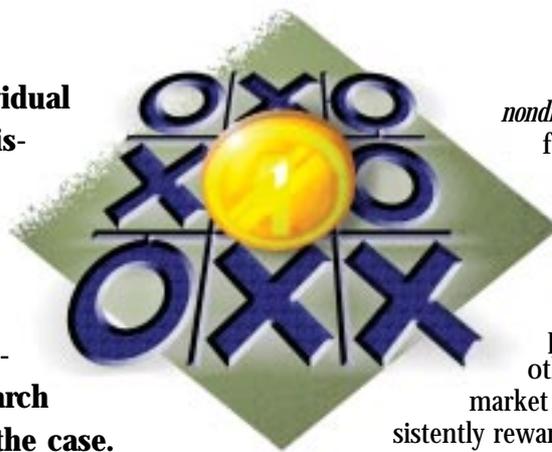


# How Many Stocks Do You Need to Be Diversified?

By Daniel J. Burnside, Donald R. Chambers and John S. Zdanowicz

**A**mong those who invest in individual stocks, one of the most commonly misunderstood concepts is that assured diversification can be accomplished with a relatively small portfolio of common stocks. Many people believe that diversification beyond 10 or 20 securities is superfluous despite clear research indicating that the opposite is in fact the case. Even some investment textbooks have helped spread the confusion.



The major reason for the confusion rests with the interpretation of many of the studies that have examined the relationship between the risk of a portfolio and the number of securities that it holds.

In this article, we clarify the previous findings by taking a fresh look at this relationship.

In addition to the misunderstanding of portfolio size and risk reduction, investors need to be aware of an increased need for diversification.

## ***Diversification: Getting Rewarded for Risk***

Diversification is an important concept because of the risk-reward relationship. Individual stocks have several kinds of risk, including firm risk, industry risk, and market risk. Firm risk and industry risk are *diversifiable* risks—in a portfolio, they can be substantially reduced by diversifying among different stocks and different industries. Market risk is

*nondiversifiable*—all stock portfolios to some degree contain market risk.

An essential point is that *diversifiable* risk is not consistently rewarded with higher expected returns. On the other hand, bearing overall market risk does tend to be consistently rewarded. Thus, investors with poorly diversified portfolios would be far better off by diversifying those risks and, if desired, taking on the risks that do tend to be rewarded. In other words, by diversifying, you can increase the expected return of your stock portfolio without increasing your risk.

For stock investors, the obvious question that arises from this is: How many stocks does it take to be diversified?

A seminal study addressing this question first appeared in 1968, and most studies since then have followed the same approach.

In this early study, researchers formed different-sized portfolios through random selection and observed the risks, as measured by the average portfolio standard deviation. Standard deviation measures volatility—the amount by which a portfolio's actual returns vary around the average return; the more volatile a portfolio, the greater the risk.

The study found that as the portfolio size was increased to roughly 10 stocks, average volatility dropped dramatically. In addition, as the number of stocks increased beyond 10, portfolio volatility continued to drop, but not nearly as dramatically. Subsequent studies have produced similar re-

sults.

It is the interpretation of these results that has produced the confusion. A number of researchers have concluded that there are few diversification benefits to justify increasing portfolio sizes much beyond 10 securities.

However, this prescription of relatively small portfolio size stems from the failure to see that investing with an average risk of X percent is not equivalent to investing with a guaranteed risk of the same amount.

For example, a portfolio that has a 50% chance of being risk-free and a 50% chance of having a standard deviation of 20% is less desirable to an investor than a portfolio that is certain to have a standard deviation of 10%, even though both opportunities have the same “average” standard deviation of 10%.

More recent research has documented that there has been an increasing amount of diversifiable risk contained in stocks. What that means is that the number of stocks necessary to achieve a given level of diversification has actually increased.

Putting together the history of erroneous reasoning regarding adequate portfolio size and the apparent trend of stocks to contain increased diversifiable risk, there is a clear need for an improved understanding of portfolio size and diversification.

### **How Many Stocks Does It Take?**

We undertook our own study that addresses the issue of how large a portfolio should be to achieve adequate diversification.

#### **The Study**

Almost all publicly traded equity securities were included in our analysis, which covers the 504 months from January 1960 to December 2001. We computed the returns of randomly selected portfolios with varying numbers of individual stocks, and compared those returns with the returns of a market index. We performed the simulation

**Table 1. Average Tracking Error for Different-Sized Portfolios (1960–2001)**

<b>No. of Stocks in Portfolio</b>	<b>Monthly Tracking Error of Portfolio Relative to:</b>	
	<b>Value-Weighted Index (%)</b>	<b>Equal-Weighted Index (%)</b>
1	5.49	9.23
3	3.34	5.84
5	2.61	4.66
7	2.22	4.01
10	1.88	3.40
15	1.54	2.80
20	1.34	2.44
30	1.10	2.02
45	0.90	1.65
65	0.75	1.39
100	0.60	1.13

separately for each of the 504 months, although some results were combined into sub-periods.

