The Quality Dimension of Value Investing

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Buying high quality assets without paying premium prices is just as much value investing as buying average quality assets at discount prices. Strategies that exploit the quality dimension of value are nearly as profitable as traditional value strategies based on price signals alone. Accounting for both dimensions by trading on combined quality and price signals yields dramatic performance improvements over traditional value strategies. Accounting for quality also yields significant performance improvements for investors trading momentum as well as value.

Benjamin Graham will always be remembered as the father of value investing. Today he is primarily associated with selecting stocks on the basis of valuation metrics like price-to-earnings or market-to-book ratios. But Graham never advocated just buying cheap stocks. He believed in buying undervalued firms, which means buying high quality firms cheaply.

Graham was just as concerned with the quality of a firm's assets as he was with the price that one had to pay to purchase them. According to Graham, an equity investor should "…apply a set of standards to each [stock] purchase, to make sure that he obtains (1) a minimum of *quality* in the past performance and current financial position of the company, and also (2) a minimum of *quantity* in terms of earnings and assets per dollar of price" (Graham 1973, pp. 183-184). Graham suggested seven "quality and quantity criteria" that a firm should meet for inclusion in an investor's portfolio, including:

1. "Adequate" enterprise size, as insulation against the "vicissitudes" of the economy;

2. Strong financial condition, measured by current ratios that exceed two and net current assets that exceed long term debt;

3. Earnings stability, measured by 10 consecutive years of positive earnings;

4. A dividend record of uninterrupted payments for at least 20 years;

5. Earnings-per-share growth of at least one-third over the last ten years;

6. Moderate price-to-earnings ratios, which typically should not exceed 15; and

7. Moderate market-to-book ratios, which typically should not exceed 1½.

The first five screens attempt to ensure that one buys only high quality firms, while the last two ensure that one buys them at reasonable prices.

While Graham devoted as much attention to the quality dimension of value as its price dimension, he is nevertheless primarily associated with buying firms cheaply because it is his valuation metrics that have delivered exceptional returns. Value investing is on average quite profitable, but the quality metrics Graham employed, and that others have advocated, have not reliably forecast relative stock performance. These quality metrics also tend to be more complicated than popular valuation ratios typically employed by value investors.

Novy-Marx (2012) shows, however, that a simple quality metric, gross profits-to-assets, has roughly as much power predicting the relative performance of different stocks as tried-and-true value measures like book-to-price. Buying profitable firms and selling unprofitable firms, where profitability is measured by the difference between a firm's total revenues and the costs of the goods or services it sells, yields a significant gross profitability premium.

While analysts spend a lot of time thinking about bottom line earnings, and to a lesser extent free cash flow and earnings before interest and deductions (EBIT), empirically gross profitability, which appears almost at the top of the income statement, is a much better predictor of a firm's future stock performance.

The gross profitability premium is not something distinct from the value premium; it is another facet of value. Buying high quality assets without paying premium prices is just as much value investing as buying average quality assets at a discount. In fact, Warren Buffet, Graham's most famous student and the most successful value investor of all time, if fond of saying that it is "far better to buy a wonderful business at a fair price than to buy a fair business at a wonderful price." Frazzini, Kabiller, and Pedersen (2012) confirm this empirically, showing that the performance of the publicly traded companies held by Berkshire Hathaway, Buffet's primary investment vehicle, can largely be explained by his commitment to buying high quality stocks.

Despite the philosophical similarities between traditional value investing and quality investing, the signal in gross profits-to-assets is negatively correlated with that in valuation ratios. High quality firms tend to trade at premium prices, so value strategies that trade on quality signals (i.e., quality strategies) hold very different stocks than value strategies that trade on price signals. Quality strategies tilt towards what would traditionally be considered growth stocks. This makes quality strategies particularly attractive to traditional value investors, because quality strategies, in addition to delivering significant returns, provide a hedge to value exposures.

One can also directly combine the quality and value signals and, in line with Graham's basic vision, only buy high quality stocks at bargain prices. By trading on a single joint profitability and value signal, an investor can effectively capture the entirety of both premiums.

The signal in gross profitability is extremely persistent, and works well in the large cap universe. Profitability strategies thus have low turnover, and can be implemented using liquid stocks with large capacities.

Finally, gross profitability is also complimentary to past performance. Quality thus provides an additional valuable signal to managers running momentum together with value.

The basic message is that investors, in general but especially traditional value investors, leave money on the table when they ignore the quality dimension of value.

Quality Investing

Pure quality strategies, which buy the most profitable assets irrespective of price, are roughly as profitable as traditional value strategies, which buy the cheapest assets irrespective of quality. This section shows this by comparing the performance of large cap quality and value strategies. The strategies are formed by sorting stocks into portfolios on the basis of the quality signal, gross-profits-to-assets, and the price signal, book-to-market.[1] Portfolios are formed using only the 500 largest non-financial firms traded on the three principle exchanges (the NYSE, Nasdaq, and AMEX).[2] Stocks are bought or sold in equal amounts, and held for one year. In order to ensure that the accounting

[1] These signals are constructed using Compustat data. Gross profits-to-assets is revenues minus cost of goods sold (REVT - COGS) scaled by total book assets (AT). Book-to-market is book equity scaled by market equity, where market equity is lagged six months to avoid taking unintentional positions in momentum. Book equity is shareholder equity, plus deferred taxes, minus preferred stock, when available. For the components of shareholder equity, I employ tiered definitions largely consistent with those used by Fama and French (1993) to construct their high minus low factor (HML). Stockholders equity is as given in Compustat (SEQ) if available, or else common equity plus the carrying value of preferred stock (CEQ + PSTX) if available, or else total assets minus total liabilities (AT - LT). Deferred taxes is deferred taxes and investment tax credits (TXDITC) if available, or else deferred taxes and/or investment tax credit (TXDB and/or ITCB). Preferred stock is redemption value (PSTKR) if available, or else liquidating value (PSTKRL) if available, or else carrying value (PSTK).

[2] I drop financial firms because the assets of financial firms are primarily financial securities, not operating assets, making it difficult to compare gross profits-to-assets across financial and non-financial firms. The 500 largest non-financial firms account, on average, for 82.6% of the aggregate market capitalization of the non-financial universe. The smallest firm at the end of the sample had a market capitalization of over a billion dollars. Allowing for trading in the biggest 1,000 or 1,500 stocks, which account on average for 92.1% or 95.9% of the non-financial universe, yields similar results.

data used in the value and quality signals are available at the time of portfolio formation, rebalancing occurs at the end of June employing accounting data for the fiscal year ending in the previous calendar year. The sample covers July 1963 to December 2011, with the start date determined by the availability of high quality accounting data.

The basic strategies are constructed by forming high and low portfolios on the basis of the value and quality signal, book-to-market and gross profits-to-assets, respectively. These portfolios hold the top or bottom 30% (150 stocks) with the highest or lowest signals, respectively. For each signal we consider the performance of both the long/short strategy, which buys the high portfolio and shorts the low portfolio, and the long-only strategy that simply buys the high portfolio. The long/short strategies are evaluated on an absolute basis, while the long-only strategies are evaluated on the performance of their tracking error relative to the total market return.

Table 1 shows that strategies formed on the basis of quality signals alone, which hold stocks selected without regard for price, were roughly as profitable as traditional value strategies formed on the basis of price signals alone, which hold stocks selected without regard for quality.

[Table 1 goes about here]

Panel A shows the average monthly excess returns to the portfolios sorted on the quality signal, and results of time-series regressions of these portfolios' returns on the market excess returns (MKT). The long/short quality strategy, which buys profitable stocks and sells unprofitable stocks, earned excess returns of 28 basis points per month, roughly two-thirds of the market excess return over the sample. The strategy was less than two-thirds as volatile as the market over the sample (9.6%), so the strategy realized a slightly higher Sharpe ratio than the market, 0.35 versus 0.33. The performance of the quality strategy was also very similar to that of the long/short large cap value strategy, shown in Panel B. The large cap value strategy generated slightly higher

returns (0.31 percent per month), but because it was more volatile (12.2%) realized a slightly lower Sharpe ratio (0.31). Both the quality and value signals are highly persistent, so the strategies have low turnover and minimal transaction costs. The quality strategy on average takes four years to turn over, and incurs total transaction costs that average three basis points per month. The traditional value strategy on average takes more than three years to turn over, and incurs total transaction costs that average less than four basis points per month.[3]

The table also shows that a long-only investor could have outperformed the market by buying either profitable or cheap stocks. The portfolio that held only the highest quality assets outperformed the market by 21 basis points per month, with a tracking error volatility of 5.6%, for an annualized information ratio of 0.44.[4] The portfolio that held only the cheapest assets outperformed the market by 24 basis points per month, with a tracking error volatility of 7.0%, yielding an annualized information ratio of 0.42.

Panel C shows that investors, either long/short or long-only, could have achieved superior performance splitting their funds between quality and traditional value strategies. The returns due to the quality and value exposures are negatively correlated, so quality investing is a great hedge for traditional value investors and vice-versa. The 50/50 mix of long/short large cap quality and value strategies earned similar returns to the individual strategies (0.29 percent per month, versus 0.28 and 0.31), but at a volatility of only 5.4%, and thus realized a Sharpe ratio of 0.65, roughly twice as high as that on the individual quality and value strategies. The 50/50 mix of long-only large cap quality and value strategies outperformed the market by a margin similar to that of the individual strategies (22 basis points per month, versus 21 and 24),

[3] These trading costs are calculated assuming portfolios are rebalanced using market orders. These costs can be further reduced by explicitly accounting for transaction costs when designing the trading strategies.
[4] The information ratio employed here is the average annual active return (i.e., return in excess of the market) divided by the tracking error volatility. An alternate definition, which calculates the information ratio as the annual CAPM alpha divided by the volatility of the CAPM residual, yields similar results.

but with a tracking error volatility of only 4.2%, for an information ratio of 0.64, half again as high as that on the individual strategies.

