We are merely establishing a baseline cost estimate to take into account the fact that costs will have *some* effect on the final outcome. In our own live trading of the quantitative momentum strategy, we have experienced much lower trading costs than those assumed, but historically the trading costs would have been much higher than those assumed. We hope that our estimate is a "goldilocks" estimate—not too cold; not too hot; and perhaps just right. We don't claim to have the perfect answers and we encourage all investors to gauge the expected costs of running these systems and adjust the results accordingly.

THE PARAMETERS OF THE UNIVERSE

To ensure other researchers have enough information to replicate and independently verify our results, we outline the details of the stock universe we explore and the assumptions we make to conduct our analysis in Table 8.1. Our universe is liquid and investable, requiring a minimum market capitalization at each rebalance period that is greater than the NYSE 40 percent market capitalization breakpoint at the time of the rebalance. Our analysis runs from March 1, 1927, through December 31, 2014,[5] and our data come from the academic research gold standard for return data: CRSP (The Center for Research in Security Prices).

TABLE 8.1 Universe Selection Parameters

Item	Item Description
Market Capitalization	NYSE 40% Breakpoint
Exchanges	NYSE/AMEX/NASDAQ
Included Security Types	Ordinary Common Shares
Excluded Industries	None
Return Data	Prices adjusted for dividends, splits, and corporate actions
Delisting Algorithm	"Delisting Returns and their Effect on Accounting-Based Market Anomalies," by William Beaver, Maureen McNichols, and Richard Price[6]
Portfolio Weights	Market-capitalization weighted (VW, or value-weight)

QUANTITATIVE MOMENTUM ANALYSIS

We do a deep dive into the historical performance of the quantitative momentum system. Our analysis is organized as follows:

- Summary statistics
- Reward analysis
- Risk analysis
- Robustness analysis

Summary Statistics

Table 8.2 sets out the standard statistical analyses of the quantitative momentum strategy's performance and risk profile, comparing it to the generic momentum strategy (no seasonality, no FIP), and the Standard & Poor's 500 Total Return Index (S&P 500 TR Index). The returns shown in Table 8.2 are net of 1.80 percent in fees for all three of the momentum strategies, and the S&P 500 Index is gross of fees. We give the passive index an unrealistic cost advantage (i.e., free) to ensure we are conservative in our assessment of the results. All results are value-weight (sometimes referred to as market-cap weight) to maintain consistency. An alternative weighting scheme is to equal-weight the portfolio holdings. This alternative equal-weighting scheme is beneficial in two ways:

1. *Diversification*—You allocate the same percentage of capital to each stock, so no one stock has a large weight in the portfolio.
2. *Small-cap Effect*—On average, the returns to smaller stocks has been larger in the past, and for our portfolio, this means higher expected returns.

Table 8.2 shows that the quantitative momentum strategy generated a compound annual growth rate (CAGR) of 15.80 percent, significantly outperforming the generic momentum performance of 13.45 percent. The Quantitative Momentum strategy also outperformed the S&P 500, which returned 9.92 percent.

The quantitative momentum portfolio achieved this return with a much higher volatility than the benchmark portfolio, which is to be expected because the portfolio is more concentrated than the passive benchmark (i.e., averages 43.9 stocks over the time period) and the strategy is designed to