

# **Do Stocks Outperform Treasury Bills?\***

Initial Draft: January 2017

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## **Abstract**

Most common stocks do not outperform Treasury Bills. Fifty eight percent of common stocks have holding period returns less than those on one-month Treasuries over their full lifetimes on CRSP. When stated in terms of lifetime dollar wealth creation, the entire gain in the U.S. stock market since 1926 is attributable to the best-performing four percent of listed stocks. These results highlight the important role of positive skewness in the cross-sectional distribution of stock returns. The skewness in long-horizon returns reflects both that monthly returns are positively skewed and the fact that compounding returns over multiple periods itself induces positive skewness. The results also help to explain why active strategies, which tend to be poorly diversified, most often underperform.

\*I thank Jennifer Conrad, Wayne Ferson, Campbell Harvey, Ed Rice, Luke Stein, Sunil Wahal, Seth Pruitt, David Schreindorfer, Kumar Venkataraman and seminar participants at Arizona State University for valuable comments, and Goeun Choi for research assistance.

# Do Stocks Outperform Treasury Bills?

## I. 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 provided by low risk investments such as government obligations has been extensively documented, for the U.S. stock market as well as for many other countries.<sup>1</sup> In fact, the *degree* to which stock markets outperform low risk investments is so large that the magnitude of the observed stock market return premium is widely referred to as the “equity premium puzzle.”<sup>2</sup> These conclusions are most frequently based on market returns that are constructed as capitalization-weighted averages of returns to individual securities. Those studies that consider equal-weighted average returns generally report even higher stock market performance.

This paper relies on the CRSP monthly stock return database, which contains all common stocks listed on the NYSE, Amex, and NASDAQ exchanges, to document that most common stocks provide returns that fall short of those earned on one-month Treasury Bills. Of all monthly common stock returns contained in the CRSP database from 1926 to 2015, only 47.7% are larger than the one-month Treasury rate. In fact, less than half of monthly CRSP common stock returns are positive. When focusing on lifetime returns (from the beginning of sample or first appearance in CRSP through the end of sample or delisting from CRSP, and including delisting returns when appropriate), just 42.1% of common stocks have a holding period return

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<sup>1</sup> See, for example, the evidence compiled in chapter 10 of Corporate Finance, by Stephen Ross, Randolph Westerfield, and Jeffrey Jaffe, McGraw-Hill Irwin, 2013.

<sup>2</sup> Mehra and Prescott (1984) first drew attention to the magnitude of the equity premium for the broad U.S. stock market. Dozens of papers have since sought to explain the premium.

that exceeds the return to holding one-month Treasury Bills over the same horizon, and more than half deliver negative lifetime returns.

Individual common stocks tend to have rather short lives. The median time that a stock is listed on the CRSP database between 1926 and 2015 is just over seven years. To assess whether individual stocks generate positive returns over the full ninety 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 2015 would have generated a 90-year holding period 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 documented by Banz, 1980) it might be 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 in ninety six percent of the simulations, and underperformed the equal-weighted market in ninety nine percent of the simulations.<sup>3</sup> The probability that such a single-stock strategy would have outperformed the one-month Treasury bill over the 1926 to 2015 period was only twenty eight percent.

The fact that the overall stock market generates puzzling high long term returns while the majority of individual stocks fail to even match T-bills can be attributed to the fact that the cross-sectional distribution of stock returns is positively skewed.<sup>4</sup> Simply put, large positive returns

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<sup>3</sup> The equal-weighted market return exceeds the value-weighted return over long time periods, and thus provides a higher hurdle, both because of the small firm effect (and because of the active rebalancing implicit in equal weighting. For discussion, see Asparhouva, Bessembinder, and Kalcheva (2013).

<sup>4</sup> That individual stock returns are positively skewed, and that return skewness declines as portfolios are diversified, has been recognized at least since Simkowitz and Beedles (1978). Numerous authors have assessed the cross-sectional relation between mean returns and skewness (either individual stocks return skewness or the co-skewness of stock returns with the broader market, generally reporting lower returns for more highly skewed stocks, consistent with an investor preference for skewness as implied by Kraus and Litzenberger (1976). See for example Harvey and Siddique (2000), Mitton and Vorkink (2007), Conrad, Dittmar and Ghysels (2013) and Amaya, Christoffersen, Jacobs, and Vasquez (2015).

are more frequent than large negative returns. The importance of positive skewness in the cross-sectional return distribution increases for longer holding periods, due to the effects of compounding.

Perhaps the most striking illustration of the importance of individual stock skewness to stock market performance arises when measuring aggregate stock market wealth creation. I calculate that the approximately 26,000 stocks that have appeared in the CRSP database since 1926 are collectively responsible for lifetime shareholder wealth creation of nearly \$32 trillion dollars. However, the eighty six top-performing stocks, less than one third of one percent of the total, collectively account for over half of the wealth creation. The 1,000 top performing stocks, less than four percent of the total, account for all of the wealth creation. That is, the other ninety six percent of stocks that have appeared on CRSP collectively generated lifetime dollar returns that only match the one-month Treasury bill.

These results challenge the notion that individual stocks most often generate a positive return premium. The results highlight the importance of skewness in the cross-sectional distribution of stock returns. As I show below, this skewness arises both from the fact that monthly returns are positively skewed and from the possibly underappreciated fact that compounding introduces skewness into the multi-period return distribution even if single period returns are symmetric. At the same time, the results reinforce the importance of portfolio diversification, but from a perspective that differs from the typical textbook presentation. It of course remains true that diversification reduces the variance of portfolio returns, but this study highlights that non-diversified stock investments are subject to the very real risk that they will fail to include the relatively few stocks that, *ex post*, generate very large cumulative returns. The results therefore help to understand why most active strategies, which tend to be poorly diversified, lead to underperformance.

These results complement recent time series evidence regarding the stock market risk premium. Savor and Wilson (2013) show that approximately sixty percent of the cumulative stock market return premium accrues on the relatively few days where macroeconomic announcements are made. Lucca and Moench (2015) show that half of the equity premium in U.S. markets since 1980 accrues on the day before Federal Reserve Open Market Committee (FOMC) meetings. Related, Cieslak, Morse, and Vissing-Jorgensen (2016) document that the entire equity premium since 1994 has accrued in even weeks after 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.

## **II. How can Most Return Premia be Negative, if Investors are Risk Averse?**

At first glance, the finding that most stocks generate negative lifetime return premia (relative to Treasury Bills) is difficult to reconcile with models that presume investors to be risk-averse, since those models imply a positive anticipated return premium.<sup>5</sup> The Capital Asset Pricing Model (CAPM) in particular implies that each individual stock's expected return premium is the stock's beta times the positive expected market-wide premium. Given positive betas, each stock's expected return premium should be positive.

Note, however, that the CAPM's implications are with regard to stocks' *mean* excess return, while the fact that the majority of common stock returns are less than the treasury rate reveals that the *median* excess return is negative. The CAPM relies on the assumption that stock returns are normally distributed, in which case mean and median returns are equal. The evidence reported here is at indeed at odds with the CAPM, but the conflict arises from the fact that the median stock return is less than the mean return.

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<sup>5</sup> I will use the terms return premium and excess return interchangeably, in each case referring to the difference between the stock return and the Treasury return.

### a. Skewness in Single-Period Returns

To better understand how the majority of stock return premia can be negative even while investors are risk averse and demand a positive expected return premium, consider as a benchmark the case where single-period excess stock returns are distributed lognormally. The log normal distributional assumption has been widely used to model stock prices.<sup>6</sup>

In particular, let  $R$  denote a simple excess return for a single period. If  $r \equiv \ln(1 + R)$  is distributed normally with mean  $\mu$  and standard deviation  $\sigma$ , then  $R$  is distributed log normally. The expected excess return,  $E(R)$  is  $\exp(\mu + 0.5\sigma^2) - 1$ , while the median excess return is  $\exp(\mu) - 1$ . The mean excess return exceeds the median, reflecting that the distribution of single period returns is positively skewed, as a positive function of the return standard deviation,  $\sigma$ .<sup>7</sup>

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

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

Stated alternatively, the log normality assumption implies that more than half of single period excess returns are expected to be negative for any stock and where the excess return variance,  $\sigma^2$ , exceeds twice the continuously compounded equivalent of the mean excess return. This is attributable to the fact that greater return variance implies greater positive skewness in the case of log normal variables.