Improving Value by Controlling for Quality

Value investors can also improve their performance by controlling for quality when investing in value stocks. Traditional value strategies formed on price signals alone tend to be short quality, because cheap firms are on average of lower quality than similar firms trading at higher prices. Because high quality firms on average outperform low quality firms, this quality deficit drags down the returns to traditional value strategies. The performance of value strategies can thus be significantly improved by explicitly controlling for quality when selecting stocks on the basis of price. Value strategies that buy (sell) cheap (expensive) firms from groups matched on the quality dimension significantly outperform value strategies formed solely on the basis of valuations.

Similar results hold for quality. Quality strategies tilt towards growth because high quality stocks trade at premium prices. Because value stocks on average outperform growth stocks, the growth exposure incurred by selecting stocks on the basis of quality without regard to price drags down the returns to these strategies. Performance of these strategies can be significantly improved by explicitly controlling for price when selecting stocks on the basis of quality.

The value strategy that controls for quality is formed by first sorting the 500 largest financial firms each June into 10 groups of 50 on the basis of the quality signal. Within each of these deciles, which contain stocks of similar quality, the 15 with the highest value signals are assigned to the high portfolio, while the 15 with the lowest value signals are assigned to the low portfolio. This procedure ensures that the value and growth portfolios, which each hold 150 stocks, contain stocks of similar average quality.

The quality strategy that controls for value is formed similarly. Stocks are first sorted into 10 groups of 50 on the basis of the value signal, and within each of these groups 15 stocks are assigned to the high portfolio and 15 are assigned to the low portfolio on the basis of the quality signal.

Table 2 shows the performance of these strategies. The table shows that these strategies dramatically outperform the unconditional strategies shown in Table 1. Panel A shows the quality strategy that controls for value. The long/short strategy generated excess returns of 46 basis points per month, slightly more than the market excess return over the period and almost 60% higher than the 28 basis points per month generated by the unconditional quality strategy, despite running at a volatility of only 8.1%, lower than that on the unconditional strategy (9.6%) and only slightly more than half the market volatility. This high return and low volatility resulted in a Sharpe ratio of 0.68, more than twice that realized by the market. The long side outperformed the market by 31 basis points per month, 10 basis points per month more than the long-only strategy formed without regard for price. It managed this active return with a market tracking error volatility of only 5.1%, realizing an information ratio of 0.73, much higher than the information ratio of 0.44 realized on the tracking error of the unconditional long-only quality strategy.

[Table 2 goes about here]

Panel B shows similar, though slightly less dramatic, results for the value strategy that controls for quality. The long/short strategy generated excess returns of 45 basis points per month, 50% higher than the 31 basis points per month generated by the unconditional quality strategy, despite running at lower volatility (10.4% as opposed to 12.2%). The long side outperformed the market by 32 basis points per month, 9 basis points per month more than the long-only strategy formed without regard for price. It managed this active return with a market tracking error volatility of only 5.9%, realizing an information ratio of 0.63, much higher than the information ratio

of 0.42 realized on the tracking error of the unconditional long-only value strategy.

Combining Quality and Price Signals

An alternative to controlling for quality when trading traditional value, and controlling for price when trading quality, is to simply trade on a single joint signal that combines quality and value. That is, to combine the quality and value at the signal level, as opposed to the portfolio level.

The simplest way to combine the signals is to add the ranks of the individual signals. That is, given the investment opportunity set (i.e., a set of firms that we can trade), stocks are ranked from best (highest) to worst (lowest) on the basis of both the quality signal, gross profits-to-assets, and the value signal, book-to-market. The joint signal that combines quality and value is simply the sum of the ranks of the two individual signals. This procedure is similar to that advocated by Greenblatt (2010), which uses return on capital as the quality signal [ROC, defined as earnings before interest and taxes (EBIT)-to-operating assets] and earnings yield as the value signal (EY, defined as EBIT-to-enterprise value) in its "magic formula" for selecting stocks. I employ gross profits-to-assets and book-to-market as the quality and price signals here because these yield trading strategies that are far more profitable than strategies based on ROC and EY. A comparison of strategies based on gross profits-to-assets and book-to-market to those based on Greenblatt's magic formula is provided in the appendix. This comparison also considers the joint quality and value strategy of Piotroski and So (2012), which employs the accounting based F-score of Piotroski (1999) as its quality signal, as well as a strategy formed using a joint quality and value signal based on Graham's seven quality and quantity criteria.

Table 3 shows the performance of the portfolios that at the end of each June buy the 150 stocks in our large cap universe with the highest and lowest combined quality and value signal, as well as the long/short strategy that buys the high portfolio and sells the low portfolio. The table shows that the strategies that trade on the joint quality and value signal significantly outperform strategies based on the quality or value signal alone, as well as those that trade quality controlling for value or value controlling for quality.

[Table 3 goes about here]

The long/short strategy based on the joint quality and value signal generated excess returns of 61 basis points per month, twice that generated by the quality or value signals alone and a third higher than the market, despite running at a volatility of only 9.7%. The strategy realized a Sharpe ratio 0.75 over the sample, almost two and a half times that on the market over the same period, despite trading exclusively in the largest, most liquid stocks.

The long side outperformed the market by 35 basis points per month, with a tracking error volatility of only 5.7 percent, for a realized information ratio of 0.75. This information ratio is 15% higher than the 0.65 achieved running quality and value side by side. Just as importantly, it allows long-only investors to achieve a greater exposure to the high information ratio opportunities provided by quality and value. While the strategy's 5.7% tracking error still provides a suboptimally small exposure to value and quality, this exposure is significantly larger than the long-only investor can obtain running quality alongside value.[5]

[5] The ex-post mean variance efficient combination of the market and the long portfolio's tracking error puts almost three times as much risk-weighted capital onto the tracking error (measured by the dollar volatility of the position) as it does on the market. While the risk-weighting on the tracking error from holding the high portfolio directly is only about a third as high as that given to the market, considerably lower than this optimal risk-weighting of almost three, it is better than the joint quality and value exposure a long-only investor can achieve by putting half their capital into quality stocks and half into value stocks. The 50/50 long-only strategy shown in Table 1 has a risk-weighting on the tracking error only about a quarter as large as that given to the market.

Figure 1 shows the performance of a dollar invested in mid-1963 in T-bills, the market, and strategies that trade on the quality signal, the value signal, and the joint quality and value signal. The top panel shows long/short strategies, which are levered each month to run at market volatility (i.e., an expected ex ante volatility of 16%, with leverage based on the observed volatility of the unlevered strategy over the preceding 60 months).[6] By the end of 2011 a dollar invested in T-bills in 1963 would have grown to $12.31. A dollar invested in the market would have grown to $84.77. A dollar invested in the quality and value strategies would have grown to $94.04 and $35.12, respectively. A dollar invested in the strategy that traded on the joint quality and value signal would have grown to more than $2,131.

[Figure 1 goes about here]

The bottom panel shows the performance of the long-only strategies. While a dollar invested in the market would have grown to more than $80, a dollar invested in profitable large cap stocks would have grown to $241, a dollar invested in cheap large cap stocks would have grown to $332, and a dollar invested in cheap, profitable large cap stocks would have grown to $572.

Figure 2 shows the drawdowns of the long/short strategies (top panel) and the worst cumulative under performance of the long-only strategies relative to the market, i.e., the drawdowns on the long-only strategies' active returns (bottom panel). The top panel shows that the worst drawdowns experienced over the period by the long/short strategies run at market volatility were similar to market's worst drawdown over the period. The joint quality and value strategy had, however, the smallest drawdowns of all the strategies considered. Its worst drawdown (48.7% in 2000) compares favorably to the worst drawdowns experienced by the market (51.6% in 2008-9, not shown), the traditional value strategy (down 59.5% by 2000), and the pure quality strategy

[6] On average the quality strategy is levered 1.52 times, the value strategy 1.44 times, and the joint quality and value strategy 1.61 times. While all three strategies are levered to run at the same expected volatility of 16%, the three strategies realized slightly higher volatilities, of 16.3%, 16.9%, and 18.2%, respectively.

(51.4% to 1977). Similar results hold for the worst five or ten drawdowns (average losses of 35.5% versus 41.1%, 38.9%, and 35.6% for the worst five drawdowns, and average losses of 25.8% versus 28.5%, 28.7%, and 26.5% for the worst ten drawdowns).

[Figure 2 goes about here]

The bottom panel shows even more dramatic results for the long-only strategies active returns. Value stocks underperformed the market by 44% through the tech run-up over the second half of the '90s. Quality stocks lagged behind the market through much of the '70s, falling 28.1% behind by the end of the decade. Cheap, profitable stocks never lagged the market by more than 15.8%. Periods over which these stocks underperformed also tended to be followed quickly by periods of strong outperformance, yielding transient drawdowns that were sharply reversed.

Trading Momentum with Value and Quality

Price momentum is, along with value, the most robust capital market anomaly. It has been extremely profitable on its own. It also tends to perform well when value underperforms, providing significant additional diversification benefits to value investors. Because of these well-known synergies, and the synergies we observe between quality and value, it is natural to ask how quality, value, and momentum perform all together.

