Sector Rotation over Business-Cycles

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Abstract

Sector rotation is a widely followed investment strategy popular among professional and individual investors. Yet, despite the growth of sector investing in recent years, the question of whether or not sector rotation outperforms a buy-and-hold strategy has not been previously answered. We examine the relative performance of a sector rotation strategy that follows conventional market wisdom on timing sector holdings over business-cycles from 1948-2006. We find that a sector rotation strategy guided by conventional market wisdom on where sectors provide optimal performance and with 20/20 hindsight timing business-cycles stages would have earned a 2% Jensen's alpha. This apparent outperformance is a best case scenario that would quickly dissipate without the benefit of hindsight and after a reasonable allowance for transaction fees. However, for investors with 20/20 hindsight there are better alternatives available. We show that a strategy which is continually invested in the market then switches to cash early in a recession provides superior returns for an investor with perfect market timing ability. Additionally, we also show that sector rotation underperforms market-timing using alternative performance measures. We conclude that, contrary to conventional market wisdom, rotating sectors over business-cycles is unlikely to be an optimal investment strategy and question the widespread acceptance of sector rotation as a strategy that provides investors with relative outperformance.

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Abstract

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I. Introduction

The basic notion of sector rotation is that different economic sectors predictably and systematically under-perform or over-perform the market at different points in a business-cycle. While rotating sectors across business-cycles is not a new strategy, sector rotation has witnessed a large growth in popularity as evidenced by the increasing number of sector funds introduced over the last two decades. One group of funds alone, Fidelity Select, currently offers investors a choice of 51 sector funds.[1] The growth of sector funds has ballooned in recent years particularly with the introduction of exchange traded funds (ETFs). In 2006, the number of sector ETFs available doubled from 67 to 135.[2] Despite the growing interest in sector investing, sector rotation investors remain reliant on conventional market wisdom and anecdotal evidence for validation of the widely held belief that rotating sectors across business-cycles outperforms a simple buy-and-hold-strategy. Indeed, the notion that sector returns are predictable at different points in a business-cycle is contrary to basic assumptions of efficient markets making the likelihood that sector rotation investors can earn excess-returns appear questionable.

This study investigates if a sector rotation strategy guided by conventional market wisdom on the sectors to hold across business-cycles generates additional alpha returns. A report by the mutual fund industry shows the net assets of sector funds valued at $235 billion with new cash flows to sector funds accounting for 20% of new cash flows to all

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[1] http://personal.fidelity.com/products/funds/content/sector/products.shtml
[2] Investment Company Institute, 2007. *Investment Company Fact Book* (Investment Company Institute).

equity funds.[1] Given the sizable amount of investment capital sector rotation attracts, we believe that documenting whether or not sector rotation consistently provides risk-adjusted outperformance will be of broad interest to both professional and private investors. Additionally, evidence of a systematic and predictable connection between sector returns and business-cycle movements would indicate anomalous market behavior and be of potential interest to financial researchers.

The results of our study indicate that sector rotation does not generate risk-adjusted returns in excess of the market. We cover the period 1948-2006 with NBER defined phases of expansion and recession divided into smaller sub-periods to coincide with business-cycle stages where the market expects optimal sector performance.[2] We find that a sector rotation investor guided by conventional market wisdom and with 20/20 hindsight timing business-cycles stages would have only realized a marginal 2% Jensen's alpha. This marginal outperformance is a best case scenario that comes before any allowance for transaction fees and with the benefit of perfect hindsight. More realistically, it would seem extremely difficult for a real-time investor to correctly time sector investments across all business-cycle stages as would be required to systematically outperform the market.

As an alternative to sector rotation, we also consider a much simpler market-timing strategy that continually invests in the market except during the first half of a recession

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[1] Investment Company Institute, 2001. *Investment Company Fact Book* (Investment Company Institute).
[2] See Destefano, 2004, Stock Returns and the Business Cycle., *Financial Review* 39, 527-547. for an example of this methodology.

when investors switch to cash. Market-timing investors would only need to anticipate one stage of the business-cycle and incur only one-fifth the transaction costs of a sector rotation strategy. For the same 1948-2006 period, a market-timing investor would have realized a slightly higher terminal wealth and higher Sharpe ratio compared to a sector rotation investor. This comparison illustrates that sector rotation would not be the optimal strategy, even for an investor with the ability to correctly anticipate business-cycle conditions. Additionally, using alternative performance measures we also show that market-timing is superior to sector rotation. We conclude that, contrary to conventional market wisdom, rotating sectors over business-cycles is not an optimal investment strategy and question the widespread acceptance of sector rotation as a strategy that provides investors with relative outperformance.

Our contribution to the literature is twofold. First, we believe our study is the first to empirically document the performance and relative strength of sectors over the course of a business-cycle. We find actual sector performance largely fails to align with the expectations of conventional market wisdom. Secondly and more critically, we document if an investor that benefits from perfect hindsight in an ideal world would follow a sector rotation strategy. We show that contrary to conventional wisdom and despite the popularity of sector rotation among investors, a sector rotation strategy yields only marginal outperformance and is inferior to a much simpler strategy that rotates from the market index to cash early in a recession.

Our study is organized as follows. Section II provides an overview and discusses the relevant literature. Section III describes business-cycles. Section IV examines the performance of sectors over business-cycles. Sector V documents the performance of a sector rotation strategy with terminal wealth estimations. Lastly, section VI concludes our analysis.

II. Overview

A sector rotation strategy is based on the idea that certain sectors provide outperformance during different phases of the business-cycle. Moreover, sector rotation investors believe the relative performance of sectors moves sequentially from one sector to the next over the course of a business-cycle.[1] The profitability of timing sector holdings across business-cycles is an idea entrenched in conventional market lore and widely supported by the financial press. For instance, conventional wisdom holds "if you are in the right sector at the right time, you can make a lot of money very fast."[2] The challenge for sector rotation investors in outperforming the market is to both correctly select sectors and correctly time the business-cycle - a daunting task for even the most astute investor.

The financial press provides abundant advice to investors on timing sector investments with business-cycles. For instance, a CNN Money article warns against the implication of an economic slowdown on sector returns after a pause in Federal Reserve Bank interest rate hikes. The same CNN article further suggests pharmaceuticals, financials, consumer

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[1] Fidelity Investments, 2007, Sector Education, (Fidelity Investments).
[2] http://www.nowvest.com/ Peter Lynch in Beating the Street

staples and utilities provide optimal performance in recessions.[1] A popular investment webpage similarly advises "when the economy cools off, cyclical companies are hit hardest" and that "defensive stocks experience profit irrespective of business-cycle phases."[2] Conventional market wisdom holds that cyclical industries provide the greatest relative strength when the economy first enters a period of expansion.[3] In his widely followed practitioner guide "Sector Investing," Stovall (1996) catalogs where sectors are believed to provide investors with the highest returns over five different stages of economic expansion and contraction.

Nonetheless, while conventional market wisdom abounds, until now prior empirical research has yet to document if sector rotation is actually a viable investment strategy. Indeed, market efficiency theory suggests earnings fluctuations that result from reoccurring business-cycle fluctuations should not influence short-term returns. If there is a pattern in sector returns, as sector rotation investors believe, this predictability is at odds with basic assumptions of market efficiency. There are several possible explanations for what might cause this anomalous market behavior.

Within an efficient markets framework, asset prices might be influenced by changing fundamental values related to fluctuations in macroeconomic determinants. Short-term cyclical returns are possibly explained by changes in expected fundamental values correlated with economic conditions. An early study by Fama and French (1989) finds

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[1] http://money.cnn.com/2006/08/08/markets/fed_pause_stocks.moneymag/index.htm
[2] http://www.investopedia.com/terms/d/defensivestock.asp
[3] Business Week Online, 2002, Get In, Get Out, and Move On, (McGraw-Hill Companies, Inc.).

that stocks and bonds contain a term-premium that coincides with business-cycle peaks and troughs. Chordia and Shivakumar (2002) and more recently Avramov and Chordia (2006) confirm that priced factors such as firm size, value, and momentum are correlated with variables known to track business-cycles.

The conclusion that sectors perform unequally or exhibit a lead/lag relationship across business-cycles is found in several studies. Hou (2007) finds a lead/lag effect in sector response to the arrival of new economic information. Hong, Torous and Valkanov (2007) and Eleswarapu and Tiwari (1996) observe that sectors with a strong link to economic activity such as the retail, metals, services, and petroleum sectors lead the market by as much as two months. Menzly and Ozbas (2004) show that the timing of industry profits relate to its position in the production/consumption supply chain where a persistent lag relationship exists between returns to upstream and downstream industries. This upstream and downstream relationship is also seen to hold by Stovall (1996) who observes that basic materials are the first industry to emerge from a recession followed in turn by manufacturing. Stovall (1996) finds that industries related to end-user consumption, such as consumer durables, are the last industry to recover from a recession.

The question remains largely unanswered if sector rotation investors have historically outperformed the market. The limited empirical research on the profitability of sector rotation strategies provides conflicting results. A study of sector fund returns by Sassetti and Tani (2003) concludes that in the medium-term sector switching is a profitable

strategy. However, they also find a long-horizon investor is still better off investing in a market index. In contrast, Tiwari and Vijh (2005) question the ability of investors to profitably rotate funds from one sector to another. Their findings based on sector fund data from 1972-1999 show sector investors lack both selection and timing ability and are unable to earn excess-returns after correcting for risk and deducting transaction fees.

