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Do stocks outperform Treasury bills?☆

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ABSTRACT

The majority of common stocks that have appeared in the Center for Research in Security Prices (CRSP) database since 1926 have lifetime buy-and-hold returns less than one-month Treasuries. When stated in terms of lifetime dollar wealth creation, the best-performing 4% of listed companies explain the net gain for the entire US stock market since 1926, as other stocks collectively matched Treasury bills. These results highlight the important role of positive skewness in the distribution of individual stock returns, attributable to skewness in monthly returns and to the effects of compounding. The results help to explain why poorly diversified active strategies most often underperform market averages.

1. Introduction

The question posed in the title of this paper may seem nonsensical. The fact that stock markets provide long-term returns that exceed the returns to low risk investments, such as government obligations, has been extensively documented, for the US stock market as well as for many other countries. In fact, the degree to which stock markets outperform is so large that there is wide spread reference to the "equity premium puzzle."[1]

The evidence that stock market returns exceed returns to government obligations in the long run is based on broadly diversified stock market portfolios. In this paper, I instead focus attention on returns to individual common stocks. I show that most individual US common stocks provide buy-and-hold returns that fall short of those earned on one-month US Treasury bills over the same horizons, implying that the positive mean excess returns observed for broad equity portfolios are attributable to relatively few stocks.[2]

I rely on the Center for Research in Securities Prices (CRSP) monthly stock return database, which contains all

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[1] Mehra and Prescott (1985) first drew attention to the magnitude of the equity premium for the broad US stock market. Dozens of papers have since sought to explain the premium.

[2] Since first circulating this paper, I have become aware of blog posts that show findings with a similar, though less comprehensive, flavor. See "The risks of owning individual stocks" at http://blog.alphaarchitect.com/2016/05/21/the-risks-of-owning-an-individual-stock/ and "The capitalism distribution" at http://www.theivyportfolio.com/wp-content/uploads/2008/12/thecapitalismdistribution.pdf.

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common stocks listed on the NYSE, Amex, and Nasdaq exchanges. Of all monthly common stock returns contained in the CRSP database from 1926 to 2016, only 47.8% are larger than the one-month Treasury rate in the same month. In fact, less than half of monthly CRSP common stock returns are positive. When focusing on stocks' full lifetimes (from the beginning of the sample in 1926, or first appearance in CRSP, through the 2016 end of the sample, or delisting from CRSP), just 42.6% of common stocks, slightly less than three out of seven, have a buy-and-hold return (inclusive of reinvested dividends) that exceeds the return to holding one-month Treasury bills over the matched horizon. More than half of CRSP common stocks deliver negative lifetime returns. The single most frequent outcome (when returns are rounded to the nearest 5%) observed for individual common stocks over their full lifetimes is a loss of 100%.

Individual common stocks tend to have rather short lives. The median time that a stock is listed on the CRSP database between 1926 and 2016 is seven-and-a-half years. To assess whether individual stocks generate positive returns over the full 90 years of available CRSP data, I conduct bootstrap simulations. In particular, I assess the likelihood that a strategy that holds one stock selected at random during each month from 1926 to 2016 would have generated an accumulated 90-year return (ignoring any transaction costs) that exceeds various benchmarks. In light of the well-documented small-firm effect (whereby smaller firms earn higher average returns than large, as originally shown by Banz (1981) it might have been anticipated that individual stocks would tend to outperform the value-weighted market. In fact, repeating the random selection process many times, I find that the single-stock strategy underperformed the value-weighted market over the full 90 years in 96% of the simulations. The single-stock strategy underperformed the one-month Treasury bill over the 1926–2016 period in 73% of the simulations.

The fact that the overall stock market generates long-term returns large enough to be referred to as a puzzle, while the majority of individual stocks fail to even match Treasury bills, can be attributed to the fact that the distribution of individual stock returns is positively skewed. Simply put, large positive returns to a few stocks offset the modest or negative returns to more typical stocks. The positive skewness in long horizon returns is attributable both to skewness in the distribution of monthly individual stock returns and to the fact that the compounding of random returns induces skewness.