The same methodology used to combine quality and value signals can be used to construct strategies that trade jointly on value and momentum, or jointly on quality, value, and momentum. Table 4 shows the performance of strategies formed on the basis of past performance (returns over the first 11 months of the year preceding portfolio formation); average book-to-market and

past performance ranks; and average gross profits-to-assets, book-to-market ranks, and past performance ranks.[7]

Panel A shows the performance of pure momentum strategies, and serves as a point of comparison for the strategies that combine momentum signals with either value signals or quality and value signals. The panel shows that the long/short momentum strategy, which buys past winners and sells past losers, earned excess returns of 48 basis points per month, more than the market excess return over the sample. The strategy ran at roughly market volatility (16.4%), and realized a Sharpe ratio similar to that realized by the market (0.35 versus 0.33) or the long/short value strategy (0.35). The long-only strategy, which holds past winners, outperformed the market by 38 basis points per month, with a tracking error volatility of 7.8%, yielding an annualized information ratio of 0.58, much higher than the 0.42 information ratio earned by the long-only value strategy.

[Table 4 goes about here]

Panel B shows the performance of strategies that combine momentum and traditional value (i.e., price) signals. The long/short strategy earned excess returns slightly higher than the pure momentum strategy, 49 basis points per month, but was less volatile than the market (13.5%), so realized a higher Sharpe ratio (0.43 versus 0.35). Long-only investors did not realize the same performance improvement. The long-only portfolio outperformed the market by 28 basis points per month, with a tracking error volatility of 6.3%, yielding an annualized information ratio of 0.54. This information ratio is higher than that on value alone, but lower than that on the long-only pure momentum strategy.

Panel C shows the performance of strategies that combine momentum with both quality and value signals. The long/short strategy earned excess returns of 73 basis points per month, 70% higher than those realized by the

[7] Putting equal weights on the signals may not be optimal. Equal weighting is employed here for the sake of simplicity.

market, but ran at less than 85% of the volatility (13.2%), so realized a Sharpe ratio twice as high (0.66 versus 0.33). It was long-only investors, however, who saw the greatest performance improvements. The strategy that only bought profitable, low priced, past winners earned twice the market excess returns. This 44 basis points per month active return, with a tracking error volatility of only 5.7%, resulted in a realized annualized information ratio of 0.93, higher than that observed on any other strategy. A long/short investor could also exploit this opportunity, of course, by buying profitable, low priced, past winners hedged with a short position in the market. This strategy levered to run at market volatility earned average monthly returns of 1.22% per month over the sample.

Figure 3 shows the performance of a dollar invested in mid-1963 in T-bills, the market, and strategies that trade on the momentum signal (stock performance over the first 11 months of the prior year), a joint value and momentum signal (average book-to-market and past performance ranks), the joint quality and value signal (average gross profits-to-assets and book-to-market ranks), and a joint quality, value, and momentum signal (average gross profits-to-assets, book-to-market, and past performance ranks). The top panel shows long/short strategies, and a strategy that buys the high joint quality, value and momentum portfolio and hedges the market risk by selling the market, all levered each month to run at market volatility (i.e., an expected ex ante volatility of 16%, based on the observed volatility of the unlevered strategy over the preceding 60 months).[8] By the end of 2011 a dollar invested in T-bills or the market in 1963 would have grown to $12.31 or $84.77. A dollar invested in the momentum strategy would have grown to $260, while a dollar invested in the joint value and momentum strategy would have grown to $333. A dollar invested in the joint quality and value strategy would have grown to $2,131. A dollar invested in the joint quality, value and momentum strategy would have

[8] On average the momentum strategy is levered 1.08 times, the joint value and momentum strategy 1.44 times, the joint quality and value strategy 1.61 times, the joint quality, value and momentum strategy 1.29 times, and the joint quality, value and momentum strategy hedged with the market 1.95 times.

grown to $2,870. A dollar invested in the joint quality, value and momentum strategy hedged with the market would have grown to $9,268.

[Figure 3 goes about here]

Panel B shows the performance of the long-only strategies. While a dollar invested in the market would have grown to more than $80, a dollar invested in large cap winners would have grown to $597, a dollar invested in cheap large cap winners would have grown to $411, a dollar invested in profitable, cheap large cap stocks would have grown to $572 dollars, and a dollar invested in profitable, cheap, large cap winners would have grown to $955.

Figure 4 shows the drawdowns of the long/short strategies (top panel) and the worst cumulative under performance of the long-only strategies relative to the market, i.e., the drawdowns on the long-only strategies' active returns (bottom panel). The most remarkable feature of the top panel is the large drawdowns experienced by all the strategies during the momentum crash of 2009 the long/short momentum strategy lost 68.8%. The strategies based on the joint value and momentum signal, and the joint quality, value and momentum signal, performed almost as poorly. The value and momentum strategy fell 61.9%, while the quality, value and momentum strategy fell 59.2%. Remarkably, the strategy that bought cheap, profitable, large cap winners, hedged the position by selling an equal quantity of the market, and levered to run at market volatility, fell only 38.1% during the crash.[9]

[Figure 4 goes about here]

The other striking feature of the figure's top panel is the strategies' remarkably steady performance outside the momentum crash of 2009. The market experienced three drawdowns over the sample in which it lost more

[9] While winners performed poorly during the momentum crash, momentum's poor performance over the period was driven primarily by the exceptionally strong performance of the losers. These losers tended have high market betas, having underperformed as the market tanked in the last quarter of 2008, and rose dramatically with the market in the spring of 2009 (Daniel and Moskowitz, 2012).

than four-ninths of its value: 46.2% in 1974, 44.9% in 2001-2, and 51.6% in 2008-9. The second worst drawdowns for the momentum and joint value and momentum strategies were closer to three-ninths (34.1% for momentum and 33.7% for joint value and momentum, both in 2001), while the second worst drawdowns for the momentum strategies that incorporate quality signals were closer to two-ninths (25.5% for long/short joint quality, value and momentum strategy, in 2001, and 22.7% for the joint quality, value and momentum strategy hedged with the market, in 1997).

The bottom panel shows similar results for the long-only strategies' active returns. The long only momentum strategy underperformed the market by 32.4% through the momentum crash of 2009. The joint value and momentum strategy fared somewhat better, underperforming by 24.7%. The joint quality, value and momentum strategy did better still, underperforming by only 17.9% (and bouncing back more quickly). Outside of the momentum crash of 2009 the strategies performed remarkably strongly, with winners and cheap winners each underperforming the market by as much as 10% only twice (20.7% into early 2001 and 15.1% into early 1985 for momentum; 16.8% through the late '90s and 11.1% through 2003 for joint value and momentum). The strategy that also accounted for quality did better still. Outside of the momentum crash of 2009 cheap, profitable winners never underperformed the market by even 9%.

Conclusion

Quality investing exploits another dimension of value. Value strategies endeavor to acquire productive capacity cheaply. Traditional value strategies do this by buying assets at bargain prices; quality strategies do this by buying uncommonly productive assets. Strategies based on either of value's dimensions generate significant abnormal returns, but the real benefits of value investing accrue to investors that pay attention to *both* price and quality. Quality signals help traditional value investors distinguish bargain stocks (i.e.,

those that are undervalued) from value traps (i.e., those that are cheap for good reasons). Price signals help quality investors avoid good firms that are already fully priced. Trading on both signals brings the double benefit of increasing expected returns while decreasing volatility and drawdowns. Cheap, profitable firms tend to outperform firms that are just cheap or just profitable. Quality tends to perform best when traditional value suffers large drawdowns, and *vice versa*, so strategies that trade on both signals generate steadier returns than do strategies that trade on quality or price alone. These benefits are available to long-only investors as well as long/short investors. Accounting for quality also significantly improves the performance of strategies that incorporate momentum as well as price signals. Investors in general, but especially traditional value investors, leave money on the table when they ignore the quality dimension of value.

Appendix A. Comparison to Other Quality Measures

This appendix considers the performance of other well-known strategies that combine price and quality signals. It analyzes the strategies advocated by Greenblatt (2010) and Piotroski and So (2012), and a strategy that implements the seven quality and quantity criteria in Graham (1973).

Greenblatt's "magic formula" for selecting stocks uses return on capital (ROC) and earnings yield (EY) as its quality and value metrics, where these are defined as the ratio of EBIT-to-tangible capital (net working capital plus net fixed assets) and EBIT-to-enterprise value [market value of equity (including preferred stock) plus debt], respectively. "Magic formula investing" entails ranking firms on the basis of ROC and EV, and only buying stocks with the highest combined ranks. Its logic is clearly that of a combined quality and value strategy, in the spirit of Graham's belief in buying good firms at low prices. The formula is designed to ensure that investors are "buying good companies (ones that have a high return on capital)… only at bargain prices (at prices that give you a good earnings yield)" (Greenblatt 2010, p.47).

Piotroski and So (2012) uses traditional book-to-market as its value signal, and the F-score of Piotroski (1999) as its quality signal. The F-score is an accounting based measure designed to capture "financial performance." It is constructed by summing nine binary variables. Four of these variables are designed to capture profitability, three are designed to capture liquidity, and two are designed to capture operating efficiency. Each component takes on a value of zero, indicating weakness, or a value of one, indicating strength.[10] The F-score thus takes a value from zero to nine, with higher numbers indicating stronger financial performance. The strategy considered here is based on the sum of firms' book-to-market and F-score ranks.

The implementation of Graham's seven criteria is also based on summing firms' rankings on a price and quality signal. The price signal is the geometric average of book-to-market and earnings to price.[11] The quality signal is a "Graham score" (G-score), which applies the Piotroski (1999) methodology to the quality rules in Graham's criteria. A firm's G-score gets one point if its current ratio exceeds two, one point if net current assets exceed long term debt, one point if it has a ten year history of positive earnings, one point if it has a ten year history of returning cash to shareholders, and one point if its earnings-per-share are at least a third higher than they were 10 years ago.[12] This results in a score from zero to five, with higher scores signaling higher quality firms.

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[10] In particular, a firm's F-score can get one point for each of four profitability signals [positive earnings, positive cash flows from operations, increasing returns-on-assets, and negative accruals (cash flows from operations that exceed earnings)]; one point for each of three liquidity signals (decreasing debt, increasing current ratio, and no equity issuance); and one point for each of two efficiency signals (increasing gross margins and increasing asset turnover).