In summary, the viability of sector rotation as an investment strategy remains something of an enigma. Widely held conventional wisdom and anecdotal evidence suggests a strategy which rotates sectors dependent on the phase of a business-cycle can generate excess-returns for investors. The literature does document evidence of cyclical patterns in asset returns and also a lead/lag relationship between sectors performance. However, the results of previous studies question the ability of sector rotation investors to systematically outperform the market. In the analysis which follows, we endeavor to address the question if an investor who rotates sectors across business-cycles can outperform the market. However, first we discuss the different stages of a business-cycle and define our timing variables.

III. Business-cycles

Sector rotation requires the correct timing of sector investments with different stages of the business-cycle. The idea of accurately predicting business-cycles has been the bane of econometricians and financial researchers for years. The official government agency responsible for dating business-cycles in the United States is The National Bureau of

Economic Research (NBER). While there are other methods for measuring U.S. business-cycles, the NBER cycle dating methodology is widely accepted and we make the assumption that the NBER business-cycle dates are correct. However, the NBER merely tracks cycle turning points (peaks and troughs) and can take as long as two years *after* the economy changes direction to publish cycle dates. Consequently, real-time investors are unable to benefit from this information. However, for the purpose of our study NBER defined business-cycle dates provide a necessary framework for the analysis of sector rotation.

While the NBER defines broad phases of economic expansion and recession, common practice is to divide cycle phases into smaller sub-periods in order to better observe asset sensitivity to business-cycle dynamics. Destefano (2004) divides cycles into two stages of expansion (early/late) and two stages of recession (early/late). Stovall (1996) further divides longer periods of expansion into three stages (early/middle/late). This convention is more aligned with common practice. We follow Stovall (1996) and partition NBER dated phases of expansion into three equal stages (early, middle, and late) and recessions into two equal stages (early and late). Figure I illustrates a stylized business-cycle with phases of expansion divided into three stages and phases of recessions into two stages. This study uses the five business-cycle stages as shown in Figure I for analysis of sector performance and the timing of a sector rotation strategy.

[Please insert Figure I]

Our study covers nine complete business-cycles over the period December 1948 to December 2006. The last published NBER turning point was the economic peak dated March 2001. To utilize all the available data, we divide the ensuing 61 month period of our study into early expansion (30 months) and middle expansion (31 months). We make the assumption that the economy enters the late stage of expansion starting in 2007 largely based on a survey of professional forecasters by the Philadelphia Federal Reserve.[1]

Panel A of Table I reports business-cycle peak and business-cycle trough reference dates published by the NBER. Additionally, the duration of business-cycles counted from peak to peak is shown. While business-cycles have lasted an average 70 months in the years since 1948, they exhibit a great deal of variability in duration with earlier business-cycles cycles much shorter than more recent ones.

In Panel B business-cycles are further divided by three stages of expansion and two stages of recession. We count the total length of a recession to be from the first month following a cycle peak to the subsequent cycle trough date. Periods of expansion are counted from the first month following a cycle trough to subsequent cycle peak date. From Table I we observe that expansions last on average approximately five years and recessions less than one year. The average duration of expansions, recessions, and business-cycle stages are shown at the bottom of Panel B.

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[1] see Philadelphia Federal Reserve Bank, 2007, Survey of Professional Forecasters, (Philadelphia Federal Reserve Bank).

[Please insert Table I]

The starting point of our sample is motivated by two considerations. First, restricting our sample to post 1948 eliminates any possible business-cycle distortions caused by the Great Depression or World War II.[1] For instance, although the US economy was officially in a depression during 1945, industries were still operating at full war time production. Second, we start our sample from 1948 as several studies suggest business-cycles are arguably different in the years since World War II. Fama (1975) finds business-cycle length and amplitude change subsequent to adoption of the 1951 Federal Reserve Accord. The 1951 Accord allows the Federal Reserve Bank to moderate business-cycle fluctuations through interest rate adjustments. Consequently, the adoption of counter-cyclical policies in the years since 1948 has resulted in different business-cycle dynamics from earlier years.

We construct business-cycle timing variables based on the sub-periods of economic expansions and recessions. Our five business-cycle stage dummy variables S_{jt} take the value one or zero conditional at time t on the current stage of the business-cycle. Dummy variables S_{1t} through S_{3t} correspond with the three stages of economic expansion (early/middle/late). Dummy variables S_{4t} and S_{5t} correspond with the two stages of economic recession (early/late).

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[1] See for example Chatterjee (1999) and Cover, and Pecorino, 2005, The length of US business expansions: When did the break in the data occur?, *Journal of Macroeconomics* 27, 452-471.)

It is possible that our results of are overly sensitive to the construction of business-cycle partitions. As a robustness check we shift the business-cycle stages forward and backward one month to observe how this might influence our empirical results. While there are some slight changes our results remain consistent and appear insensitive to slight shifts in the timing of our business-cycle stages.

IV. Sector Performance

Our data is well known monthly industry returns, market returns, and Treasury-bill rates from 1948-2006 obtained from the Kenneth French website.[1] Market returns represent the total value weighted returns on all NYSE, AMEX, and NASDAQ stocks. The one-month Treasury-bill from Ibbotson serves as a proxy for the risk-free interest rate. 48 value-weighted industry portfolios are formed by CRSP and Compustat SIC classifications. All return data is described in further detail on the Kenneth French website.[2] For clarity of interpretation, continuously compounded monthly returns are reported as annualized percentage points. All returns throughout this paper are reported in excess of the one-month Treasury-bill rate.

[Please insert Table II]

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[1] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_49_ind_port.html
[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library

In Table II we show the business-cycle stage where sector outperformance is documented by a popular practitioner's guide (Stovall, 1996). It is of interest to note that Stovall (1996) simply observes nominal returns without any risk adjustment. Nonetheless, the assignment of sectors to these business-cycle stages largely tracks conventional market wisdom and is widely followed by investors and popular mutual funds.[1] Each of the 48 industries in our study is assigned to a unique business-cycle stage corresponding with the appropriate sector. Stage I (early expansion) has two sectors with a total six industries; Stage II (middle expansion) has two sectors with a total twelve industries; Stage III (late expansion) has two sectors with a total ten industries; Stage IV (early recession) has two sectors with a total two industries; and lastly Stage IV (late expansion) has two sectors with a total eighteen industries. The total number of industries included in each business-cycle stage range significantly from two in Stage IV to eighteen in Stage V with important implications for comparable diversification benefits across periods.

We now observe summary statistics for the entire 1948-2006 sample period and also conditional on the stage of the business-cycle from our basic model equation (1)

$$r_{it} - r_{ft} = \sum_{j=1}^{5} \alpha_j S_{jt} + \varepsilon_t \tag{1}$$

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[1] See for example http://personal.fidelity.com/products/funds/content/sector/basics.shtml.cvsr

where excess industry returns $r_{it} - r_{ft}$ are the difference between nominal industry returns and the one-month Treasury-bill and $S_j's$ are business-cycle timing variables as described earlier. The $\alpha_j's$ can be interpreted as industry returns conditional on the stage of the business-cycle.

Table III reports average excess-returns, standard deviations, and CAPM market betas for all 48 industries. Summary statistics for the market index and 30-day Treasury-bills are shown at the bottom of Table III. Industries are grouped by the business-cycle stage expected to provide optimal performance.[1] Returns are then sorted from highest to lowest beta within each group. The total number of observations for the entire period and each business-cycle stage are shown at the top and observations by industry are shown on the left-hand column of Table III. Note that all but five industries span the full sample period. The exceptions are fabricated products, precious metals, defence, and healthcare which start in July 1963 and computer software industry which starts in July 1965.

[Please insert Table III]

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[1] See for example Stovall (1996), Sam Stovall's Sector Watch http://www.businessweek.com/investor/list/stovall_toc01.htm, and Fidelity Sector Funds at http://personal.fidelity.com/products/funds/content/sector/basics.shtml.cvsr

We first look at summary statistics for the market and Treasury-bills. The market averages a 7.1% return for the entire period. The highest market returns occur during Stage V (34.9%) and the lowest occur during Stage IV (-22.8%) for a sizable 57.7% difference in market returns between the beginning and end of recession. This large difference in market returns over the course of a recession is all the more remarkable considering recessions last on average less than one year. Similarly, Destefano (2004) observes that returns to the S&P 500 are highest across all business-cycle stages during late recessions. In contrast with market returns, market volatility as measured by standard deviation, is relatively stable across business-cycles with an average 14.5% for the entire period and a range from a low of 12.8% in Stage I to a high of 18.2% in Stage V. Not surprisingly, the highest Treasury-bill rates (6.4%) are observed during Stage IV and the lowest (3.8%) during Stage I as Treasury-bill rates are a key economic indicator that tracks Federal Reserve monetary policy. Treasury-bill rates show an expected monotonic increase from early expansion to early recession but then decrease during late recession.

Industry returns exhibit the same pattern as market averages with virtually all returns lowest during Stage IV and highest during Stage V. The tobacco industry has the only positive return (0.6%) with the lowest beta of all industries as the economy enters a recession in Stage IV. When we look further at industries, the highest volatility of returns occurs for 10 industries in Stage IV and 36 industries in Stage V. Twenty-five industries experience their lowest volatility during Stage II. A possible explanation for the overall low volatility found during the middle period of economic expansion is the relatively stable industry earnings which occur between the rapid growth typical of early

expansions and decelerating growth typical of late expansions. Unequal sector volatility across business-cycle stages is perhaps related to differences in earnings that might reflect an upstream/downstream effect such as previous studies document.

