal digital assistant (PDA) manufacturer. 3Com owned 95% of Palm while 5% was traded in the capital market. Immediately Palm's share price shot up. Later that year Palm's market capitalization (share price multiplied by shares outstanding) was far greater than 3Com's even though 3Com owned 95% of Palm and had other profitable businesses. The other parts of 3Com's corporation were valued at a -$63 per share. This obvious example of mispricing in the capital markets persisted for several months. While much short selling of Palm's shares did occur, it was not powerful enough to unite Palm's or 3Com's price and intrinsic value [Varian, C.2, 2005].

There are four reasons why short selling is incomplete and limited.

First, the market for borrowing shares is decentralized; it can be difficult for rational agents to find shares to borrow and short. When many people short a particular stock borrowing costs rise, making it difficult to earn a profit off the short sale [Varian, C.2, 2005]. This decreases the amount of short selling in the market.

Second, short selling is risky. Short selling is a type of arbitrage, and it entails risks just like other types of arbitrage do. A short seller, who must borrow shares in order to sell them, can have the shares they borrowed recalled by the lender on demand. Whenever the lender wants, he can demand the shares and the short seller will have to buy the stock back at its current price, even if it's above the original sale price. The short seller does not have total control over the timing of the purchase, a fact that keeps some investors from short selling [Varian, C.2, 2005].

Third, the maximum loss when an investor buys a stock is the amount of the investment. A short seller's maximum loss is unlimited because there is no upward bound on stock prices. Short selling entails substantially greater risk than simply investing in stocks, leading investors to either allocate less money to short selling or none at all [Shiller, 2003, 100].

Fourth, short sellers have historically come under fire for their tactics. After the stock market crash in 1929 a series of regulations were put in place to restrict short selling. J. Edgar Hoover, the former Federal Bureau of Investigation's head, threatened to investigate charges that short sellers were engaging in a conspiracy to keep stock prices low. Short sellers hope a stock's price falls, an unpopular stance among most investors and the government [Shiller, 2003, 100].

Short selling does not play much of a role in the stock market [Lamont & Stein, 2004, 2]. From 1977 to 2000 the percentage of total shares shorted varied between .14% and 1.91% of total shares sold. Shorting characteristics such as high risk, the difficulty of finding affordable shares to borrow, and the cultural and political opposition to shorting stocks have lowered the amount of short selling. Most investors, even relatively sophisticated ones, do not even consider selling shares short. Because of the lack of short selling prices are set on the margin by the most emotional investors instead of the most rational. The insignificance of short selling invalidates another assumption of the efficient markets hypothesis because it is the primary tool used by rational agents to reunite the price and intrinsic value of overpriced stocks. Without complete short selling to bring overpriced stocks back to intrinsic

value, nothing stands in the way of stock prices remaining above value for extended periods of time.

E. SUMMARY

Three assumptions that the efficient markets hypothesis depends on are grossly inaccurate. First, stock market pricing is not continuous. Only in unusual circumstances does this inconsistency matter, so the continuous pricing assumption is acceptable. Second, changes in stock prices are not normally distributed. The S&P 500 has a kurtosis value more than double the normally distributed value even after ignoring the October 1987 market crash. Third, arbitrage is not unlimited because it is inherently risky. The riskiness of arbitrage encourages rational investors to push prices further from intrinsic value instead of closer. For these reasons arbitrage is not widely used, making the assumption that price always equals intrinsic value inaccurate. Fourth, short selling is neither complete nor unlimited. The short seller does not have total control over investment decisions because the shorted stocks can be recalled by the lender at any point. Short selling also entails greater risk than simply buying a stock and is generally looked upon with disdain by investors and the government. Clearly the assumption made by the efficient markets hypothesis that short selling is complete and unlimited is not met in financial markets. Because short selling is uncommon, nothing stops price from deviating from intrinsic value. Simply put, the assumptions the efficient markets hypothesis is based on are inaccurate and unrealistic.

Some economists believe that assumptions cannot be used to determine if a theory is valid; they do not believe that inaccurate assumptions invalidate a theory. Instead they argue that a given theory can be applied to situations where behavior follows the theory as if the assumptions were upheld [Friedman, 1953, 19]. The usefulness of analyzing the validity of assumptions is debated by economists. Fortunately, we need not worry about this issue because the argument against the efficient markets hypothesis stands on much more than just inaccurate assumptions.