[11] Graham suggested only buying stocks of firms with price-to-book ratios below 1.5 and price-to-earnings ratios below 15. He believed that an investor could occasionally violate one of these prohibitions in good conscience if one of the signals was sufficiently favorable, but suggested that the product of the two ratios should not exceed 22.5. The use of the geometric average of book-to-market and price-to-book is consistent with this threshold on the product of price-to-book and price-to-earnings.

[12] I have reduced the required earnings history from 20 to 10 years to get more variation in this component of the G-score. I have also relaxed the dividend condition to include net repurchases because share repurchases have gained popularity as a means for returning cash to shareholders since Graham's day. Graham also preferred large firms, but I have ignored this criteria as all the firms we are considering are large.

The performance of portfolios sorted on these joint quality and price signals are presented in Table A1. The table shows that while all three strategies outperform traditional value strategies, none of them performs nearly as well as the strategy based on combined gross profits-to-assets and book-to-market ranks (shown in Table 3).

Panel A shows the Greenblatt strategy, which sorts stocks on combined return-on-capital and earnings yield ranks. The long/short strategy earned 37 basis points per month, with a Sharpe ratio of 0.41. This compares favorably with the 31 basis points per month and 0.31 Sharpe ratio on the straight value strategy (Panel B of Table 1), but is greatly inferior to the 61 basis points per month and 0.75 Sharpe ratio on the joint gross profits-to-assets and book-to-market strategy (Table 3). Greenblatt's long-only strategy outperformed the market by 27 basis points per month with a tracking volatility of 5.7%, for an information ratio of 0.57. This again compares favorably with the long-only value strategy, which outperformed the market by 21 basis points per month with a tracking volatility of 7.0% for an information ratio of 0.57, but is again greatly inferior to the strategy that buys on combined gross profits-to-assets and book-to-market ranks, which outperformed the market by 35 basis points per month with a tracking volatility of 5.1% for an information ratio of 0.75.

Panel B shows the Piotroski and So strategy, which sorts stocks on combined F-score and book-on-market ranks. Panel C shows the Graham strategy, which sorts stocks on combined ranks of the G-score and the geometric average book-on-price and earnings-to-price. These panels show similar results to those depicted in Panel A. The long/short Piotroski and So strategy earned 27 basis points per month, with a Sharpe ratio of 0.37, while the long/short Graham strategy earned 34 basis points per month, with a Sharpe ratio of 0.44. The long-only Piotroski and So strategy outperformed the market by 26 basis points per month with a tracking volatility of 5.7%, for an information ratio of 0.54, while the long-only Graham strategy outperformed the market by 26 basis points per month with a tracking volatility of 5.7%, for

an information ratio of 0.55. These results compare favorably with the straight value strategies, but are greatly inferior to the strategies based on the joint gross profits-to-assets and book-to-market signal.

Keywords: Value Investing, Quality Investing, Asset Pricing.

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Figure 1. Performance of Portfolios Sorted on Quality and Value

Performance of a dollar invested in the middle of 1963 in T-bills, the market, and large cap strategies that trade on the quality signal, the value signal, and the joint quality and value signal. Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks with the highest (lowest) ranks of gross profits-to-assets (GP/A, quality), book-to-market (B/M, value), or the average of the two ranks (joint quality and value) from among the 500 largest non-financial firms. The top panel shows long/short strategies, which buy the high portfolios and sell the low portfolios, levered each month to run at an ex ante expected volatility of 16%. The bottom panel shows the performance of the long-only strategies, which buy the high portfolios.

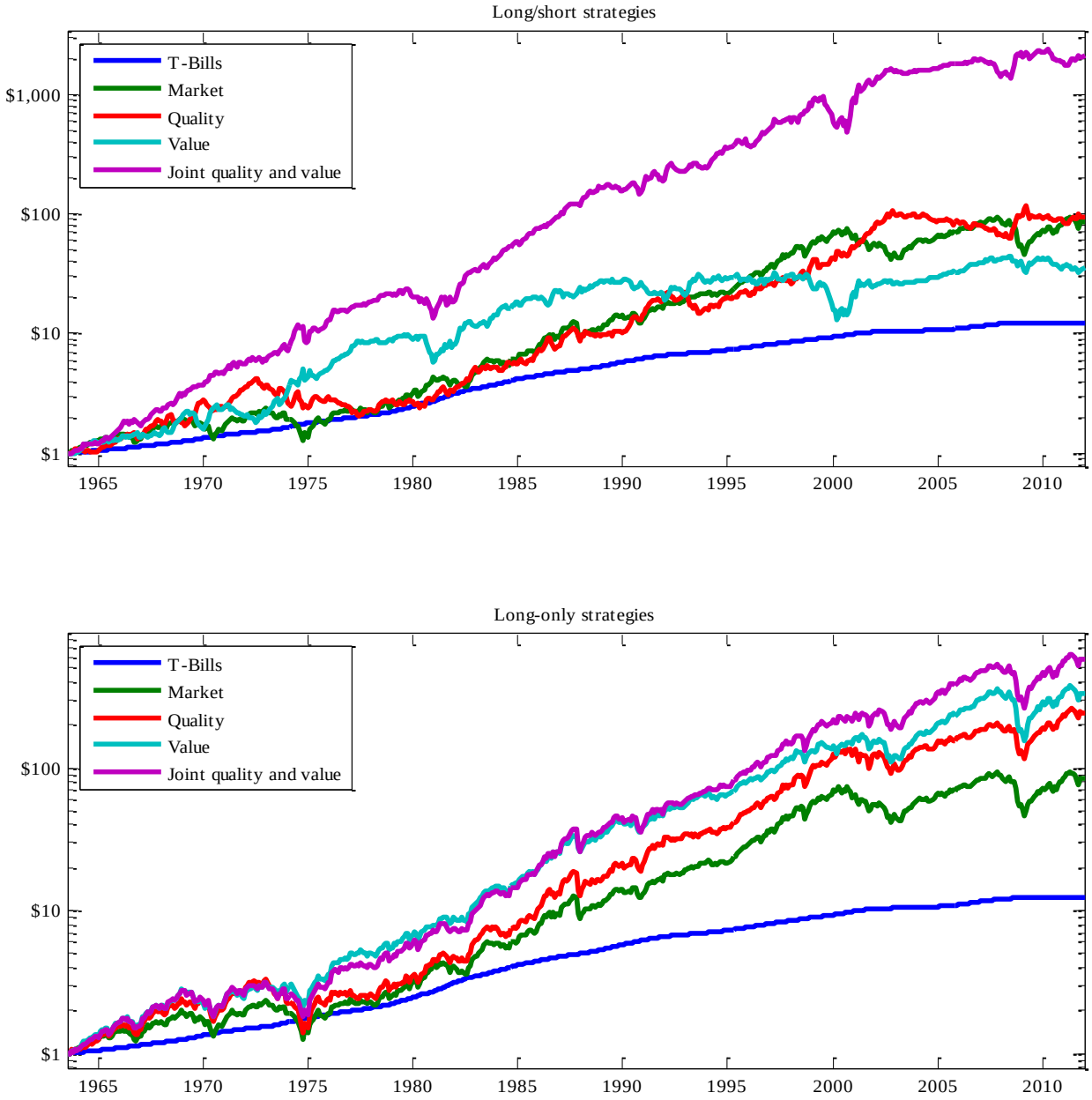

Figure 2. Drawdowns of Strategies Formed on the Basis of Quality and Value

Drawdowns since mid-1963 of large cap strategies that trade on the quality signal, the value signal, and the joint quality and value signal. Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks with the highest (lowest) ranks of gross profits-to-assets (GP/A, quality), book-to-market (B/M, value), or the average of the two ranks (joint quality and value) from among the 500 largest non-financial firms. The top panel shows drawdowns (cumulative losses from previous highs) of long/short strategies, which buy the high portfolios and sell the low portfolios, levered each month to run at an ex ante expected volatility of 16%. The bottom panel shows the drawdowns of the active returns of the long-only strategies' that buy the high portfolios, i.e., their worst cumulative underperformance relative to the market.

