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Sector Selection Based on the Cyclically Adjusted Price-Earnings (CAPE) Ratio

Barclays has partnered with Professor Robert J. Shiller of Yale University to research investment strategies based on the well-known investment principles he has developed. This publication is based on the joint work of Professor Shiller and Oliver Bunn of Yale University and the authors. [1]

This paper investigates the use of the Cyclically Adjusted Price-Earnings (CAPE) ratio, originally devised by John Campbell and Robert Shiller in their paper "Stock Prices, Earnings and Expected Dividends" (1988), for sector selection with a long-term focus. In terms of methodological contributions, the paper presents a modification of the original CAPE ratio to guarantee invariance not only with regard to inflation (as in Campbell and Shiller (1988)), but also with regard to the corporate payout policy. Moreover, comparing different sectors necessitates a standardization of CAPE, which this paper accomplishes by introducing the Relative CAPE indicator.

The paper suggests an investment strategy that selects value sectors based on the Relative CAPE indicator and uses momentum to eliminate value traps. Rebalancing monthly, this strategy exhibits 3.5% of annualized excess return (gross of estimated costs) compared with the S&P500 Total Return index between February 1988 and May 2012, with an improved risk profile. This analysis builds on 40 years of sector-level return and earnings information, which has been made possible by the use of firm-level data and aggregating these into sector-level quantities.

As an extension to the original strategy, this paper also suggests a beta-hedged CAPE-based sector selection strategy extracting excess returns over the market while targeting market neutrality. Additionally, it introduces another variant of the strategy that tilts away from market weights based on the selection in the original strategy while targeting minimal tracking error with respect to the S&P500 Total Return index.

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1. Introduction

Value investing has a long tradition in the investment management community and plays a prominent role in the academic finance literature as an outgrowth of the analysis of market (in)efficiency. Within the realm of academic finance, its origins can be traced back to the work of Basu (1977), Fama and French (1992), and Lakonishok, Shleifer, and Vishny (1994). Traditional valuation measures relate market variables to balance sheet variables (eg, the Book-to-Price ratio) or market variables to income statement variables (eg, the Price-Earnings (PE) ratio).

A problematic aspect of the PE ratio for investors with a medium-/long-term focus is its reliance on earnings information from only the past year. One-year earnings tend to provide noisy signals, which are influenced by the business cycle. While this information can be useful for investors with a short investment horizon as it incorporates the most up-to-date trends, the noise of this signal increases with the investment horizon.

The Cyclically Adjusted Price-Earnings (CAPE) ratio[2] addresses this concern by using an average of longer-term earnings. Instead of using earnings over just the past 12 months, it is a ratio of current price to an average of inflation-adjusted earnings over the past ten years. This long-term focus motivates the use of the term "cyclically adjusted", as it exceeds the length of most business cycles. It makes the ratio suited for detecting long-term over- and under-valuations in the stock market, making it more informative for investors with a long-term focus.

The CAPE ratio was formally devised by Campbell and Shiller (1988) and has been used as a valuation tool for the overall stock market in Campbell and Shiller (1998, 2001). Analogous to the more widely publicized PE ratio, the intuition behind the CAPE ratio is that low ratios generally indicate high future market returns and high ratios provide an overall contraction signal. Figure 1 shows the historical CAPE ratios at each quarter-end going back to the 1880s for the overall stock market (as measured by the S&P 500 Index) with corresponding subsequent 10-year returns[3] of this market index.[4] In line with the intuition, there is a strongly negative correlation (-55%) between the CAPE ratio and subsequent long-term returns, indicating that the CAPE ratio provides useful information about the subsequent long-term performance of the stock market.[5]

Considering the evidence for the overall stock market, this paper discusses how to extend the long-term predictive ability of the CAPE ratio to a more granular level than the market itself, to the level of sectors of the stock market. Using a stock universe of the largest 500 companies in the US (the universe is reset every month), this paper constructs a 40-year dataset of returns and earnings for the ten sectors in the S&P Global Industry Classification Standard (GICS).

Figure 2 illustrates the predictive ability of CAPE, analogous to Figure 1, for a couple of the ten GICS sectors, namely consumer staples and materials. It should be noted that the historical time period used for the analysis in Figure 2 is substantially shorter than that of Figure 1, 30 years instead of 130 years. In order to ensure statistical significance in our

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[2] The CAPE ratio is also known as the Campbell-Shiller PE(10) or as the Shiller(10).
[3] 10-year returns in this context are annualized, inflation-adjusted total returns.
[4] Campbell and Shiller (2001) display a similar graph using data until 2000. This graph, updating the plot in Campbell and Shiller (2001), is from Bunn and Shiller (2012). The latter paper analyzes the long-term valuation of a historical sector classification, separating the overall US economy into Industrials, utilities, and railroads. Merging data from Cowles (1939) with publicly available data sources published by Standard & Poor's, the sample of this historical analysis spans the beginning of the 1870s until 2012.
[5] For similar evidence about the long-term information embedded in the CAPE ratio in the context of European equities, see Figures 5 through 7 of Jose and Shing (2010).

analysis for the sectors, we limit the return horizon to two years (and accordingly in Figure 2), which results in 15 non-overlapping periods, more in line with the analysis for the overall market in Figure 1. Otherwise one might encounter spurious relationships between the predictor variable and subsequent returns.

Figure 1: The CAPE Ratio of the US Stock Market in Connection with Subsequent Annualized 10-Year Real Total Returns from 1882 until 2012

Annualized 10-Year Real Total Return
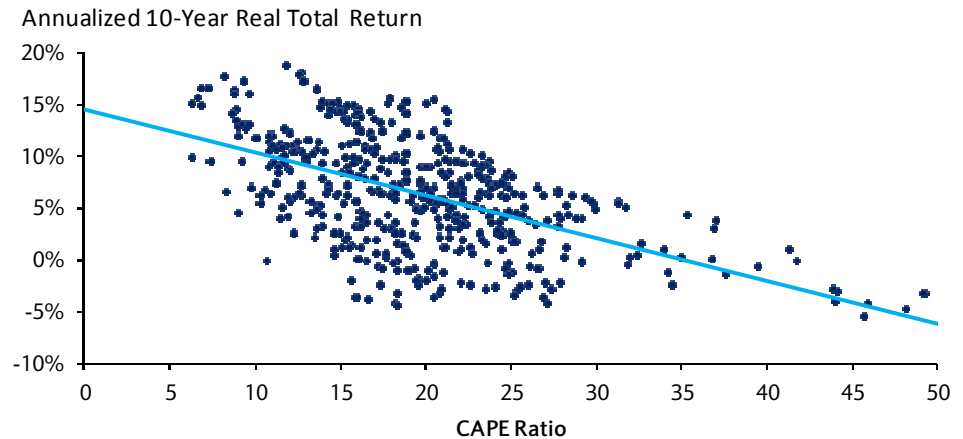
Note: See Bunn and Shiller (2012) for further details about this plot. Source: Cowles (1939), S&P Security Price Index Record (Various Volumes), S&P Analysts; Handbook (Various Volumes)

What we see in Figure 2 is in line with the above evidence for the overall market, as lower values of CAPE are generally associated with higher future returns and higher values of CAPE indicate lower future returns, which is complemented by the evidence in Appendix A that displays analogous scatter plots for all 10 sectors (including the respective correlations). Building on these initial findings on the predictive power of CAPE for long-term sector returns, we develop an investment strategy that systematically selects the favourable – undervalued – sectors based on the CAPE ratio. It is important to note that this strategy is based on the relative valuation of sectors and translates these assessments into an allocation, which is fundamentally different from an approach based on market timing.

Figure 2: The CAPE Ratio of Consumer Staples and of Materials in Connection with Subsequent Annualized Two-Year Total Returns from 1982 until 2012

Consumer Staples

Subsequent 2-Year Total Return

Materials

Subsequent 2-Year Total Return
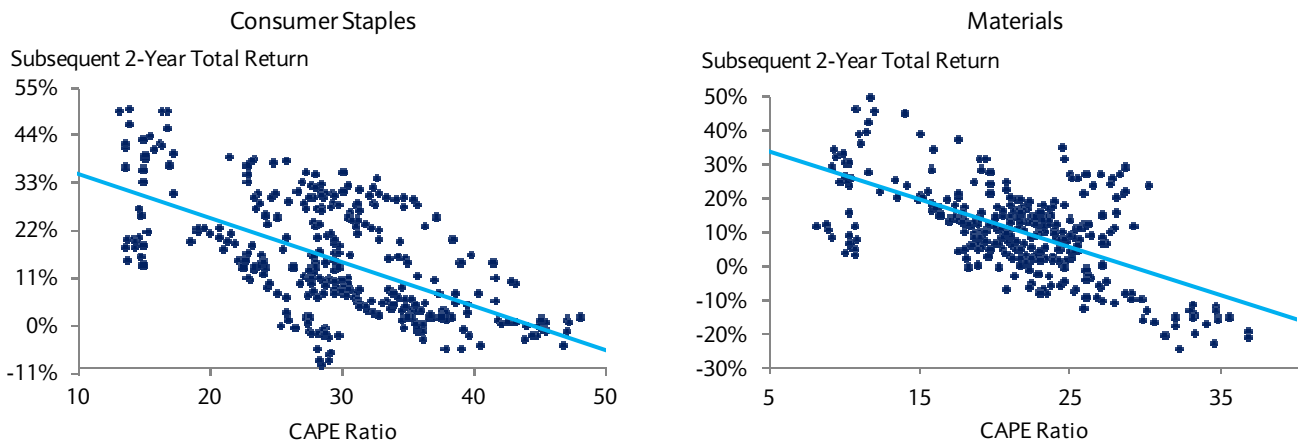
Note: For plots of all ten sectors, please refer to Appendix A. Source: Barclays Research

Before turning our attention to the investment strategy, it is necessary to take a more detailed look at the evolution of the CAPE ratio across different sectors. As an example, Figure 3 depicts the CAPE ratio for the industrials and the utilities sectors. Whereas the industrials sector is being considered a rather typical cyclical sector, the utilities sector is a good example for a defensive sector. Accordingly, the CAPE ratio for the industrials sector is substantially more volatile than that of the utilities. However, not only does the volatility of the CAPE ratio vary between the two sectors, but they also appear to be fluctuating at different levels.

Figure 3: CAPE Ratio for Industrials Sector (cyclical) and Utilities Sector (defensive). (Dec 1982- May 2012)
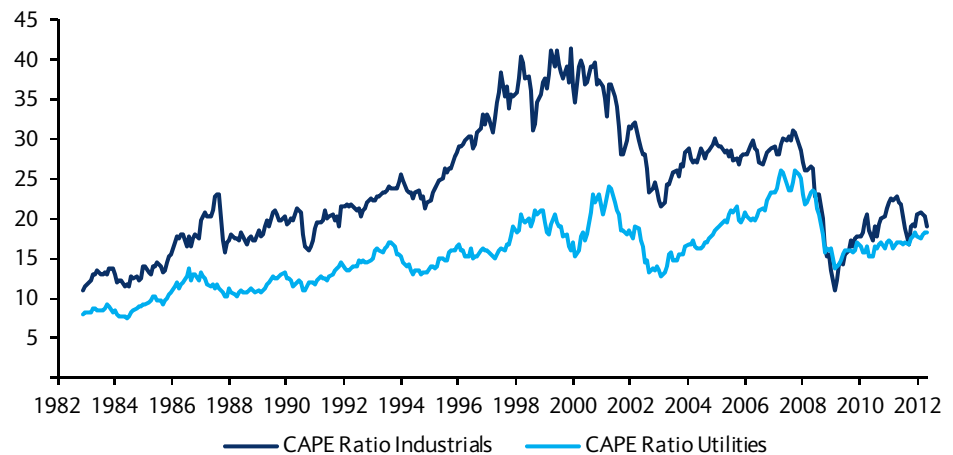
Note: For plots of the CAPE ratio of all ten sectors, please refer to Appendix B. Source: Barclays Research

Fundamental valuation ratios, such as the CAPE ratio, are potentially difficult to compare across different sectors for a variety of reasons, including different levels of maturity and, accordingly, different growth prospects for the sectors and varying accounting standards. Hence, to make the CAPE ratio more comparable across sectors, this paper introduces a standardization of it, the Relative CAPE indicator. To compute this indicator, we divide a sector's CAPE ratio at a given point in time by the 20-year historical average of this sector's CAPE ratio (numbers used for this average are winsorized at the 5% level).