IV. Tools of Modern Finance

Tools have been developed by financial economists that quantify risk and return. Risk is measured ex-post and ex-ante by standard deviation while

returns are measured by geometric mean and expected return. But investors are not concerned with the standard deviation of a given stock; they care about how adding a particular stock will affect their existing portfolio. One of the most fundamental principles underlying the efficient markets hypothesis is the relationship between risk and return. One cannot earn a larger return without accepting more risk. Return is easy to quantify; the measurement of risk is the source of controversy. Risk is quantified by beta, one of the most important and controversial tools of modern finance. While an explanation of beta's flaws and inconsistencies is beyond the scope of this paper, a basic understanding of beta is necessary. Beta is simply a comparison between an individual stock's movements and the movements of the entire market. Because the S&P 500 Index is a proxy for the broader stock market its beta is 1. Yahoo, a risky stock, has a high beta while Anheuser-Busch, a less risky stock, has a low beta. Most researchers agree that beta is flawed, perhaps fatally so.

Any test of the efficient markets hypothesis is also a test of the risk measurement tool used; the theory and its risk measurement tool are inseparable. All tests of the efficient markets hypothesis are joint tests of the risk measurement tool used as well. Because beta is known to be flawed, results that defy the efficient markets hypothesis can be blamed on beta instead of the efficient markets hypothesis. It is impossible to definitively disprove the efficient markets hypothesis.

Apparent violations of the efficient markets hypothesis have been found that bring the theory into question. In an attempt to prove the measure of risk is to blame instead of the efficient markets hypothesis itself, researchers have developed new risk measurement tools like zero beta, three factor model, and arbitrage pricing theory to replace beta. None have been successful in replacing beta as the risk measurement of choice among researchers and practitioners so far. Beta is a vital tool of modern finance because it is used to calculate risk-adjusted returns. Put simply, beta is a necessary but flawed risk measurement tool that clouds the debate over the accuracy and validity of the efficient markets hypothesis.

V. Efficient Markets Hypothesis: Taxonomy and Anomalies

Since the 1970's, researchers have scoured financial databases with

advanced screening tools in hopes of finding anomalies inconsistent with the efficient markets hypothesis. Tests typically involve comparing the return on a researcher's strategy of buying and selling stocks against the return of the broad stock market after adjusting for risk by including beta. If a strategy's return consistently exceeds the market portfolio return after adjusting for risk, then a violation of the efficient markets hypothesis has been found. Conversely, the efficient markets hypothesis is validated when a strategy's return falls short of or equals the market return. The return of the broad stock market is also known as the return to a strategy of buying and holding a broad mix of stocks that proxy for the market portfolio. The phrases buy-and-hold return and market portfolio return will be used interchangeably throughout the rest of the paper. The three forms of market efficiency and corresponding anomalies are analyzed below in order to assess the validity of the efficient markets hypothesis applied to the U.S. stock market.

A. WEAK FORM MARKET EFFICIENCY

Weak form market efficiency states that security prices fully reflect all information that can be taken from past price and volume data. If the weak form holds, then it is impossible to consistently earn excess returns (the return on a portfolio in excess of the market portfolio return after adjusting for risk) using past price and volume data [Fama, 1970, 383]. A violation of weak form market efficiency is also a violation of the semi-strong and strong form because the forms build on each other and become progressively more restrictive. Calendar effects, trading rules, autocorrelation, and technical strategies are anomalies that if valid would violate all three forms of the efficient markets hypothesis.

The January effect is the phenomena of stock prices rising in January. The January effect occurs because investors sell stocks in December that have depreciated over the past year in order to get the short-term capital loss for income tax purposes. In January those stocks that were sold for short-term purposes are bought again by investors, leading to excess returns in the month of January [Malkiel, 1990, 193]. The January effect is seen most often in stocks with small market capitalizations because bid-ask spreads and transaction costs are higher. These two costs limit the return potential to anomalies based on buying low market capitalization stocks. These costs decrease the value of the January effect to the point where no economically significant excess returns exist. Investors realize

that they can earn greater returns by buying small stocks in early January, but when they take into consideration transaction costs of 2% and a 1% bid price premium the strategy no longer allows investors to make excess returns over the market portfolio. Thus the January effect can be observed but not used to earn excess returns. There are a bevy of other calendar, day of the week, and time of day effects that do not provide excess returns above the buy-and-hold market portfolio return and are not anomalous to the efficient markets hypothesis [Malkiel, 1990, 192-193].

A second apparent anomaly of weak form market efficiency is strategies that rely on objective trading rules to determine when to buy and sell. Trading rules instruct investors to buy if a stock rises by x % and sell if the stock falls by x %. These trading rules have been studied in great detail by researchers on both sides of the efficient markets debate. There is no filter rule that can earn excess returns over a buy-and-hold strategy after adjusting for transaction costs [Malkiel, 1990, 139-189].