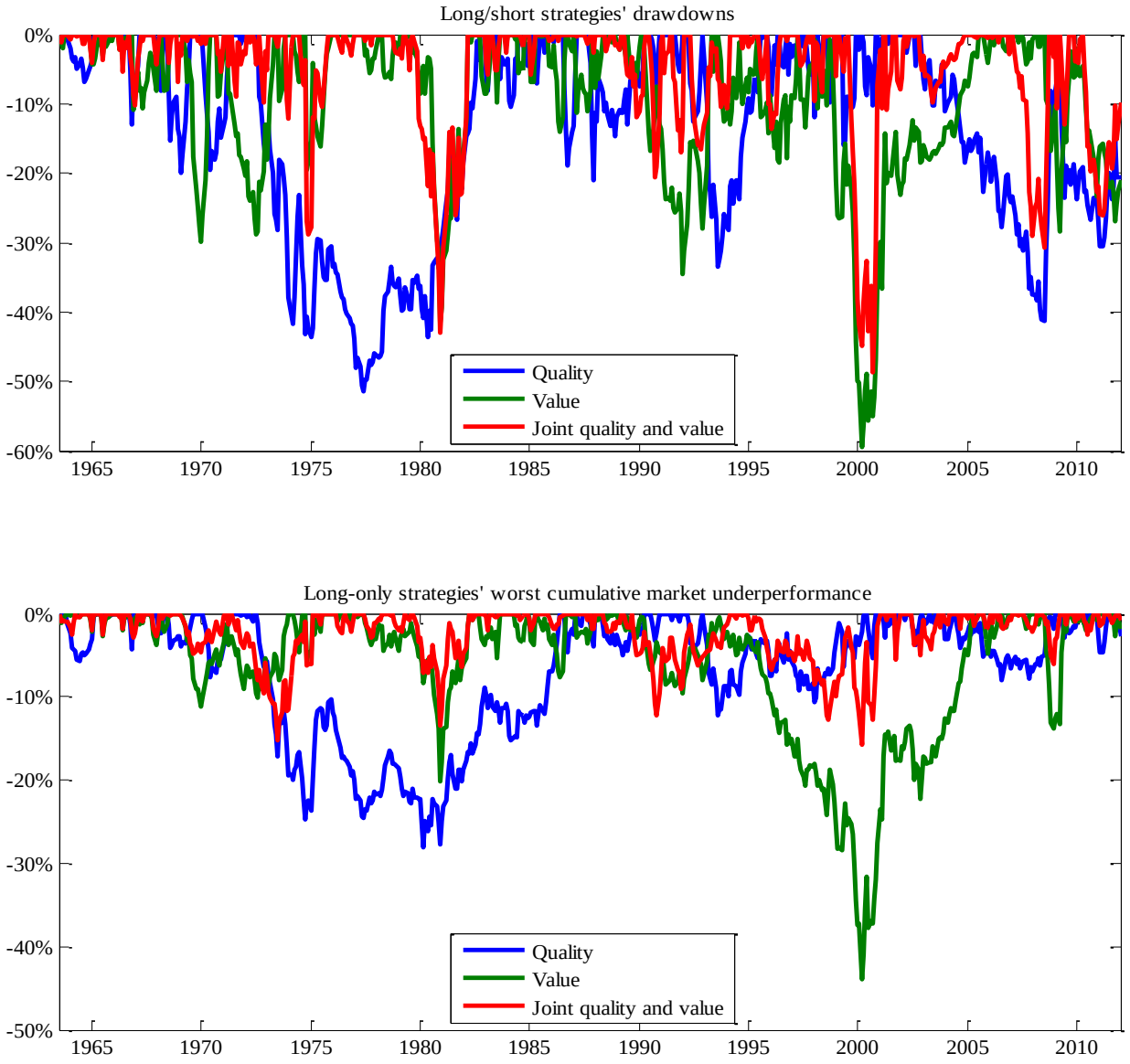

Figure 3. Performance of Strategies that Include Momentum

Performance of a dollar invested in the middle of 1963 in T-bills, the market, and large cap strategies that trade on the quality, value and momentum signals (gross profits-to-assets, book-to-market, and stock performance over the first 11 months of the prior year, respectively). Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks from among the 500 largest non-financial firms with the highest (lowest) ranks of momentum; average value and momentum ranks; average quality and value ranks; and average quality, value, and momentum ranks. The top panel shows long/short strategies, which buy the high portfolios and sell the low portfolios (or sells the market), levered each month to run at an ex ante expected volatility of 16%. The bottom panel shows the performance of the long-only strategies, which buy the high portfolios.

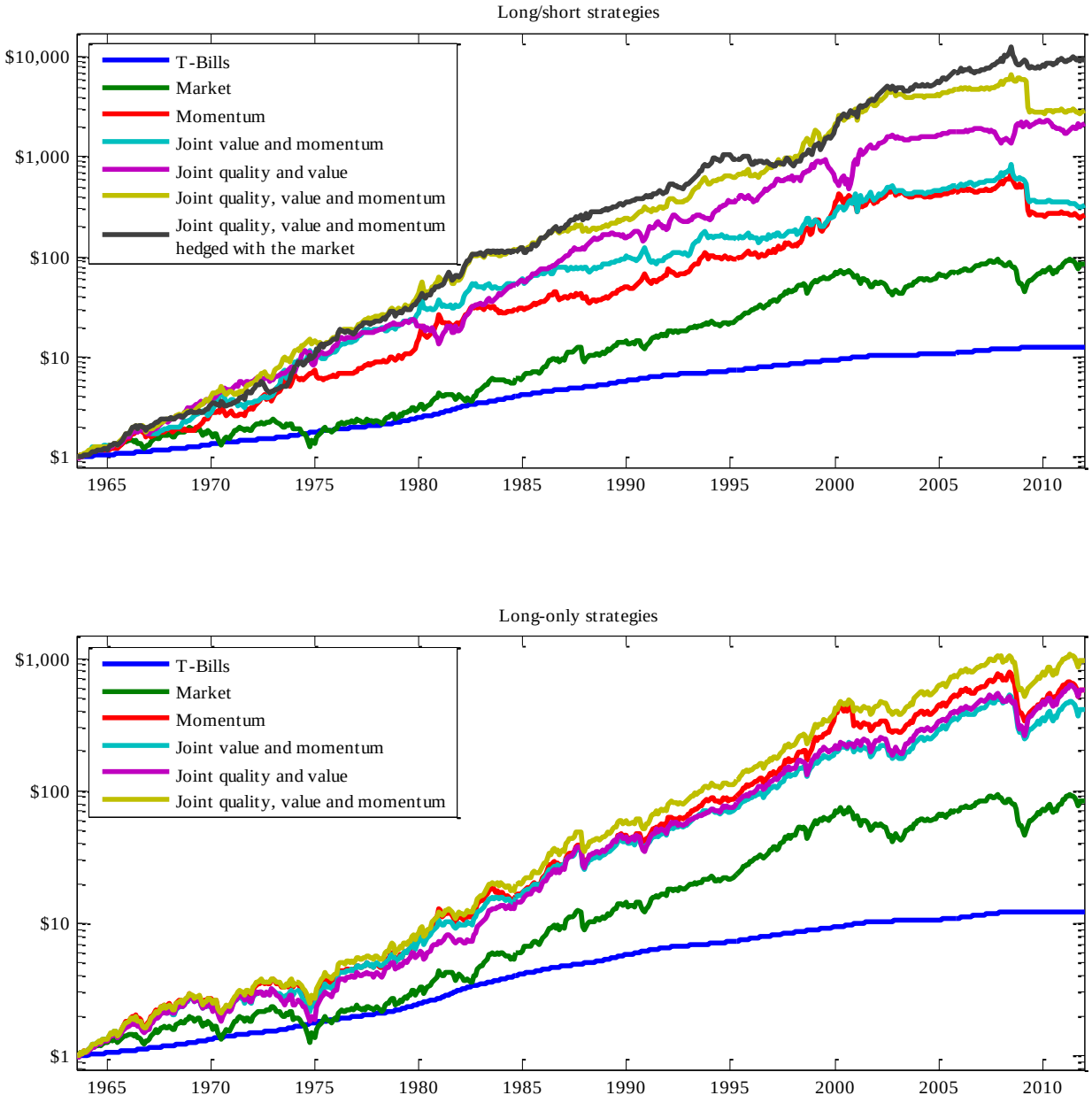

Figure 4. Drawdowns of Strategies that Include Momentum

Drawdowns since mid-1963 of large cap strategies that trade on quality, value and momentum signals (gross profits-to-assets, book-to-market, and stock performance over the first 11 months of the prior year, respectively). Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks from among the 500 largest non-financial firms with the highest (lowest) ranks of momentum; average value and momentum ranks; average quality and value ranks; and average quality, value, and momentum ranks. The top panel shows long/short strategies, which buy the high portfolios and sell the low portfolios (or sells the market), levered each month to run at an ex ante expected volatility of 16%. The bottom panel shows the drawdowns of the active returns of the long-only strategies' that buy the high portfolios, i.e., their worst cumulative underperformance relative to the market.