While actual stock returns do not conform exactly to the log normality assumption, they are indeed right skewed (as documented further in Section III below), as the median return is less

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<sup>6</sup> See, for example, Rubinstein (1976).

<sup>7</sup> The expression for the standardized skewness of a log normal variable depends monotonically on the standard deviation,  $\sigma$ , and implies positive skewness for all  $\sigma > 0$ . See, for example, <http://www.itl.nist.gov/div898/handbook/eda/section3/eda3669.htm>.

than the mean return. Expression (1) shows that the median excess return will be negative for stocks with sufficiently high return volatility relative to their mean 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 return monthly return if the standard deviation,  $\sigma$ , exceeds 12.6%. By comparison, the full sample standard deviation of monthly CRSP common stock returns about is 18%.

### **b. 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 the log normal distribution, the positive skewness of multi-period returns increases with the number of periods, as, assuming time independence, the return standard deviation is proportional to the square root of the number of periods.

It appears to be less widely appreciated that the compounding of returns over multiple periods will typically impart positive skewness to longer horizon returns, even if the distribution of single-period returns is symmetric.<sup>8</sup> Consider, as a simple example, the case where single-period stock returns are either 20% or -20%, with equal probability. This distribution is symmetric about a mean of zero. Assuming independence across periods, two period returns are 44% (probability 25%), -4% (probability 50%) or -36% (probability 25%). The two period distribution is positively skewed; note that the median (-4%) that is less than the zero mean, and that the probability of observing a negative two-period return is seventy five percent.<sup>9</sup>

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<sup>8</sup> Ensthaler, Nottmeyer, Weizsacker, and Zankiewicz (2017) 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.”

<sup>9</sup> The standardized skewness coefficient in this case is 0.412. Note though, that a simple comparison of the mean to the median need not reliably reveal the sign of the skewness coefficient for more complex distributions. See, <http://ww2.amstat.org/publications/jse/v13n2/vonhippel.html>. An exception to the conventional wisdom that

The normal distribution in single period returns also implies positive skewness in multi-period returns. Results reported in Siejas-Macias and Oliveira (2012) imply that the distribution of the product of two positive-mean independent normal random variables is positively skewed, except when the variance of at least one variable is zero. Since multi-period returns are obtained by multiplying gross (one plus) returns, the positive mean condition is satisfied for rates of return. The implication is that two-period returns are positively skewed even when single period returns are independent and normally distributed, unless returns are riskless in at least one period.

To summarize, the evidence that most stocks generate holding-period returns that are less than would have been earned on Treasury bills is not necessarily inconsistent with theories implying that investors require a positive risk premium. Asset pricing theories typically focus on mean returns, while the evidence here emphasizes median returns. The results therefore highlight the practical importance of positive skewness in the return distribution, particularly over multiple periods.

### **III. The Distribution of Holding Period Returns**

I study monthly returns for all CRSP common stocks (share codes 10, 11, and 12) from July 1926 to December 2015.<sup>10</sup> The starting date is the earliest for which data on one-month Treasury Bills is available from Kenneth French's website. The data includes 25,782 distinct CRSP permanent numbers (PERMNOs), which I refer to as firms or stocks.<sup>11</sup> I include in all

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positive skewness necessarily implies that the mean is larger than the median can be observed for geometric returns on Panel B of Table 1 herein.

<sup>10</sup> The sample excludes fifty seven common stocks for which CRSP data on shares outstanding is always equal to zero. These stocks were listed for between one and nineteen months, and thirty nine of the fifty seven stocks had a negative mean monthly return. Their inclusion would therefore strengthen the conclusions drawn here.

<sup>11</sup> According to the CRSP data guide (available at [http://www.crsp.com/files/data\\_descriptions\\_guide\\_0.pdf](http://www.crsp.com/files/data_descriptions_guide_0.pdf)), the PERMNO is "a unique permanent identification number assigned by CRSP to each security. Unlike the CUSIP, Ticker Symbol, and Company Name, the PERMNO neither changes during an issue's trading

calculations the CRSP delisting return for those firms that delist prior to the end of 2015. When studying periods longer than one month I create holding period returns by linking monthly returns, inclusive of dividends. Holding period returns capture the experience of a hypothetical investor who reinvests dividends but does not otherwise alter her position by buying or selling shares.<sup>12</sup>

### **a. Monthly Returns**

Panel A of Table 1 reports some summary statistics for the 3,524,849 monthly common stock returns contained in the CRSP database from July 1926 to December 2015. The data confirms that the mean return premium is positive, as the average monthly return is 1.13%, which exceeds the average one-month Treasury Bill rate of 0.38%, by 0.75% per month. Several additional observations regarding monthly common stock returns are noteworthy. First, monthly returns are positively skewed, with a skewness coefficient (the third sample moment standardized by the second moment to the 3/2 power) equal to 6.72. Second, monthly returns are highly variable, with a standard deviation of 18.0%. Third, and most important, only a minority, 47.7%, of CRSP monthly stock returns exceed the one-month Treasury return in the same month. In fact, less than half (48.3%) of monthly stock returns are positive.<sup>13</sup>

If I weight the results by beginning-of-month market capitalization, I obtain that 53.3% of the market value of stocks in a given month deliver a return that exceeds the one month Treasury return, while 54.5% of the market value of stocks in a given month deliver a return that is positive. Comparing these results to those for the number of stocks in Panel A of Table 2

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history, nor is it reassigned after an issue ceases trading. The user may track a security through its entire trading history in CRSP's files with one PERMNO, regardless of name or capital structure changes."

<sup>12</sup> However, holding period returns do not capture the investment experience of firms' investors in aggregate, who fund new equity issuances and receive the proceeds of share repurchases, but do not reinvest dividends. The experience of investors in aggregate is considered in Section V.

<sup>13</sup> If I compute the mean of indicator variables that are one for stocks with returns that exceed value weight the

implies that smaller capitalization stocks are more likely to have returns that fall below the benchmarks of zero or the Treasury bill rate, a result explored more fully in Section III.d below.

### **b. Annual and Decade Returns**

Panels B and C of Table 2 report summary statistics for CRSP common stock returns computed on a calendar year and decade basis, respectively. Decades are non-overlapping, and are defined as 1926 to 1935, 1936 to 1945, etc. For stocks that list or delist within the calendar period, I measure the return over the portion of the calendar interval that the stock was included in the CRSP data.<sup>14</sup> For each stock, I compute the simple sum of returns for the calendar interval, and also holding period return for the interval. The former reveals whether the arithmetic mean return is positive, while the latter reveals the magnitude of the actual gain or loss to a hypothetical investor who reinvests dividends but otherwise does not trade. I also compute the geometric mean of monthly returns for each stock over each interval.<sup>15</sup> (Since I will subsequently assess the cross sectional mean and median of this statistic I will refer to the geometric return for each stock, to avoid confusion.) The sum of returns will be positive more often than the geometric return, reflecting that some stocks have positive arithmetic mean returns even though buy-and-hold investors suffer losses.

Figure 1 displays the frequency distribution of annual (Figure 1A) and decade (Figure 1B) holding period returns (to a maximum of 500%). The frequency distribution of annual returns (each rounded to the nearest 1%) displays a notable spike at zero (which is also the most frequent outcome), and smaller spikes at 100% and 200%, presumably as the result of price

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<sup>14</sup> The alternative of including only those stocks that were listed continuously for the full calendar interval would introduce a severe survivorship bias. In those cases where a stock is listed for only a portion of the calendar interval, I also compute benchmark returns (to Treasury-Bills and the overall stock market) over the same shorter interval for comparison.

<sup>15</sup> The geometric mean for a sample of  $n$  returns is the  $n$ th root of one plus the holding period return, less one.

rounding. The positive skewness of annual holding period returns can be observed, in part because numerous returns exceed 100%, while, due to limited liability, no returns are less than -100%.<sup>16</sup>

The frequency distribution of decade holding period returns in Figure 1B also reveals positive skewness.<sup>17</sup> Unlike annual returns, where the most frequent observation was zero, the most frequently-observed decade holding period return (rounded to the nearest 5%) is -100%.<sup>18</sup> Zero returns at the decade horizon are only slightly more frequent than slightly positive or slightly negative returns. On balance, the frequency distribution of decade holding period returns is notably asymmetric, with the most frequent outcomes near -100% and many outcomes greater than 100%.