We also investigate industry betas estimated from a standard CAPM model as a measure of relative market risk. The communications sector (0.72) and utilities sector (0.54) are regarded by the market as recession hedges and have among the lowest overall betas for the entire period. Not surprisingly, the computer software industry (1.78) has the highest overall beta. The lowest beta for all business-cycle stages is the utilities sector (0.33) in Stage V and highest is the computer software sector (2.37) in Stage IV. There is some apparent clustering of betas within business-cycle stages with maximum betas for 14 industries occurring in Stage V and minimum betas for 18 industries occurring in Stage III. Generally, there is no evident pattern across the business-cycle where certain sectors exhibit the highest relative beta risk. Rather, industry minimum and maximum betas are widely dispersed over the entire business-cycle. To surmise, no strong correlation appears between industry betas and the business-cycle stage where they are expected to provide outperformance. The clear exceptions are the telecom and utility sectors in Stage V.

Overall our investigation of nominal returns indicates that actual industry performance across business-cycle stages partially aligns with what is expected by conventional market wisdom from Table II. Those sectors selected for late expansion, early recession, and late recession succeed in outperforming the market. For instance, in early recession

the sectors considered optimal for that period (utilities and telecom) show an average return of -7.6% as compares with an average -30.4% return for the worst performing sectors (technology and transportation) or a relative outperformance of 22.8% between the best and worst performing sectors for that stage. For the two remaining periods, early and middle expansion, sector averages are within a much narrower range.

In addition to observing industry returns by each business-cycle stage, we are also interested in determining if there is a statistical difference in industry returns *across* business-cycle stages. The right-hand column of Table III reports p-values from a Wald test of joint significance for nominal industry returns conditional on the stage of a business-cycle. Our null hypothesis is that there is no difference in industry returns across the five different business-cycle stages. If industry returns are constant across business-cycle stages then differences in means should be statistically indistinguishable from zero. The null hypothesis is formally stated:

$$H_o : \alpha_i = \alpha_j$$

$$H_1 : \alpha_i \neq \alpha_j$$

where $\alpha_j 's$ are nominal industry returns conditional on each of the five business-cycle stages as obtained from our basic business-cycle model (eq.1). We reject the null

hypothesis of constant industry returns across all business-cycle stages with p-values from the Wald test of joint significance close to zero for all but two industries. Only computer software and precious metals have p-value greater than 10% which might be explained by a loss of statistical power due to the shorter sample sizes of these industries. Overall, the results of the Wald test indicate that industry returns are not equal over the course of a business-cycle which opens the possibility of potential outperformance from a strategy that correctly rotates sectors dependent on the current stage of a business-cycle.

Table IV compares Sharpe ratios and Jensen's alphas for industries across business-cycle stages. The Sharpe ratios provide a comparison of excess industry returns relative to risk. Jensen's alphas provide a measure of industry performance in excess of the risk-free rate and adjusted for systematic market risk. Conditional Jensen's alphas are obtained as the intercept terms from our modified CAPM model equation (2) as follows:

$$r_{it} - r_{ft} = \sum_{j=1}^{5} \alpha_j S_{jt} + \sum_{j=1}^{5} \beta_j S_{jt} (r_{mt} - r_{ft}) + \varepsilon_t \tag{2}$$

where excess industry returns $r_{it} - r_{ft}$ are the difference between industry returns and the one-month Treasury-bill and $S_j's$ our business-cycle timing variables as described earlier. The $\alpha_j's$ can now be interpreted as Jensen's alphas conditional on the stage of the business-cycle. We report Jensen alphas as annualized percentage points for clarity of interpretation with corresponding t-stats based on White heteroskedasticity consistent

19

standard errors, (White, 1980). A positive and statistically significant Jensen's alpha indicates risk-adjusted outperformance of an industry relative to the market during that business-cycle stage. Under a null hypothesis of no outperformance, the Jensen's alphas should be statistically indistinguishable from zero as we would expect in efficient markets. However, at odds with the basic premise of market efficiency is the conclusion of Stovall (1996) and the underlying assumption of sector investors that positive Jensen's alphas are attainable by investing in certain industries at different stages in the business-cycle. We also observe Sharpe ratios as an additional measure of risk-adjusted performance. Sharpe ratios are calculated as industry returns in excess of the Treasury-bill rate divided by the standard deviation of industry returns. A higher Sharper ratio relative to the market or other industries indicates relative outperformance from the perspective of a risk and return trade-off. Table III groups Industries by the business-cycle stage considered optimal according to widely held conventional market wisdom.[1] Returns are then sorted from highest to lowest Sharpe ratio within each group.

[Please insert Table IV]

A look at Jensen's alphas reveals several interesting results. In Stage I we observe approximately 60% of industries have negative alphas. Contrary to conventional wisdom,

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[1] See for example Stovall (1996), Sam Stovall's Sector Watch
http://www.businessweek.com/investor/list/stovall_toc01.htm, and Fidelity Sector Funds at
http://personal.fidelity.com/products/funds/content/sector/basics.shtml.cvsr

20

of the six industries in the technology and transportation sectors that are expected to outperform in Stage I, only two (shipping containers and general transportation) have positive alphas. All industries in the technology sector have particular large negative alphas. Automobiles (7.0%) have the highest Jensen's alpha during early expansion although consumer cyclical industries are not expected to provide outperformance until Stage V. On average, all Stage II sectors (capital goods, basic materials, services sectors) underperform the market as measured by their Jensen's alphas. Aircraft (3.9%) and electrical equipment (2.7%) industries provide the best outperformance while shipbuilding (-5.8%) and personal service (-4.1%) provide the worst. The realized outperformance of Stage III sectors largely aligns with market expectations with only one negative alpha industry (candy and soda). Notably, the energy sectors (coal and petroleum) provide high overall alpha returns during Stage III. The two Stage IV sectors, communication (5.7%) and utilities (13.3%), also significantly outperform the market. In particular, utilities are the strongest Stage IV performer with only 18 industries providing outperformance. Most industries also perform as anticipated during Stage V with only three industries returning negative alphas. Several consumer durable industries, apparel (17.1%) and printing (15.4%), perform exceptionally well. However, unexpectedly it is the Stage III sectors (consumer staples and energy) that collectively provide the best Stage V performance and not the expected Stage V sectors (consumer cyclical and financial) with Jensen's alphas of 9.7% and 4.8% respectively.

Overall, an examination of the Jensen's alphas offers limited evidence that sectors provide relative outperformance during the business-cycle stages suggested by

conventional market wisdom. Contrary to the expectations of sector rotation investors, an investment in the market index provides superior performance during early and middle expansion with average Jensen's alphas that are negative for industries thought optimal during those stages. During late expansion and early recession industry alphas for the most part align with the expectations of sector investors. While Jensen's alphas for late contraction industries are mostly positive, as a group they are not the optimal industries for that period. At this point in our investigation it appears that sector outperformance only partially conforms to the expectations of sector rotation investors.

We now observe industry Sharpe ratios as an extra measure of industry performance from the perspective of risk and return trade-off. Stage I sectors (technology and transportation) have a substantially lower average Sharpe ratio than the market at 0.14 and 0.26 respectively. Sectors expected to provide relative Stage II strength also underperform the market on average although only marginally. Electrical equipment (0.21) is the sole industry of those expected to provide relative Stage II strength that outperforms the market. Looking at the remainder of industries during middle expansion, those in the consumer staples sector provide the best Sharpe ratio outperformance. Sharpe ratios for sectors expected to provide Stage III and Stage IV outperformance align with market expectations. Notably, tobacco (0.01) is the only industry with a positive Sharpe ratio during Stage IV. Capital goods is the overall worst performing sector as the economy enters a recession with fabricated products (-0.64) the worst industry. Lastly, only five of eighteen industries expected to provide relative strength during Stage V realize higher Sharpe ratios than the market. Although nominal industry returns are

mostly higher than the market during Stage V, investors using Sharpe ratios as a risk and return metric are actually better off invested in the market during this period.

Similar to our earlier analysis of alpha returns, Sharpe ratios also provide a mixed picture of sector performance across business-cycles. Investors appear to be better off invested in the market index for every business-cycle stage except late expansion and early recession. The consumer staple and energy sectors provide the clearest Sharpe ratio outperformance over the entire business-cycle during late expansion. Otherwise there is no definite pattern of where sectors and industries provide relative outperformance using either Jensen's alphas or Sharpe ratios as a performance metric.

As a final evaluation of sector performance, we conduct a Wald test on industry Jensen's alphas to observe if there is a significant difference in risk-adjusted performance across business-cycle stages. The right-hand column in Table IV reports p-values from a Wald test of joint significance for Jensen's alphas conditional on the stage of a business-cycle. Our null hypothesis is that there is no difference in industry Jensen's alphas across the five different business-cycle stages. If risk-adjusted industry performance is constant across all business-cycle stages then the differences in Jensen's alphas should be statistically indistinguishable from zero.

The null hypothesis is formally stated:

$$H_o : \alpha_i = \alpha_j$$

$$H_1 : \alpha_i \neq \alpha_j$$

with the $\alpha_j 's$ interpreted as industry Jensen's alphas conditional on each of the five business-cycle stages as obtained from our modified CAPM model (eq.2). Based on the results of the Wald test of joint significance, we can accept the null hypothesis of constant Jensen's alphas across business-cycles stages for 36 industries with p-values that are greater than 10%. For the remaining 12 industries the null hypothesis of constant Jensen's alphas is rejected. However, these 12 industries come from virtually all sectors and consequently there is no pattern to suggest that the alpha performance of one sector is more influenced by the stages of a business-cycle than another sector.

V. Sector Rotation Strategy

Lastly, we compare payoffs for a hypothetical dollar investment from December 1948 through December 2006 for three different investment strategies: market index, sector rotation, and a market-timing strategy that holds only cash during Stage IV and the market index during all other business-cycle stages. All three strategies assume no short-sales. In Figure II we graphically illustrate the growth in value for each strategy over the 58 year period. At the bottom of Figure II we also report terminal values and Sharpe

ratios for each strategy and Jensen's alpha for the sector rotation strategy. Shaded areas on Figure II indicate NBER defined periods of recession.