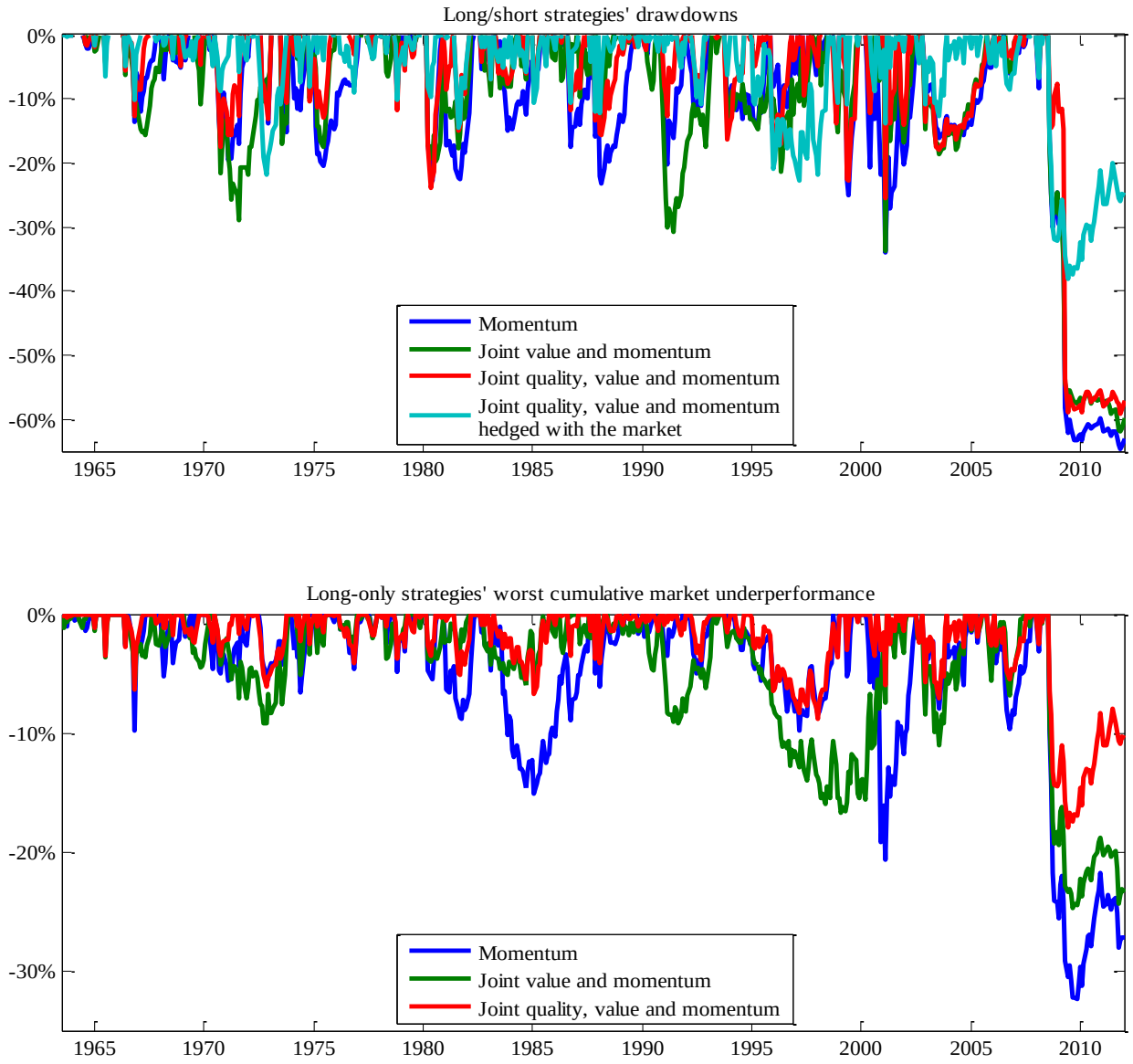

Table 1. Performance of Portfolios Sorted on Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on quality (GP/A rank)							
Low	0.37	-0.06	0.97	0.26	-0.07	6.6%	-0.13
	[1.83]	[-0.76]	[56.2]		[-0.91]		
High	0.64	0.18	1.07	0.44	0.21	5.6%	0.44
	[3.05]	[2.68]	[73.1]		[3.07]		
High-low	0.28	0.24	0.09	0.35			
	[2.42]	[2.09]	[3.65]				
Panel B: Sorted on value (B/M rank)							
Low	0.37	-0.16	1.20	0.22	-0.07	7.8%	-0.11
	[1.53]	[-1.82]	[63.9]		[-0.75]		
High	0.68	0.27	0.93	0.50	0.24	7.0%	0.42
	[3.51]	[3.28]	[51.2]		[2.90]		
High-low	0.31	0.43	-0.27	0.31			
	[2.13]	[3.10]	[-8.84]				
Panel C: 50/50 mix of quality and value strategies							
Low	0.37	-0.11	1.09	0.25	-0.07	5.1%	-0.16
	[1.72]	[-1.81]	[83.0]		[-1.15]		
High	0.66	0.22	1.00	0.49	0.22	4.2%	0.64
	[3.40]	[4.47]	[90.4]		[4.48]		
High-low	0.29	0.33	-0.09	0.65			
	[4.52]	[5.25]	[-6.33]				

Notes: This table shows the performance of large cap portfolios formed by sorting on quality and price signals. Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks with the highest (lowest) ranks of gross profits-to-assets (GP/A, Panel A) or book-to-market (B/M, Panel B) from among the 500 largest non-financial firms. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). Panel C shows the strategies that hold equal positions in the quality and value strategies. The sample covers July 1963 to December 2011.

Table 2. Quality Controlling for Value, and Value Controlling for Quality

		CAPM results			Tracking error		
Protfolio	E[r^e]	α	β	S.R.	E[r^e]	Vol.	I.R.
Panel A: Sorted on quality (GP/A), controlling for value (B/M)							
Low	0.29	-0.18	1.07	0.19	-0.15	6.2%	-0.29
	[1.34]	[-2.46]	[66.4]		[-1.99]		
High	0.74	0.29	1.04	0.52	0.31	5.1%	0.73
	[3.63]	[4.76]	[78.4]		[5.05]		
High-low	0.46	0.47	-0.03	0.68			
	[4.74]	[4.87]	[-1.52]				
Panel B: Sorted on value (B/M), controlling for quality (GP/A)							
Low	0.30	-0.23	1.21	0.18	-0.14	7.7%	-0.21
	[1.24]	[-2.74]	[66.1]		[-1.49]		
High	0.75	0.31	1.00	0.53	0.31	5.9%	0.63
	[3.71]	[4.34]	[64.2]		[4.37]		
High-low	0.45	0.54	-0.21	0.52			
	[3.60]	[4.56]	[-8.13]				

Notes: This table shows the performance of large cap portfolios formed by sorting on quality from among stocks with similar valuations, and sorting on valuations from among stocks of similar quality. Each year, at the end of June, the 500 largest non-financial firms are first sorted into 10 bins of 50 stocks on the basis of their book-to-market ranks (B/M, Panel A) or gross profits-to-assets ranks (GP/A, Panel B). High (low) portfolios are formed by buying one dollar's worth of each of the 15 stocks in each bin with the highest (lowest) ranks of gross profits-to-assets (Panel A) or book-to-market (Panel B). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio (E[r^e], with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Table 3. Performance of Portfolios Sorted on Combined Quality and Value Signal

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Low	0.18	-0.33	1.18	0.11	-0.25	7.9%	-0.39
	[0.77]	[-3.74]	[60.5]		[-2.69]		
High	0.79	0.33	1.05	0.55	0.35	5.7%	0.75
	[3.80]	[4.91]	[70.4]		[5.20]		
High-low	0.61	0.67	-0.13	0.75			
	[5.23]	[5.82]	[-5.20]				

Notes: This table shows the performance of large cap portfolios formed by sorting on the joint quality and price signal. Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks with the highest (lowest) combined ranks of gross profits-to-assets and book-to-market from among the 500 largest non-financial firms. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Table 4. Performance of Strategies that Combined Momentum with Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on momentum (past performance rank)							
Low	0.33	-0.19	1.20	0.18	-0.11	11.4%	-0.11
	[1.27]	[-1.47]	[41.7]		[-0.77]		
High	0.81	0.34	1.08	0.52	0.38	7.8%	0.58
	[3.64]	[3.69]	[53.4]		[4.05]		
High-low	0.48	0.53	-0.12	0.35			
	[2.43]	[2.70]	[-2.82]				
Panel B: Sorted on joint value and momentum signal (average of B/M and past performance ranks)							
Low	0.23	-0.30	1.21	0.13	-0.21	9.8%	-0.25
	[0.91]	[-2.68]	[49.5]		[-1.76]		
High	0.72	0.30	0.95	0.53	0.28	6.3%	0.54
	[3.70]	[4.04]	[58.0]		[3.75]		
High-low	0.49	0.60	-0.26	0.43			
	[3.02]	[3.87]	[-7.53]				
Panel C: Sorted on joint quality, value, and momentum signal (average of GP/A, B/M and past performance ranks)							
Low	0.15	-0.37	1.19	0.08	-0.29	10.1%	-0.34
	[0.59]	[-3.23]	[47.0]		[-2.39]		
High	0.87	0.43	1.02	0.62	0.44	5.7%	0.93
	[4.30]	[6.31]	[68.5]		[6.47]		
High-low	0.73	0.80	-0.17	0.66			
	[4.58]	[5.13]	[-5.04]				

Notes: This table shows the performance of large cap portfolios formed by sorting on the momentum signal (Panel A), the joint value and momentum signal (Panel B), and the joint quality, value, and momentum signal (Panel C). Each month, high (low) portfolios are formed from among the 500 largest non-financial firms by end of June market capitalization by buying one dollar's worth of each of the 150 stocks with the highest (lowest) combined ranks of past performance (stock return over the first eleven months of the prior year, Panel A), book-to-market and past performance (Panel B), and gross profits-to-assets, book-to-market and past performance (Panel C). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Table A1. Performance of Other Known Combined Quality/Value Strategies

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Greenblatt's "magic formula" strategy							
Low	0.34	-0.18	1.18	0.20	-0.10	8.3%	-0.14
	[1.40]	[-1.89]	[57.4]		[-0.98]		
High	0.71	0.27	1.01	0.51	0.27	5.7%	0.57
	[3.52]	[3.90]	[66.7]		[3.97]		
High-low	0.37	0.45	-0.18	0.41			
	[2.89]	[3.60]	[-6.49]				
Panel B: Piotroski and So strategy							
Low	0.43	-0.08	1.16	0.27	-0.01	6.0%	-0.02
	[1.86]	[-1.28]	[81.6]		[-0.16]		
High	0.69	0.28	0.94	0.53	0.26	5.7%	0.54
	[3.68]	[4.19]	[62.8]		[3.74]		
High-low	0.27	0.37	-0.23	0.37			
	[2.55]	[3.81]	[-10.79]				
Panel C: Graham strategy							
Low	0.36	-0.17	1.22	0.21	-0.08	7.0%	-0.13
	[1.49]	[-2.37]	[75.8]		[-0.94]		
High	0.70	0.28	0.96	0.52	0.26	5.7%	0.55
	[3.63]	[4.12]	[64.3]		[3.83]		
High-low	0.34	0.45	-0.26	0.44			
	[3.07]	[4.57]	[-12.00]				

Notes: This table shows the performance of large cap portfolios formed by sorting on joint quality and price signals. Each year, at the end of June, high (low) portfolios are formed by buying one dollar's worth of each of the 150 stocks with the highest (lowest) joint quality and value signal from among the 500 largest non-financial firms. The Greenblatt strategy uses combined EBIT-to-tangible capital and EBIT-to-enterprise value ranks as its signal (Panel A). The Piotroski and So strategy uses combined F-score and book-to-market (Panel B), and the Graham strategy uses combined G-score and geometric average book-to-market and earnings-to-price (Panel C). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix. Performance of Value- and Signal-Weighted Strategies

This appendix considers the performance of value-weighted strategies and signal-weighted strategies.