The statistics on Panels B and C of Table 1 verify that that holding period returns across multiple months are positively skewed. The standardized skewness coefficient is 19.92 for annual returns and 14.21 for decade returns. Note also that mean holding period returns substantially exceed median returns. The mean annual holding period return is 14.72%, while the median is 5.08%. The divergence is more notable for the decade horizon, where the mean holding period return is 118.6%, compared to a median of just 14.9%.

The mean decade holding period return of 118.6% exceeds the average sum of returns, which is 73.5%. However, the sum of returns (or arithmetic mean return) is positive more frequently than the holding period return. At the decade horizon, 73.2% of arithmetic mean returns are positive, while only 55.7% of holding period returns are positive. The fact that the

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<sup>16</sup> A total of 20,805 (6.6% of all annual return observations) holding period returns exceed 100%. Of these, 828 exceed 500% and are not displayed on Figure 1A. The maximum annual holding period return was 11,060%.

<sup>17</sup> A total of 16,026 (29.7% of all decade return observations) holding period returns exceed 100%. Of these, 3,504 exceed 500% and are not displayed on Figure 1A. The maximum decade holding period return was 22,825%.

<sup>18</sup> The data contains only 375 occurrences where a stock has a delisting return of exactly -100%. More often a final (delisting) share price is small but positive, implying a holding return through the delisting date slightly better than -100%.

standardized skewness of annual holding period returns greatly exceeds that of the sum of annual returns (19.92 vs. 1.25) emphasizes the important role of compounding in generating skewness over multiple periods.

At the annual horizon, a slight majority (51.4%) of stocks generate holding period returns that exceed the holding period return on one-month Treasury Bills. Notably, at the decade horizon, a minority (49.2%) of stocks outperform Treasury Bills.

The effects of right skewness in the distribution of holding period returns can also be observed when comparing individual stocks to market-wide benchmarks. At the decade horizon, only 37.4% of stocks have holding period returns that exceed the holding period return to the value-weighted portfolio of all common stocks, and just 33.9% outperform the holding period return to the equal-weighted portfolio of all common stocks.

The comparison of geometric returns across the annual and decade horizons is informative. The cross-sectional median geometric return is positive at both horizons, but is larger (0.48% per month) at the annual horizon than at the decade (0.31% per month) horizon. Notably, the distribution of geometric returns across stocks is positively skewed at the annual horizon (skewness statistic of 6.43) but is negatively skewed at the decade horizon (skewness statistic of -3.12). That is, extreme negative geometric returns are relatively more common (compared to extreme positive geometric returns) at the decade horizon than at the annual horizon.

The positive cross-sectional skewness in decade holding period returns could, in principle, have been attributable in part to positive skewness in geometric returns. Since the actual skewness in geometric returns is negative, the skewness in decade holding period returns can be fully attributed to a combination of positive skewness in monthly returns and the effects of compounding.

### c. Lifetime Returns

In Panel D of Table 1, I report on lifetime returns to CRSP common stocks. For each stock, the lifetime return spans from July 1926 or the original listing date to December 2015 or the delisting date, inclusive of the delisting return.

While over seventy one percent of individual stocks have a positive arithmetic average return over their full life, only a minority (49.2%) of CRSP common stocks have a positive lifetime holding period return, and the median lifetime return is -3.67%. This result highlights that arithmetic mean returns tend to overstate actual performance. While over 71% of CRSP common stocks show a positive arithmetic mean return over their lifetimes, less than half generate a positive holding period return.

The distribution of lifetime holding period returns is also highly positively skewed. The standardized skewness coefficient is 154.2. In contrast to the negative median lifetime holding period return, the cross-sectional mean lifetime return is over 16,000 percent.<sup>19</sup> Also reflective of the positive skewness, only 599 stocks, or 2.3% of the total, have lifetime holding period returns that exceed the cross-sectional mean lifetime return.

Geometric returns over stocks' full lives are negatively skewed (skewness coefficient -4.05) in the cross section. As discussed above, negative skewness in the distribution of geometric returns, which are stated on a per-month basis, implies that the very strong positive skewness in lifetime holding period returns is attributable to skewness in monthly returns in combination with the effects of compounding.

Perhaps most notably, only 42.1% of CRSP common stocks have lifetime holding period returns that exceed the holding period return on one-month Treasury Bills over the same time

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<sup>19</sup> The maximum lifetime holding period return is 202.96 million percent, by the firm now known as Altria Group, Inc.

periods. The answer to the question posed on the title of this paper is that most common stocks, (slightly more than four out of every seven) *do not* outperform Treasury Bills over their lives. The fact that the broad stock market does outperform Treasuries over longer time periods is fully attributable to the positive skewness of the stock return distribution – i.e. to the relatively few stocks that generate large returns, not to the performance of typical stocks.

The importance of the right skewness in the stock return distribution can also be illustrated by comparing the holding period returns of individual stocks to the holding period returns earned on the equal and value-weighted portfolios of all common stocks. As shown on Panel D of Table 1, only 30.6% of individual common stocks generated lifetime holding period returns that exceed the performance of the value weighted portfolio over the same intervals, and only 26.2% outperformed the equal-weighted portfolio.

#### **d. Return Distributions Delineated by Firm Size**

In Table 2 I report a number of statistics regarding holding period returns to common stocks, when firms are stratified based on market capitalization, for monthly (Panel A), calendar year (Panel B), and non-overlapping decade (Panel C) horizons.<sup>20</sup> Each stock is assigned to a size decile group based on its market capitalization at the end of the last month prior to the interval for which the return is measured (for stocks already listed at the beginning of the interval) or at the time of its first appearance in the database (for stocks initially listed during the interval). Each decile group contains ten percent of the stocks in the database as of the month prior to the interval over which the return is measured.

The data reported on Table 2 show a distinct pattern by which small stocks more frequently deliver returns that are less than benchmark returns. At the decade horizon, only

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<sup>20</sup> I omit results for lifetime returns, since market capitalization at original listing is not very informative regarding a firm's longer term market capitalization.

43.1% of stocks in the smallest decile have holding period returns that are positive, and only 37.4% have holding period returns that exceed those of the one-month Treasury bill. In contrast, 80.0% of stocks in the largest decile have positive decade holding period returns, and 69.6% outperform the one-month Treasury Bill. Only 31.0% of smallest-decile stocks have decade holding period returns that exceed the return to the value-weighted market over the same period, and only 28.6% beat the equal-weighted market.

However, as has previously been noted (e.g. Kumar, 2009), small stocks generate “lottery-like” returns, as evidenced by the large positive skewness in the return distribution. The standardized skewness of the decade holding period returns for the smallest decile of stocks is 13.14, which far exceeds that of the largest decile of stocks, which is 3.62.

While large capitalization stocks display less return skewness than small stocks, positive skewness in the large stock distribution manifests itself in the fact that most large stocks fail to match the overall market. The percentage of large stock holding period returns that exceed matched holding period return to the value-weighted market is 48.9% at the monthly horizon, 46.6% at the annual horizon, and 44.2% at the decade horizon.

#### **IV. Individual Stocks over the Full Ninety Years**

The CRSP data I employ includes returns pertaining to ninety calendar years, spanning 1926 to 2015. In section III, I report data on lifetime returns to CRSP common stocks, showing that the majority fail to outperform one-month Treasury bills over their lifetime. However, for the large majority of stocks the lifetime return pertains to a period much shorter than the full ninety year sample. In fact, just thirty six stocks were present in the database for the full ninety years. The median life of a common stock on CRSP, from the beginning of sample or first appearance to the end of sample or delisting, is just 84 months, or slightly over seven years. The 90<sup>th</sup> percentile life span is 326 months, or just over 27 years.