A third proposed anomaly is whether autocorrelation exists in stock prices. The submartingale condition of the efficient markets hypothesis requires that subsequent price changes are independent of one another. That is, the direction or size of price changes today is not dependant on the direction or size of price changes yesterday. Several studies have documented autocorrelation in stock prices for both short (daily and weekly) and long (three to five years) time horizons [Malkiel, 1990, 184 & Fama, 1988, 246]. Researchers on both sides of the efficient markets debate have agreed on this point. While the existence of autocorrelation in stock prices is largely agreed upon as a violation of the efficient markets hypothesis's independence assumption, the difference in opinion stems from whether autocorrelations directly violate weak form market efficiency. If excess returns can be earned using a strategy based on exploiting autocorrelations, then a violation has been found. If no excess returns can be earned then the efficient markets hypothesis holds. Proponents of efficient markets have even made the argument that if an economic explanation underlies autocorrelations, then the efficient hypothesis has not been violated [LeRoy, 1989, 1594]. The submartingale assumption allows for no such economically reasonable autocorrelations. While it is unknown whether the existence of autocorrelation results in excess returns, it does invalidate an assumption of the efficient markets hypothesis.

Some investors decide when to buy and sell securities by analyzing stock charts. These technical analysts believe that supply and demand for

financial assets follow predictable patterns that repeat over time. Learning these patterns will allow an investor to make excess returns, or so goes the theory [Malkiel, 1990, 111]. A survey of technical analysts and their arcane methods could go on forever, but we must know only one thing. In the words of Burton Malkiel, an efficient markets expert and professor of economics at Princeton, "There has been a remarkable uniformity in the conclusions of all studies done on all forms of technical analysis. Not one has consistently outperformed the placebo of a buy-and-hold strategy" [Malkiel, 1990, 151].

Weak form market efficiency defeats the challenges proposed by seasonal patterns, filter rules, and technical analysis. Autocorrelation, both over short and long time periods, has been documented. This violates the independence assumption of the efficient markets hypothesis and may lead to excess returns. Further research and more powerful statistical tools must be developed before a conclusion can be reached.

B. SEMI-STRONG FORM MARKET EFFICIENCY

Semi-strong form market efficiency posits that security prices fully reflect all publicly available information [Fama, 1970, 383]. If the semi-strong form holds it is impossible to consistently earn excess returns using publicly available information. Fundamental analysis, the process of determining the intrinsic value of a stock by analyzing financial statements and other characteristics of a firm, would be rendered useless if semi-strong form holds. As with weak form, researchers have uncovered a number of anomalies suggesting market inefficiency.

Researchers have found that stocks with large dividend yields earn excess returns after adjusting for risk [Malkiel, 1990, 197]. In early studies dividend yields explained up to 40% of the variability in returns. It was later found that this apparent anomaly can be attributed to changes in interest rates. A change in interest rates affects bond yields. Bond yields tend to move with dividend yields. The apparent significance of dividend yields was actually the significance of macroeconomic changes [Malkiel, 2003, 65]. This anomaly disappeared altogether in the 1980's because many investors noticed the anomaly and moved to profit off the irregularity. The buying led to increased prices and lower than expected returns for these high dividend-paying stocks.

A second anomaly that appears to violate semi-strong form market efficiency is the small firm effect. The small firm effect states that small

company stocks have outperformed large company stocks after accounting for differences in risk by 1% per year since 1926. When the Great Depression is not included in the sample period the magnitude of the small firm effect is lessened. Because unsuccessful small firms often go bankrupt, meaning their returns are not included in the sample after the time of bankruptcy, a survivorship bias likely imparts an upward bias on the returns of small firms [Malkiel, 2003, 68]. Instead of performing poorly for an extended period of time as struggling large firms do, small firms are more likely to go out of business after a shorter period of poor performance. The small firm effect has not been explained away by proponents of the efficient markets hypothesis; it has led efficient markets researchers to question whether their measures of risk are sufficiently accurate or if newer techniques measure risk more accurately though.

Value stocks present another challenge to the semi-strong form. The value stock anomaly states that stocks with low price-earnings (P/E) and price-book (P/B) ratios tend to generate excess returns over long periods of time. Efficient markets proponents claim that this anomaly is dependant on the measure of risk used by researchers instead of a violation of the efficient markets hypothesis. Proponents of efficient markets say that stocks with low P/E and P/B ratios deserve low ratios because they are especially risky or volatile. This anomaly is also seen most often in small stocks with higher transaction costs, greatly diminishing the likelihood of earning excess returns [Malkiel, 2003, 68-70]. As with the small firm effect, efficient markets researchers have been forced to rethink their measures of risk in response to the value anomaly and have not completely explained away this anomaly.

The most important test of semi-strong form market efficiency is the performance of mutual funds relative to the broader stock market. Mutual funds are run by the highest paid and most intelligent security analysts and portfolio managers in the world. These professionals work with the very best fundamental analysis tools available. If anyone can consistently earn excess risk-adjusted returns over a buy-and-hold strategy it would surely be the mutual funds.