[Please insert Figure II]

We first compare our sector rotation strategy to a simple investment in the market index. Our sector rotation strategy constructs portfolios by business-cycle stage with equal weighting for all industries included in that stage. For example, there are six industries in the Stage I (early expansion) portfolio held in weights of 1/6 each. Portfolios for each of the remaining four business-cycle stages are constructed likewise. Portfolios are rotated at each stage of the business-cycle. The market index strategy simply invests 100% in the market index continually from the start to the end of the sample period.

A sector rotation strategy outperforms the market index with terminal values of $1,094 and $372 respectively for the entire 1948-2006 period. Moreover, sector rotation has a Jensen's alpha of 2.1% for the full period that is significant at a 10% level. The overall risk and return trade-off measured by the Sharpe ratio is also marginally better for sector rotation (0.15) than for the market (0.13). However, the outperformance of sector rotation relative to the market index is uneven across the different business-cycle stages. Sector rotation underperforms the market index in both Stage I and Stage II with negative alphas of -5.3% and -1.0% respectively. Sharpe ratios for the market index are also higher than those for sector rotation during both periods. Underperformance of the sector

rotation strategy during Stage I and Stage II comes as no surprise given our earlier observation of the performance of sectors assigned to those two stages. Sector rotation provides the highest outperformance during Stage IV with a 10.3% Jensen's alpha and a Sharpe ratio that, while negative (-0.15), is superior to the market Sharpe ratio (-0.43). However, the outperformance of sector rotation during Stage IV can be attributed to simply holding the two lowest beta sectors (utilities and communications) during a period when market returns turn highly negative.

Sector rotation shows much higher volatility than the market during periods of economic crisis as Figure II illustrates for the 1987 market crash, 1997/98 Asian economic crisis, and 2001 dot-com collapse. The amplified volatility seen in the sector rotation strategy illustrates the inherent additional risk of over-exposure to a limited number of sectors in comparison to the diversification benefits of holding the market index.

There is the possibility that sector rotation investors might have the ability to anticipate business-cycle turning points and potentially the performance of our sector rotation model fails to capture this additional investor foresight. As a robustness check we also rotate the business-cycle stage portfolios one month and one quarter prior to the actual turn of our business-cycle stages. We find the sector rotation performance declines when the stage portfolios are rotated prior to business-cycle stage turning points with terminal values of $904 and $585 at one month and one quarter leads respectively. It appears that even if investors have the prescience to anticipate business-cycle conditions in advance

26

they are still better off rotating sectors contemporaneously with business-cycle stage turning points.

Of course, a profitable sector rotation strategy requires correctly timing the different stages of a business-cycle. The 2.1% outperformance of our sector rotation strategy comes from the benefit of an investor with 20/20 hindsight. However, business-cycles are notoriously difficult to forecast. More realistically, a real-time investor would be unable to correctly anticipate all business-cycle stages. The marginal outperformance we find for a sector rotation strategy is a best case scenario that would quickly dissipate without perfect hindsight and with an allowance for normal transaction fees. Our results suggest that, although an investor with the ability to forecast business-cycles with 100% accuracy could marginally outperform the market, with more realistic assumptions it is unlikely that rotating sectors across business-cycles yields superior returns.

As an alternative to sector rotation, we also consider a much simpler timing strategy. Our market-timing strategy invests fully in the market for all periods except the first half of a recession when only cash is held. Studies such as Siegel (1991) and Brocato and Steed (1998) among others document that investors should switch entirely from stocks to cash as the economy enters a recession. Our analysis similarly confirms that investors are better off completely out of equities during early recession. However, as with sector rotation, our market-timing strategy is dependent on correctly anticipating business-cycle conditions.

Results for the market-timing strategy are shown at the bottom of Figure II. The terminal value for market-timing is slightly higher than sector rotation at $1,142 and $1,094 respectively. Overall, market-timing (0.18) also outperforms sector rotation (0.15) from a Sharpe ratio perspective. The obvious advantages to market-timing over sector rotation is the need to forecast only one business-cycle stage rather five stages and a significant reduction in associated transaction fees. Additionally market-timing has greater diversification benefits than sector rotation. Even for an investor with the ability to correctly time business-cycles, a market-timing strategy appears optimal to sector rotation or a simple buy-and-hold strategy. However, the comparison of investment strategies is somewhat inconclusive based on traditional performance measures.

[Please insert Table V]

We now evaluate alternative performance measures to check the robustness of our three different investment strategies. Table V Panel A evaluates a relatively new performance measure introduced by Goetzmann, Ingersoll, Spiegel and Welch (2007). The manipulation-proof performance measure (MPPM) estimates portfolio returns after adjusting for benchmark risk. Goetzmann, Ingersoll, Spiegel and Welch (2007) show the MPPM is superior to popular performance metrics such as Sharpe ratios and Jensen's alphas for potentially non-normal return distributions. The MPPM is nearly identical in form and with similar results to the widely quoted Morning Star Risk Adjusted Rating.

28

MPPM resembles a power utility function and provides an intuitive measure of a portfolio's annual returns after adjusting for risk estimated as follows:

$$\widehat{\Theta} \equiv \frac{1}{(1-\rho)\Delta t} \ln(\sum_{t=1}^{T}[(1+r_t)/(1+rf_t)]^{1-\rho}) \qquad (3)$$

where Δt is the length of time between observations measured as a percentage of a full year, r_t strategy returns, rf_t the risk-free rate, and ρ is a measure of benchmark risk that penalizes returns more heavily at increasing levels of risk. The measure of benchmark risk ρ is estimated by Goetzmann, Ingersoll, Spiegel and Welch (2007) to historically fall in the region between 2 to 4 for the CRSP value-weighted market index. The MPPM performance measure $\widehat{\Theta}$ is interpreted as the annualized strategy return premium after adjusting for risk. Panel A shows that the market timing strategy outperforms both the buy-and-hold and sector rotation strategies for a normal range of performance risk. For instance, where $\rho = 3$ market-timing has an annualized risk adjusted performance of 5.5% in comparison to 3.3% and 4.2% for the market and sector rotation strategies respectively. Using a MPPM performance measure the difference between sector rotation and the market shrinks to 0.9% in comparison with the previously reported Jensen's alpha of 2.1%

Additionally, Table V Panel B reports the results for Barrett and Donald (2002) simulated tests of second-order stochastic dominance. Studies by Cho, Linton and Whang (2007)

and Barrett and Donald (2003) among others find stochastic dominance preferable to ranking investments based on traditional mean variance metrics such as Sharpe ratios due to inherent problems with omitted risk factors. A stochastic dominance approach is suitable for investors who seek to maximize expected utility. Moreover, tests for second-order stochastic dominance are particularly suitable for risk-averse investors. Panel B reports *p*-values based on Kolmogorov-Smirnov type test statistics as described further in Barrett and Donald (2003). The null-hypothesis is that strategy A is dominant *or* indifferent to strategy B. To obtain a strong inference, the dominance of strategy B over strategy A must also be tested. If the null-hypothesis that strategy A is dominant or indifferent to strategy B is accepted and additionally the hypothesis that strategy B is dominant or indifferent to strategy A rejected we can make a strong inference that strategy A has second-order dominance over strategy B. The results of Panel B show that the market-timing strategy second-order stochastically dominates both sector rotation and a buy-and-hold strategy. Interestingly, the results show that an investor would be indifferent between sector rotation and a buy-and-hold strategy from a stochastic dominance perspective. The alternative MPPM and second-order stochastic dominance criteria seem to confirm our previous conclusion based on traditional performance measures that a market-timing strategy outperforms sector rotation.

VI. Conclusion

The results of our study show that a sector rotation strategy that follows conventional market wisdom on which sectors to rotate over the different stages of a business-cycle is not an optimal investment strategy. A sector rotation investor with the benefit of perfect

hindsight timing business-cycles stages would have only realized a 2.1% Jensen's alpha from 1948-2006. This marginal outperformance would quickly dissipate without the benefit of 20/20 hindsight and after an allowance for reasonable transaction fees. Alternatively, we find that a much simpler market-timing strategy that switches to cash during the first half of a recession and holds the market index the remainder of a business-cycle outperforms sector rotation. Additionally, using alternative performance measures we also show that market-timing is superior to sector rotation. We conclude that, contrary to conventional market wisdom, rotating sectors over business-cycles is not an optimal investment strategy and question the widespread acceptance of sector rotation as a strategy that provides investors with relative outperformance.

Table I

Notes: Panel A shows NBER reference dates for business cycle peaks and troughs from January 1948 to December 2006. Business-cycles are measured from the first month following a peak to subsequent peak. Periods of recession are counted as the first month following a cycle peak to the subsequent trough. Periods of economic expansion are counted as the first month following a cycle trough to subsequent peak. The last available NBER cycle date is the trough recorded March 2001. Estimates of early and middle stages of current expansion phase are based on available consensus forecasts.[1]

Panel B shows total duration in months for recessions and expansions based on NBER turning points from Panel A. Similar to previous research we divide expansions into three equal stages (early, middle, and late) and recessions into two equal stages (early and late) to observe how sector returns align with market expectations.[2] The average duration of each stage is shown at bottom of Panel B.