To obtain evidence regarding the long term performance of individual stocks that spans the full ninety years, I adopt a bootstrap procedure. In particular, for each month from July 1926 to December 2015 I select one stock at random, and then link these monthly returns. The resulting continuous return series represents one possible outcome from a strategy of holding a single random stock in each month of the sample, ignoring any transaction costs. I compare returns from the one-stock strategy at the annual, decade, and ninety-year horizons to several benchmarks, including zero, the accumulated return to holding one-month Treasury bills, the accumulated return on the value-weighted portfolio of all common stocks, and the accumulated return to the equal-weighted portfolio of all common stocks over the same calendar interval. I repeat the procedure 10,000 times, to obtain a bootstrap distribution of possible returns to single stock strategies. In light of the well-documented small firm effect, it might be anticipated that single stock portfolios would tend to frequently outperform benchmarks that included larger firms over long horizons.

Panel A of Table 3 reports the mean and median holding period return, as well as the skewness, for the one-month Treasury bill as well as the equal and value-weighted portfolios of all CRSP common stocks, for annual, decade, and lifetime (90 year) horizons.<sup>21</sup> Since we only observe one actual history, these series contain only time series variation, and the 90-year series contains a single outcome. Panel B of Table 3 reports mean and median holding period returns for each time horizon, computed across the 10,000 bootstrap simulations.

The results reveal that single stock strategies would have been profitable on average (ignoring transaction costs). The mean holding return to the single stock strategy is 16.6% at a one year horizon, 265.0% at a decade horizon, and 526,325% at the 90-year horizon. However,

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<sup>21</sup> The skewness of annual value-weighted market returns is negative. Albuquerque (2012) presents evidence that negative skewness in market returns can be reconciled with positive skewness in individual stock returns by heterogeneity in information announcement dates across stocks.

the right skewness in the distribution of bootstrapped single stock strategies is extreme – the standardized skewness coefficient is 7.04 at the annual horizon, 41.0 at the decade horizon, and 44.3 at the 90-year horizon, implying that these mean returns greatly exceeded typical returns.

Despite the positive mean returns, most single stock portfolios performed poorly, especially at the 90-year horizon. While a slight majority (50.9%) of single stock strategies generated a positive 90-year holding return, the median 90-year return is only 13.1%, compared to a 90-year holding period return on Treasury bills of 1,923%. Only 27.6% of single stock strategies produced a holding period return greater than one-month Treasury Bills. That is, the data indicates that in the long term (defined here as the 90 years for which CRSP and Treasury bill returns are available) only about one fourth of individual stocks outperform Treasuries.

Further, only 3.8% of single stock strategies produced a holding period return greater than the value-weighted market, and only 1.2% beat the equal-weighted market over the full 90-year horizon. These observations, which again reflect the substantial positive skewness in the distribution of stock returns, may help to explain the result that most active managers, who tend to be poorly diversified, underperform the broad stock market.

## **V. Aggregate Value Creation in the U.S. Stock Market**

The results reported here show that most individual common stocks have generated holding period returns that are less than the holding period returns that would have been obtained from investing in U.S. Treasuries over the same time periods. Stated alternatively, the fact that the overall stock market has outperformed low risk treasuries is attributable to positive skewness in returns, i.e. to large returns earned by relatively few stocks.

However, rates of return are percentages, and as such are insensitive to scale. Further, as noted, holding period returns measure the experience of a hypothetical investor who reinvests

dividends, but otherwise makes no transactions after the initial purchase of shares. The experience of this hypothetical investor will differ from the experience of investors in aggregate, because equity investors collectively do not reinvest dividends, but do fund new equity issuances and receive the proceeds of equity repurchases. For these reasons, a high holding period return need not imply large wealth creation for investors in aggregate, and vice versa.

Consider, as a case in point, General Motors Corporation (PERMNO 12079), which delisted in June 2009 following a Chapter 11 bankruptcy filing.<sup>22</sup> Its delisting share price was \$0.61, down from \$93 less than a decade earlier and from \$23 a little over two years earlier. Had the delisting share price been zero instead of sixty one cents, GM's lifetime holding period return would have been -100%. However, GM paid more than \$64 billion in dividends to its shareholders in the decades prior to its bankruptcy, and these funds were collectively available to be invested elsewhere prior to GM's bankruptcy filing. In fact, as I show below, GM common stock was one of the most successful stocks in terms of lifetime wealth creation for shareholders in aggregate, despite its ignoble ending.

To assess the practical importance of the fact that most stocks deliver holding period returns that underperform Treasury bills, I create a measure of dollar wealth creation for each of the 25,782 individual CRSP common stocks in the sample, using the following framework. Let  $W_0$  denote an investor's initial wealth, and assume an investment horizon of  $T$  periods. The investor chooses each period to allocate her wealth between a riskless bond that pays a known return  $R_f$ , (assumed for expositional simplicity to be constant over time) and a risky investment that pays an uncertain return  $R_t = R_{ct} + R_{dt}$ , where  $R_{ct}$  is the capital gain component of the period  $t$  return and  $R_{dt}$  is the dividend component. Dividends are returned to the investor's riskless bond account. Separate from the dividend, the investor makes an additional time  $t$  investment

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<sup>22</sup> A new General Motors stock emerged from the bankruptcy filing and completed an IPO in November 2010.

(from the bond account) in the risky asset in the amount  $F_t$  (with a repurchase of shares by the firm denoted by  $F_t < 0$ ). Let  $W_t$ ,  $B_t$ , and  $I_t$  denote the investor's total wealth, the value of her position in riskless bonds, and the value of her position in the risky asset at time  $t$ , with  $W_t = B_t + I_t$ .

The value of the investor's position in the riskless bond evolves according to

$B_t = B_{t-1}(1+R_f) + I_{t-1}R_{dt} - F_t$ , as the investor earns interest, collects any dividend, and potentially increases or decreases her investment in the risky asset. The value of the investor's position in the risky asset evolves according to  $I_t = I_{t-1}(1+R_{ct}) + F_t$ , that is based on the capital gains return and any new investment. The investor's overall wealth at time  $t$  can be expressed as

$W_t = B_{t-1}(1+R_f) + I_{t-1}(1+R_t)$ , and we can state:

$$W_t - W_{t-1}(1+R_f) = I_{t-1}(R_t - R_f).^{23} \quad (2)$$

Expression (2) states that the investor's actual wealth at time  $t$ , as compared to the wealth that would have been obtained had her prior period wealth been invested entirely in risk free bonds, is the product of the dollar investment in the risky asset times the asset's excess return. The right side of expression (2) can therefore be interpreted as the dollar wealth created during period  $t$  by investing some funds in the risky asset rather than the risk-free bond.

Applying expression (2) iteratively leads to the following expression:

$$W_T - W_0(1+R_f)^T = I_0(R_1 - R_f)(1+R_f)^{T-1} + I_1(R_2 - R_f)(1+R_f)^{T-2} + \dots + I_{T-1}(R_T - R_f). \quad (3)$$

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<sup>23</sup> Note that  $F_t$  and  $R_{dt}$  have been eliminated from expression (2). Dividends and new investments in the risky asset matter only indirectly, though their effect on  $I_t$ .

The first line of expression (3) can be interpreted as the investor's final wealth, in excess of the wealth the investor would have attained had she invested entirely in the risk free asset, or equivalently as the wealth created by investing in the risky asset rather than the Treasury bill. The second line of expression (3) shows that the dollar amount of wealth creation attributable to the investment in the risky asset can be computed as the sum of the future values (using the risk free rate to compound forward) of the period by period wealth creation specified by the right side of expression (2).<sup>24,25</sup>

I implement expression (3) for each stock, using the beginning of period market capitalization (share price times shares outstanding, from CRSP) in the role of  $I_t$ . Results therefore apply to each stock's investors in aggregate. Compounding is accomplished by linking actual one-month Treasury rates from time  $t$  to December 2015. The results indicate that the 25,782 individual common stocks that have appeared in the CRSP data since July 1926 have collectively created over \$31.8 trillion in wealth for investors, measured as of December 2015.