In the study, we examined tracking error, which measures the average amount by which the returns of the portfolios deviated from the returns of a target index. We measured the portfolios relative to two target indexes, one a value-weighted market index and the other an equal-weighted market index.

In a value-weighted market index, the weighting of each stock is based on its market capitalization; these indexes, such as the familiar S&P 500, are dominated by large stocks since the total capitalization of large stocks greatly exceeds the total capitalization of small stocks. When comparing the randomly selected portfolios against the value-weighted market index, the random portfolios were constructed to take into consideration the domination of larger-cap stocks.

In an equal-weighted market index, equal dollar amounts of each stock are held.

#### **The Results**

Table 1 shows the monthly average tracking error for each portfolio size for both the value-weighted and equal-weighted benchmarks for the en-

tire period of 1960–2001.

The table indicates that a single security selected at random would have an average tracking error in its monthly return of 5.49% from the value-weighted index and 9.23% from the equal-weighted index. The remaining rows demonstrate the familiar decline in diversifiable risk as portfolio size is increased.

Most importantly, Table 1 indicates that even a portfolio of 100 stocks will deviate from its target index by an average of 1.13% per month for the equal-weighted approach and 0.60% per month for the value-weighted approach.

Doesn't seem like much? A monthly average deviation of 1.13% would correspond to an annualized deviation of approximately 3.9%, and a monthly average deviation of 0.60% would correspond to an annualized deviation of approximately 2.1%. Thus, even a portfolio consisting of as many as 100 stocks deviates substantially from the overall market average. Translation: Investors with portfolios containing 100 stocks are bearing substantial diversifiable risk which, on average, is not rewarded with higher return.

Table 2 shows the monthly average tracking error for each portfolio size under the value-weighted strategy for the six sub-periods. The largest

**Table 2. Portfolio Size: Tracking Errors Relative to Value-Weighted Index Over Various Periods**

No. of Stocks in Portfolio	Time Period (84 Months Each)					
	1960–1966	1967–1973	1974–1980	1981–1987	1988–1994	1995–2001
	<b>Monthly Tracking Error Relative to Value-Weighted Index (%):</b>					
1	3.91	4.98	5.48	5.77	5.09	7.72
3	2.33	3.01	3.34	3.46	3.16	4.76
5	1.85	2.37	2.60	2.74	2.48	3.64
7	1.54	2.02	2.21	2.34	2.12	3.11
10	1.30	1.70	1.87	1.98	1.81	2.64
15	1.07	1.39	1.52	1.62	1.48	2.14
20	0.93	1.20	1.31	1.40	1.28	1.90
30	0.76	1.00	1.08	1.15	1.05	1.55
45	0.63	0.81	0.89	0.94	0.87	1.26
65	0.52	0.68	0.75	0.77	0.72	1.07
100	0.42	0.55	0.59	0.64	0.58	0.85

portfolio size, 100, has average absolute monthly deviations that increase from a low of 0.42% in the first period to a high of 0.85% in the last period.

Table 3 shows the corresponding results for the equal-weighted approach. For the most recent seven-year period, 1995–2001, the average absolute deviation of a single stock from the equal-weighted average of all stocks was 12.15%—which annualizes to 42%!

Both Tables 2 and 3 indicate that diversifiable risk has been generally increasing substantially over the last 42 years. Thus, investors maintaining a fixed level of stocks in a portfolio will find that they are “less diversified” than they were in the past. They are bearing unnecessary risk that could be avoided.

### The Implications

What do these results imply for individual investors?

For investors with smaller stock portfolios—for instance, less than \$100,000—it is typically not reasonable to try to hold the large number of stocks, 100 or more, that removes “enough” diversifiable risk. The commissions, spreads and time involved in the numerous purchases and occasional maintenance of such a large portfolio

would probably not be worth the benefits. However, the added risk of owning a relatively small number of stocks is also undesirable.

Such investors would probably be better off using very broadly diversified, low-expense mutual funds or exchange-traded funds.

There can be benefits to owning a portfolio of individual stocks rather than a mutual fund or exchange-traded fund. First, the funds levy expenses (starting in the area of 20 basis points per year and moving much higher). Second, owning individual stocks allows investors to reduce income tax liabilities by strategically timing capital gains—such as by taking short-term losses during high-income years and deferring long-term gains until lower-income years. In both cases, the larger the total dollar value of the equity portfolio, the more important the benefits of individual stock ownership as opposed to fund ownership.