It is this Relative CAPE indicator that rests at the core of the CAPE-based sector selection strategy that this paper proposes. Each month, the strategy selects the five sectors with the lowest values of the Relative CAPE indicator, ie, the sectors that are the most undervalued according to the indicator. Only four of these five sectors, however, end up in the final portfolio for a given month, as the sector with the worst 12-month momentum among the five selected sectors is eliminated. This momentum filter, identifying the sector with the worst market sentiment in recent history, helps us in addressing the so-called "value traps", a key theme in value investing.

Figure 4 shows the historical monthly performance of the CAPE-based sector selection strategy compared with the S&P500 Total Return Index (SPTR).[6] The strategy generates around 3.5% annualized excess returns (12.80% versus 9.19% for the benchmark) over the benchmark with a slightly lower annualized volatility (14.43% versus 15.05% for the benchmark). It is also important to note that the strategy realizes a maximum drawdown

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[6] In general, all performance graphs and associated performance statistics included in this paper are on a monthly level.

that is significantly lower than that of the benchmark (39.12% versus 50.95% for the benchmark).[7]

Figure 4: Performance of CAPE-Based Sector Selection Strategy (Feb 1988 – May 2012)
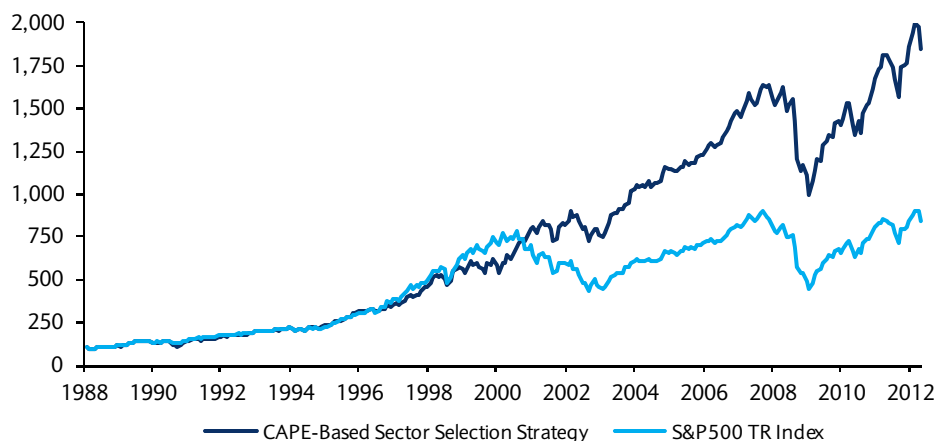
Source: Barclays Research

Figure 5 summarizes the historical performance the CAPE-based sector selection strategy together with a couple of its extensions. The first extension is a beta-hedged version, which is designed to extract excess returns over the market while targeting market neutrality. As we can see, this version delivers an attractive information ratio along with a relatively low maximum drawdown and low correlation with the S&P 500 Total Return index. The second extension aims at closely tracking the market benchmark while tilting the weights of the sectors away from their market weights as a function of the CAPE-based selection of sectors. This strategy generates returns that are more than 95% correlated with the market benchmark. Crucially, this strategy outperforms the market, in line with the core CAPE-based sector selection strategy, as evidenced by an excess 17% in its information ratio.

Figure 5: Comparison of Performance Statistics for the CAPE-Based Sector Selection Strategy, Its 2 Extensions, and SPTR (Feb 1988 – May 2012)

	CAPE-Based Sector Selection Strategy	Beta-Hedged CAPE-Based Sector Selection Strategy	Tilted CAPE-Based Sector Selection Strategy	S&P500 TR Index
Return	12.80%	3.98%	11.18%	9.19%
Volatility	14.43%	6.47%	14.30%	15.05%
Information Ratio	88.65%	61.51%	78.17%	61.04%
Maximum Drawdown	(39.12%)	(17.88%)	(43.10%)	(50.95%)
Correlation with SPTR	88.01%	(8.96%)	96.58%	

Source: Barclays Research

2. Constructing a Sector-Specific CAPE Ratio

Whereas the previous section discussed the motivation behind the CAPE ratio, this section will detail its construction, which is the core building block of the strategy, as well as the

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[7] To provide an assessment of the performance of the CAPE-based sector selection strategy over a reasonably long time, an adjustment to the construction of the Relative CAPE indicator becomes necessary. For the early part of the period, the Relative CAPE indicator makes use of the maximum number of available CAPE observations instead of a fixed horizon of 240 months in the denominator. The winsorization of the sample remains unchanged at the 5% level.

Relative CAPE indicator. Schematically, Figure 6 outlines the variables needed for the calculation of the CAPE ratio at a given month (April 2012).

Figure 6: Construction of the CAPE Ratio

CAPE Ratio in April 2012:
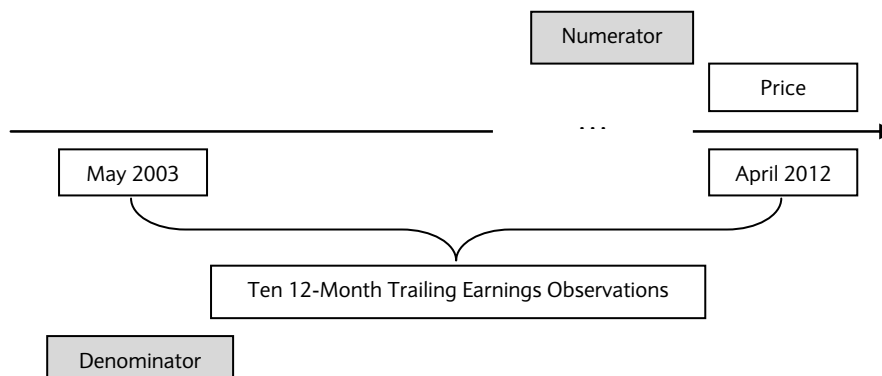
Source: Barclays Research

As captured by Figure 6, the numerator of the CAPE ratio is a spot variable, whereas the earnings in the denominator span a ten-year period. This discrepancy necessitates two kinds of adaptations to the nominal price and earnings numbers reported for a sector. First, to rule out any effect of inflation on the comparison of earnings over ten years to the contemporaneous price, one needs to consider real, ie, inflation-adjusted, numbers.[8] This is accomplished by dividing sector prices and 12-month trailing earnings in a given month by the level of US CPI in the previous month and by multiplying them by a fixed base level of US CPI.[9] It is crucial to lag US CPI by one month to avoid a forward-looking bias in the construction of the CAPE-based investment strategy. This is because the Bureau of Labor Statistics (BLS) does not release CPI numbers corresponding to a specific month until the middle of the subsequent month.

The second modification to the original formulation, which is novel within the realm of CAPE as a valuation metric, aims at eliminating the effects of corporate payout policy. To develop some intuition for the effect of corporate payout policy, consider two companies that are exactly the same except for their payout policies. One company prefers to return more of its profits to the investors in terms of dividends and the other one prefers not to pay out any dividends; otherwise they are identical. Without further information, it is fair to assume that these companies produce the same amount of earnings per dollar investment at a given point. Therefore, one would think that they are similar from a price-earnings valuation perspective, hence by extension also from the perspective of the CAPE ratio. If we re-write the CAPE ratio as in Appendix C, we can see that the denominator is the sum of earnings per dollar times the discount rate, where the summed product extends over the past ten years. As we assume that these two companies produce the same amount of earnings per dollar at a given point, the only other component in the CAPE ratio is the discount rate, which is a function of stock returns over the history. If these two companies are identical, we would expect them to provide identical total returns irrespective of their payout policy and hereby we would assign the same valuation ratio to these companies.

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[8] An inflation-correction has already been included in the original formulation of the CAPE ratio in Campbell and Shiller (1988). At that time, it was a major modification in the implementation of the idea of long-term earnings averages, as previously discussed in Graham and Dodd (1934).
[9] This is the common level of CPI as of the end of March 2012 for Figure 6.

Total returns are in general better invariants across companies and provide a better base for performance comparisons. By using total returns in the computation of CAPE ratio, we make sure that the metric is still comparable between companies with different payout policies. What we have mentioned for companies also applies to sectors; there can be significant differences across sectors in terms of their payout policies and it is important that our valuation metric is still comparable across them in the presence of such policy differences.

To incorporate total returns in the computation of CAPE, we replace the price index level in the numerator with a total return price and the earnings in the denominator with total-return-adjusted earnings. To compute the total return price, we construct a hypothetical total return index that starts at a value of 100 at the inception of the index and evolves as a function of the monthly total returns of the index. To calculate the total return earnings, we first compute an earnings per dollar number for each year over the past ten years, which is derived by dividing a sector's earnings per share by that sector's price index level. We then multiply the earnings per dollar quantity by the total return index level to obtain the total-return-adjusted earnings. Another way to understand this kind of total-return adjustment is as follows: The total-return-adjusted earnings quantity is that specific earnings number that preserves the price-earnings ratio when one replaces the price index level by the total return index.

To summarize, Figure 7 outlines the steps to compute the CAPE ratio for an individual sector, incorporating the payout- and the inflation-adjustment together with the earnings lag.

Figure 7: Computation of the Modified CAPE Ratio

Step 1 — Construct the total return index and extract 12-month trailing earnings data for the ten sectors.

Step 2 — Scale 12-month trailing earnings by the ratio of total return index to price index level, both taken at the end of the 12-month period over which earnings are computed.

Step 3 — Adjust total return index and the total-return-adjusted 12-month trailing earnings for inflation, imposing a one-month lag on CPI.

Step 4 — Divide the real total return index level by the average of ten successive 12-month trailing real, adjusted earnings observations, starting three months prior to the time of the total return index level (three months lag to account for the time difference between the fiscal quarter end and the announcement of earnings).

Source: Barclays Research

Once we have the CAPE ratios for the individual sectors, we need to address the issue that we have illustrated in Figure 3 in terms of the comparability of valuation ratios across sectors. As we mentioned, valuation ratios are not easily comparable across different sectors for a variety of reasons, including different levels of maturity and, accordingly, different growth prospects for the sectors and different accounting standards. As Figure 3 shows, the CAPE ratio of the cyclical sector (industrials) is not only more volatile than the CAPE ratio of the defensive sector (utilities), but also fluctuates around different levels. Overall, the CAPE ratio for industrials exceeds the CAPE ratio for utilities for the entire time under consideration (December 1982 until May 2012), except for a brief period starting in late 2008 until late 2009 and an instance in 2011. The question arises whether this difference in levels of the two respective CAPE ratios

should be taken as an indication that the utilities sector always represents a more attractive investment opportunity compared with industrials.

For this purpose, consider a hypothetical long-short strategy that only involves industrials and utilities. The long position is in the sector with the lower CAPE ratio, which would be utilities most of the time, with a corresponding short position in the sector with the higher CAPE ratio. This strategy will be compared with an analogous long-short strategy that is based on the Relative CAPE indicator.

The Relative CAPE indicator is – as the CAPE ratio, from which it is derived – a sector-specific quantity. It is a standardization of the CAPE ratio of a sector relative to a sector's own long-term history. Explicitly, it is defined as the ratio of the current CAPE ratio for a sector to that sector's 20-year average of the CAPE ratio. To produce a more robust average, we winsorize the sample of CAPE numbers used for the computation of the 20-year average at the 5% level[10].

Figure 8 is analogous to Figure 3, displaying the Relative CAPE indicator for the industrials and the utilities sectors. It already becomes apparent that the two sectors now operate on a more comparable scale, with the lines crossing each in a more frequent manner.

We now run the long-short strategy outlined above using the CAPE ratio versus the Relative CAPE indicator of the industrials and the utilities sectors. Figure 9 compares the performance of this strategy using these two metrics and for simplicity abstracts from any funding considerations, as well as shorting costs.