Table 4 reports lifetime wealth creation for the thirty individual stocks that created the most wealth. Individual stocks are identified by CRSP PERMNO and by the most recent name associated with the PERMNO. The largest amount of wealth creation attributable to any stock is \$939.8 billion, by Exxon Mobil Corporation. The second largest wealth creation is attributable to Apple, Inc., which created \$677.4 billion in shareholder wealth, despite a CRSP life of only 420 months (compared to 1,073 months for Exxon Mobil and other firms that were present for the full sample.) General Electric (\$597.5 billion), Microsoft (\$567.7 billion),

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<sup>24</sup> Compounding at the risk free rate reflects the fact that the Treasury bill always comprises the opportunity cost on invested capital, or equivalently the return on cash given off by the risky asset, in this computation. An alternative would be measure wealth creation from investing in a given asset rather than the value-weighted portfolio, in which case the value-weighted return would replace the risk free rate on the right side of expression (3).

<sup>25</sup> Expression (3) is also equivalent to calculating wealth creation as the date T value of the stock's outstanding shares less the date T value (using the treasury rate) of all cash flows (positive in the case of stock issuances, negative in the case of dividends and share repurchases) from investors to the firm prior to date T.

International Business Machines (\$487.3 billion), Altria Group (\$448.1 billion), General Motors (\$394.1 billion), Johnson and Johnson (\$383.7 billion), Walmart Stores (\$337.7 billion), and Proctor and Gamble (\$335.8 billion) comprise the rest of the top ten stocks in terms of lifetime value creation.

In addition to lifetime wealth creation, Table 4 identifies the lifetime cumulative gross return (measured by linking individual monthly returns over the life of the stock) and the geometric mean excess monthly return (the geometric mean monthly return for the stock over its life, less the geometric mean monthly Treasury bill return over the same interval). The largest cumulative gross return was 202.9 million percent, earned by Altria Group (which includes among its holdings Phillip Morris USA). Altria Group's geometric mean monthly return over its 1,073 month life exceeded the geometric mean Treasury bill return by 1.08%. By comparison, Exxon Mobile Corporation (which had the largest dollar wealth creation) had an excess geometric mean return of 0.66% per month, and Microsoft had an excess geometric mean return of 1.62% per month.

As noted, Exxon Mobil was responsible for lifetime wealth creation of \$939.8 billion. Thus, Exxon Mobile alone was responsible for 2.96% of the \$31.8 trillion in total wealth creation by CRSP common stocks over the 1926 to 2015 period. Apple Corporation was responsible for an additional 2.13% of total stock market wealth creation. The right column of Table 4 displays the cumulative percentage of total U.S. stock market wealth creation since 1926 accounted for by the indicated firm and those listed above it on the Table. It can be observed that the top thirty firms together accounted for 31.2% of the total stock market's wealth creation.

Figure 2A displays the cumulative percentage of the total stock market wealth creation attributable to the 25,782 individual common stocks in the CRSP database, when firms are ranked from highest to lowest wealth creation. The curve on Figure 2A asymptotes at 100%, by

construction. It exceeds 100% for a broad range, reflecting the fact that total wealth creation would have been larger if not for the impact of the 14,946 (57.9% of total) stocks with negative lifetime wealth creation.

Figure 2B displays the same data as Figure 2A, but is confined to the 1,000 stocks with the largest lifetime wealth creation. Strikingly, the curve on Figure 2B passes through 50% at just 86 stocks and passes through 75% at 282 stocks. That is, just 0.33% of all CRSP common stocks account for half of the cumulative wealth creation in the U.S. stock market from 1926 to 2015, and 1.09% of the stocks account for three quarters of the wealth creation.

The curve on Figure 2B reaches 100% at 983 stocks, which is 3.81% of the 25,782 stocks in the sample. The striking implication is that less than four percent of the common stocks contained in the CRSP database collectively account for all of the wealth creation in the U.S. stock market since 1926. The remaining 96.19% of common stocks collectively generated dollar gains that matched those that would have been earned had the invested capital earned the same rates as one-month U.S. Treasury bills.<sup>26,27</sup>

It should be noted that there are at least five considerations that collectively contribute to the fact that wealth creation in the U.S. stock market is concentrated in relatively few stocks. Some stocks have long lives while others have short lives. As noted, the median life of a CRSP common stock is just over seven years, while, not surprisingly, the stocks with the greatest wealth creation generally have much longer lives. Some stocks have large market capitalization at a given time, while others are small. A given return equates to larger wealth creation for stocks with greater market capitalization. Even if the cross-sectional distribution of holding

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<sup>26</sup> Beyond the best-performing 983, an additional 9,734 stocks (37.76%) of stocks created positive wealth over their lifetimes. The wealth creation of these 9,734 stocks was just offset by the wealth destruction of the remaining 15,065 (58.43% of total) stocks, so that the top 983 stocks created the same wealth as the overall market.

<sup>27</sup> Of course, equilibrium interest rates and stock market prices would surely have differed from those actually observed had the capital actually invested in these stocks been invested in Treasury obligations instead.

period returns was symmetric, some stocks would have high returns and some would have low returns, ex post. Fourth, monthly returns are positively skewed. Finally, the compounding of returns over multiple periods itself induces positive skewness in the distribution of returns, which contributes to the concentration of wealth creation.

These explanations are not independent, and potentially reinforce each other. Stocks with large positive returns tend to both grow larger and to survive longer, while those with low returns become smaller and tend to delist. Nevertheless, the fact that all of the dollar wealth creation in the U.S. market is attributable to less than four percent of stocks is striking.

## **VI. Conclusions**

While the overall stock market outperforms Treasury bills, most individual common stocks do not. Of the nearly 26,000 common stocks that have appeared on CRSP since 1926, less than half generated a positive holding period return, and only 42% has a holding period return higher than the one-month Treasury bill over the same time interval. The positive performance of the overall market is attributable to large returns generated by relatively few stocks. When stated in terms of lifetime dollar wealth creation, one third of one percent of common stocks account for half of the overall stock market gains, and less than four percent of common stocks account for all of the stock market gains. The other ninety six percent of stocks collectively matched Treasury-Bill returns over their lifetimes.

These results highlight the practical importance of positive skewness in the cross-sectional distribution of returns. The positive skewness arises both from the fact that monthly returns are positively skewed, and from the possibly underappreciated fact that compounding introduces positive skewness into the multi-period return distribution even if single period returns are distributed symmetrically.

These results reaffirm the importance of portfolio diversification, but focus attention on the fact that poorly diversified portfolios may omit the relatively few stocks that generate large positive returns. The results also help to explain why active portfolio strategies, which tend to be poorly diversified, most often underperform their benchmarks. Underperformance is typically attributed to transaction costs, fees, and/or behavioral biases that amount to a sort of negative skill. The results here show that underperformance can be anticipated more often than not for active managers with poorly diversified portfolios, even in the absence of costs, fees, or perverse skill.