The value-weighted portfolios are constructed in the same manner as those considered in Tables 1-4 and Table A1, except that instead of buying one dollar of each stock in each portfolio, stocks are instead held in proportion to the stocks' market capitalizations at the time of portfolio formation.

The signal-weighted portfolios hold each stock in proportion to the deviation of the rank of its signal from the median rank of the sorting variable. With 500 stocks this means that a stock with an extreme signal (1 or 500) gets far more weight than a near median signal (250 or 251). The stock with the highest (lowest) signal would get (500 – 250.5)/(251 – 250.5) = 499 times as much weight as the stock with the lowest (highest) signal to make it into the high (low) portfolio. I do not consider rank-weighted versions of the conditional strategies, like those considered in Table 2, because these strategies depend on the conditional bivariate sorting methodology.

Internet Appendix Table 1. Performance of Value-Weighted Portfolios Sorted on Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on quality (GP/A rank)							
Low	0.31	-0.10	0.92	0.24	-0.13	5.7%	-0.27
	[1.65]	[-1.44]	[63.2]		[-1.91]		
High	0.51	0.10	0.94	0.38	0.08	6.2%	0.15
	[2.67]	[1.36]	[58.1]		[1.02]		
High-low	0.21	0.20	0.02	0.24			
	[1.70]	[1.62]	[0.75]				
Panel B: Sorted on value (B/M rank)							
Low	0.38	-0.06	1.01	0.26	-0.06	6.4%	-0.11
	[1.84]	[-0.83]	[59.7]		[-0.76]		
High	0.58	0.20	0.86	0.47	0.14	6.5%	0.26
	[3.24]	[2.70]	[53.0]		[1.79]		
High-low	0.20	0.26	-0.15	0.21			
	[1.47]	[2.00]	[-5.20]				
Panel C: 50/50 mix of quality and value strategies							
Low	0.34	-0.08	0.97	0.26	-0.09	3.5%	-0.32
	[1.84]	[-1.92]	[105.8]		[-2.24]		
High	0.54	0.15	0.90	0.45	0.11	3.4%	0.38
	[3.14]	[4.10]	[112.1]		[2.65]		
High-low	0.20	0.23	-0.07	0.63			
	[4.36]	[5.14]	[-6.66]				

Notes: This table shows the performance of large cap portfolios formed by sorting on quality and price signals. Each year, at the end of June, value-weighted high (low) portfolios are formed by buying the 150 stocks with the highest (lowest) ranks of gross profits-to-assets (GP/A, Panel A) or book-to-market (B/M, Panel B) from among the 500 largest non-financial firms. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). Panel C shows the strategies that hold equal positions in the quality and value strategies. The sample covers July 1963 to December 2011.

Internet Appendix Table 2. Quality Controlling for Value, and Value Controlling for Quality, Value-Weighted Results

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on quality (GP/A), controlling for value (B/M)							
Low	0.30	-0.14	1.00	0.22	-0.14	4.7%	-0.36
	[1.50]	[-2.51]	[80.5]		[-2.51]		
High	0.60	0.20	0.92	0.48	0.17	5.0%	0.41
	[3.30]	[3.47]	[72.8]		[2.83]		
High-low	0.31	0.34	-0.08	0.47			
	[3.25]	[3.64]	[-3.76]				
Panel B: Sorted on value (B/M), controlling for quality (GP/A)							
Low	0.31	-0.15	1.06	0.21	-0.12	6.3%	-0.24
	[1.47]	[-2.02]	[64.7]		[-1.64]		
High	0.65	0.25	0.92	0.52	0.21	5.0%	0.52
	[3.58]	[4.35]	[72.6]		[3.61]		
High-low	0.34	0.40	-0.15	0.41			
	[2.86]	[3.48]	[-5.78]				

Notes: This table shows the performance of the value-weighted large cap portfolios formed by sorting on quality from among stocks with similar valuations, and sorting on valuations from among stocks of similar quality. Each year, at the end of June, the 500 largest non-financial firms are first sorted into 10 bins of 50 stocks on the basis of their book-to-market ranks (B/M, Panel A) or gross profits-to-assets ranks (GP/A, Panel B). High (low) portfolios are formed by buying each of the 15 stocks in each bin with the highest (lowest) ranks of gross profits-to-assets (Panel A) or book-to-market (Panel B). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 3. Performance of Value-Weighted Portfolios Sorted on Combined Quality and Value Signal

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Low	0.22	-0.26	1.08	0.14	-0.22	6.0%	-0.44
	[1.01]	[-3.63]	[69.8]		[-3.09]		
High	0.72	0.30	0.94	0.55	0.28	5.2%	0.65
	[3.82]	[4.96]	[69.8]		[4.49]		
High-low	0.50	0.56	-0.14	0.65			
	[4.53]	[5.19]	[-5.81]				

Notes: This table shows the performance of value-weighted large cap portfolios formed by sorting on the joint quality and price signal. Each year, at the end of June, high (low) portfolios are formed by buying each of the 150 stocks with the highest (lowest) combined ranks of gross profits-to-assets and book-to-market from among the 500 largest non-financial firms. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 4. Performance of Value-Weighted Strategies that Combined Momentum with Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on momentum (past performance rank)							
Low	0.34	-0.12	1.05	0.21	-0.10	9.7%	-0.12
	[1.49]	[-1.02]	[41.2]		[-0.85]		
High	0.72	0.27	1.01	0.48	0.28	8.1%	0.41
	[3.35]	[2.82]	[47.4]		[2.89]		
High-low	0.38	0.39	-0.03	0.28			
	[1.95]	[2.02]	[-0.81]				
Panel B: Sorted on joint value and momentum signal (average of B/M and past performance ranks)							
Low	0.25	-0.19	1.01	0.18	-0.18	7.0%	-0.32
	[1.22]	[-2.22]	[54.5]		[-2.20]		
High	0.63	0.23	0.91	0.48	0.19	6.8%	0.33
	[3.31]	[2.84]	[51.6]		[2.31]		
High-low	0.37	0.41	-0.10	0.36			
	[2.51]	[2.79]	[-2.93]				
Panel C: Sorted on joint quality, value, and momentum signal (average of GP/A, B/M and past performance ranks)							
Low	0.18	-0.28	1.06	0.12	-0.26	7.4%	-0.41
	[0.83]	[-3.16]	[54.2]		[-2.89]		
High	0.76	0.34	0.96	0.55	0.32	6.9%	0.56
	[3.83]	[4.12]	[53.0]		[3.92]		
High-low	0.58	0.62	-0.09	0.54			
	[3.77]	[4.04]	[-2.75]				

Notes: This table shows the performance of value-weighted large cap portfolios formed by sorting on the momentum signal (Panel A), the joint value and momentum signal (Panel B), and the joint quality, value, and momentum signal (Panel C). Each month, high (low) portfolios are formed from among the 500 largest non-financial firms by end of June market capitalization by buying each of the 150 stocks with the highest (lowest) combined ranks of past performance (stock return over the first eleven months of the prior year, Panel A), book-to-market and past performance (Panel B), and gross profits-to-assets, book-to-market and past performance (Panel C). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 5. Performance of Other Known Combined Quality/Value Strategies, Value-Weighted Results

		CAPM results			Tracking error		
Protfolio	E[r^e]	α	β	S.R.	E[r^e]	Vol.	I.R.
Panel A: Greenblatt's "magic formula" strategy							
Low	0.30	-0.16	1.04	0.20	-0.14	7.0%	-0.24
	[1.41]	[-1.85]	[56.6]		[-1.65]		
High	0.56	0.17	0.91	0.44	0.13	5.6%	0.27
	[3.08]	[2.56]	[63.7]		[1.88]		
High-low	0.26	0.32	-0.13	0.31			
	[2.15]	[2.66]	[-4.96]				
Panel B: Piotroski and So strategy							
Low	0.36	-0.08	1.00	0.26	-0.08	5.3%	-0.17
	[1.80]	[-1.23]	[71.3]		[-1.22]		
High	0.58	0.20	0.86	0.47	0.14	6.1%	0.27
	[3.26]	[2.87]	[57.2]		[1.89]		
High-low	0.22	0.28	-0.14	0.27			
	[1.90]	[2.49]	[-5.69]				
Panel C: Graham strategy							
Low	0.44	-0.03	1.06	0.30	0.00	5.8%	0.00
	[2.07]	[-0.41]	[70.7]		[-0.02]		
High	0.55	0.16	0.89	0.45	0.11	5.0%	0.27
	[3.11]	[2.82]	[71.4]		[1.86]		
High-low	0.11	0.19	-0.17	0.15			
	[1.05]	[1.82]	[-7.58]				

Notes: This table shows the performance of value-weighted large cap portfolios formed by sorting on joint quality and price signals. Each year, at the end of June, high (low) portfolios are formed by buying each of the 150 stocks with the highest (lowest) joint quality and value signal from among the 500 largest non-financial firms. The Greenblatt strategy uses combined EBIT-to-tangible capital and EBIT-to-enterprise value ranks as its signal (Panel A). The Piotroski and So strategy uses combined F-score and book-to-market (Panel B), and the Graham strategy uses combined G-score and geometric average book-to-market and earnings-to-price (Panel C). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio (E[r^e], with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 6. Performance of Signal-Weighted Portfolios Sorted on Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on quality (GP/A rank)							
Low	0.37	-0.05	0.97	0.27	-0.07	6.3%	-0.13
	[1.87]	[-0.71]	[58.5]		[-0.87]		
High	0.62	0.17	1.04	0.43	0.18	5.3%	0.42
	[3.02]	[2.62]	[74.9]		[2.90]		
High-low	0.25	0.22	0.07	0.33			
	[2.32]	[2.05]	[2.89]				
Panel B: Sorted on value (B/M rank)							
Low	0.38	-0.14	1.17	0.23	-0.06	7.3%	-0.10
	[1.60]	[-1.66]	[65.8]		[-0.69]		
High	0.64	0.24	0.93	0.49	0.21	6.6%	0.38
	[3.37]	[3.07]	[54.2]		[2.63]		
High-low	0.27	0.37	-0.25	0.28			
	[1.96]	[2.91]	[-8.73]				
Panel C: 50/50 mix of quality and value strategies							
Low	0.37	-0.09	1.07	0.26	-0.06	4.9%	-0.15
	[1.78]	[-1.65]	[85.2]		[-1.07]		
High	0.63	0.20	0.98	0.48	0.20	4.0%	0.59
	[3.31]	[4.22]	[93.3]		[4.08]		
High-low	0.26	0.30	-0.09	0.63			
	[4.36]	[5.21]	[-7.12]				

Notes: This table shows the performance of signal-weighted large cap portfolios formed by sorting on quality and price signals. Each year, at the end of June, high (low) portfolios are formed by buying stocks with ranks of gross profits-to-assets (GP/A, Panel A) or book-to-market (B/M, Panel B) higher (lower) than the median from among the 500 largest non-financial firms. The weight put on each stock is proportional to the deviation of the rank of its signal from the median. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). Panel C shows the strategies that hold equal positions in the quality and value strategies. The sample covers July 1963 to December 2011.