Figure 8: Relative CAPE Indicator for Industrials Sector and for Utilities Sector (Feb 1988 - Apr 2012)

Relative CAPE Indicator for Industrials Sector

Relative CAPE Indicator for Utilities Sector
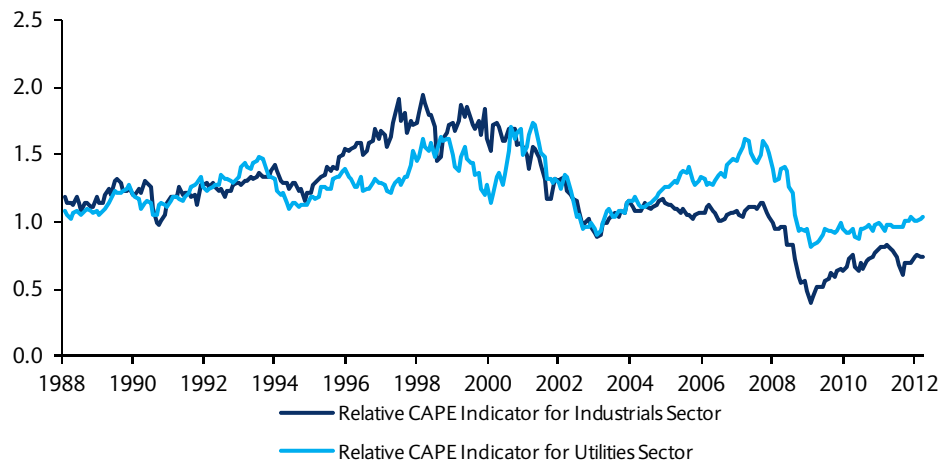
Source: Barclays Research

Figure 9 shows that the Relative CAPE indicator provides a more successful assessment of the relative under- and overvaluation of the two sectors, as also evidenced by the performance overview displayed in Figure 10. The comparison using these two specific sectors is for illustration purposes only and does not provide a generic evidence for such outperformance. In the subsequent section, when outlining our general CAPE-based sector selection strategy that involves all ten GICS sectors, we generalize our investment approach

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[10] Please note that when we do not have 20 years of CAPE history, we use as much history as we have to compute the denominator of the Relative CAPE indicator. For instance in 1988, we have only five years of history for CAPE, therefore, the average in the Relative CAPE indicator uses five years of data.

based on the Relative CAPE indicator and re-assess the performance difference that results from the consideration of the Relative CAPE indicator versus using the CAPE ratio itself to assess the relative valuation of sectors.

Figure 9: Long-Short Strategies Involving Industrials and Utilities Sector Based on CAPE Ratio and on Relative CAPE Indicator (February 1988-May 2012)
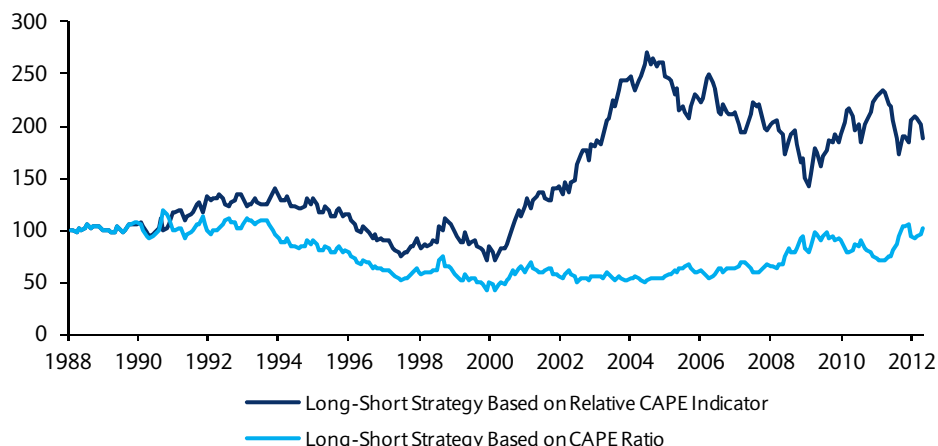
Source: Barclays Research

Figure 10: Performance of Long-Short Strategies Involving Industrials and Utilities Sectors Based on CAPE Ratio and on Relative CAPE Indicator (February 1988-May 2012)

	Long-Short Strategy Based on Relative CAPE Indicator	Long-Short Strategy Based on CAPE Ratio
Return	2.66%	0.10%
Volatility	5.04%	5.06%
Information Ratio	52.81%	1.98%
Maximum Drawdown	(49.59%)	(64.41%)

Source: Barclays Research

The definition of the Relative CAPE indicator acknowledges that different sectors' prices and earnings might be subject to fundamentally different factors. First, sectors can differ substantially in terms of their growth prospects, which then feed into their price levels. For example, consider the information technology sector, whose constituents tend to have large growth prospects embedded in their stock price, especially for young companies. Another factor related to cross-sector comparisons of the CAPE ratio is differing accounting standards across sectors, which might affect the earnings numbers that are reported for a sector's constituents. Due to such reasons, valuation ratios such as CAPE are not easily comparable across different sectors without some sort of standardization.

By construction, the CAPE ratio measures the long-term over- or undervaluation of sectors. For this reason, it is crucial to assess the performance of a strategy based on this ratio over a long time. In this endeavor, we rely on individual firm-level data to construct a 40-year history of sector prices and earnings. Over this period, the US economy has gone through several distinct phases, allowing for a robust analysis of the performance of the strategy.

3. CAPE-Based Sector Selection Strategy

Building on the construction of the Relative CAPE indicator in the previous section, this section discusses the derivation of a CAPE-based sector selection strategy, which consists of a two-step procedure that is applied at the level of individual sectors and rebalances the portfolio allocation at the end of each month.

The first step selects the set of undervalued sectors by splitting the ten sectors into two groups, five sectors with the lowest Relative CAPE indicator versus the five with the highest. The premise is that the sectors in the first group are relatively undervalued and expected to outperform the market over the longer run.

A major consideration in value investing is the identification of "value traps." A systematic portfolio constructed using a fundamental valuation metric, such as the CAPE ratio, might incorporate constituents that are undervalued due to legitimate fundamental reasons. To identify these, which are also known as value traps, we use a momentum filter, which represents investor sentiment in recent history. More specifically, among the five undervalued sectors identified by the Relative CAPE indicator, we eliminate the one with the worst 12-month momentum, that is, the sector with the worst market sentiment over the past year.

The portfolio allocation distributes the capital equally[11] (25% each) into the four remaining sectors, and this allocation is rebalanced every month. Schematically, this methodology can be summarized as in Figure 11.

Figure 11: CAPE-Based Sector Selection Strategy
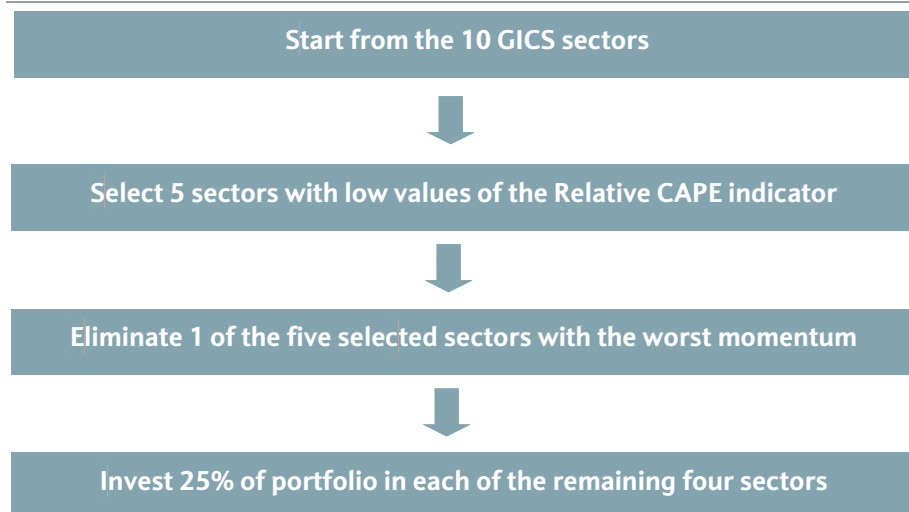
Source: Barclays Research

In terms of the overall strategy, the relative importance of the selection steps is noteworthy. The first, which is based on the Relative CAPE indicator, is dominant compared over the second, which incorporates the momentum filter. The first step eliminates 5 sectors out of a portfolio of 10 sectors, and the order of steps implies that the momentum consideration applies only conditional on the valuation signal given by the Relative CAPE indicator. Nevertheless, the momentum consideration plays an important subsidiary role, in terms of avoiding sectors that are potentially value traps.

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[11] This equal weighting procedure provides simplicity and diversification for the final portfolio. An alternative would be to weight the four sectors as a function of their Relative CAPE indicator, by assigning higher weights to the sectors with lower Relative CAPE indicator. Such an alternative would have more sector concentration.

Figure 12 assesses the historical portfolio performance at each stage of the portfolio construction procedure for the CAPE-based sector selection strategy. The top part of the graph shows the superior long-term performance of a portfolio that at each rebalancing date selects the five sectors with the lowest Relative CAPE indicator, compared with one that selects the remaining sectors. The bottom graph represents a decomposition of the performance of the portfolio comprising the five sectors with the lowest Relative CAPE indicator. It separates the four sectors that ultimately end up in the sector allocation from the one that is eliminated by the momentum consideration. It becomes apparent how each step in the CAPE-based sector selection strategy adds value.

Figure 12: Performance of CAPE-Based Investment Strategy at Different Stages (February 1988-May 2012)

Elimination based on Relative CAPE Indicator – From 10 GICS Sectors to 5 Sectors with Lowest Relative CAPE Indicator

Elimination based on Momentum – From 5 Sectors with Lowest Relative CAPE Indicator to 4 Sectors for CAPE-Based Sector Selection
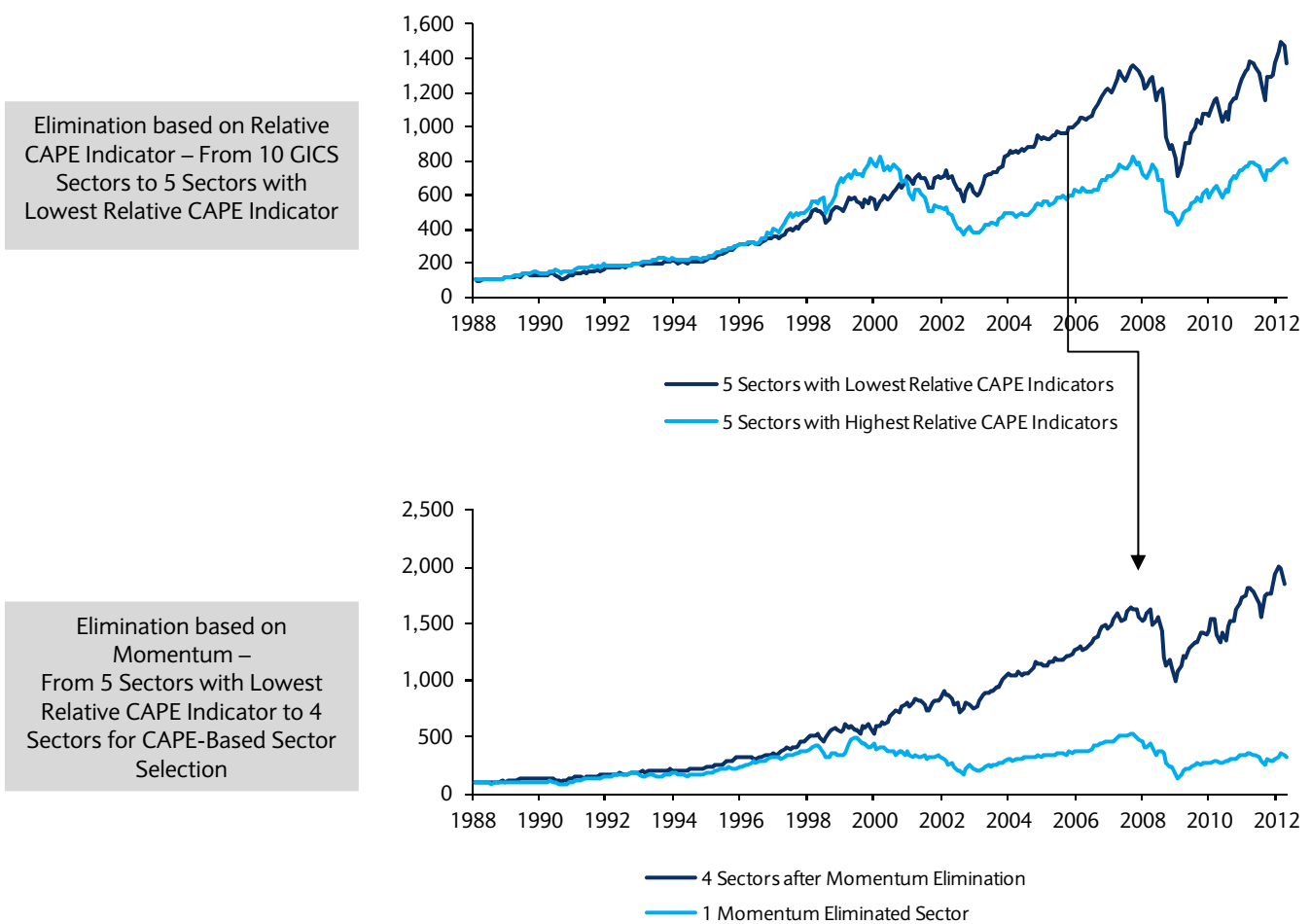
Source: Barclays Research

In its approach to interact a long-term value-based investment approach with a momentum consideration, our strategy proves to provide outperformance during the two and a half decades over which its performance is assessed. In this sense, it contributes to the overall evidence in favor of return prediction from valuation ratios, as Campbell and Thompson (2008), for example, emphasize. Their analysis represents a rebuttal to the concern raised by Welch and Goyal (2008), reinstating the predictive ability of valuation ratios by introducing intuitive parameter restrictions into their rolling regression framework. Although our portfolio approach is related to the literature on predictive regressions, it is

important to point out that its selection does not employ any regressions, but derives a portfolio strategy from its core valuation tool in a more intuitive manner.