The performance evaluation of mutual funds against a buy-and-hold strategy is difficult because results are highly dependent on the method used to calculate risk and return. Widely varying results can be gleaned from the same set of data due to differences in risk measurement. Mutual fund performance tends to range between ± 1% of a buy-and-hold strategy after the inclusion of transaction costs and mutual fund expenses [Fama,

1991, 1605-1607 and Wermers, 2000, 1655].

In addition to scientific studies there have been a number of informal tests of mutual fund performance. In 1967 Forbes magazine began testing mutual fund performance by comparing mutual fund returns against a strategy of throwing darts at a stock market page. Forbes threw 28 darts and tracked subsequent returns on those stocks for seventeen years. Over that time only a handful of mutual funds outperformed the dart throwing strategy's annual return of 9.5% [Malkiel, 1990, 172]. *The Wall Street Journal* ran a similar test when they compared the darts strategy against stock picks made by prominent security analysts. The contest found that while analysts ended the eighteen year period with a higher final portfolio value, risk-adjusted returns on the analyst picks were below the dartboard strategy [Porter, 2004, 52]. While there is no consensus among researchers, it seems unlikely that mutual funds as a whole have fared better than a simple buy-and-hold strategy. So is it true that mutual funds cannot earn excess risk-adjusted returns due to market efficiency or is it that mutual funds have simply been unable to do so in the past?

There are a couple explanations for mutual fund underperformance. The first is creative accounting practices among corporations. Balance sheet and income statement line items can be vague and essentially meaningless, making it easier for management to hide weaknesses in a firm's operations. When you combine this with less than remarkable security analysts, whom we have already discussed as being less than rational, you have a recipe for mediocrity. Second, analysts have been easily convinced by management of above-average growth prospects, display euphoric and herd-like behavior in recommending stocks, fail to consistently show sufficient attention to detail, and fail to conduct unbiased research at times. Third, the best security analysts leave the profession to become salesmen for mutual funds or fund managers who use security analyst's research to make investment decisions. Both professions pay better and are more prestigious than an analyst position. To the average person this grim reality is difficult to accept; security analysts, highly-skilled and highly-paid professionals, should not make mindless and lazy mistakes [Malkiel, 1990, 161-168].

But security analysts are not alone. Physicians, for example, fare no better. As part of a study done in New York City 389 children were taken to a group of physicians and 174 recommended tonsillectomies. The 215 who did not need tonsillectomies were then taken to another group of physicians who determined that 99 of them needed tonsillectomies. The

116 children who had been ruled tonsillitis-free twice were taken to another group of physicians and 51 were said to need tonsillectomies. Security analysts, much like physicians and other highly-skilled professionals, do not necessarily perform their job in an above average manor.

In the words of former Wall Street trainee and current efficient markets proponent Burton Malkiel, a security analyst is "a well-paid and usually highly intelligent person who has an extraordinarily difficult job and does it in a rather mediocre fashion…In short, they are really very human beings" [Malkiel, 1990, 167]. Average analyst performance leads to average mutual fund performance. The statistics support this conclusion [Malkiel, 1990, 161].

The semi-strong form of the efficient markets hypothesis has outlasted the challenge from the explanatory power of dividend yields. The semi-strong form holds up less well against the small firm and value anomalies, although by no means has the semi-strong form of efficient markets hypothesis been invalidated. More important, though, is the inability of mutual funds to consistently outperform a buy-and-hold strategy. It is difficult, or maybe impossible, to tell whether the average performance of mutual funds is due to market efficiency or mutual fund mediocrity.

C. STRONG FORM MARKET EFFICIENCY

Strong form market efficiency implies that security prices fully reflect all information, both public and private [Fama, 1970, 383]. This includes insider information known only to a handful of business executives. If the strong form holds it is impossible to consistently earn excess returns. In practice the U.S. stock market is strong form inefficient [Fama, 1991, 1603].

Two anomalies prove strong form market efficiency does not hold. Inside information held by company executives leads to excess returns over buy-and-hold. Company insiders have nonpublic information that would have a material effect on the company's stock price. Insiders use their private information to profit off the difference between the stock's value with the nonpublic information and the stock's current price. Legal insider trading does in fact allow directors and officers to earn excess risk-adjusted returns on their Securities and Exchange Commission reported transactions [Jaffe, 1974, 427-428].

Another group with access to inside information is specialists working on the floor of organized stock exchanges. Specialists have monopolistic access to information contained in limit order books. Limit order books contain the listing of buy and sell limit orders, orders placed by investors to buy or sell at a specified price, for a given stock. The specialist maintains and updates the limit order book while executing trades when the stock price hits the specified price determined by an investor. Thus the specialist has an exclusive look at future demand and supply for shares of a given stock. Using the supply and demand information contained in these limit order books, specialists legally buy and sell from their own stock inventory to consistently earn excess returns [Neiderhoffer & Osborne cited in Fama, 1991, 1603].