Internet Appendix Table 7. Performance of Signal-Weighted Portfolios Sorted on Combined Quality and Value Signal

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Low	0.23	-0.28	1.16	0.14	-0.21	7.4%	-0.33
	[0.99]	[-3.31]	[63.4]		[-2.33]		
High	0.75	0.30	1.02	0.54	0.31	5.2%	0.71
	[3.72]	[4.85]	[73.6]		[4.98]		
High-low	0.52	0.58	-0.15	0.67			
	[4.67]	[5.38]	[-6.13]				

Notes: This table shows the performance of rank-weighted large cap portfolios formed by sorting on the joint quality and price signal. Each year, at the end of June, high (low) portfolios are formed by buying stocks with the combined ranks of gross profits-to-assets and book-to-market higher (lower) than the median from among the 500 largest non-financial firms. The weight put on each stock is proportional to the deviation of the rank of its signal from the median. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 8. Performance of Signal-Weighted Strategies that Combined Momentum with Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Sorted on momentum (past performance rank)							
Low	0.25	-0.23	1.10	0.16	-0.19	8.4%	-0.27
	[1.10]	[-2.29]	[50.3]		[-1.85]		
High	0.85	0.38	1.07	0.54	0.41	8.9%	0.56
	[3.74]	[3.61]	[46.3]		[3.91]		
High-low	0.60	0.61	-0.02	0.45			
	[3.16]	[3.19]	[-0.50]				
Panel B: Sorted on joint value and momentum signal (average of B/M and past performance ranks)							
Low	0.22	-0.26	1.11	0.14	-0.21	7.2%	-0.35
	[1.00]	[-3.11]	[60.3]		[-2.47]		
High	0.74	0.32	0.95	0.55	0.30	6.2%	0.58
	[3.81]	[4.34]	[58.3]		[4.02]		
High-low	0.51	0.58	-0.16	0.53			
	[3.68]	[4.28]	[-5.49]				
Panel C: Sorted on joint quality, value, and momentum signal (average of GP/A, B/M and past performance ranks)							
Low	0.15	-0.33	1.10	0.10	-0.29	7.3%	-0.47
	[0.68]	[-3.82]	[58.3]		[-3.27]		
High	0.86	0.42	1.01	0.61	0.42	5.9%	0.85
	[4.25]	[5.88]	[64.4]		[5.95]		
High-low	0.71	0.75	-0.09	0.74			
	[5.17]	[5.46]	[-2.99]				

Notes: This table shows the performance of rank-weighted large cap portfolios formed by sorting on the momentum signal (Panel A), the joint value and momentum signal (Panel B), and the joint quality, value, and momentum signal (Panel C). Each month, high (low) portfolios are formed from among the 500 largest non-financial firms by end of June market capitalization by buying one stocks with the higher (lower) than median combined ranks of past performance (stock return over the first eleven months of the prior year, Panel A), book-to-market and past performance (Panel B), and gross profits-to-assets, book-to-market and past performance (Panel C). The weight put on each stock is proportional to the deviation of the rank of its signal from the median. The high-low strategy buys (sells) the high (low) portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 9. Performance of Other Known Combined Quality/Value Strategies, Signal-Weighted Results

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Greenblatt's "magic formula" strategy							
Low	0.30	-0.16	1.04	0.20	-0.14	7.0%	-0.24
	[1.41]	[-1.85]	[56.6]		[-1.65]		
High	0.56	0.17	0.91	0.44	0.13	5.6%	0.27
	[3.08]	[2.56]	[63.7]		[1.88]		
High-low	0.26	0.32	-0.13	0.31			
	[2.15]	[2.66]	[-4.96]				
Panel B: Piotroski and So strategy							
Low	0.36	-0.08	1.00	0.26	-0.08	5.3%	-0.17
	[1.80]	[-1.23]	[71.3]		[-1.22]		
High	0.58	0.20	0.86	0.47	0.14	6.1%	0.27
	[3.26]	[2.87]	[57.2]		[1.89]		
High-low	0.22	0.28	-0.14	0.27			
	[1.90]	[2.49]	[-5.69]				
Panel C: Graham strategy							
Low	0.44	-0.03	1.06	0.30	0.00	5.8%	0.00
	[2.07]	[-0.41]	[70.7]		[-0.02]		
High	0.55	0.16	0.89	0.45	0.11	5.0%	0.27
	[3.11]	[2.82]	[71.4]		[1.86]		
High-low	0.11	0.19	-0.17	0.15			
	[1.05]	[1.82]	[-7.58]				

Notes: This table shows the performance of rank-weighted large cap portfolios formed by sorting on joint quality and price signals. Each year, at the end of June, high (low) portfolios are formed by buying stocks with higher (lower) than median joint quality and value signal from among the 500 largest non-financial firms. The weight put on each stock is proportional to the deviation of the rank of its signal from the median. The Greenblatt strategy uses combined EBIT-to-tangible capital and EBIT-to-enterprise value ranks as its signal (Panel A). The Piotroski and So strategy uses combined F-score and book-to-market (Panel B), and the Graham strategy uses combined G-score and geometric average book-to-market and earnings-to-price (Panel C). The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.

Internet Appendix Table 10. Performance of Alternative Equal-Weighted Strategies that Combined Momentum with Quality and Value

		CAPM results			Tracking error		
Protfolio	$E[r^e]$	α	β	S.R.	$E[r^e]$	Vol.	I.R.
Panel A: Quality, value, and momentum							
Low	0.15	-0.37	1.19	0.08	-0.29	10.1%	-0.34
	[0.59]	[-3.23]	[47.0]		[-2.39]		
High	0.87	0.43	1.02	0.62	0.44	5.7%	0.93
	[4.30]	[6.31]	[68.5]		[6.47]		
High-low	0.73	0.80	-0.17	0.66			
	[4.58]	[5.13]	[-5.04]				
Panel B: Quality, high frequency value, and momentum							
Low	0.13	-0.40	1.20	0.07	-0.31	9.9%	-0.38
	[0.50]	[-3.50]	[48.1]		[-2.62]		
High	0.87	0.43	1.00	0.63	0.43	5.4%	0.97
	[4.37]	[6.73]	[70.9]		[6.78]		
High-low	0.74	0.83	-0.19	0.69			
	[4.79]	[5.46]	[-5.80]				
Panel C: Quality, value, and momentum with IRR screen							
Low	0.13	-0.38	1.16	0.08	-0.31	9.2%	-0.40
	[0.54]	[-3.55]	[50.0]		[-2.78]		
High	0.90	0.45	1.04	0.63	0.47	5.3%	1.06
	[4.38]	[7.13]	[75.8]		[7.40]		
High-low	0.77	0.82	-0.12	0.79			
	[5.52]	[5.94]	[-3.91]				
Panel D: Quality, high frequency value, and momentum, with IRR screen							
Low	0.11	-0.40	1.16	0.06	-0.33	8.9%	-0.44
	[0.44]	[-3.89]	[51.3]		[-3.09]		
High	0.90	0.45	1.03	0.64	0.46	5.0%	1.11
	[4.44]	[7.53]	[78.3]		[7.75]		
High-low	0.79	0.85	-0.13	0.84			
	[5.83]	[6.33]	[-4.46]				

Notes: This table shows the performance of equal-weighted large cap portfolios formed by sorting on joint quality, value, and momentum signals. Each month, high (low) portfolios are formed from among the 500 largest non-financial firms by end of June market capitalization by buying each of the 150 stocks with the highest (lowest) combined ranks of past performance (stock return over the first eleven months of the prior year), book-to-market and gross profits-to-assets. Panels A and C measure book-to-market using lagged price (end of June book equity scaled by the preceding December's market capitalization), while panels B and D measure book-to-market using current price (end of June book equity scaled by end of month market capitalization). Panels C and D also employ an industry-relative reversal screen. Stocks already held in the high (low) portfolio are not sold, even if they fall out of the 150 of the largest non-financial stocks with the highest (lowest) joint quality, value and momentum signal, if they underperformed (outperformed) their industry (Fama and French 49) in the preceding month. The high-low strategy buys the high portfolio and sells the low portfolio. The table shows the average monthly excess returns to each portfolio ($E[r^e]$, with t-stats in square brackets), results of time-series regressions of the portfolios' returns on the excess returns to the market [intercept (α) and slope (β)], the portfolios' annual Sharpe ratios, and the average monthly return, volatility, and information ratio of the portfolios' market tracking errors (portfolios' returns in excess of the market return). The sample covers July 1963 to December 2011.