The joint consideration of a value and a momentum variable bears resemblance to the research by Asness et al. (2009) and Fama and French (2011), who investigate the interplay of value and momentum across a broad range of geographic regions and asset classes. Crucially, their research interacts the two variables in a linear manner only, whereas this paper explicitly exploits momentum in a stepwise fashion, as a conditional signal acting on a value-based selection of sectors.

Figure 13 provides additional evidence in favor of the conditional approach by which we incorporate momentum into a value-based selection strategy. It compares the performance of the CAPE-based sector selection strategy to a hypothetical strategy that weights value- and momentum investing linearly, which is closer in spirit to the approaches pursued in Asness et al. (2009) and Fama and French (2011). Explicitly, the hypothetical strategy consists of two building blocks that are weighted equally. The first is a strategy that relies only on the Relative CAPE indicator to select four sectors out of all ten, without any involvement of momentum. The second selects four sectors based solely on 12-month momentum. As we can see in the figure, our conditional approach outperforms the linear interaction of value and momentum over the full sample period, in particular after the turn of the century, which is also evidenced by Figure 14.

Figure 13: Performance of the CAPE-Based Sector Selection Strategy and a 50-50 Strategy Consisting of a Pure CAPE Component and a Pure Momentum Component (February 1988-May 2012)
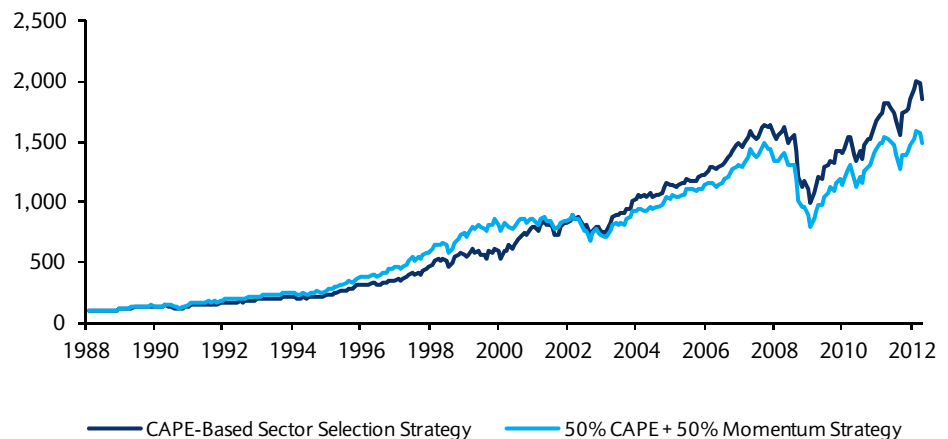
Source: Barclays Research

Figure 14: Performance Statistics for Series in Figure 13

	CAPE-Based Sector Selection Strategy	50% CAPE-Strategy Plus 50% Momentum-Strategy
Return	12.80%	11.78%
Volatility	14.43%	14.03%
Information Ratio	88.65%	83.97%
Maximum Drawdown	(39.12%)	(46.24%)

Source: Barclays Research

One might argue that due to the nature of our strategy that weights selected sectors equally, a better benchmark would be an equal weighted portfolio of ten sectors of the market, as opposed to the market value-weighted S&P 500 TR Index. Figure 4 has already displayed the performance of the CAPE-based sector selection strategy compared with the S&P500 TR Index (SPTR).[12] Based on the information contained there, Figure 15 summarizes the performance statistics of the CAPE-based sector selection strategy, the S&P500 TR Index, and an equally weighted benchmark.

Figure 15: Performance Statistics for CAPE-Based Sector Allocation, SPTR and an Equally Weighted Benchmark (February 1988-May 2012)

	CAPE-Based Sector Selection Strategy	S&P500 TR Index	Equally Weighted Benchmark
Return	12.80%	9.19%	10.31%
Volatility	14.43%	15.05%	14.03%
Information Ratio	88.65%	61.04%	73.48%
Maximum Drawdown	(39.12%)	(50.95%)	(47.92%)

Source: Barclays Research

For the whole sample period (February 1988 to May 2012), the sector selection strategy based on the Relative CAPE indicator yields more than 3.5% outperformance over the S&P500 index and almost 2.5% over the equally weighted benchmark. On a risk-adjusted basis, this translates into a more than 25% higher information ratio than the S&P500 and approximately 15% than the equally weighted benchmark. Also note that the CAPE-based strategy is superior to the benchmarks in terms of its drawdown.

The nature of the strategy as a value investment is most apparent around the technology bubble (late 1990s and the early 2000s), as can be seen in Figure 16, with a significant difference in relative performance of the strategy over the benchmark before and after the burst of the bubble. The CAPE-based sector selection strategy slightly underperforms the market benchmark in the later part of the growth-driven bull market in the 1990s, whereas it significantly outperforms after the bubble bursts in the early 2000s.

Figure 16: Performance of CAPE-Based Sector Selection Strategy, S&P500 TR Index and Equally Weighted Benchmark (February 1988-May 2012)
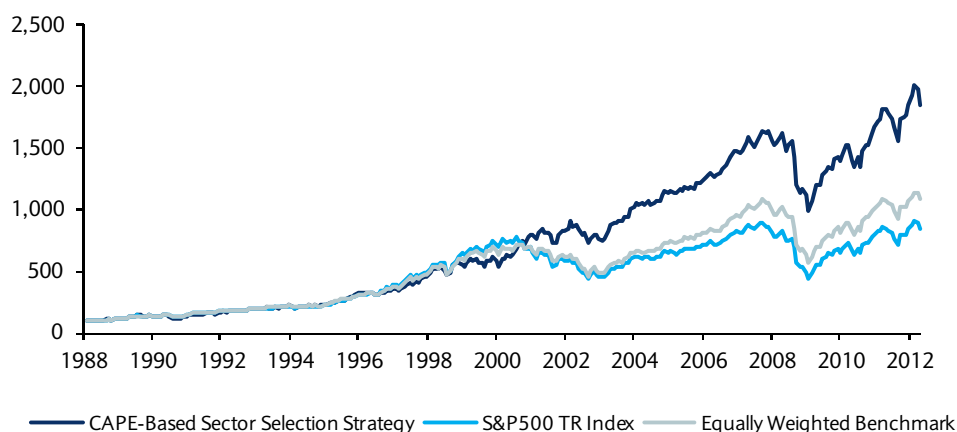
Source: Barclays Research

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[12] See footnote 7 for a description of the procedure to handle the portfolio construction at the beginning of the sample under consideration.

Figure 17 illustrates the long-term nature of the strategy from the perspective of an outperformance ratio. For a given time horizon, outperformance ratio is defined as the percentage of times the strategy outperforms its benchmark (SPTR) over rolling time periods with this selected time horizon. Figure 17 exhibits the outperformance ratio for time horizons ranging from one to 24 months. We see that as the time horizon increases, outperformance ratio generally increases with a significant upward trend, reaching about 70% as we approach to two years, indicating the performance benefits of our strategy for investors with a medium-long term focus. We limit the analysis at two years due to the same reasons mentioned above related to the length of the historical analysis period.

Figure 17: Outperformance Ratio of the CAPE-Based Sector Selection Strategy (February 1988-May 2012)
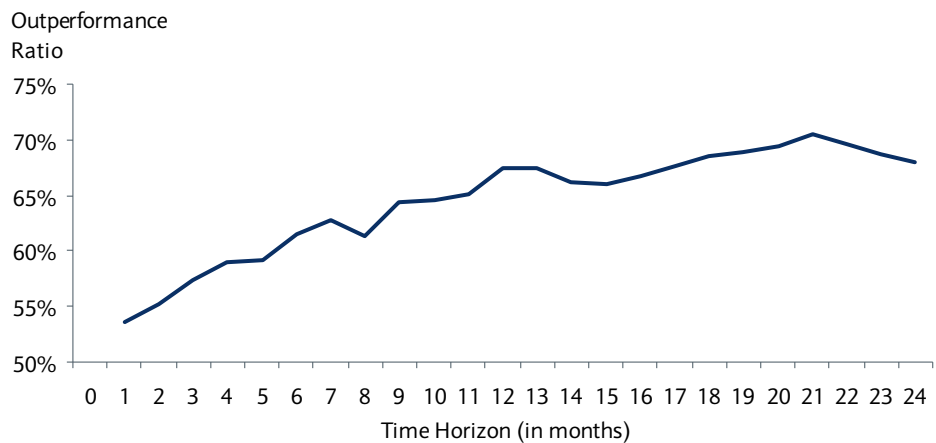
Source: Barclays Research

Figures 18 and 19 analyze the performance of the CAPE-based sector selection strategy in more detail. Figure 18 depicts the actual sector allocation implied by the CAPE-based strategy. It distinguishes between those sectors that have been selected by the Relative CAPE indicator and those that have been eliminated by the momentum consideration. Figure 19 splits the period into six sub-periods to compare the returns of the CAPE-based sector selection strategy to the market benchmark. The construction of these intervals is determined by the evolution of the S&P500 TR index, not the CAPE-based sector selection strategy. Explicitly, they capture the period before the technology-driven market run-up, the run-up leading to the technology bubble, the burst of the bubble, the bull run until the big drawdown of the credit crisis, the credit crisis market drawdown, and the post-crisis period until today. All the cut-off points are the major turning points in the evolution of the overall US stock market, naturally suggesting a performance comparison along these lines.

At its very core, the CAPE ratio and Relative CAPE indicator are value indicators that take a long-term view at the sectors. During the 1990s, this focus led the strategy to identify the information technology sector[13] – the crucial driver of the run-up to the technology bubble – as overvalued already in 1993, as Figure 18 shows. As a result, the strategy took a defensive stance against the technology bubble early on, which ultimately led to its outperformance after the bubble burst.

By its very nature, the run-up to the technology bubble was driven by the outperformance of growth stocks, which necessarily disadvantaged value-based investment approaches, as

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[13] For a display of the CAPE ratio of the Information technology sector, please consult Figures 34 and 35 in the appendix.

Figure 19 shows. This period brings about the most substantial underperformance of the CAPE-based sector selection versus the market benchmark. The underperformance before the burst of the technology bubble is followed by the most dramatic outperformance period. In a time when the market fell an annualized 20%, the CAPE-based sector selection strategy actually realized gains of about 8% annualized.

During the period up to the height of the credit crisis between 2007 and 2009, the momentum filter drops the Financials sector (Figure 18). The CAPE-based sector selection demonstrates its value as an investment strategy during this downturn, as it generates a considerably smaller loss than the market (about 10%), by allocating into more defensive sectors such as healthcare and consumer staples. During the two sub-periods before and after the drawdown of the credit crisis, the performance of the strategy and the market benchmark resemble each other rather closely. In contrast to the late 1990s, these market rallies are not driven by growth stocks and the value strategy realizes very similar performance to the market.

It is important to point out the dual nature of the performance of the strategy compared with the benchmark. In times of a bull run, the strategy has not necessarily outperformed the market, but has not fallen far behind it, either. During times of big market corrections, the strategy tends to outperform significantly, with its long-term value focus providing sector allocations that help weather the biggest drawdowns of the market. This can also be seen in Figure 20, where we compare the performance of the strategy to the market during the worst years for the market in our historical data period (years with more than 5% loss for the market). We see how our strategy provides protection during the worst episodes for the overall stock market.

A final characteristic that becomes evident from Figure 18 further substantiates the notion of the Relative CAPE indicator as a long-term signal. The strategy selects sectors fairly consistently throughout the period under consideration and rotates through them rather slowly, ensuring a substantial amount of stability in the selection of undervalued sectors.