Panel A: NBER business-cycle dates

Peak	Trough	Peak	Months
11/48	10/49	07/53	56
07/53	05/54	08/57	49
08/57	04/58	04/60	32
04/60	02/61	12/69	116
12/69	11/70	11/73	47
11/73	03/75	01/80	74
01/80	07/80	07/81	18
07/81	11/82	07/90	108
07/90	03/91	03/01	128
03/01	11/01	NA	NA

Panel B: NBER business-cycle phases divided by stage

Expansion				Recession		
Stage I	Stage II	Stage III		Stage IV	Stage V	
Early	Middle	Late	Total	Early	Late	Total
15	15	15	45	6	5	11
13	13	13	39	5	5	10
8	8	8	24	4	4	8
35	35	36	106	5	5	10
12	12	12	36	6	5	11
19	19	20	58	8	8	16
4	4	4	12	3	3	6
30	31	31	92	8	8	16
40	40	40	120	4	4	8
*30	*31	NA	NA	4	4	8
20	20	20	59	Avg: 5	5	10

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[1] See Federal Reserve Bank of Philadelphia, 2007, The Survey of Professional Forecasters, *Federal Reserve Bank of Philadelphia Business Review* 1–13. http://www.phil.frb.org/files/spf/survq207.html
[2] See for example Stovall (1996), Sam Stovall's Sector Watch
http://www.businessweek.com/investor/list/stovall_toc01.htm, and Fidelity Sector Funds at
http://personal.fidelity.com/products/funds/content/sector/basics.shtml.cvsr

Table II

Notes: Table shows the stages of business-cycle where previous studies such as Stovall (1996) and conventional market wisdom as documented in popular investment websites suggest sectors are expected to provide relative outperformance.[1] Periods of expansion are divided into three equal stages (early, middle, and late) and are Periods of recession are divided into two equal stages (early and late). Industry portfolios are grouped by the first two digits of their SIC classification codes.[2] Each of the 48 industries portfolios in our study are assigned to a unique business-cycle stage by their appropriate sector (shown in bold).

Three Stages of Expansion			Two Stages of Recession	
Stage I	Stage II	Stage III	Stage IV	Stage V
Technology:	**Basic Materials:**	**Consumer Staples:**	**Utilities:**	**Consumer Cyclical:**
Computer Software	Precious Metals	Agriculture	Gas & Electrical Utilities	Apparel
Measuring & Control Equip.	Chemicals	Beer & Liquor	Telecom	Automobiles & Trucks
Computers	Steel Works Etc	Candy & Soda		Business Supplies
Electronic Equipment	Non-Metallic & Metal Minin	Food Products		Construction
Transportation:	**Capital Goods:**	Healthcare		Construction Materials
General Transportation	Fabricated Products	Medical Equipment		Consumer Goods
Shipping Containers	Defense	Pharmaceutical Products		Entertainment
	Machinery	Tobacco Products		Printing & Publishing
	Ships & Railroad Equip.	**Energy:**		Recreation
	Aircraft	Coal		Restaraunts, Hotels, Motels
	Electrical Equipment	Petroleum & Natural Gas		Retail
	Services:			Rubber & Plastic Products
	Business Services			Textiles
	Personal Services			Wholesale
				Financial:
				Banking
				Insurance
				Real Estate
				Trading

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[1] See for example Sam Stovall's Sector Watch
http://www.businessweek.com/investor/list/stovall_toc01.htm and Fidelity Sector Funds at
http://personal.fidelity.com/products/funds/content/sector/basics.shtml.cvsr
[2] For a complete description of SIC codes included in each industry portfolio see
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_49_ind_port.html

Table III

Notes: Table reports descriptive statistics for value weighted industry returns, market returns, and Treasury-bill rates for the full period and by business-cycle stages. Periods of expansion are divided into three stages and recessions into two stages. Returns are shown in excess of the risk-free rate as annualized percentage points. Industry returns are ordered by the stage with expected outperformance then from lowest to highest CAPM beta. Averages are shown by business-cycle stage. We also report p-values from a Wald test of joint significance under the null hypothesis of equal returns across all cycle stages.