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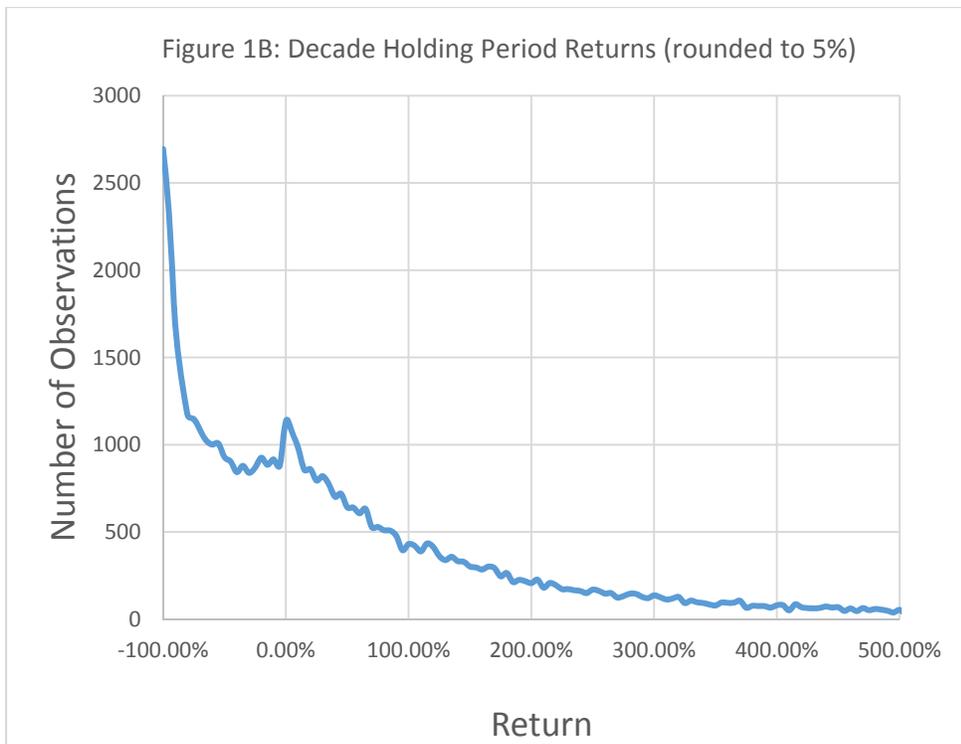
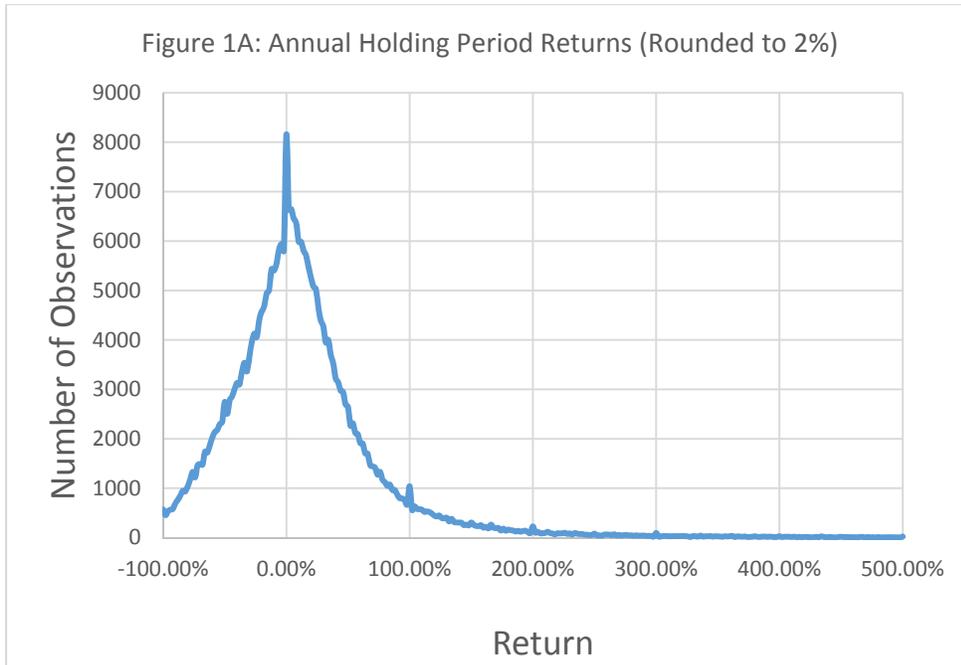
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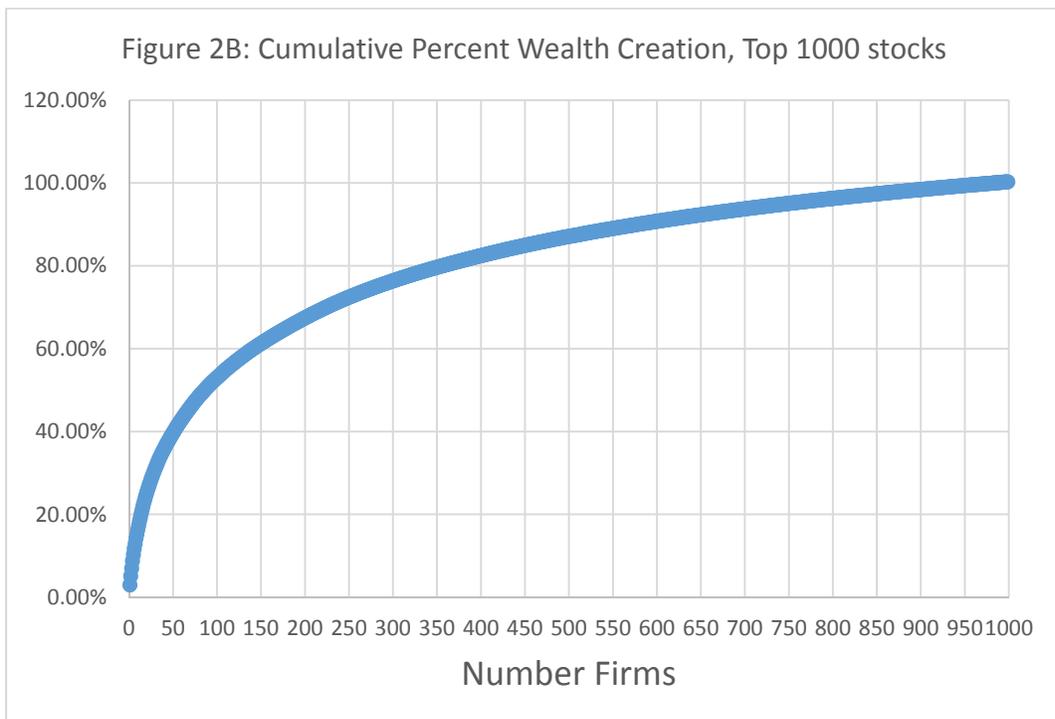
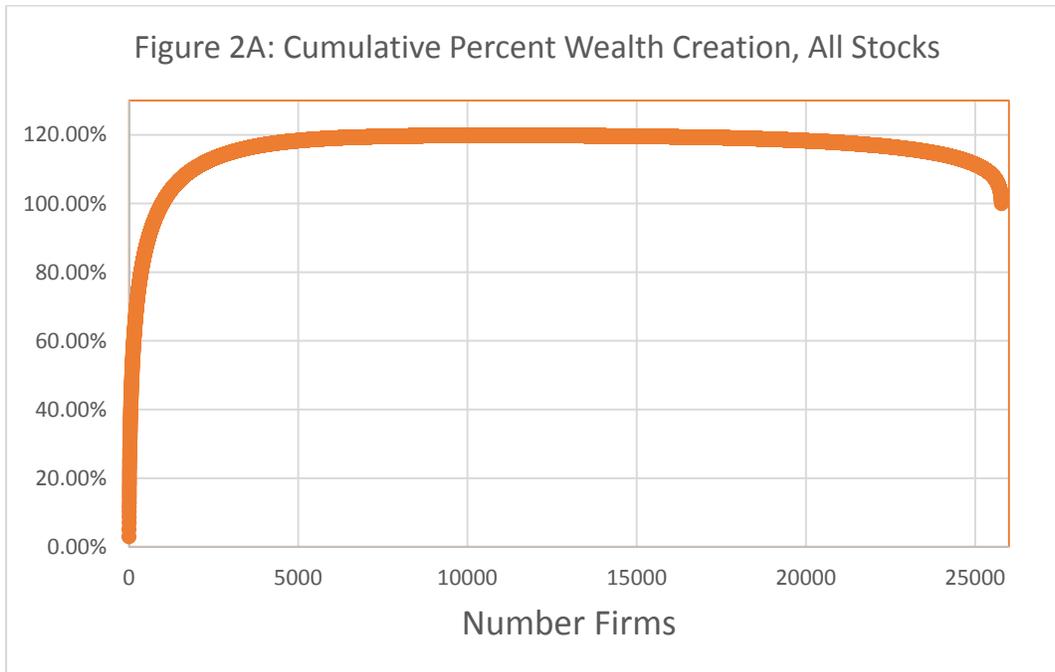
### Figure 1: Frequency Distributions of Holding Period Returns.

Displayed are frequencies of holding period returns, to a maximum of 500%. The data includes all CRSP common stocks from 1926 to 2015. In cases where stocks list or delist with a calendar period the return is computed for portion of the period where data is available.



## Figures 2A and 2B. Cumulative Percentages of Stock Market Wealth Creation.

The figures display the cumulative percentage of U.S. stock market wealth creation since 1926 and measured as of the end of 2015 attributable to individual stocks, when stocks are sorted from largest to smallest wealth creation. Figure 2A includes all 25,782 CRSP stocks, while Figure 2B includes only the 250 largest wealth creating stocks.