Figure 18: Portfolio Weights of the CAPE-Based Sector Allocation Strategy at Rebalancing Dates from February 1988 to April 2012

■ Sector Selected by Strategy
■ Sector Eliminated by Momentum
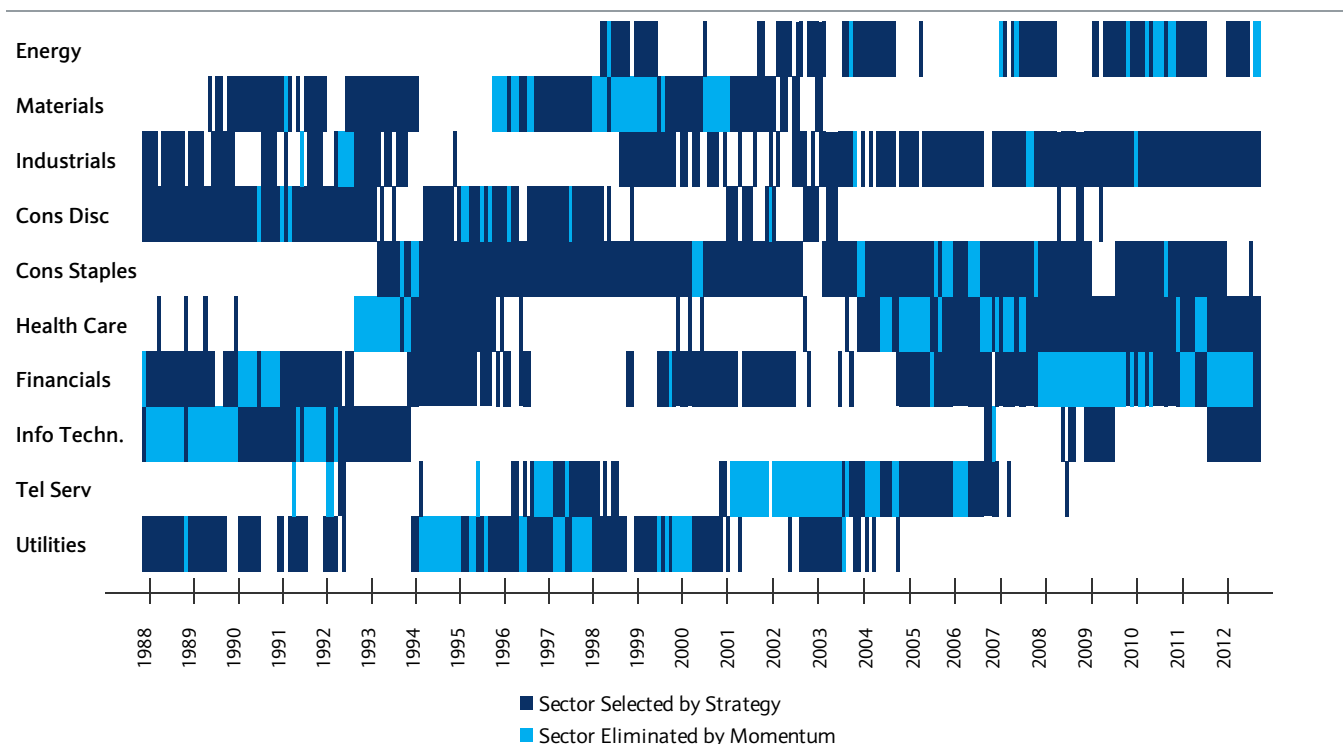
Source: Barclays Research

Figure 19: Returns for the CAPE-Based Sector Selection Strategy and the Overall Stock Market for Different Market Episodes (February 1988-May 2012)

	Return of CAPE-Based Sector Selection Strategy	Return of S&P500 Total Return Index
Before Technology Bubble (02/1988 – 12/1994)	12.18%	11.75%
Run-Up to Technology Bubble (12/1994 – 03/2000)	20.88%	27.58%
Burst of Technology Bubble (03/2000 – 09/2002)	08.40%	-20.56%
2000s Bull Market (09/2002 – 10/2007)	17.36%	15.54%
Credit Crisis (10/2007 – 03/2009)	-25.71%	-35.82%
Post-Credit-Crisis Years (03/2009 – 05/2012)	18.77%	19.46%

Source: Barclays Research

Figure 20: Performance of the Strategy versus the Market in the Worst Years for the Market (More than 5% Loss) (February 1988-May 2012)

Year	Return of CAPE-Based Sector Selection Strategy	Return of S&P500 Total Return Index
2008	-28.03%	-37.00%
2002	-4.14%	-22.10%
2001	7.03%	-11.89%
2000	25.08%	-9.10%

Source: Barclays Research

To conclude the discussion of the performance of the CAPE-based sector selection strategy, we revisit the comparison between the CAPE ratio and the Relative CAPE indicator that was initially addressed in Section 2. However, instead of arguing within the framework of the comparison between two individual sectors, here we outline the effect of the Relative CAPE indicator on the overall CAPE-based sector selection strategy. For this purpose, the CAPE-based sector selection strategy is compared with an analogous strategy that does not rely on the Relative CAPE indicator to make the initial sector selection but on the CAPE ratio of the sectors itself. Otherwise, the comparison strategy is identical to the approach displayed in Figure 11. Figures 21 and 22 outline the degree to which the Relative CAPE indicator adds value to the CAPE-based sector selection strategy by allowing for a more efficient assessment of the relative over- and undervaluation of the sectors; the Relative CAPE indicator improves the performance by 1.5% annualized, with about the same volatility and lower maximum drawdown.

Figure 21: Sector Selection Strategy using the CAPE Ratio and the Relative CAPE Indicator (February 1988-May 2012)
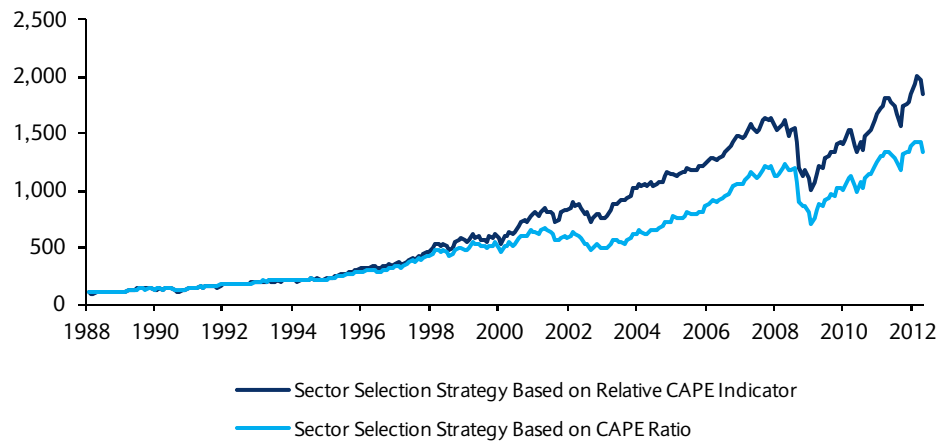
Source: Barclays Research

Figure 22: Performance Statistics for Series in Figure 21 (February 1988-May 2012)

	With Relative CAPE Indicator	Without Relative CAPE Indicator
Return	12.80%	11.30%
Volatility	14.43%	14.47%
Information Ratio	88.65%	78.08%
Maximum Drawdown	(39.12%)	(42.15%)

Source: Barclays Research

4. Risk-Adjusted Performance and Return Attribution

To understand the performance of the CAPE-based sector selection strategy better, this section explores its exposure to a variety of market-wide risk factors. More specifically, we assess its performance within the framework of CAPM and Fama-French regressions. Subsequently, we run a return attribution analysis to decompose the overall performance into contributions coming from the two major variables used for sector selection, namely the CAPE ratio and 12-month momentum.

The CAPM assumes a single factor, the market (we use the market factor from Kenneth French data library), to explain the systematic sources of return of the security. It can be expressed in a regression framework in the following form:

$$r_t - r_t^f = \alpha + \beta^M (r_t^M - r_t^f) + \varepsilon_t$$

where r_t, represents the monthly total return of the CAPE-based sector selection strategy, r_t^f represents the risk-free rate, r_t^M represents the market (total) return, and ε_t represents the idiosyncratic return at month t. β^M is the sensitivity of the strategy return to the return of the market factor, called the (market) beta, and α is the expected return of the strategy adjusted for market risk, called the alpha.

Figure 23 reports the coefficients of this regression (alpha and beta) with a time horizon of 20 years, using monthly data from June 1992 to May 2012. Standard errors in this regression, as well as any subsequent one, are adjusted for heteroskedasticity and serial correlation, using the Newey and West (1983) adjustment. Not surprisingly, the strategy has a substantial exposure to the market factor, with a beta of more than 74%. Adjusting for this market exposure, the strategy exhibits significant outperformance, with an alpha of 5.26% annually.

Figure 23: CAPM Regression for CAPE-Based Sector Selection Strategy

CAPM Regression	Regression Coefficient	T-Statistic
Constant	0.0044	2.7905
Excess Market Return	0.7443	17.1282

CAPM Regression	Annualized Alpha	Adjusted R-Squared
Regression Statistics	5.26%	68.59%

Source: Kenneth French data library, Barclays Research

We now investigate the performance of the strategy in a Fama-French framework. Besides the market factor in the CAPM, Fama-French incorporates size and value factors into the regression. We also extend this original framework by adding momentum as a factor. The resulting equation becomes

$$r_t - r_t^f = \alpha + \beta^M (r_t^M - r_t^f) + \beta^{SMB} r_t^{SMB} + \beta^{HML} r_t^{HML} + \beta^{MMT} r_t^{MMT} + \varepsilon_t$$

The three additional terms in this equation are r_t^{HML}, the return of the value factor (high minus low value), r_t^{SMB}, the return of the size factor (small minus big capitalization), and r_t^{MMT}, the return of the momentum factor (high minus low momentum) at month t and the sensitivities (betas) of the strategy return to these factors.[14]

Figure 24 shows that the exposure to the market factor increases compared with the CAPM regression with the inclusion of three additional factors, now amounting to about 82%. There is also a significant negative loading on the size factor, indicating a large capitalization bias. This can, however, be traced to the fact that our strategy's universe is the largest 500 stocks in the US, which naturally has a large capitalization bias compared to the broader universe behind the Fama-French market factor. It is also noteworthy, albeit expected because of the strategy's long-term value focus, that the loading on the Fama-French value factor is positive and significant. We also observe that the loading to the momentum factor is not significant, in

[14] See mba.tuck.dartmouth.edu/pages/faculty/ken.french/ for the data for these factors. The Fama-French factors are constructed from all the stocks listed on NYSE, AMEX, and NASDAQ, for which the appropriate data are available.

line with the relative importance of the value and momentum filters in our strategy. After taking into account the exposures to the market, size, value, and momentum factors, the strategy still exhibits a significant alpha of about 4.9% (annualized).

Figure 24: Fama-French Regression for CAPE-Based Sector Selection Strategy

Fama French Regression	Regression Coefficient	T-Statistic
Constant	0.0041	3.37
Excess Market Return	0.8250	27.82
SMB (Small Minus Big)	-0.2583	-5.53
HML (Value Minus Growth)	0.2585	4.01
Momentum	-0.0399	-1.00

Fama French Regression	Annualized Alpha	Adjusted R-Squared
Regression Statistics	4.94%	80.92%

Source: Kenneth French data library, Barclays Research

The final piece of the risk-adjusted performance analysis is a performance attribution regression involving a CAPE factor and a 12-month momentum factor. The idea is to investigate what component of the performance of our strategy is attributable to the Relative CAPE indicator versus the momentum criterion. Instead of selecting 5 sectors via the Relative CAPE indicator followed by the elimination of one sector using a momentum filter, the CAPE factor in this regression represents a selection of four sectors by relying purely on the Relative CAPE indicator. Similarly, the momentum factor represents a portfolio that selects four sectors based solely on the momentum-criterion (choose the four best momentum sectors every month) without any involvement of the Relative CAPE indicator.[15] Once we construct the returns of these CAPE and momentum factors, we incorporate them into the following regression:

$$r_t - r_t^M = \alpha + \beta^{CAPE}(r_t^{CAPE} - r_t^M) + \beta^{MMT}(r_t^{MMT} - r_t^M) + \varepsilon_t$$

Please note that if we use momentum and CAPE factors jointly in such a multivariate regression, we have a multicollinearity problem due to high correlation between these two regressors. To avoid this issue, we take out the market return (SPTR) from all three returns in this regression and use excess returns in doing the analysis. This regression is similar to what we have shown previously but incorporates two bespoke systematic risk factors corresponding to the Relative CAPE indicator and 12-month momentum variables. The results in Figure 25 are not surprising in that the CAPE-based sector selection strategy loads significantly on both factors. Importantly, the regression coefficient of the CAPE factor is nearly four times as large as that for the momentum factor, while both are significant, which appropriately reflects the fact that our strategy is driven mainly by value considerations, represented by CAPE, whereas momentum plays a subsidiary role in sector selection, conditional on the value criterion. Note that there is still 1.58% annualized excess return after accounting for the CAPE and momentum factors. The approach to incorporating the momentum consideration into sector selection in a non-linear fashion – in a conditional manner as a means to differentiate between undervalued sectors – adds value to the strategy beyond a simple linear combination of CAPE and momentum factors, which has also become apparent from Figures 13 and 14.