		Full Period			Stage I (206 obs.)			Stage II (208 obs.)			Stage III (179 obs.)			Stage IV (53 obs.)			Stage V (51 obs.)			Wald
					Expansion									Recession						
	obs	Mean	σ	β	Mean	σ	β	Mean	σ	β	Mean	σ	β	Mean	σ	β	Mean	σ	β	Prob.
Early Expansion:																				
Shipping Containers	697	7.3%	18.5%	0.98	13.3%	17.0%	0.96	11.2%	16.8%	0.97	-4.0%	20.0%	0.98	-12.6%	17.5%	0.96	34.8%	22.6%	1.08	0%
Transportation	697	6.0%	19.2%	1.07	19.7%	16.6%	1.00	8.1%	17.3%	1.07	-5.7%	19.9%	1.01	-30.5%	20.4%	1.09	37.4%	24.9%	1.24	0%
Measuring & Control	697	6.7%	23.9%	1.33	5.4%	21.7%	1.36	13.4%	21.0%	1.29	3.5%	25.5%	1.37	-29.3%	26.8%	1.26	47.9%	29.4%	1.37	0%
Computers	697	8.0%	23.9%	1.25	9.2%	22.5%	1.41	11.6%	20.0%	1.14	3.7%	26.7%	1.24	-24.2%	20.5%	1.03	48.7%	32.2%	1.41	0%
Electronic Equipment	697	6.8%	25.5%	1.44	12.3%	24.4%	1.51	10.4%	21.2%	1.30	0.2%	28.6%	1.59	-30.6%	26.1%	1.39	46.1%	29.2%	1.33	0%
Computer Software	498	-3.4%	42.2%	1.78	-4.3%	32.5%	1.69	6.1%	35.1%	1.35	-5.7%	46.7%	2.18	-54.8%	56.3%	2.37	50.9%	63.1%	1.41	13%
avg:		5.2%	25.5%	1.31	9.3%	22.5%	1.32	10.1%	21.9%	1.19	-1.3%	27.9%	1.39	-30.4%	27.9%	1.35	44.3%	33.6%	1.31	
Middle Expansion:																				
Precious Metals	522	2.5%	35.2%	0.68	1.0%	33.3%	0.41	3.0%	31.6%	0.74	3.0%	37.3%	0.50	-23.2%	39.1%	0.91	39.5%	47.0%	1.15	60%
Fabricated Products	522	-0.7%	24.2%	1.11	2.5%	23.3%	1.18	8.2%	20.0%	1.01	-1.6%	24.0%	0.97	-51.0%	31.2%	1.37	14.7%	32.3%	1.17	0%
Business Services	697	6.1%	18.7%	1.10	9.0%	17.2%	1.11	8.6%	15.9%	1.04	3.0%	19.9%	1.13	-28.5%	21.9%	1.13	44.0%	22.1%	1.08	0%
Defense	522	5.9%	23.5%	0.84	11.0%	20.6%	0.66	11.3%	20.7%	1.07	-5.0%	26.2%	0.69	-27.7%	25.0%	0.90	55.0%	29.8%	0.77	1%
Chemicals	697	6.0%	17.6%	1.01	15.3%	16.5%	1.07	7.7%	16.7%	1.12	-4.0%	17.8%	0.88	-15.6%	17.6%	0.95	25.6%	21.1%	1.07	0%
Aircraft	697	8.8%	23.1%	1.13	14.9%	18.2%	1.16	14.9%	20.8%	1.16	-3.1%	24.5%	1.10	-25.6%	27.0%	1.27	38.5%	29.0%	1.20	0%
Shipbuilding & Railroad	697	5.4%	21.6%	1.00	14.0%	21.2%	1.03	4.4%	18.9%	1.16	2.2%	21.5%	0.80	-27.4%	28.2%	1.22	30.2%	22.8%	0.87	1%
Personal Services	697	4.4%	22.9%	1.08	11.9%	16.6%	0.83	6.3%	21.7%	1.16	-3.1%	26.4%	1.17	-34.9%	28.3%	1.12	53.6%	23.3%	0.99	0%
Mining	697	6.0%	21.0%	1.00	12.4%	19.4%	0.93	8.2%	22.3%	1.20	5.0%	18.9%	0.85	-32.8%	23.5%	0.97	25.5%	22.4%	1.04	0%
Machinery	697	6.4%	19.2%	1.17	13.6%	17.0%	1.14	11.9%	17.9%	1.21	-0.3%	19.3%	1.11	-31.6%	20.8%	1.17	30.6%	25.1%	1.24	0%
Steel Works	697	4.3%	22.7%	1.25	12.0%	21.3%	1.34	9.4%	21.7%	1.25	-3.4%	24.1%	1.30	-30.3%	22.3%	1.10	26.7%	24.5%	1.14	0%
Electrical Equipment	697	9.0%	20.3%	1.19	13.1%	18.5%	1.20	14.7%	19.1%	1.27	4.5%	20.9%	1.17	-27.5%	21.0%	1.04	33.6%	24.5%	1.20	0%
avg:		5.3%	22.5%	1.05	11.1%	20.4%	0.99	9.1%	20.6%	1.12	-0.2%	23.4%	0.97	-29.7%	25.5%	1.10	34.8%	27.0%	1.08	
Late Expansion:																				
Tobacco Products	697	9.6%	20.2%	0.66	3.4%	22.2%	0.91	12.2%	18.4%	0.87	9.2%	21.4%	0.42	0.6%	15.5%	0.39	38.6%	18.2%	0.61	4%
Food Products	697	7.9%	14.4%	0.71	8.9%	13.5%	0.73	8.7%	12.9%	0.78	1.7%	15.6%	0.60	-6.3%	15.8%	0.76	42.8%	16.0%	0.70	0%
Petroleum & Natural	697	8.5%	17.4%	0.81	16.5%	15.1%	0.77	10.1%	17.1%	0.90	5.0%	16.8%	0.67	-24.4%	22.5%	1.02	24.9%	19.1%	0.78	0%
Candy & Soda	697	6.7%	21.7%	0.80	11.4%	21.0%	0.85	13.3%	18.0%	0.75	-2.6%	23.3%	0.67	-20.9%	23.2%	0.78	30.9%	27.6%	0.99	1%
Pharmaceutical	697	8.9%	17.4%	0.86	5.0%	17.4%	1.02	15.6%	16.5%	0.97	5.9%	16.6%	0.69	-10.9%	18.0%	0.83	33.7%	21.2%	0.85	0%
Beer & Liquor	697	7.7%	17.6%	0.82	8.5%	14.0%	0.73	11.3%	16.7%	0.90	3.0%	20.0%	0.79	-16.2%	16.1%	0.78	37.8%	23.2%	0.89	0%
Medical Equipment	697	8.8%	19.0%	0.92	6.9%	18.2%	1.02	9.4%	18.6%	0.97	6.4%	17.4%	0.82	-10.7%	21.2%	0.88	50.4%	23.5%	0.96	1%
Agriculture	697	3.7%	22.0%	0.93	4.6%	19.7%	0.93	10.1%	18.5%	0.86	1.5%	24.9%	0.93	-31.1%	27.3%	1.11	28.8%	23.2%	0.84	0%
Coal	697	7.6%	28.8%	1.07	13.7%	25.9%	1.11	2.6%	25.5%	1.10	15.3%	32.4%	0.99	-38.3%	28.0%	1.06	43.8%	34.4%	1.03	0%
Healthcare	522	0.9%	35.9%	1.25	8.9%	27.3%	1.11	-3.9%	33.9%	1.20	3.2%	41.0%	1.34	-51.5%	41.9%	1.18	73.9%	40.5%	1.18	1%
avg:		7.0%	21.4%	0.88	8.8%	19.4%	0.92	8.9%	19.6%	0.93	4.9%	22.9%	0.79	-21.0%	22.9%	0.88	40.6%	24.7%	0.88	
Early Contraction:																				
Communication	697	5.5%	14.7%	0.72	8.1%	15.7%	0.89	7.8%	11.8%	0.63	0.8%	16.2%	0.74	-9.6%	14.3%	0.65	20.3%	15.5%	0.60	3%
Utilities	697	6.2%	13.0%	0.54	9.4%	12.6%	0.67	7.4%	11.0%	0.51	0.1%	13.4%	0.33	-5.5%	16.4%	0.76	25.2%	15.3%	0.64	2%
avg:		5.9%	13.9%	0.63	8.7%	14.2%	0.78	7.6%	11.4%	0.57	0.4%	14.8%	0.54	-7.6%	15.3%	0.71	22.7%	15.4%	0.62	
Late Contraction:																				
Insurance	697	6.9%	18.4%	0.88	11.4%	17.1%	0.92	8.1%	15.6%	0.87	1.3%	20.1%	0.80	-18.4%	22.4%	1.05	37.6%	20.4%	0.86	0%
Rubber & Plastic	697	7.6%	19.7%	1.04	12.4%	17.2%	1.02	13.8%	18.5%	1.14	0.6%	21.3%	1.01	-26.7%	21.3%	1.01	33.8%	22.1%	0.89	0%
Consumer Goods	697	7.1%	16.2%	0.87	11.9%	14.5%	0.88	9.7%	15.2%	1.00	-2.1%	16.1%	0.70	-15.0%	17.6%	0.81	41.1%	20.8%	1.01	0%
Printing & Publishing	697	8.1%	19.5%	1.04	10.7%	17.8%	1.01	12.6%	16.8%	1.02	0.6%	20.0%	1.02	-24.7%	24.4%	1.16	54.4%	22.7%	1.02	0%
Automobiles & Truck	697	6.0%	20.3%	1.03	20.1%	19.1%	1.00	5.6%	18.8%	1.16	-4.1%	20.5%	1.00	-25.4%	19.8%	0.81	31.8%	24.6%	1.04	0%
Apparel	697	7.2%	21.2%	1.08	13.9%	18.2%	1.07	9.9%	18.9%	1.10	-2.0%	23.3%	1.07	-29.4%	20.3%	0.92	58.5%	27.0%	1.06	0%
Textiles	697	4.6%	20.1%	0.99	15.5%	18.8%	1.02	5.3%	17.7%	0.99	-5.8%	20.8%	0.91	-26.4%	21.1%	0.89	41.1%	24.6%	1.07	0%
Trading	697	8.9%	18.1%	1.11	15.6%	15.6%	1.09	13.2%	14.9%	1.01	0.5%	20.3%	1.16	-27.2%	21.5%	1.21	44.9%	21.4%	1.09	0%
Retail	697	7.0%	17.7%	0.99	10.9%	15.5%	0.95	4.7%	16.7%	1.03	3.0%	18.1%	0.97	-16.5%	18.3%	0.90	47.7%	23.5%	1.11	0%
Banking	697	8.8%	18.0%	0.95	11.7%	17.1%	1.02	9.6%	15.2%	0.90	3.1%	18.9%	0.90	-12.0%	20.5%	0.98	41.3%	23.1%	1.11	2%
Construction Material	697	6.9%	18.5%	1.10	13.0%	15.9%	1.05	11.2%	16.4%	1.13	-1.3%	20.0%	1.05	-28.0%	19.7%	1.09	43.9%	23.3%	1.16	0%
Wholesale	697	6.7%	18.7%	1.08	10.5%	15.3%	1.02	8.1%	17.9%	1.17	3.6%	20.3%	1.06	-24.4%	17.5%	0.94	38.2%	24.8%	1.17	0%
Real Estate	697	3.3%	23.4%	1.10	9.1%	20.9%	1.00	5.5%	19.6%	1.03	-0.4%	24.4%	1.02	-38.3%	28.3%	1.37	45.8%	30.4%	1.18	0%
Business Supplies	697	7.1%	19.2%	1.00	17.7%	17.7%	0.96	6.4%	17.9%	1.10	-1.1%	18.7%	0.83	-24.2%	20.6%	0.93	41.0%	24.5%	1.20	0%
Recreation	697	5.4%	24.8%	1.16	7.7%	23.0%	1.17	7.3%	23.5%	1.30	0.1%	25.4%	1.00	-26.4%	24.3%	1.10	55.6%	31.0%	1.21	0%
Entertainment	697	9.1%	23.9%	1.25	10.9%	21.7%	1.20	13.3%	20.7%	1.25	0.8%	25.9%	1.32	-12.2%	28.0%	1.43	44.1%	30.6%	1.25	8%
Restaraunts & Hotels	697	8.5%	22.3%	1.10	12.4%	19.9%	1.08	12.0%	17.4%	1.00	4.3%	25.9%	1.12	-28.8%	24.4%	1.12	45.6%	28.2%	1.26	0%
Construction	697	6.0%	23.6%	1.26	6.7%	21.1%	1.19	8.2%	20.9%	1.20	8.5%	24.2%	1.23	-40.6%	23.7%	1.21	55.7%	32.5%	1.47	0%
avg:		7.0%	20.2%	1.06	12.3%	18.1%	1.04	9.1%	17.9%	1.08	0.5%	21.3%	1.01	-24.7%	21.9%	1.05	44.6%	25.3%	1.12	
Market		7.1%	14.5%	1.00	12.7%	12.8%	1.00	9.6%	13.0%	1.00	0.8%	15.0%	1.00	-22.8%	16.0%	1.00	34.9%	18.1%	1.00	
Treasury-bill		4.8%	0.8%	-	3.8%	0.8%	-	4.4%	0.6%	-	5.9%	0.7%	-	6.4%	1.2%	-	5.0%	1.0%	-	

Table IV

Notes: Table reports Jensen's alphas and Sharpe ratio performance measures for value weighted industry returns. Results are shown for the full period and also returns conditional on each of five business cycle stages. Jensen's alphas are reported as annualized rates with t-stats based on White (1980) heteroskedasticity consistent standard errors. Sharpe ratios are calculated as excess industry returns divided by its standard deviation. Industry returns are ordered by the business-cycle stage where they are expected to provide relative outperformance then from lowest to highest Sharpe ratio. We also report probability from a Wald test of joint significance under the null hypothesis of equal Jensen's alphas by industry for all five business-cycle stages.