Excess returns due to material, nonpublic information are limited to corporate insiders and specialists on the floor of stock exchanges [Fama, 1991, 1603].

D. SUMMARY

After reviewing the three forms of market efficiency and the corresponding anomalies literature it is evident that earning excess risk-adjusted returns above a buy-and-hold strategy is difficult. Technical analysis has failed miserably. Fundamental analysis has not shown an ability to earn excess returns as demonstrated by the lackluster performance of mutual funds.

The weak form holds up well to challenges from the anomalies literature not including autocorrelations. Autocorrelations in stock prices exist, directly violating the independence assumption. The strong form has been invalidated by corporate insiders and exchange specialists. The semi-strong form has been damaged by the small firm and value stock anomalies, but lives to fight one more day.

VI. Warren Buffett's Superinvestors

A. SETTING THE STAGE

The semi-strong form of the efficient markets hypothesis says that stock prices reflect all public information. The semi-strong form says that there are no over or undervalued stocks because a stock's price at any time is

the market's best estimate of intrinsic value [Fama, 1965, 4]. If a stock is undervalued (overvalued) security analysts and arbitragers will quickly recognize the opportunity and buy (sell) until price rises (falls) to fair value. Semi-strong form says investors can not consistently earn excess returns over a buy-and-hold strategy in a manor inconsistent with the laws of chance [Malkiel, 1990, 175]. Let's put these semi-strong form statements to the test.

Suppose of the nearly three hundred million people living in the United States, one million are portfolio managers at a mutual fund or other investment fund. These managers decide to engage in a coin flipping contest. Each manager has a 50% chance of throwing heads and staying in the contest while those that throw tails will be out of the game. After one toss approximately 500,000 managers will have flipped heads and stayed in the game. After two tosses 250,000. This process continues until after the fifteenth toss when only thirty managers are still in the game. The thirty managers that flipped heads fifteen consecutive times did so not because of their skill at tossing coins but because of chance. Seemingly amazing accomplishments can in certain situations be explained by chance. According to proponents of efficient markets the stock market is one such situation where the law of chance applies [Malkiel, 1990, 175-176]. The amazing results of the world's most successful investors are explained by luck, proponents say.

Let me tell you the story of Warren Buffett and his friends. Buffett is the CEO of Berkshire Hathaway, a conglomerate investment corporation headquartered in Omaha, Nebraska. He is also one of the world's most famous investors. Buffett was taught the art of investing by Benjamin Graham, a former professor at Columbia University who co-wrote the seminal investing text *Security Analysis* with David Dodd. After graduating, Buffett went to work as an analyst for his professor at Graham-Newman Corporation. There were three other analysts at the firm, all of whom were taught investing by Graham. Of the four, three went on to have careers in money management. Over time Buffett and his friends convinced four others to adopt Graham's investing methodology. One would become Buffett's business partner at Berkshire and another ran a fund Buffett had originated but then left after buying Berkshire. Two others were brought into the fold separately by Buffett and his aforementioned business partner. These seven individuals took Graham's methodology and applied it with startling results.

B. MEET THE SUPERINVESTORS

Walter Schloss never went to college. Instead he took Graham's Security Analysis course at Columbia and went to work at Graham-Newman. Later Schloss become a fund manager at Walter & Edwin Schloss Associates. His 15.65% annual return over twenty-nine years beat the corresponding S&P 500 annual return of 8.65% by a comfortable margin [Buffett, 1984, 6-9]. Annual returns for all superinvestors are displayed in appendix one.

Tom Knapp is another former Graham-Newman analyst. He graduated from Princeton with a degree in chemistry before serving in World War II. When he returned he took Graham's Security Analysis course and eventually earned an MBA from Columbia. After graduating he too went to work for Graham. Knapp later become a fund manager at Tweedy, Browne Partners. Knapp earned a 15.74% annual return over sixteen years, solidly beating the S&P 500's return of 7.81% annually over the same time period [Buffett, 1984, 7 & 9].

The third Graham-Newman analyst to have a career in money management was Warren Buffett himself. You could say Buffett has done well for himself since leaving Graham-Newman in 1957. From 1957-1969 Buffett ran an investment partnership where he invested the money of friends and other clients. His annual return over those thirteen years is a modest 23.8%. Over the same time period the S&P 500 earned an 8.74% annual return [Buffett, 1984, 7-10].