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[15] The construction of these portfolios is identical to the construction of the linearly weighted CAPE and momentum portfolio in Figures 13 and 14.

Figure 25: Return Attribution Regression for CAPE-Based Sector Selection Strategy

Return Attribution Regression	Regression Coefficient	T-Statistic
Constant	0.0013	1.5321
CAPE Benchmark	0.8172	15.6162
Momentum Benchmark	0.2628	3.9783

Return Attribution Regression	Annualized Alpha	Adjusted R-Squared
Regression Statistics	1.58%	67.57%

Source: Barclays Research

5. Extensions

This section discusses two extensions to the CAPE-based sector selection strategy. First, we analyze a beta-hedged version in which we aim to eliminate the market exposure by dynamically computing the beta of the strategy as a function of the sectors in the portfolio. Then, we investigate a tilted version of our strategy, which starts with the market portfolio as its baseline and moves away from this portfolio by overweighting the sectors selected by the strategy at the expense of the sectors that the core CAPE-based sector selection strategy eliminates.

Beta-Hedged Strategy

The objective of this extension is to extract the excess return over the market while aiming to achieve minimal market exposure in conjunction with low volatility. The resulting performance profile offers the excess returns of the CAPE-based sector selection strategy and the possibility for leverage due to its low-volatility nature. The beta-hedged approach represents an attractive deviation from the core CAPE-based sector selection strategy, as this core strategy, despite exhibiting an information ratio that exceeds that of the market (SPTR) by more than 30% (Figure 5), the (total) returns of the CAPE-based sector selection strategy are very highly correlated (88%) with the returns of SPTR between 1988 and 2012.

The approach to extract the excess returns of the CAPE-based sector selection strategy over the market is beta-hedging. As a first step, this approach computes the beta of each sector individually at each point in time, regressing monthly total returns of a sector to those of the market over the past five years. The strategy always includes four sectors with equal weights (25%). Therefore, we use these weights to aggregate the betas of the individual selected sectors into a beta for the overall strategy, which will then determine the short position in the SPTR. This procedure is repeated each month.[16]

Figure 26 illustrates the beta calculation procedure for the CAPE-based sector selection strategy at the end of a given month (October 1997 in this example).

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[16] The performance analysis for the beta-hedged strategy below spans February 1988 to May 2012. Total return information before February 1988, which is necessary for the early part of the beta-hedged analysis, is inferred from price information and accompanying dividend yields of the S&P500.

Figure 26: Calculation of the Beta for the CAPE-Based Sector Selection Strategy at the End of October 1997
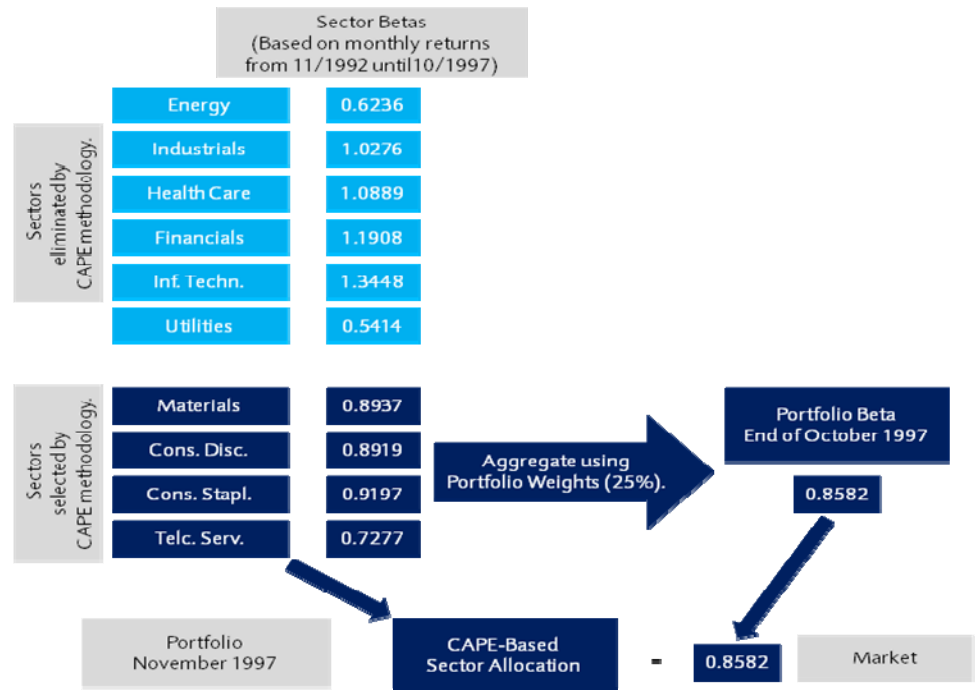
Source: Barclays Research

There are two assumptions involved in the outlined procedure for the computation of the portfolio-level beta. The first is to compute betas on an individual sector-level and aggregate them into a portfolio beta. A potential alternative is to compute a portfolio beta directly, regressing overall portfolio returns to market returns. It is, however, the very nature of the CAPE-based sector selection strategy to rotate between sectors, which implies that a beta that is computed from a five-year history of portfolio returns might not be indicative at all of the market exposure of the strategy at that point in time, as the underlying sectors tend to change significantly during a five-year time span.

The second assumption relates to the time horizon used in the beta regressions. Shorter ones lead to a more reactive beta, whereas the estimates might become too noisy as they get shorter. Longer-term betas are more stable but may not be effective in eliminating the current market exposure as the regression horizon gets longer. Taking these considerations into account, we think that a time horizon of five years represents a good compromise, where it should be noted that we use monthly data in regression calculations.

Figure 27 displays the time series of the portfolio beta for the CAPE-based sector selection strategy. The variability even over short periods is noticeable, but arises by construction, as it might undergo sudden shifts when the underlying strategy moves from one sector into another. Overall, the average beta throughout the entire period is 0.89. The strategy has a beta of about 1 in the early run-up to the technology bubble, i.e. the strategy follows the market fairly closely, as also apparent from Figure 4. During the later phase of the technology boom, the beta starts decreasing, a trend that continues until about 2004, when it reaches its minimum value of below 0.4. This is closely linked to the relative performance of the strategy compared with the benchmark, underperformance in the later phase of the technology boom and outperformance after the burst of the bubble. Starting in 2004, the beta starts picking up again until the end of the sample period.

Figure 27: Beta for the CAPE-Based Sector Selection Strategy, at Rebalancing Dates from February 1988-April 2012
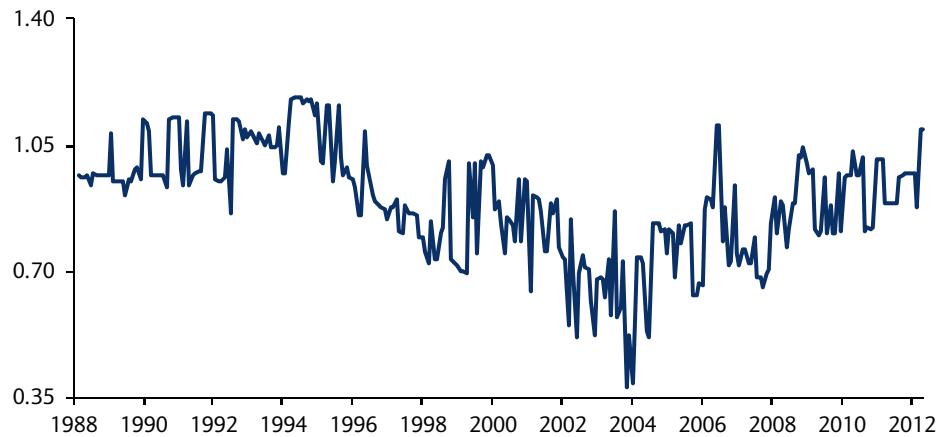
Source: Barclays Research

The performance of the beta-hedged CAPE-based sector selection strategy is displayed in Figure 28, assuming that shorting can be performed with no costs and that cash returns are negligible. As beta-hedging extracts the excess return of the long-term value strategy based on the CAPE ratio, we choose our benchmark to be a hypothetical long-short strategy based on the Fama-French value factor.[17]

One can distinguish between the two phases in the performance of the beta-hedged CAPE-based sector selection strategy. Whereas it is fairly flat until around 2000, it performs consistently well thereafter. Figure 29 shows its performance statistics for the full period between 1988 and 2012, exhibiting about 4% annualized return, combined with a fairly low volatility of less than 6.5% and about 18% maximum drawdown, underscoring the stability in the performance of the beta-hedged strategy.

Figure 28: Beta-Hedged CAPE-Based Sector Selection Strategy and a Hypothetical Value Strategy Based on the Fama-French Value (HML) Factor (February 1988-May 2012)

— Beta-Hedged CAPE-Based Sector Selection Strategy

— Long-Short Strategy Based on Fama French Value Factor
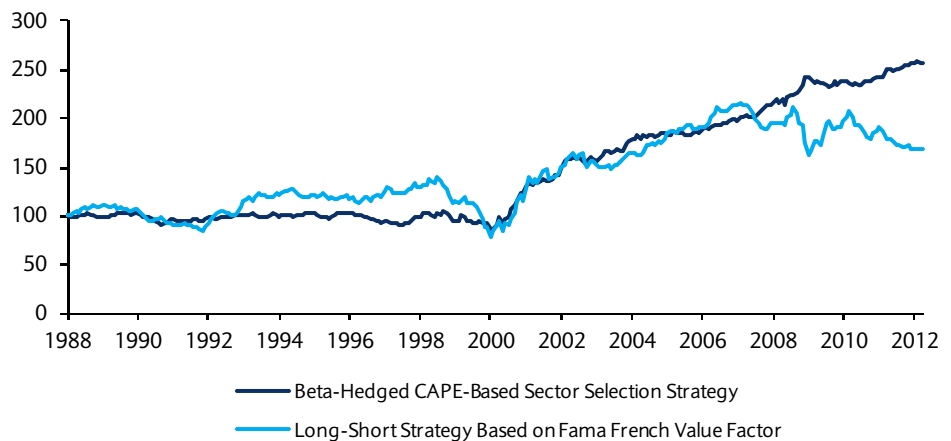
Source: Kenneth French data library, Barclays Research

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[17] See Fama and French (1992). The data for this hypothetical strategy comes from Kenneth French's webpage mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

Figure 29: Performance Statistics for Series in Figure 28

	Beta-Hedged CAPE-Based Sector Selection Strategy	Fama-French Value Factor
Return	3.98%	2.19%
Volatility	6.47%	10.90%
Information Ratio	61.51%	20.07%
Maximum Drawdown	(17.88%)	(45.00%)
Correlation with S&P500 TR Index	(8.96%)	(19.12%)

Source: Kenneth French data library, Barclays Research

Furthermore, Figure 29 shows the realized correlation between the returns of the beta-hedged CAPE-based sector selection strategy with the market returns, where the ex-post realized market exposure is very small.

Another noteworthy feature of the beta-hedged strategy is its tradability, as it involves only a single short position, in the S&P 500 total return index, which is a major distinguishing characteristic from other such long-short portfolios such as the Fama-French value factor. The latter takes short positions in individual stocks, which are determined by the book-to-market ratios of individual companies. In particular, it involves short positions in stocks that are identified as growth stocks, whose shorting costs are difficult to account for because growth stocks tend to be younger companies and have more volatile performance.

Moreover, Figure 29 shows that this hypothetical strategy based on the Fama-French factor also exhibits low correlation with the market but has a significantly less stable performance profile than the CAPE-based strategy and underperforms the CAPE-based strategy during the most recent period of the sample.

Tilted Market Weights

Whereas the previous section has focused on extending the CAPE-based sector selection strategy to extract the excess return over the market while targeting market neutrality, the objective of this extension is to tilt a market portfolio away from the market weights of the individual sectors to create a performance profile with outperformance over the benchmark with minimal tracking error. This strategy is specifically tailored to an investor benchmarked against the S&P500, who may benefit from the exposure to the CAPE-based sector selection methodology and needs to adhere carefully to benchmarking limitations.