This paper is not the first to study skewness in stock returns. Since at least Simkowitz and Beedles (1978) it has been recognized that individual stock returns are positively skewed, and that skewness declines as portfolios are diversified. The model of Krauss and Litzenberger (1976) implies a negative return premium for the coskewness of stock returns with market returns, while the models of Barberis and Huang (2008) and Brunnermeier et al. (2007) imply a negative return premium for firm-specific skewness. Evidence broadly consistent with these models is provided by Harvey and Siddique (2000), Mitton and Vorkink (2007), Conrad et al. (2013), and Amaya et al. (2016). However, the existing literature focuses on skewness in short horizon returns and has not emphasized either the magnitude or the consequences of skewness in longer horizon returns.

Perhaps the most striking illustration of the degree to which long-term return performance is concentrated in relatively few stocks arises when measuring aggregate wealth creation in the US public stock markets. I define wealth creation as the accumulation of market value in excess of the value that would have been obtained if the invested capital had earned one-month Treasury bill interest rates. I calculate that the approximately 25,300 companies that issued stocks appearing in the CRSP common stock database since 1926 are collectively responsible for lifetime shareholder wealth creation of nearly $35 trillion, measured as of December 2016. However, just five firms (Exxon Mobile, Apple, Microsoft, General Electric, and International Business Machines) account for 10% of the total wealth creation. The 90 top-performing companies, slightly more than one-third of 1% of the companies that have listed common stock, collectively account for over half of the wealth creation. The 1092 top-performing companies, slightly more than 4% of the total, account for all of the net wealth creation. That is, the remaining 96% of companies whose common stock has appeared in the CRSP data collectively generate lifetime dollar gains that matched gains on one-month Treasury bills.

At first glance, the finding that most stocks generate negative lifetime excess (relative to Treasury bills) returns is difficult to reconcile with models that presume investors to be risk averse, since those models imply a positive anticipated mean excess return. Note, however, that implications of standard asset pricing models are with regard to stocks' mean excess return, while the fact that the majority of common stock returns are less than Treasury returns reveals that the median excess return is negative. Thus, the results are not necessarily at odds with the implications of standard asset pricing models.

However, the results challenge the notion that most individual stocks generate a positive time series excess return and highlight the practical importance of positive skewness in the distribution of individual stock returns. While, as I show, monthly stock returns are positively skewed, the skewness increases with the time horizon over which returns are measured due to the effects of compounding.

These results complement recent time series evidence regarding the stock market risk premium. Savor and Wilson (2013) show that approximately 60% of the cumulative stock market excess return accrues on the relatively few days where macroeconomic announcements are made. Related, Lucca and Moench (2016) show that half of the excess return in US markets since 1980 accrues on the day before Federal Reserve Open Market Committee (FOMC) meetings. Those papers demonstrate the importance of not being out of the market at key points in time, while the results here show the importance of not omitting key stocks from investment portfolios.

For those who are inclined to focus on the mean and variance of portfolio returns, the results presented here reinforce the importance of portfolio diversification. Not only does diversification reduce the variance of portfolio returns, but also non-diversified stock portfolios are subject

to the risk that they will fail to include the relatively few stocks that, ex post, generate large cumulative returns. Indeed, as noted by Ikenberry et al. (1998) and Heaton et al. (2017), positive skewness in returns helps to explain why active strategies, which tend to be poorly diversified, underperform relative to market-wide benchmarks more than half of the time. These results imply that it may be useful to reassess standard methods of evaluating investment management performance.

The focus on the mean and variance of portfolio returns, and on the Sharpe ratio as a measure of investment performance, is often justified by the assumption that returns are reasonably approximated by the normal distribution. While this assumption may be reasonable at short horizons, the results here highlight strong positive skewness in longer-horizon returns. They thereby potentially justify the selection of less diversified portfolios by investors with long investment horizons who particularly value positive return skewness, i.e., the possibility of large positive outcomes, despite the knowledge that a typical undiversified portfolio is more likely to underperform the overall market. Further, the results highlight the potentially large gains from active stock selection if a decision maker has a comparative advantage in identifying in advance the stocks that will generate extreme positive returns.