Charles Munger was a graduate of Harvard Law School who started his own law firm after college. He abruptly quit his law practice and began a new career in money management. Over fourteen years Munger generated an annual return of 13.65% as compared to the corresponding S&P 500 annual return of 5.19%. [Buffett, 1984, 10-11].

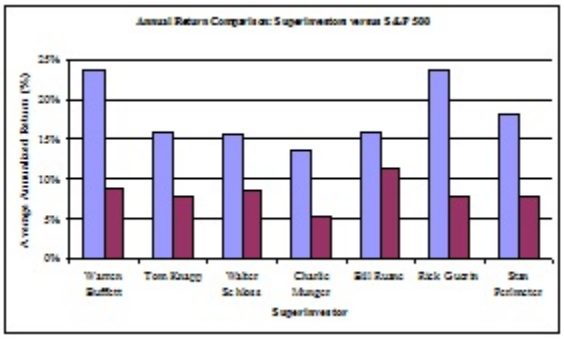
Bill Ruane was chosen by Buffett to run his investment partnership after Buffett bought Berkshire Hathaway. Ruane graduated from Harvard Business School and proceeded to go to work on Wall Street. Later he went to Columbia and took Graham's Security Analysis course. When Ruane took over the Buffett Partnership its name was changed to Sequoia Fund. Since 1970 Ruane earned investors a return of 15.87% annually. In that time the S&P 500 returned 11.2% per year [Buffett, 1984, 8-10].

In 1964 Munger converted a friend of his to Graham's methodology. Rick Guerin was a math major from the University of Southern California who was an IBM salesman before becoming an investor. Guerin had no formal business education; it appears Benjamin Graham gave him all the knowledge he needed. His nineteen year annual return was 23.64% versus the S&P 500's annual return over the same time period of 7.89% [Buffett, 1984, 11].

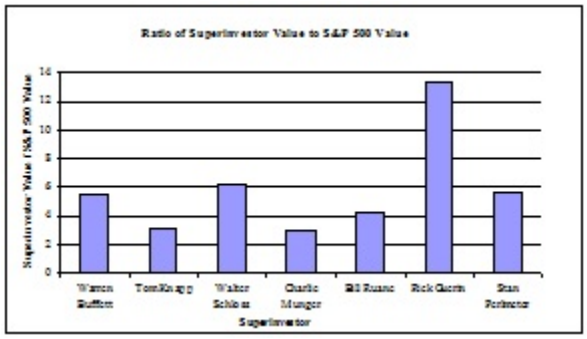
Stan Perlmeter earned a liberal arts degree from Michigan. He started

off in advertising before choosing to follow Buffett into an investing career. He, much like Guerin, was an immediate convert to the Graham style of investing. In 1965 Perlmeter began an investment fund that over nineteen years earned an average annual return of 18.24%. When compared to the Dow's annual return of 7.89%, Perlmeter's results look pretty decent [Buffett, 1984, 6-9].

The superinvestors have amassed astounding performance results. All seven boast an average annual return far in excess of the market index. In this graph the light bars are the average annual return for each superinvestor while the dark bar is the average annual return of the S&P 500 over the same time period.



When the superinvestor's investment results are coupled with the magic of compounding the results become truly amazing. The following graph displays the ratio of the value of an investment at inception in each of the superinvestor's funds divided by the value of a similar investment in the S&P 500 over the same time period. For each superinvestor the value of the superinvestor's fund more than doubles the value of the S&P 500. All seven superinvestors outperformed the market in convincing fashion.



C. ANALYSIS

If only a "few" managers have been able to consistently beat the market [Malkiel, 1990, 183-184], and of the few, seven have unmistakable ties to the same theory of investing, then we have found a result that yields valuable insight into the efficiency of the stock market. Since we seem to be on to something let us look more closely at the exceptional concentration of above average returns generated by Graham's disciples [Buffett, 1984, 6].

Do the seven superinvestors who make up a disproportionate percentage of above average investors have anything in common? For starters all seven share the same intellect, temperament and character that allows them to carry out Graham's methodology. They all share a deep understanding of the same intellectual framework established by Benjamin Graham in 1934 that guides their investment decision making.

Graham's intellectual framework instructs investors to buy securities selling at a steep discount to intrinsic value. The greater the margin of safety between price and value the better. Superinvestors never cut it close. Graham's superinvestors do not buy stock because a firm's beta increases or because a firm's covariance of returns with the market has changed [Buffett, 1984, 7]. The idea is to buy businesses worth $1 for 60 cents. All seven superinvestors adhere strictly to Graham's philosophy. Personal characteristics and investment philosophy are the extent of the superinvestor's similarities [Buffett, 1984, 13].

