The Myth of Sector Rotation

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Abstract

Conventional wisdom suggests that sectors/industries provide systematic performance and that business cycle rotation strategies generate excess market performance. However, we find no evidence of systematic sector performance where popular belief anticipates it will occur. At best, conventional sector rotation generates modest outperformance, which quickly diminishes after allowing for transaction costs and incorrectly timing the business cycle. The results are robust to alternative sector and business cycle definitions. We find that relaxing sector rotation assumptions and letting any industry excess return predict future returns of other industries results in predictability not significantly different than what would be expected by random chance.

Keywords: Sector Rotation, Return Predictability, Investments.

JEL Codes: G11, G14

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1. Introduction

Sector rotation refers to a common investment strategy that targets investments in particular economic sectors at different stages of the business cycle. Bodie, Kane, and Marcus (2009) suggest the "way that many [financial] analysts think about the relationship between industry analysis and the business cycle is the notion of sector rotation." Similarly, Lofthouse (2001) states that financial analysts "think in terms of stylized economic cycles, with different sectors performing at different stages of the cycle." Fabozzi (2007, pg. 581) acknowledges, "Sector rotation strategies have long played a key role in equity portfolio management."

The seemingly mythical belief that tactically timing sector/industry investments generates systematic excess returns persists unabated with certain investors, as supported by the media. Popular investment websites (Investopedia, Stockcharts, and Seeking Alpha) detail the sector rotation strategy, while providing examples of practical application. Any number of "How to Guides", starting with "Sector Investing" (1996) to "Trading for Dummies" (2013) also provide step-by-step instruction on timing sector investments with business cycles. While the largest investment companies (iShares, Vanguard, and Fidelity), provide a suite of sector funds that facilitate sector rotation application. Several direct sector rotation funds are available, including the Sector Rotation ETF (XRO), Line Industry Rotation Portfolio Fund (PYH), and Sector Rotation Fund (NAVFX). However, comparing NAVFX returns since inception (2010-2018) with the S&P 500 Index over the same period reveals roughly 5% underperformance (7.34% versus 12.23%). Raising the question, does investor belief in sector rotation outperformance represent a myth or reality?

Our study tests the two fundamental assumptions of sector rotation. Do certain sectors provide systematic performance across business cycles? Does sector rotation generate excess market performance? Bodie, Kane, and Marcus (2009) comment that "sector rotation, like any other

form of market timing, will be successful only if one anticipates the next stage of the business cycle better than other investors." This study overcomes the obstacle of correctly timing business cycles with a simple and intuitive approach. That approach gives sector rotation investors the benefit of the doubt, by assuming investors can perfectly time business cycle turning points. If the business cycle drives sector returns, then an investor who perfectly times business cycle stages and rotates sectors following popular belief on sector performance should generate excess returns. Our analysis begins with the assumption of a sector rotation strategy that follows conventional guidance on sector performance. However, we acknowledge many potential versions of sector rotation strategy implementation. Consequently, we relax any assumptions of a specific sector rotation model, testing performance of all sectors across all business cycle stages.

Investors can choose to implement sector rotation at sector, industry, or firm level. The choice depends on how precisely an investor wants to target expected sector performance and the desired level of diversification. A common approach to sector rotation is industry-level implementation. Industries allow a targeted approach to sector exposure, while still maintaining the benefits of diversification. For instance, the healthcare sector includes pharmaceutical, healthcare provider, and medical equipment industries. A sector rotation investor might outweigh pharmaceuticals relative to other healthcare industries, based on a specific view of expected industry performance. Our initial analysis focuses on the Fama and French 49 industry portfolios. Expanded robustness analysis considers alternative sector and industry groupings.

The initial analysis documents sector rotation outperformance – but only marginally so. The analysis investigates industry performance over 10 National Bureau of Economic Research (NBER) dated business cycles from 1948 to 2018. The NBER defines only broad phases of economic expansion and recession. The analysis first divides broad NBER phases into

additional sub-periods. We then map industries to business cycle stages where popular belief anticipates optimal performance will occur. With few exceptions, industries expected to perform well in various stages show no systematic performance. The analysis next combines industries across stages to analyse whether conventional sector rotation generates outperformance. Investors, guided by popular belief on sector performance and with perfect foresight in timing business cycle stages, achieve a risk-adjusted return of 0.11 percent per month before transaction costs. While this may seem high, a simple market timing strategy that invests continuously in the market except during early recession generates a 0.15 percent outperformance. With transaction costs, sector rotation performance quickly dissipates.