The starting point is again the sector selection in the core CAPE-based methodology. This selection is employed to sort the set of ten sectors into two classes, whose portfolio weights will then be derived from their market weights.[18] The first class consists of those six sectors that the CAPE-based methodology has eliminated. These are underweighted relative to their market weights by reducing their allocation by 60%. This reduction is then transferred into the selected sectors as an overweight. So all the sectors chosen by the core CAPE-based sector selection strategy are overweighted such that the sum of the weights equals 100%. When we overweight selected sectors, each is assigned an allocation proportional to its market weight.

Figure 30 provides an example for the calculation of the portfolio weights at the end of a given month (August 2004 in this example).

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[18] The market weight of a sector is computed as the sector's market capitalization divided by the sum of all sectors' market capitalization.

Figure 30: Calculation of the Tilting Weights for the CAPE-Based Sector Allocation Strategy at the End of August 2004

Source: Barclays Research
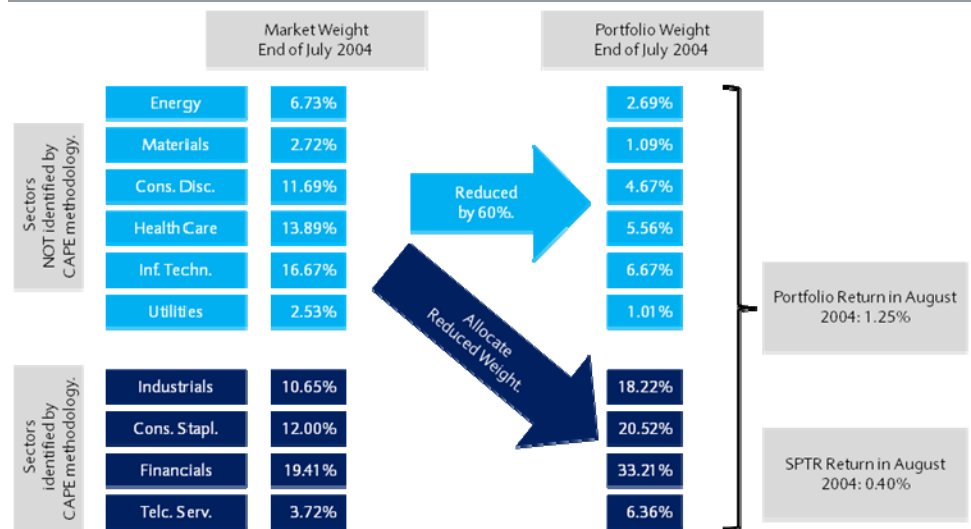
Figure 31 shows how the tilted CAPE-based sector selection strategy accomplishes its objective to provide outperformance over the benchmark while tracking it closely. Figure 32 displays an excess in the information ratio of approximately 17%, accompanied by a slightly less than 8% lower maximum drawdown. Despite its outperformance, the approach to shift weights based on the long-term valuation signal of the Relative CAPE indicator results in a return series that is nearly 97% correlated to the return series of the S&P500 TR index. Moreover, the tracking error is less than 4% (annualized).

Figure 31: Tilted CAPE-Based Sector Allocation Strategy and the SPTR
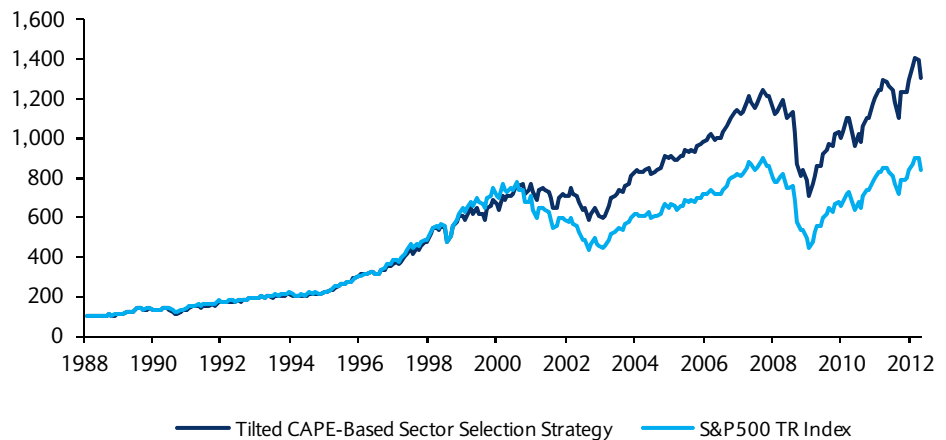
Source: Barclays Research

Figure 32: Performance Statistics for Series in Figure 31

	Tilted CAPE-Based Sector Selection Strategy	S&P500 TR Index
Return	11.18%	9.19%
Volatility	14.30%	15.04%
Information Ratio	78.17%	61.04%
Maximum Drawdown	(43.10%)	(50.95%)
Correlation with S&P500 TR Index	96.58%	
Tracking Error to S&P500 TR Index	3.88%	

Source: Barclays Research

References

Asness, C. S., T. J. Moskowitz, and L. H. Pedersen, "Value and Momentum Everywhere," New York University Working Paper, 2009.

Basu, S., "Investment Performance of Common Stocks in Relation to their Price-Earnings Ratios: A Test of the Efficient Markets Hypothesis," *Journal of Finance*, 32:3, 663-82, 1977.

Bunn, O. D., and R. J. Shiller, "Changing Times, Changing Values: A Historical Analysis of Sectors within the US Stock Market 1872-2012," Yale University Working Paper, 2012.

Campbell, J. Y., and S. Thompson, "Predicting the Equity Premium Out of Sample: Can Anything Beat the Historical Average," *Review of Financial Studies*, 21(4), 1509-31, 2008.

Campbell, J. Y., and R. J. Shiller, "Stock Prices, Earnings, and Expected Dividends," *Journal of Finance*, 43:3, 661-76, 1988.

Campbell, J. Y., and R. J. Shiller, "Valuation Ratios and the Long-Run Stock Market Outlook," *Journal of Portfolio Management*, 24:2, 11-26, 1998.

Campbell, J. Y., and R. J. Shiller, "Valuation Ratios and the Long-Run Stock Market Outlook: An Update," NBER Working Paper 8221, 2001.

Cowles, A. III, and Associates, *Common-Stock Indexes*, 2nd Edition, Principia Press, Bloomington, IN, 1939.

Graham, B., and G. Dodd, *Security Analysis*, McGraw-Hill Book Company, Inc., New York, NY, 1934.

Fama, E. F., and K. R. French, "The Cross-Section of Expected Stock Returns," *Journal of Finance*, 47:2, 427-65, 1992.

Fama, E. F., and K. R. French, "Value, Size, and Momentum in International Stock Returns," University of Chicago - Working Paper, 2011.

Jose, D., and E. Shing, "European Strategy Essay: Equities Gleam through the Valuation Prism," Barclays Capital Equity Research, 2010.

Lakonishok, J., A. Shleifer, and R. W. Vishny, "Contrarian Investment, Extrapolation, and Risk," *Journal of Finance*, 49:5, 1541-78, 1994.

Newey, W. K., and K. D. West, "A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, 55:3, 817-58, 1987.

Welch, I., and A. Goyal., "A Comprehensive Look at the Empirical Performance of Equity Premium Prediction," *Review of Financial Studies*, 21(4), 1455-1508, 2008.

Appendix A – Scatter Plots of the CAPE Ratio and Subsequent Long-Term Returns for the Ten Sectors

In the following, scatter plots depict the CAPE ratio together with subsequent annualized two-year total returns for the ten sectors. These are analogous to the plots for Financials and Consumer Staples in Section 1.

Figure 33: Scatter Plots of the CAPE Ratio of Ten Sectors Paired with Subsequent Annualized Two-Year Total Returns

Source: Barclays Research
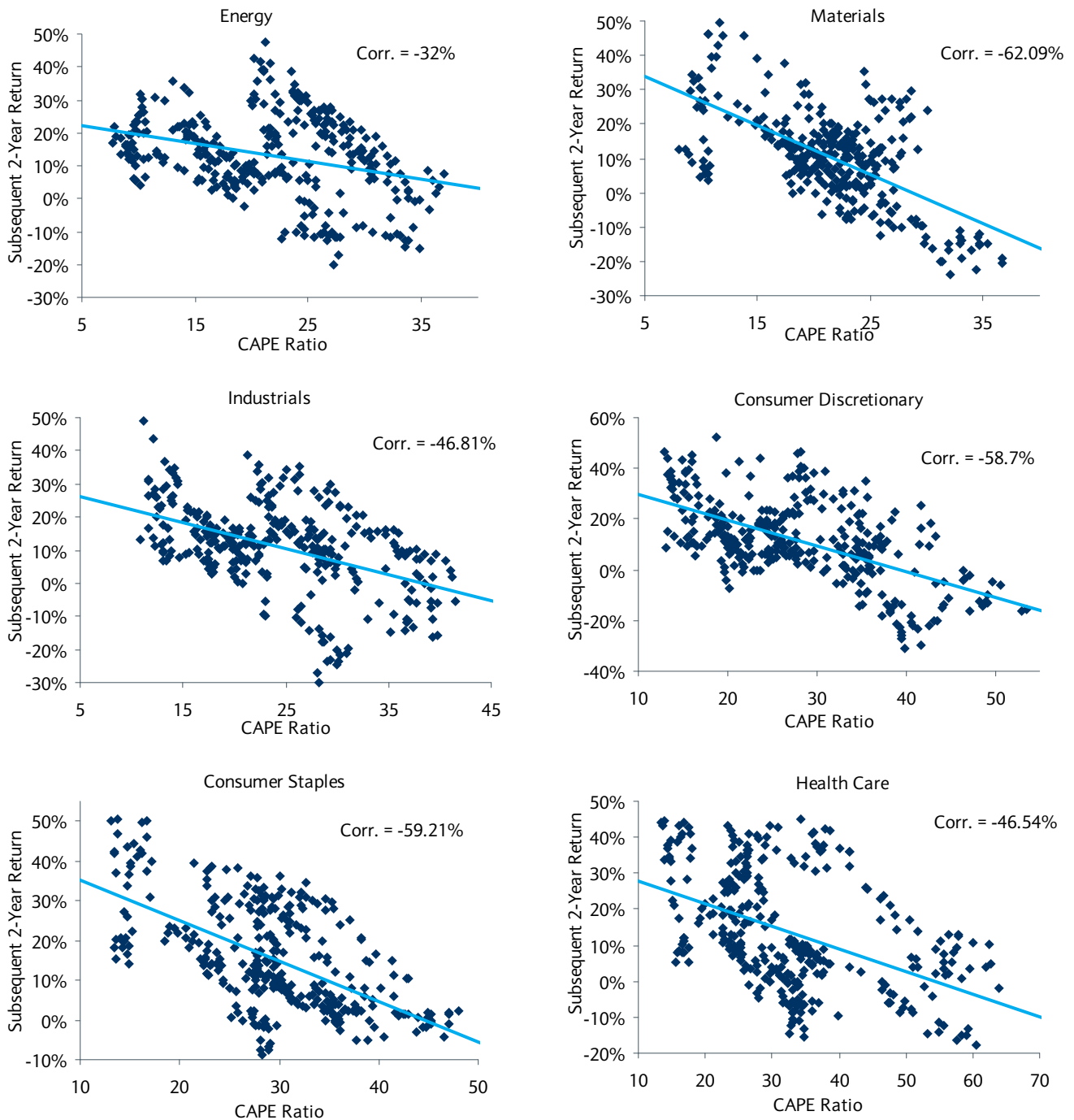
Figure 33: Scatter Plots of the CAPE Ratio of Ten Sectors Paired with Subsequent Annualized Two-Year Total Returns (continued)

Appendix B – Time Series of CAPE Ratios and Relative CAPE Indicators for the Ten Sectors

In the following, ten graphs capture the time series of the CAPE ratio for the GICS sectors.