More differentiates the superinvestors than binds them together. There has been very little duplication among the portfolios of the seven investors and none of them take cues from any of the others. Some of the superinvestors buy entire businesses while others simply buy shares of businesses. Some hold portfolios concentrated in as little as ten stocks while others own over one hundred stocks at any given time. Some have bought the stock of companies outside the U.S. while others have not ventured overseas at all. Some have a formal business education while others have taken just a single investing class. All have chosen to invest in different sectors of the U.S. stock market.

D. ESSENTIAL DISCUSSION

Before assessing the implications of the superinvestors on market efficiency, a discussion of efficient markets research and risk is

necessary. In attempting to prove or disprove the efficient markets hypothesis a variety of mathematical models and quantitative analyses are required. When research on a topic like efficient markets becomes so heavily quantitative it becomes easy to dismiss qualitative arguments that, when combined with sound economic theory, are convincing. I believe the efficient markets literature has reached one such critical point. The efficient markets hypothesis cannot be disproved due to the joint hypothesis problem. The autocorrelations question will go unanswered until more sophisticated mathematical models are developed. The small firm and value anomalies cannot be fully understood until a measurement tool has been found that correctly measures risk.

Considering the inability of quantitative methods to answer these essential questions it is difficult to understand why there has been no effort on the part of efficient markets researchers to consider the implications of Buffett's superinvestors (or any other mainly qualitative approach) on market efficiency. Why do researchers spend huge amounts of time, money, and effort attempting to determine whether seasonality in returns exists when the greatest challenge to the efficient markets hypothesis is sitting in an office in Omaha reading a 10-K [Buffett, 1984, 8]? The answer has to do with flawed risk measurement techniques.

Buffett's superinvestors could not care less about essential tools of the efficient market hypothesis like beta and the capital asset pricing model (CAPM) [Buffett, 1984, 7]. Proponents say that the small firm and value anomalies are due to poor risk measurement techniques. Because beta has serious measurement flaws the CAPM, a tool that relies on beta as the measure of a stock's risk, is unreliable [Malkiel, 1990, 242]. Other measures of risk do no better.

Buffett's superinvestors have a completely different view of risk. Buffett believes that risk and return can be negatively related, an opinion at odds with the efficient markets hypothesis. That is, the expected return on an asset can rise while risk falls. This idea goes back to Graham's most basic principle: buy stocks worth $1 for considerably less than $1. If a stock's price falls from say 60 to 50 cents its beta (risk) will rise because the expected return has gone up. When the stock's price falls it becomes a better value and its expected return rises, increasing risk as well. But in the minds of our superinvestors the stock has become less risky; buying a $1 stock for 60 cents is more risky than buying the same stock for 50 cents. What measure of risk makes more sense to you?

This illustration shows the problem with market efficiency risk measurements and the virtue of buying assets worth quite a bit more than the current price. While the stocks chosen by Buffett's superinvestors are inherently low risk (superinvestors only buy stocks that are selling far below their estimate of intrinsic value) efficient markets proponents will say that the stocks are very high risk. Because the efficient markets hypothesis equates increased risk with increased return, market efficiency proponents say Buffett has simply taken on more risk, allowing him to earn a return greater than the market return. Efficient markets proponents then claim that the superinvestor's risk-adjusted returns are no better than the market's. The efficient markets hypothesis uses flawed risk measurement techniques that proponents rely on to dismiss the extraordinary results of the superinvestors.

E. SUMMARY

So what does the existence of the superinvestors say about market efficiency? Proponents of the efficient markets hypothesis claim that investors who are consistently able to earn returns in excess of the market return are the product of chance. After all, someone has to win the coin flipping contest, right? The existence of Buffett's superinvestors indicates that the stock market is not a coin flipping contest. It is possible to consistently earn returns greater than a buy-and-hold strategy; Buffett's superinvestors are the proof. It remains true that outperforming the market using fundamental analysis is difficult, but not impossible. The crux of Graham's investment methodology is to find discrepancies between stock price and intrinsic value. In the world of efficient markets there is no difference between the two. A vital assumption of the submartingale model is that price always equals the present value of future cash flows, or intrinsic value. The returns of Buffett's superinvestors prove that semi-strong form market efficiency does not hold by demonstrating a strategy based on public information that has consistently outperformed the market after adjusting for risk.