| | Full Period | | | Stage I | | | Stage II | | | Stage III | | | Stage IV | | | Stage V | | | Wald |
| | | | | Expansion | | | | | | | | | Recession | | | | | | |
	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Prob
Early Expansion:																			
Computer Software	-10.6%	-2.25	-0.02	-15.7%	-2.26	-0.04	-5.3%	-0.67	0.05	-8.7%	-1.00	-0.04	5.0%	0.20	-0.39	7.5%	0.22	0.19	76%
Measuring & Control	-2.3%	-1.22	0.08	-10.1%	-3.42	0.07	1.2%	0.39	0.17	2.4%	0.61	0.04	-3.9%	-0.47	-0.37	-0.2%	-0.02	0.39	4%
Computers	-0.5%	-0.25	0.09	-7.3%	-2.25	0.11	1.0%	0.30	0.16	2.7%	0.54	0.04	-2.8%	-0.43	-0.39	-0.9%	-0.08	0.36	34%
Electronic Equipment	-2.9%	-1.48	0.07	-5.8%	-1.58	0.14	-1.5%	-0.50	0.14	-0.9%	-0.23	0.00	-2.6%	-0.38	-0.40	-0.4%	-0.04	0.38	89%
Shipping Containers	0.6%	0.40	0.11	1.4%	0.47	0.21	2.1%	0.74	0.18	-4.7%	-1.35	-0.06	10.0%	2.46	-0.22	-1.2%	-0.19	0.39	10%
Transportation	-1.2%	-0.83	0.09	6.7%	2.54	0.31	-1.6%	-0.61	0.13	-6.4%	-1.94	-0.08	-9.3%	-1.73	-0.51	-3.8%	-0.64	0.37	1%
avg:	-2.8%		0.07	-5.1%		0.14	-0.7%		0.14	-2.6%		-0.02	-0.6%		-0.38	0.2%		0.35	
Middle Expansion:																			
Precious Metals	-0.6%	-0.11	0.02	-2.2%	-0.22	0.01	-3.0%	-0.35	0.03	2.2%	0.21	0.02	5.2%	0.23	-0.19	5.6%	0.20	0.21	99%
Shipbuilding & Railroad	-1.3%	-0.57	0.07	1.2%	0.26	0.18	-5.8%	-2.00	0.07	1.6%	0.35	0.03	-2.4%	-0.22	-0.33	1.3%	0.11	0.34	58%
Personal Services	-2.7%	-1.24	0.06	1.7%	0.52	0.20	-4.1%	-1.17	0.08	-3.9%	-0.78	-0.03	-14.2%	-1.65	-0.43	15.9%	2.04	0.54	6%
Mining	-0.8%	-0.37	0.08	1.0%	0.27	0.18	-2.6%	-0.65	0.10	4.3%	1.17	0.07	-14.7%	-1.98	-0.49	-7.2%	-1.00	0.30	15%
Fabricated Products	-5.6%	-2.14	-0.01	-6.6%	-1.22	0.03	-0.3%	-0.08	0.11	-3.1%	-0.58	-0.02	-19.9%	-1.49	-0.64	-13.8%	-1.14	0.12	50%
Steel Works	-4.0%	-2.23	0.05	-4.2%	-1.35	0.15	-2.0%	-0.54	0.12	-4.3%	-1.20	-0.04	-8.9%	-1.42	-0.46	-9.0%	-1.06	0.28	86%
Chemicals	-0.8%	-0.66	0.10	1.9%	0.83	0.25	-2.5%	-1.23	0.13	-4.6%	-1.54	-0.07	6.1%	1.61	-0.28	-8.0%	-1.81	0.32	4%
Business Services	-1.3%	-1.02	0.09	-4.3%	-1.76	0.14	-0.9%	-0.47	0.15	2.2%	0.79	0.04	-5.9%	-1.03	-0.44	5.5%	1.01	0.48	25%
Defense	1.9%	0.64	0.07	5.5%	0.94	0.15	2.0%	0.48	0.15	-6.0%	-0.89	-0.04		-0.05	-0.37	29.0%	1.63	0.43	39%
Machinery	-1.5%	-1.19	0.09	-0.4%	-0.20	0.22	0.7%	0.29	0.18	-1.2%	-0.46	-0.01	-9.1%	-1.88	-0.53	-8.8%	-1.31		30%
Aircraft	1.0%	0.44	0.11	4.6%	1.24	0.24	3.9%	1.06	0.19	-3.9%	-0.84	-0.04	1.1%	0.12	-0.32	-2.0%	-0.14	0.33	66%
Electrical Equipment	0.8%	0.57	0.12	-1.6%	-0.69	0.19	2.7%	1.06	0.21	3.6%	1.21	0.06	-6.5%	-1.04	-0.44	-5.6%	-1.08	0.35	26%
avg:	-1.2%		0.07	-0.3%		0.16	-1.0%		0.13	-1.1%		0.00	-5.8%		-0.41	0.2%		0.33	
Late Expansion:																			
Candy & Soda	1.3%	0.51	0.09	0.9%	0.20	0.15	6.0%	1.61	0.20	-3.1%	-0.57	-0.03	-4.5%	-0.45	-0.29	-1.7%	-0.11	0.28	64%
Agriculture	-2.4%	-1.03	0.05	-6.1%	-1.61	0.07	2.1%	0.58	0.15	0.8%	0.15	0.02	-9.6%	-0.97	-0.39	0.9%	0.09	0.32	49%
Healthcare	-4.6%	-1.03	0.01	0.0%	0.00	0.09	-12.9%	-1.77	-0.03	1.2%	0.12	0.02	-25.8%	-1.21	-0.48	31.5%	1.49	0.40	17%
Food Products	3.0%	2.17	0.15	0.0%	0.02	0.18	1.4%	0.74	0.19	1.2%	0.38	0.03	12.4%	2.01	-0.12	16.8%	2.72	0.66	5%
Beer & Liquor	2.1%	1.18	0.12	-0.3%	-0.14	0.17	2.8%	0.96	0.18	2.4%	0.56	0.04	1.1%	0.19	-0.32	6.7%	0.59	0.41	91%
Petroleum & Natural	2.9%	1.70	0.14	6.5%	2.33	0.29	1.7%	0.56	0.16	4.5%	1.25	0.08	-3.0%	-0.45	-0.36	-0.1%	-0.02	0.34	59%
Pharmaceutical	2.9%	1.79	0.14	-6.8%	-2.46	0.08	6.2%	2.27	0.25	5.4%	1.56	0.10	8.7%	1.39	-0.19	4.7%	0.64	0.40	1%
Medical Equipment	2.4%	1.33	0.13	-5.0%	-1.61	0.11	0.5%	0.14	0.14	5.8%	1.76	0.10	10.2%	1.22	-0.16	14.3%	1.63	0.51	5%
Tobacco Products	4.9%	2.01	0.13	-7.0%	-1.42	0.04	3.9%	1.14	0.18	8.8%	1.60	0.12	10.5%	1.41	-0.19	16.4%	1.73	0.53	6%
Coal	0.3%	0.09	0.07	-0.1%	-0.01	0.14	-6.9%	-1.39	0.03	14.5%	1.81	0.13	-19.9%	-1.95	-0.49	7.2%	0.48	0.31	6%
avg:	1.3%		0.10	-1.8%		0.13	0.5%		0.15	4.2%		0.06	-2.0%		-0.28	9.7%		0.42	
Early Contraction:																			
Communication	0.6%	0.46	0.11	-2.6%	-1.00	0.14	2.0%	0.93	0.18	0.2%	0.08	0.01	5.7%	1.29	-0.20	1.0%	0.16	0.35	51%
Utilities	2.5%	1.75	0.13	1.2%	0.48	0.21	2.8%	1.19	0.19	-0.2%	-0.06	0.00	13.3%	2.43	-0.10	4.0%	0.78	0.43	29%
avg:	1.6%		0.02	1.6%		0.02	1.6%		0.02	1.6%		0.02	1.6%		0.02	1.6%		0.02	
Late Contraction:																			
Automobiles & Truck	-0.9%	-0.52	0.08	7.0%	2.06	0.28	-4.7%	-1.71	0.08	-4.8%	-1.33	-0.06	-9.2%	-1.15	-0.43	-2.3%	-0.29	0.33	5%
Entertainment	0.5%	0.24	0.11	-3.5%	-0.89	0.14	1.6%	0.49	0.17	-0.2%	-0.04	0.01	23.4%	2.97	-0.13	0.6%	0.05	0.35	5%
Real Estate	-3.9%	-1.74	0.04	-2.9%	-0.75	0.12	-3.7%	-1.15	0.08	-1.1%	-0.23	0.00	-13.5%	-1.60	-0.49	4.1%	0.40	0.36	68%
Wholesale	-0.6%	-0.44	0.10	-1.8%	-0.91	0.19	-2.5%	-1.05	0.13	2.8%	0.83	0.05	-5.0%	-1.17	-0.40	-1.4%	-0.25	0.38	63%
Rubber & Plastic	0.5%	0.27	0.11	-0.2%	-0.06	0.20	2.9%	1.02	0.20	-0.2%	-0.05	0.01	-6.3%	-0.88	-0.42	3.4%	0.40	0.39	77%
Restaraunts & Hotels	0.9%	0.43	0.11	-0.8%	-0.24	0.17	2.6%	0.90	0.19	3.4%	0.66	0.05	-6.3%	-0.89	-0.40	1.3%	0.14	0.39	76%
Construction	-2.4%	-1.23	0.07	-7.0%	-2.00	0.09	-2.6%	-0.76	0.11	7.5%	1.79	0.04	-19.8%	-2.76	-0.63	2.2%	0.20	0.40	1%
Textiles	-2.0%	-1.03	0.07	2.6%	0.71	0.22	-3.5%	-1.05	0.08	-6.4%	-1.63	-0.08	-8.5%	-1.24	-0.41	3.9%	0.48	0.41	34%
Business Supplies	0.3%	0.18	0.10	5.3%	1.57	0.27	-3.5%	-1.37	0.10	-1.7%	-0.49	-0.02	-5.0%	-0.67	-0.39	-0.2%	-0.03	0.42	31%
Recreation	-2.3%	-0.95	0.06	-6.1%	-1.46	0.09	-4.4%	-1.10	0.09	-0.7%	-0.13	0.00	-3.8%	-0.43	-0.36	10.2%	0.74	0.42	77%
Banking	2.2%	1.40	0.14	-0.8%	-0.29	0.19	1.3%	0.52	0.17	2.5%	0.71	0.05	11.3%	1.61	-0.18	2.6%	0.47	0.44	59%
Construction Material	-0.5%	-0.38	0.11	0.0%	0.02	0.22	0.7%	0.38	0.19	-2.0%	-0.63	-0.02	-6.2%	-1.26	-0.48	3.3%	0.60	0.46	64%
Insurance	0.9%	0.52	0.11	0.1%	0.05	0.18	0.2%	0.07	0.14	0.7%	0.16	0.02	5.2%	0.68	-0.26	7.5%	0.89	0.46	89%
Retail	0.2%	0.17	0.11	-0.7%	-0.32	0.19	-4.4%	-1.75	0.08	2.3%	0.81	0.05	3.7%	0.74	-0.29	7.4%	1.33	0.49	19%
Consumer Goods	1.2%	0.85	0.12	1.1%	0.43	0.23	0.5%	0.25	0.18	-2.6%	-0.85	-0.04	3.3%	0.55	-0.27	5.8%	0.79	0.49	77%
Apparel	-0.1%	-0.06	0.10	0.6%	0.22	0.21	-0.3%	-0.08	0.14	-2.8%	-0.63	-0.03	-11.5%	-1.72	-0.49	17.1%	1.68	0.50	18%
Trading	1.2%	1.09	0.14	1.9%	1.16	0.27	3.6%	1.98	0.24	-0.4%	-0.14	0.01	-2.2%	-0.55	-0.42	6.1%	1.21	0.51	51%
Printing & Publishing	1.0%	0.60	0.12	-1.6%	-0.50	0.17	3.0%	1.16	0.20	-0.1%	-0.04	0.01	-0.3%	-0.03	-0.33	15.4%	2.68	0.57	12%
avg:	-0.2%		0.10	-0.4%		0.19	-0.7%		0.14	-0.2%		0.01	-2.8%		-0.38	4.8%		0.43	
Market	-	-	0.13	-	-	0.26	-	-	0.20	-	-	0.01	-	-	-0.43	-	-	0.46	