**Table 1: CRSP Common Stock Returns at Various Horizons**

The data includes all CRSP common stock (shrcd 10, 11, or 12) returns from September 1926 to December 2015. Annual returns refer to calendar years. Decade returns are non-overlapping, referring to 1926 to 1935, 1936 to 1945, etc. Holding period returns pertain to shorter intervals if the stock is listed or delisted within the calendar period. Lifetime returns span from September 1926 or a stocks first appearance on CRSP to the stocks delisting or December 2015. Delisting returns are included. The geometric return for  $q$  months is the  $q^{\text{th}}$  root of one plus the holding period return, less one.

**Panel A: Individual Stocks, Monthly Horizon (N = 3,524,849)**

| Variable               | Mean       | Median            | SD    | Skewness          | % Positive |
|------------------------|------------|-------------------|-------|-------------------|------------|
| Holding Return, T-Bill | 0.0038     | 0.0039            | 0.003 | 0.619             | 92.4%      |
| Holding Return, Stock  | 0.0113     | 0.0000            | 0.180 | 6.718             | 48.3%      |
|                        | % > T-bill | % > VW Mkt Return |       | % > EW Mkt Return |            |
| Holding Return, Stock  | 47.7%      | 46.2%             |       | 45.9%             |            |

**Panel B: Individual Stocks, Annual Horizon (N = 315,880)**

| Variable                | Mean       | Median            | SD    | Skewness          | % Positive |
|-------------------------|------------|-------------------|-------|-------------------|------------|
| Sum Stock Return        | 0.1257     | 0.1173            | 0.617 | 1.352             | 62.6%      |
| Holding Return, T-Bill  | 0.0435     | 0.0467            | 0.032 | 0.641             | 96.5%      |
| Holding Return, Stock   | 0.1472     | 0.0508            | 0.820 | 19.922            | 55.5%      |
| Geometric Return, Stock | -0.0023    | 0.0048            | 0.076 | 6.429             | 55.5%      |
|                         | % > T-bill | % > VW Mkt Return |       | % > EW Mkt Return |            |
| Holding Return, Stock   | 51.4%      | 44.3%             |       | 42.5%             |            |

**Panel C: Individual Stocks, Decade Horizon (N = 54,015)**

| Variable                | Mean       | Median            | SD    | Skewness          | % Positive |
|-------------------------|------------|-------------------|-------|-------------------|------------|
| Sum Stock Return        | 0.7349     | 0.6744            | 1.484 | 0.485             | 73.2%      |
| Holding Return, T-Bill  | 0.3138     | 0.1884            | 0.336 | 1.753             | 99.9%      |
| Holding Return, Stock   | 1.1855     | 0.1494            | 4.780 | 14.205            | 55.7%      |
| Geometric Return, Stock | -0.0100    | 0.0031            | 0.063 | -3.138            | 55.7%      |
|                         | % > T-bill | % > VW Mkt Return |       | % > EW Mkt Return |            |
| Holding Return, Stock   | 49.2%      | 37.4%             |       | 33.9%             |            |

**Panel D: Individual Stocks, Lifetime Horizon (N = 25,782)**

| Variable                | Mean       | Median            | SD        | Skewness          | % Positive |
|-------------------------|------------|-------------------|-----------|-------------------|------------|
| Sum Stock Return        | 1.5395     | 1.0370            | 2.795     | 1.187             | 71.3%      |
| Holding Return, T-Bill  | 1.1347     | 0.3516            | 2.282     | 4.103             | 99.8%      |
| Holding Return, Stock   | 161.9077   | -0.0367           | 12818.020 | 154.214           | 49.2%      |
| Geometric Return, Stock | -0.0194    | -0.0005           | 0.061     | -4.047            | 49.2%      |
|                         | % > T-bill | % > VW Mkt Return |           | % > EW Mkt Return |            |
| Holding Return, Stock   | 42.1%      | 30.6%             |           | 26.2%             |            |

**Table 2: The Distribution of Stock Holding Period Returns, by Size Group**

Stocks are assigned to market capitalization deciles as of the end of the prior month (Panel A), year (Panel B) or decade (Panel C). Annual and Decade holding period returns pertain to shorter intervals if the stock is listed or delisted within the calendar period. Delisting returns are included.

**Panel A: Individual Stocks, Monthly horizon**

| Group<br>(Market Cap) | Mean   | Median | Skewness | % > 0 | % > T-bill | % > VW<br>Mkt Return | % > EW<br>Mkt Return |
|-----------------------|--------|--------|----------|-------|------------|----------------------|----------------------|
| 1                     | 0.0245 | 0.0000 | 8.420    | 40.3% | 40.2%      | 43.7%                | 43.5%                |
| 2                     | 0.0095 | 0.0000 | 3.699    | 43.1% | 42.9%      | 43.6%                | 43.2%                |
| 3                     | 0.0086 | 0.0000 | 2.968    | 45.0% | 44.6%      | 44.2%                | 43.9%                |
| 4                     | 0.0092 | 0.0000 | 4.513    | 46.7% | 46.2%      | 45.1%                | 44.7%                |
| 5                     | 0.0096 | 0.0000 | 5.475    | 48.1% | 47.6%      | 45.7%                | 45.5%                |
| 6                     | 0.0101 | 0.0000 | 1.823    | 49.5% | 48.9%      | 46.6%                | 46.2%                |
| 7                     | 0.0104 | 0.0036 | 1.340    | 50.8% | 50.0%      | 47.4%                | 46.9%                |
| 8                     | 0.0107 | 0.0065 | 1.313    | 52.2% | 51.2%      | 48.2%                | 47.9%                |
| 9                     | 0.0105 | 0.0079 | 0.819    | 53.4% | 52.3%      | 48.8%                | 48.4%                |
| 10                    | 0.0096 | 0.0083 | 0.495    | 54.3% | 52.8%      | 48.9%                | 48.6%                |

**Panel B: Individual Stocks, Annual Horizon**

| Group<br>(Market Cap) | Mean   | Median | Skewness | % > 0 | % > T-bill | % > VW<br>Mkt Return | % > EW<br>Mkt Return |
|-----------------------|--------|--------|----------|-------|------------|----------------------|----------------------|
| 1                     | 0.2408 | 0.0000 | 16.903   | 47.9% | 45.0%      | 41.7%                | 40.1%                |
| 2                     | 0.1670 | 0.0000 | 29.517   | 49.6% | 46.3%      | 41.0%                | 40.1%                |
| 3                     | 0.1390 | 0.0132 | 5.065    | 51.4% | 47.8%      | 42.0%                | 40.4%                |
| 4                     | 0.1391 | 0.0247 | 8.752    | 52.6% | 48.9%      | 43.0%                | 41.7%                |
| 5                     | 0.1330 | 0.0427 | 3.837    | 54.5% | 50.8%      | 44.4%                | 42.6%                |
| 6                     | 0.1353 | 0.0548 | 4.246    | 55.8% | 51.8%      | 45.1%                | 42.8%                |
| 7                     | 0.1283 | 0.0654 | 3.041    | 57.3% | 53.1%      | 45.6%                | 43.6%                |
| 8                     | 0.1332 | 0.0840 | 3.737    | 59.9% | 55.4%      | 46.9%                | 44.3%                |
| 9                     | 0.1332 | 0.0946 | 4.172    | 62.4% | 57.2%      | 47.5%                | 44.9%                |
| 10                    | 0.1229 | 0.0982 | 10.785   | 64.9% | 58.5%      | 46.6%                | 44.4%                |