I find that the percentage of stocks that generate lifetime returns less than those on Treasury bills is larger for stocks that entered the CRSP database in recent decades. This finding is consistent with evidence reported by Fama and French (2004), who show a surge in new listings after about 1980 that included increased numbers of risky stocks with high asset growth but low profitability, and low ex post survival rates. The recent evidence also supports the implications of Noe and Parker (2005) that the Internet economy will be associated with "winner take all" outcomes, characterized by highly skewed returns, and the findings of Grullon et al. (2018) showing increased industry concentration accompanied by abnormally high returns to successful firms in recent years.

It is well known that returns to early stage equity investments, such as venture capital, are highly risky and positively skewed, as most investments generate losses that are offset by large gains on a few investments. The evidence here shows that such a payoff distribution is not only confined to pre-Initial Public Offering investments but also characterizes the structure of longer term returns to investments in public equity, particularly smaller firms and firms listed in recent decades.

2. How can excess returns to most stocks be negative if investors are risk averse?

I show in the subsequent sections of this paper that the majority of individual stocks underperform one-month Treasury bills over their full lifetimes, and that the bulk of the dollar wealth created in the US stock markets can be attributed to a relatively few successful stocks. However, these results are not necessarily inconsistent with models implying that risk-averse stock investors require an expected return premium. Asset pricing models typically focus on mean returns, while the evidence here highlights that the median stock return is negative. The distinction between the positive mean and negative median stock return arises due to positive skewness in the return distribution.

2.1. Skewness in single-period returns

To better understand how the majority of excess stock returns can be negative, consider as a benchmark the case in which single-period excess stock returns are distributed lognormally. Let R denote a simple excess return for a single period. Assume that $r \equiv \ln(1+R)$ is distributed normally with mean μ and standard deviation σ. The expected or mean excess simply return, $E(R)$, is $\exp(\mu+0.5\sigma^2) - 1$. In contrast, the median excess simple return is $\exp(\mu) - 1$, which is less than the mean return for all $\sigma > 0$. The lognormal distribution does not have a distinct skewness parameter. However, the skewness of simple returns is positive, is monotone increasing in, and depends only on, σ.[3]

Note that the mean excess log return, μ, can be stated as $\mu = \ln[1 + E(R)] - 0.5\sigma^2$. If μ is negative then the median simple excess return is also negative. This occurs if

$$\sigma^2 > 2 * \ln[1 + E(R)]. \quad (1)$$

Stated alternatively, the lognormality assumption implies that more than half of single-period excess simple returns will be negative if the excess return variance is sufficiently large relative to the mean excess simple return. For example, a stock that has an expected simple excess return of 0.8% per month will, assuming the lognormal distribution applies, have a negative median excess monthly return if the monthly return standard deviation, σ, exceeds 12.62%.

2.2. Skewness in multi-period returns

It is intuitive that skewness in single-period returns will typically also imply skewness in returns compounded over multiple time periods. In the case of independent draws from a lognormal distribution, the skewness of multi-period simple returns increases with the number of periods, because the return standard deviation (which in turn solely determines the skewness of simple returns) is proportional to the square root of the number of elapsed periods.

It appears to be less widely appreciated that the compounding of random returns over multiple periods will typically impart positive skewness to longer horizon returns, even if the distribution of single-period returns is symmetric. To my knowledge, this point was first demonstrated by Arditti and Levy (1975).[4] More recently, Fama and French (2018) rely on bootstrap simulations to estimate probability distributions for buy-and-hold returns to

[3] See, for example, http://www.itl.nist.gov/div898/handbook/eda/section3/eda3669.htm.

[4] Ensthaler et al. (2018) report experimental evidence indicating that subjects fail to appreciate the importance of multi-period compounding and the skewness that it imparts, a phenomenon they refer to as "skewness neglect."