VII. Conclusion

The efficient markets hypothesis is not an accurate theory of financial markets. Its unrealistic assumptions and flawed forms of market efficiency make it highly contestable. The efficient markets hypothesis

assumes stock price movements follow the normal distribution, arbitrage is unlimited, and short selling is commonly used by rational agents in the market. All three assumptions are grossly inaccurate, putting all three forms of market efficiency in question. Strong form market efficiency is violated by specialists on stock exchanges and corporate insiders. Weak form market efficiency stands up to challenges from most anomalies. The well documented existence of autocorrelations does have the potential to violate the weak form, but no definitive proof either way has been presented as of yet. The semi-strong form, supported by the inability of many anomalies to earn excess returns, is threatened by the existence of the small firm and value stock anomalies. While important questions remain about the joint hypothesis problem, both anomalies seem to violate the semi-strong form of the efficient markets hypothesis. Buffett's superinvestors strike the final blow. The existence of a strategy based on publicly available information that accounts for a disproportionate amount of market beating investment funds is a direct violation of the semi-strong form. While the superinvestors are dismissed by proponents of the efficient markets hypothesis, the superinvestor's results and arguments present contradictory evidence to semi-strong form market efficiency that should not be ignored. After considering the evidence on the efficient markets hypothesis this paper comes to the conclusion that the efficient markets hypothesis is of little value in predicting or describing U.S. stock market behavior. While the efficient markets hypothesis may be a useful theoretical tool, its practical application is prohibited by unrealistic assumptions and documented violations of the theory.

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Appendix 1: Superinvestor's Annual Returns versus S&P 500
(All data are percentages)

Super-investor	S&P 500	Warren Buffet	Tom Knapp	Walter Schloss	Charlie Munger	Bill Ruane	Rick Guerin	Stan Perlmeter
Year		Buffett Partnership	Tweedy, Browne Inc.	W. Schloss Partnership	Charlie Munger	Sequoia Fund	Pacific Partners Ltd.	Perlmeter Investments
1956	7.5			5.1				
1957	-10.5	9.3		-4.7				
1958	42.1	32.2		42.1				
1959	12.7	20.9		17.5				
1960	-1.6	18.6		7				
1961	26.4	35.9		21.6				
1962	-10.2	11.9		8.3	20.1			
1963	23.3	30.5		15.1	47.8			
1964	16.5	22.3		17.1	33.1			
1965	10	36.9		26.8	6		21.2	32.5
1966	-11.7	16.8		0.5	8.3		24.5	5.1
1967	30.9	28.4		25.8	37.5		120.1	58.8
1968	11	45.6	22	26.6	27		114.6	52
1969	-8.4	6.6	10	-9	21.3		64.7	-13.8
1970	3.9		-1.9	-8.2	-0.1	12.1	-7.2	-6
1971	14.6		16.1	25.5	20.6	13.64	10.9	49.3
1972	18.9		11.8	11.6	7.3	3.61	12.8	18.9
1973	014.8		7.5	-8	-31.9	-24.8	-42.1	-28.1
1974	-26.4		1.5	-6.2	-31.5	-15.48	-34.4	-12
1975	37.2		22	42.7	73.2	61.84	23.4	38.5
1976	23.6		32.8	29.4		72.37	127.8	34.5
1977	-7.4		18.7	25.8		19.88	20.3	25.5
1978	6.4		32.1	36.6		23.93	28.4	26.6
1979	18.2		20.5	29.8		12.05	36.1	28.9
1980	32.3		17.3	23.3		12.66	18.1	34.7
1981	-5		11.6	18.4		21.49	6	3.3
1982	21.4		8.2	24.1		31.12	24	25.4
1983	22.4		28.2	38.4		27.31	18.6	18.4
1984	6.1			0.8		18.5		
1985	31.6					27.95		

Super-investor	S&P 500	Warren Buffet	Tom Knapp	Walter Schloss	Charlie Munger	Bill Ruane	Rick Guerin	Stan Perlmeter
Year		Buffett Partnership	Tweedy, Browne Inc.	W. Schloss Partnership	Charlie Munger	Sequoia Fund	Pacific Partners Ltd.	Perlmeter Investments
1986	18.6					13.38		
1987	5.1					7.4		
1988	16.6					11.05		
1989	31.7					27.91		
1990	-3.1					-3.8		
1991	30.5					40		
1992	7.6					9.36		
1993	10.1					10.78		
1994	1.3					3.34		
1995	37.6					41.38		
1996	23					21.74		
1997	33.4					43.2		
1998	28.6					35.25		
1999	21					-16.54		
2000	-9.1					20.06		
2001	-11.9					10.52		
2002	-22.1					-2.64		
2003	28.7					17.12		
2004	10.9					4.66		
/average Annual Return	10.49%	23.80%	15.74%	15.65%	13.65%	15.87%	23.64%	18.24%
S&P 500 Corresponding Return		8.74%	7.81%	8.65%	5.19%	11.20%	7.89%	7.89%
Superinvestor	S&P 500	Warren Buffet	Tom Knapp	Walter Schloss	Charlie Munger	Bill Ruane	Rick Guerin	Stan Perlmeter
Year		Buffett Partnership	Tweedy, Browne Inc.	W. Schloss Partnership	Charlie Munger	Sequoia Fund	Pacific Partners Ltd.	Perlmeter Investments

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