Table V

Notes:
Table V Panel A reports results from the Goetzmann, Ingersoll, Spiegel and Welch (2007) manipulation-proof performance measure (MPPM) for different measures of benchmark risk. Portfolio returns are penalized more heavily for risk as ρ increases. The results ($\widehat{\Theta}$) are interpreted as the annualized strategy return premium after adjusting for risk. Table V Panel B reports results from a Barrett and Donald (2002) simulated test of second-order stochastic dominance with p-values based on Kolmogorov-Smirnov type test statistics.

Panel A:

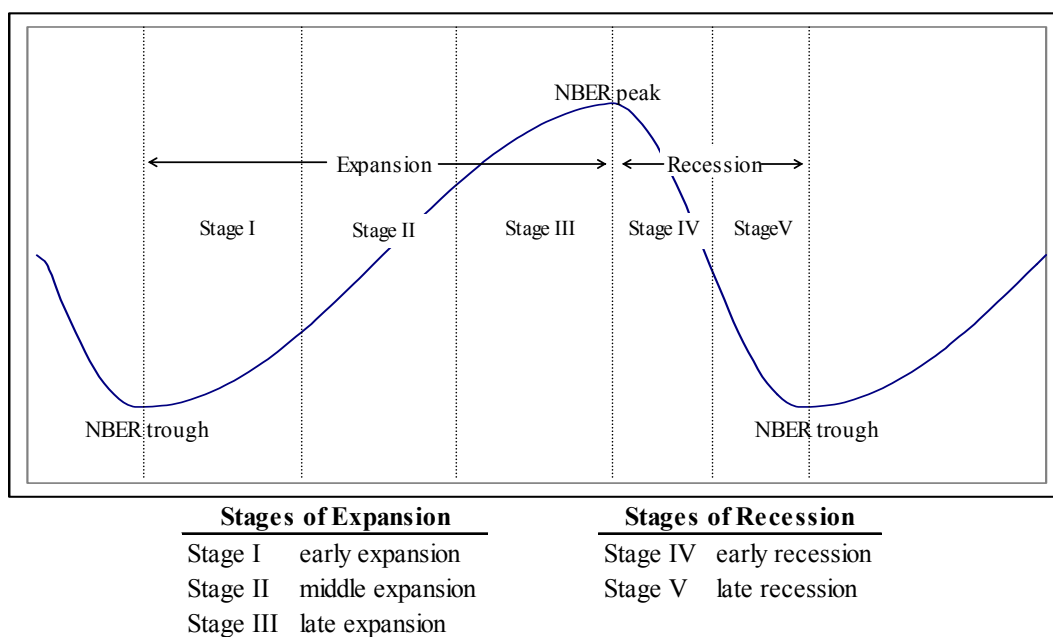$$\widehat{\Theta} \equiv \frac{1}{(1-\rho)\Delta t} \ln(\sum_{t=1}^{T}[(1+r_t)/(1+rf_t)]^{1-\rho})$$

Strategy	MPPM $\rho=2$	$\rho=3$	$\rho=4$
Market	4.4%	3.3%	2.1%
Market-timing	6.5%	5.5%	4.4%
Sector rotation	5.8%	4.2%	2.5%

Panel B:

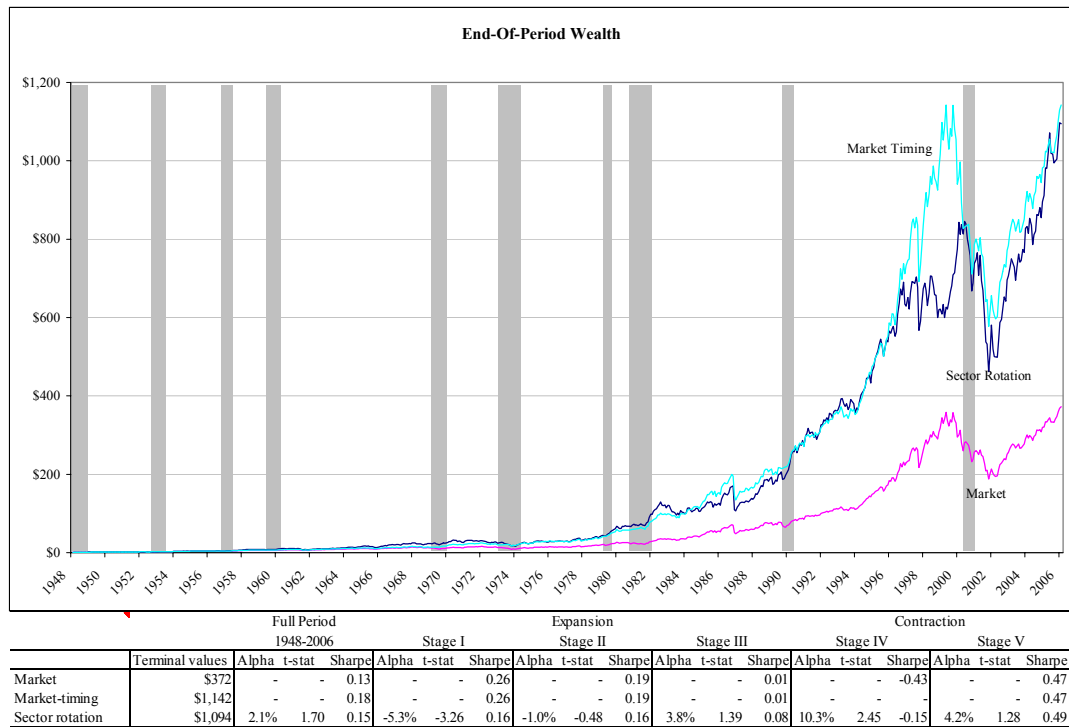|	Second-order stochastic dominance p-values	decision	conclusion
H_0: rotation dominates or is indifferent to market	0.127	accept	indifferent between sector-rotation and market
H_1: rotation is inferior to market			
H_0: market dominates or is indifferent to rotation	0.127	accept	
H_1: market is inferior to rotation			
H_0: timing dominates or is indifferent to market	0.708	accept	market-timing dominates market
H_1: timing is inferior to market			
H_0: market dominates or is indifferent to timing	0.063	reject	
H_1: market is inferior to timing			
H_0: timing dominates or is indifferent to rotation	0.495	accept	market-timing dominates sector-rotation
H_1: timing is inferior to rotation			
H_0: rotation dominates or is indifferent to timing	0.004	reject	
H_1: rotation is inferior to timing			

Figure I

Notes: Figure illustrates a stylized economic business-cycle. The official government agency responsible for dating U.S. business cycles is the National Bureau of Economic Research (NBER). The NBER publishes dates for business-cycle peaks and troughs. Phases of expansion are measured from trough to peak and recession from peak to trough. As figure I illustrates, periods of expansion are typically much longer than periods of recession. Similar to previous research, we divide expansions into three equal stages (early/middle/late) and recessions into two stages (early/late) as shown.[1]

Stages of Expansion		Stages of Recession	
Stage I	early expansion	Stage IV	early recession
Stage II	middle expansion	Stage V	late recession
Stage III	late expansion		

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[1] See for example Stovall (1996) and references by Fidelity Sector Funds at
http://personal.fidelity.com/products/funds/content/sector/basics.shtml.cvsr

Figure II

Notes: Table reports end-of-period wealth from an initial investment of one dollar for each of the three investment strategies shown over the period 1948-2006. The market strategy simply holds the market portfolio for the entire period. Sector rotation strategy holds sector portfolios in equal weights during the business cycle stage in which they are expected to perform optimally. Market-timing holds the market portfolio for all business cycle stages except the early stage of a recession when cash is held. Jensen's alphas are obtained from a standard CAPM model. Jensen's alphas are reported as annualized rates with t-stats based on White (1980) heteroskedasticity consistent standard errors. Sharpe ratios are calculated as strategy returns in excess of the risk-free rate divided by its standard deviation. Shaded areas indicate NBER defined periods of recession.

End-Of-Period Wealth

	Terminal values	Full Period 1948-2006			Expansion Stage I			Stage II			Stage III			Contraction Stage IV			Stage V		
		Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe	Alpha	t-stat	Sharpe
Market	$372	-	-	0.13	-	-	0.26	-	-	0.19	-	-	0.01	-	-	-0.43	-	-	0.47
Market-timing	$1,142	-	-	0.18	-	-	0.26	-	-	0.19	-	-	0.01	-	-	-	-	-	0.47
Sector rotation	$1,094	2.1%	1.70	0.15	-5.3%	-3.26	0.16	-1.0%	-0.48	0.16	3.8%	1.39	0.08	10.3%	2.45	-0.15	4.2%	1.28	0.49

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