Figure 34: CAPE Ratios for GICS Sectors
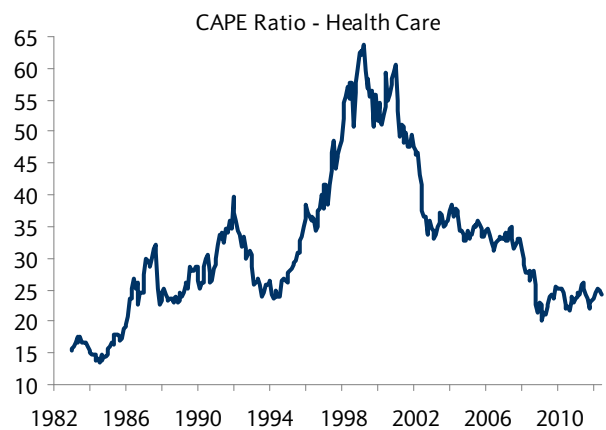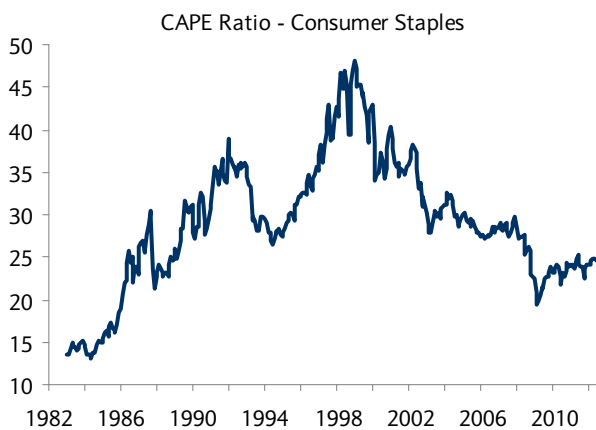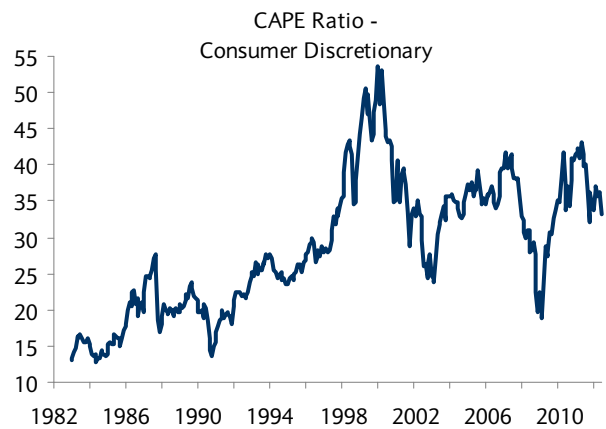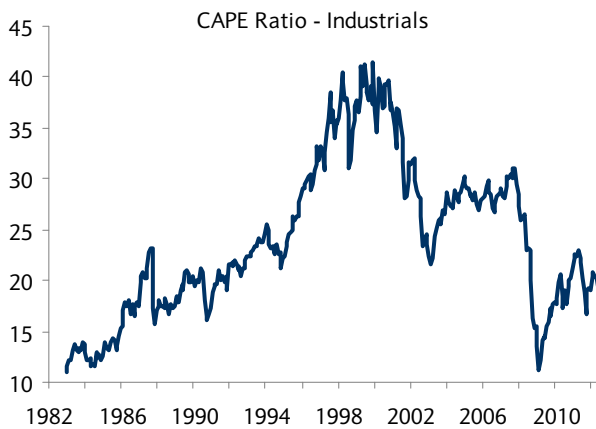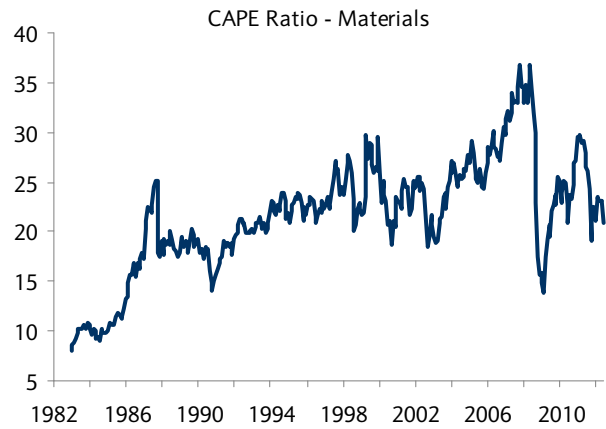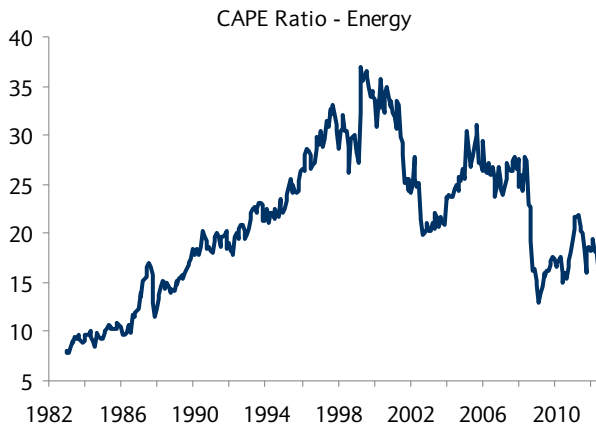
Source: Barclays Research

Figure 34: CAPE Ratios for GICS Sectors (continued)

CAPE Ratio - Financials

CAPE Ratio - Information Technology

CAPE Ratio - Telecommunication Services

CAPE Ratio - Utilities
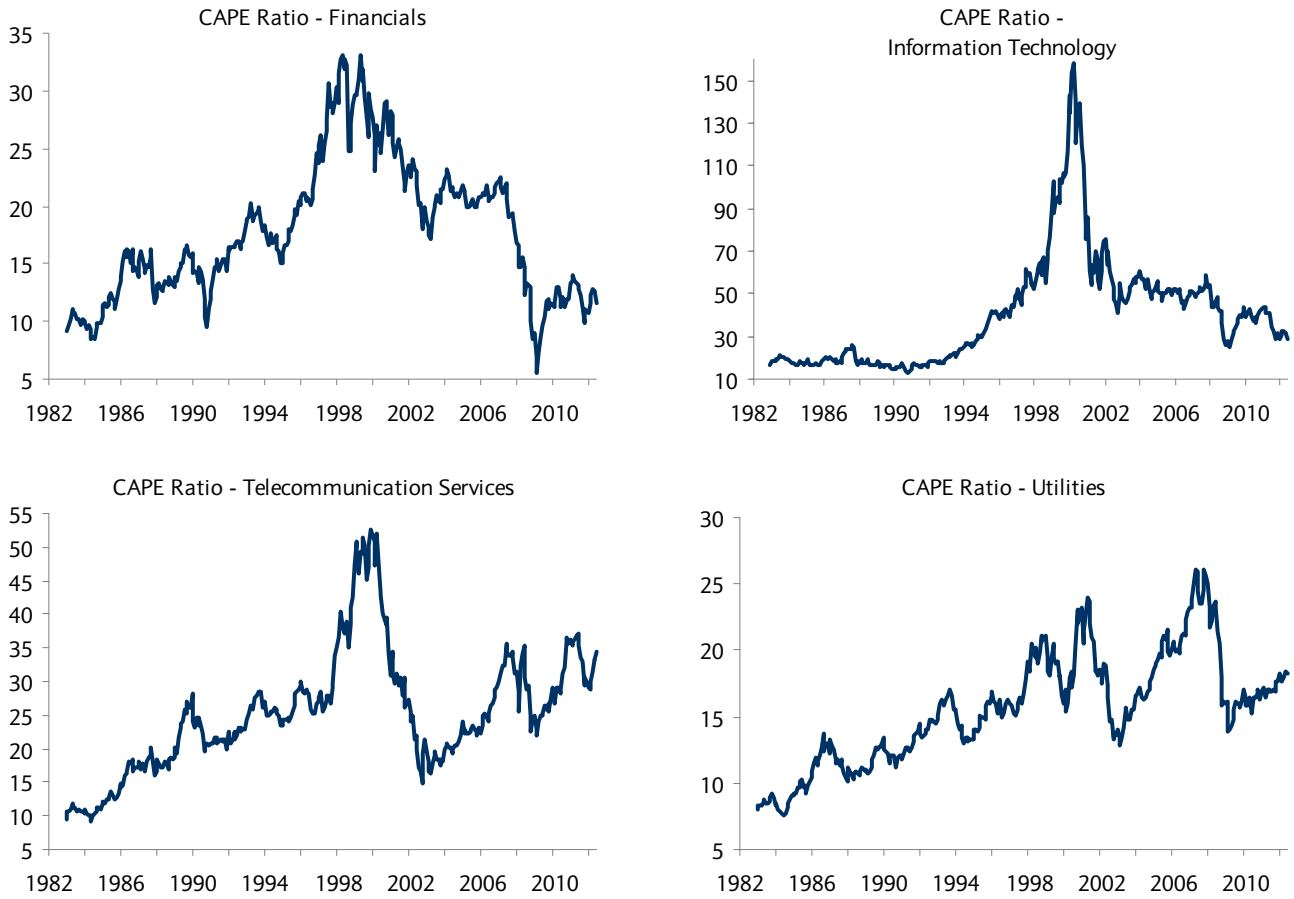
Source: Barclays Research

Analogous to Figure 34, Figure 35 shows the Relative CAPE indicator for the ten GICS sectors.

Figure 35: Relative CAPE Indicator for the Ten GICS Sectors
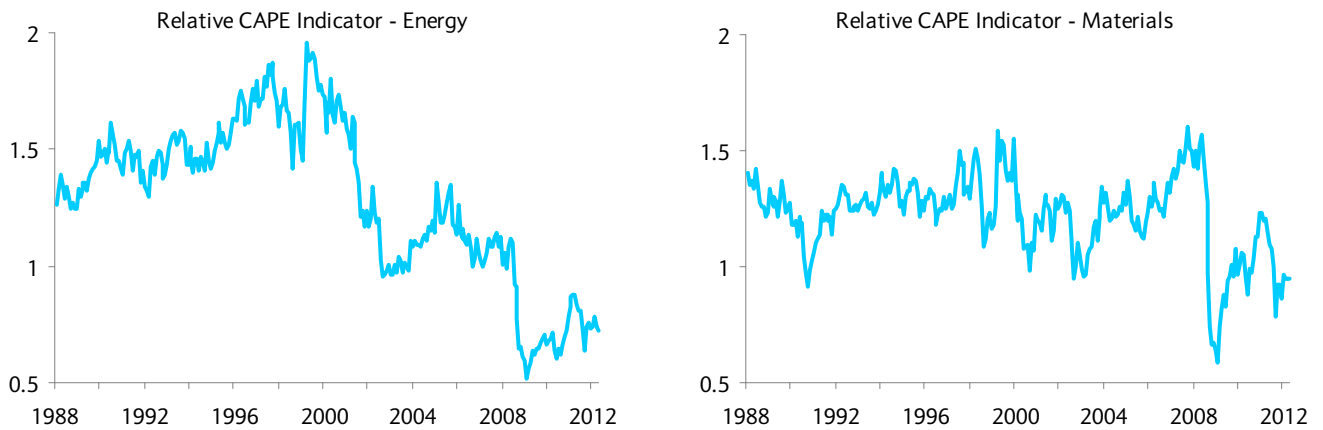
Relative CAPE Indicator - Energy

Relative CAPE Indicator - Materials

Source: Barclays Research

Figure 35: Relative CAPE Indicator for the Ten GICS Sectors (continued)

Relative CAPE Indicator - Industrials

Relative CAPE Indicator - Consumer Discretionary

Relative CAPE Indicator - Consumer Staples

Relative CAPE Indicator - Health Care

Relative CAPE Indicator - Financials

Relative CAPE Indicator - Information Technology

Source: Barclays Research

Figure 35: Relative CAPE Indicator for the Ten GICS Sectors (continued)

Relative CAPE Indicator - Telecommunication Services

Relative CAPE Indicator - Utilities

Source: Barclays Research

Appendix C – Reformulation of the CAPE Ratio

Section 2 motivates the consideration of total return numbers in the construction of the CAPE ratio by decomposing the CAPE ratio into earnings per dollar numbers and total returns. This decomposition can be derived as in the following:

$$CAPE_T = \frac{P_T}{\frac{1}{10}\sum_{t=1}^{10} E_{T-t}}$$

$$CAPE_T = \frac{\frac{P_T}{P_T}}{\frac{1}{10}\sum_{t=1}^{10} \frac{E_{T-t}}{P_{T-t}}\frac{P_{T-t}}{P_T}}$$

$$CAPE_T = \frac{1}{\frac{1}{10}\sum_{t=1}^{10} EPD_{T-t}\, d_{T-t,T}}$$

where $CAPE_T$ is the CAPE ratio at time T; P_T is the share price at time T; E_{T-t}, P_{T-t}, and EPD_{T-t} are earnings per share, share price, and earnings per dollar t years from time T; and $d_{T-t,T}$ is the inverse of the price appreciation/depreciation from time T-t to T (the price discount rate).

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