**Panel C: Individual Stocks, Decade Horizon**

| Group<br>(Market Cap) | Mean   | Median  | Skewness | % > 0 | % > T-bill | % > VW<br>Mkt Return | % > EW<br>Mkt Return |
|-----------------------|--------|---------|----------|-------|------------|----------------------|----------------------|
| 1                     | 1.4164 | -0.1905 | 13.144   | 43.1% | 37.4%      | 31.0%                | 28.6%                |
| 2                     | 1.0628 | -0.1023 | 11.533   | 46.4% | 40.8%      | 32.6%                | 30.6%                |
| 3                     | 0.9900 | -0.0551 | 14.417   | 47.9% | 42.5%      | 33.8%                | 31.5%                |
| 4                     | 1.0189 | 0.0393  | 16.431   | 51.7% | 45.9%      | 36.2%                | 33.1%                |
| 5                     | 1.0875 | 0.1064  | 10.464   | 54.2% | 48.2%      | 37.5%                | 34.7%                |
| 6                     | 1.1444 | 0.1385  | 10.583   | 55.5% | 49.6%      | 38.6%                | 35.1%                |
| 7                     | 1.2201 | 0.2319  | 6.794    | 58.5% | 52.1%      | 39.9%                | 36.3%                |
| 8                     | 1.3027 | 0.4181  | 5.015    | 65.4% | 57.5%      | 43.0%                | 37.4%                |
| 9                     | 1.3832 | 0.5627  | 6.311    | 70.1% | 61.6%      | 43.0%                | 37.4%                |
| 10                    | 1.5478 | 1.0027  | 3.624    | 80.0% | 69.6%      | 44.2%                | 36.9%                |

**Table 3: Returns to Single Stock Strategies, July 1926 to December 2015.**

One stock is selected at random for each month, and these random returns are linked over one, ten, and ninety year horizons. The procedure is repeated 10,000 times. Each linked return is compared to zero, and to the actual holding period return on one month Treasury Bills, the value-weighted portfolio, and the equal-weighted portfolio over the same interval.

|  | <u>1 Year Horizon</u> |            |             | <u>10 Year Horizon</u> |            |             | <u>Life (90 Year) Horizon</u> |            |             |
|--|-----------------------|------------|-------------|------------------------|------------|-------------|-------------------------------|------------|-------------|
| <b>Panel A: Actual Holding Period Returns</b>        |                       |            |             |                        |            |             |                               |            |             |
|  | <u>Mean</u>           | <u>Med</u> | <u>Skew</u> | <u>Mean</u>            | <u>Med</u> | <u>Skew</u> | <u>Mean</u>                   | <u>Med</u> | <u>Skew</u> |
| Value-Weighed Market                                 | 0.1172                | 0.1434     | -0.424      | 1.7290                 | 1.4314     | 0.172       | 4233.51                       | 4233.51    | .           |
| Equal-Weighed Market                                 | 0.1652                | 0.1752     | 0.536       | 2.6459                 | 2.3265     | 1.569       | 33133.41                      | 33133.41   | .           |
| One Month Treasury Bill                              | 0.0344                | 0.0298     | 1.013       | 0.4465                 | 0.3204     | 1.109       | 19.23                         | 19.23      | .           |
| <b>Panel B: Bootstrapped Single Stock Strategies</b> |                       |            |             |                        |            |             |                               |            |             |
| Holding Return                                       | 0.1658                | 0.0403     | 7.035       | 2.6500                 | 0.3021     | 41.031      | 5263.25                       | 0.1311     | 44.328      |
| % > 0  | 53.59%                |            |             | 56.32%                 |            |             | 50.86%                        |            |             |
| % > T-Bill   | 50.74%                |            |             | 48.48%                 |            |             | 27.58%                        |            |             |
| % > VW Mkt   | 42.86%                |            |             | 29.83%                 |            |             | 3.75%                         |            |             |
| % > EW Mkt   | 40.56%                |            |             | 24.33%                 |            |             | 1.23%                         |            |             |

**Table 4: Lifetime Wealth Creation**

This table reports lifetime wealth creation to shareholders in aggregate, as measured by text equation (3) based excess returns and prior-period market capitalization. Also reported is the lifetime gross holding period return from first appearance on CRSP to last, and the lifetime geometric mean excess return, measured as the geometric mean of lifetime monthly returns in excess of the geometric mean Treasury Bill return over the same life. Includes the 30 best performing stocks from all CRSP common stock returns from July 1926 to December 2015.

| <u>Permno</u> | <u>Name</u>                    | <u>Lifetime Dollar Wealth Creation (Millions)</u> | <u>Lifetime Gross Holding Return</u> | <u>Geometric Mean Excess Monthly Return</u> | <u>Life (Months)</u> | <u>Cumulative Percent of Market Wealth Creation</u> |
|---------------|--------------------------------|---|--------------------------------------|---|----------------------|---|
| 11850         | EXXON MOBIL CORP               | 939,831   | 22,584.7                             | 0.66%                                       | 1073                 | 2.96%   |
| 14593         | APPLE INC                      | 677,411   | 202.5                                | 0.91%                                       | 420                  | 5.09%   |
| 12060         | GENERAL ELECTRIC CO            | 597,545   | 9,221.7                              | 0.57%                                       | 1073                 | 6.96%   |
| 10107         | MICROSOFT CORP                 | 567,701   | 834.4                                | 1.62%                                       | 357                  | 8.75%   |
| 12490         | INTERNATIONAL BUSINESS MACHS C | 487,384   | 94,564.1                             | 0.79%                                       | 1073                 | 10.28%  |
| 13901         | ALTRIA GROUP INC               | 448,051   | 2,029,630.4                          | 1.08%                                       | 1073                 | 11.69%  |
| 12079         | GENERAL MOTORS CORP            | 394,132   | 59.0                                 | 0.11%                                       | 995                  | 12.93%  |
| 22111         | JOHNSON & JOHNSON              | 383,702   | 29,306.7                             | 0.88%                                       | 855                  | 14.14%  |
| 55976         | WAL MART STORES INC            | 337,738   | 1,495.4                              | 1.02%                                       | 517                  | 15.20%  |
| 18163         | PROCTER & GAMBLE CO            | 335,811   | 5,377.0                              | 0.55%                                       | 1036                 | 16.26%  |
| 14541         | CHEVRON CORP NEW               | 330,406   | 9,454.3                              | 0.58%                                       | 1073                 | 17.29%  |
| 11308         | COCA COLA CO                   | 326,990   | 66,634.0                             | 0.76%                                       | 1073                 | 18.32%  |
| 10401         | A T & T CORP                   | 302,550   | 393.5                                | 0.32%                                       | 952                  | 19.27%  |
| 84788         | AMAZON COM INC                 | 300,228   | 450.6                                | 2.60%                                       | 223                  | 20.22%  |
| 11703         | DU PONT E I DE NEMOURS         | 299,497   | 7,919.8                              | 0.56%                                       | 1073                 | 21.16%  |
| 90319         | ALPHABET INC                   | 276,539   | 15.2                                 | 1.91%                                       | 136                  | 22.03%  |
| 22752         | MERCK & CO INC NEW             | 265,694   | 7,917.8                              | 0.74%                                       | 835                  | 22.87%  |
| 38703         | WELLS FARGO & CO NEW           | 250,843   | 797.0                                | 0.66%                                       | 636                  | 23.65%  |
| 59328         | INTEL CORP                     | 246,030   | 1,195.9                              | 0.98%                                       | 516                  | 24.43%  |
| 66181         | HOME DEPOT INC                 | 225,150   | 5,239.9                              | 1.77%                                       | 411                  | 25.14%  |
| 13856         | PEPSICO INC                    | 213,920   | 42,284.4                             | 0.72%                                       | 1073                 | 25.81%  |
| 17778         | BERKSHIRE HATHAWAY INC         | 209,839   | 2,908.8                              | 1.33%                                       | 470                  | 26.47%  |
| 10104         | ORACLE CORP                    | 203,726   | 607.5                                | 1.53%                                       | 357                  | 27.11%  |
| 15966         | MOBIL CORP                     | 202,573   | 2,795.5                              | 0.60%                                       | 875                  | 27.75%  |
| 26403         | DISNEY WALT CO                 | 192,834   | 8,115.2                              | 0.92%                                       | 697                  | 28.35%  |
| 20482         | ABBOTT LABORATORIES            | 189,642   | 28,206.7                             | 0.79%                                       | 945                  | 28.95%  |
| 22592         | 3M CO                          | 180,706   | 7,492.6                              | 0.73%                                       | 839                  | 29.52%  |
| 19393         | BRISTOL MYERS SQUIBB CO        | 177,167   | 34,848.4                             | 0.78%                                       | 987                  | 30.07%  |
| 43449         | MCDONALDS CORP                 | 172,186   | 3,709.3                              | 0.99%                                       | 593                  | 30.62%  |
| 21936         | PFIZER INC                     | 171,584   | 25,886.5                             | 0.86%                                       | 863                  | 31.16%  |