For larger equity portfolios wherein the benefits of individual stock ownership exceed the costs, the implication is to hold a very large number of stocks.

How many stocks an investor should hold would be based on portfolio size, trading costs, willingness to

devote time, tax bracket and so forth.

Holding a single stock rather than a perfectly diversified portfolio increases annual volatility by roughly 30%. Thus, instead of bearing the market’s volatility of, say, 15%, the single-stock investor bears portfolio volatility of perhaps 45% [15% + 30%]. Roughly, investors may view volatility as the typical amount by which a portfolio’s return will deviate from long-term averages. Thus, the single-stock investor will experi-

ence annual returns that average a whopping 35% above or below the market—with some years closer to the market and some years further from the market.

As a rule of thumb, diversifiable risk will be reduced by the following amounts:

- Holding 25 stocks reduces diversifiable risk by about 80%,
- Holding 100 stocks reduces diversifiable risk by about 90%, and
- Holding 400 stocks reduces diversifiable risk by about 95%.

All of these reductions are compared to the risk of holding a single stock. Thus, a single stock’s tracking error of about 40% would be reduced to about 8% if you hold 25 stocks, 4% if you hold 100 stocks and 2% if you hold 400 stocks.

### Tips for Building a Well-Diversified Portfolio

Remember that diversifiable risk is not consistently rewarded with higher expected returns, which is why it pays to be well diversified. Here are some suggestions for building a well-diversified portfolio.

In order to achieve the best diversification, stocks should be weighted by capitalization size. That means that a stock with a \$300 billion total market value (currently, GE) should be held in a size about 20 times the size of a company with a market capitalization of about \$15 billion (currently, Corning). Further, the larger a firm is, the more important that it be included in the portfolio. The largest 50 or so stocks should

**Table 3. Portfolio Size: Tracking Errors Relative to Equal-Weighted Index Over Various Periods**

No. of Stocks in Portfolio	Time Period (84 Months Each)					
	1960–1966	1967–1973	1974–1980	1981–1987	1988–1994	1995–2001
	<b>Monthly Tracking Error Relative to Equal-Weighted Index (%):</b>					
1	6.13	7.95	9.26	9.86	10.09	12.15
3	3.78	4.84	5.83	6.26	6.60	7.76
5	2.95	3.82	4.62	4.99	5.39	6.20
7	2.56	3.31	3.85	4.39	4.64	5.30
10	2.12	2.75	3.31	3.66	3.93	4.61
15	1.75	2.23	2.70	3.10	3.28	3.74
20	1.51	1.94	2.36	2.64	2.89	3.32
30	1.25	1.60	1.99	2.18	2.39	2.70
45	1.02	1.32	1.60	1.79	1.96	2.23
65	0.85	1.08	1.37	1.51	1.66	1.89
100	0.69	0.88	1.09	1.19	1.36	1.54

almost all be held in any portfolio of individual stocks attempting to match the performance of the overall market.

A portfolio with nearly equal weights (the same dollar amount of holdings in each stock) will not be well-diversified relative to the overall market regardless of how many stocks are selected. In fact, an equal-weighted portfolio of every U.S. stock will behave primarily like a small-cap fund, since approximately 3% of the holdings would be large cap, about 12% would be mid cap and about 85% would be small cap (and the small cap would be dominated by micro caps). Although our study reports the performance of

equal portfolio weightings, this is not a recommended strategy for an investor.

The stocks should be selected at random (with selection probabilities directly proportional to capitalization size) or with careful and purposeful diversification, such as by selecting stocks from a variety of industries and balancing with respect to effects such as style (e.g., value or growth) and size. Our experience is that many investors select poorly diversified portfolios because they deliberately select a particular type of stock (e.g., low price-earnings ratios) or because they subconsciously are drawn to particular types of stocks (e.g., firms with consumer

products that have familiar sounding names).

A good test of a portfolio's diversification would be to use a portfolio analyzer (some are available free on the Internet, such as Morningstar.com's "Instant X-Ray") and to match the portfolio's various attributes with the same analysis performed on a very broadly diversified portfolio—an example for domestic stocks would be the Vanguard Total Stock Market Index Fund (VTSMX). A very well-diversified portfolio must be similar to the target index in capitalization mix, investment style, industry weights, dividend yields and so forth. ▲

**Daniel I. Burnside, Ph.D., CFA, is vice president of Clover Capital Management in Rochester, New York, and lecturer in finance at the University of Rochester's William E. Simon Graduate School of Business Administration.**

**Donald R. Chambers is the Walter E. Hanson/KPMG Peat Marwick Professor of Finance at Lafayette College in Easton, Pennsylvania.**

**John S. Zdanowicz is professor and director of the Center for Banking and Financial Institutions, Florida International University, Miami.**