The results are robust to variety of tests and specifications. The analysis investigates whether the results differ when investors anticipate business cycles early or late. Alternatively, we examine business cycle stages delineated by the Chicago Federal Reserve National Activity Index (CFNAI). When considering alternative sector and industry groupings, the results remain unaffected. The main results are also robust to various performance measures such as the Sharpe ratio and Jensen's alpha. The results remain the same whether measured by a single index, Fama and French three-factor, or Carhart four-factor model.

Lastly, the study generalizes the analysis to allow for all variations of sector rotation. The initial analysis follows a commonly accepted version of sector rotation, as defined by Stovall (1996) in Table 3 and illustrated by Standard & Poor's in Figure 1. However, there are other potential versions of sector rotation. The results are thus subject to the criticism of being limited to a specific sector rotation model. To counter such criticism, the analysis tests for systematic performance of any sector across any business-cycle stage. Measuring statistically significant outperformance, the generalized results align with a hypothesis of neither systematic nor persistent differences in sector returns across business-cycle stages. The significance levels observed are only marginally different from those expected to occur randomly, without any

systematic outperformance. The result suggests that no sector rotation variant provides systematic outperformance, questioning the popular belief that timing sector investments with business cycles generates excess market performance.

This study contributes to the literature as the first to question the underlying assumptions of sector rotation: systematic sector performance and the opportunity for investors to profitably time sector rotation with the business cycle. Elton, Gruber, and Blake (2011) and Avramov and Wermers (2006), suggest the importance that sector rotation plays in mutual fund performance. Apart from a return predictability perspective, this study provides additional insights. Sector rotation generates order flows, which transmit information about asset fundamentals. For instance, Beber, Brandt, and Kavajecz (2010) provide evidence that sector-order flows forecast macroeconomic conditions. The evidence suggests that sector-order flows, however, do not translate into systematic sector performance. Evidence in Avramov and Wermers (2006) finds that switching industry investments across business cycles drives equity fund performance. Jiang, Yao, and Yu (2007), similarly, conclude that industry rotation underlies mutual fund timing strategies, where fund managers switch between cyclical and non-cyclical stocks. A natural question to ask is whether mutual funds follow conventional sector rotation or alternative timing strategies. The results suggest that mutual funds profit from the latter. This study contributes to a renewed interest in the literature on rotation strategies and industry allocation, providing additional insight into these questions, among others.

2. Background and Hypotheses

One can dismiss, within the framework of rational expectations and the efficient market hypothesis, the idea that investors systematically profit from sector rotation. Sector prices should instantaneously reflect all available information and fundamental value – irrespective of business-cycle stages. Yet, the prominence of sector rotation in practice suggests that investors profit from timing systematic sector performance with the business cycle.

The apparent ability to profit from sector rotation might be consistent with the Hong and Stein (1999) gradual information diffusion hypothesis. Gradual information diffusion, as Hong and Stein (1999) describe, involves two groups of traders (news watchers and arbitrageurs) and the lead-lag relation of their responses to economic news. News watchers have a limited ability to process news and consequently revise asset prices with a delay. Arbitrageurs, in contrast, fully incorporate news in their price adjustments and devise simple trading strategies that generate excess returns. Analogously, one can view sector rotation investors as arbitrage traders who respond to economic news by profitably timing sector rotation.

Hong, Torous, and Valkanov (2007) empirically test the gradual information diffusion hypothesis with U.S. industries. They conjecture that economic news affect industry fundamentals differently, and that the information content in the performance of certain industries diffuses slowly across asset markets. Related literature documents differences in the informational content of economic news, dependent on business cycle conditions. McQueen and Roley (1993) find that the S&P 500 decreases in value with news of economic growth when the economy is strong and increases in value when the economy is weak. Boyd, Hu, and Jagannathan (2005) find that the impact of unemployment news on equity returns depends on whether the economy is in a period of expansion or recession. The empirical evidence thus shows that the effect of economic news on expected sector performance depends not only on the sector but also on current business-cycle conditions.

Empirical research provides evidence that fund managers time their sector investments with business cycles and that their order flows coincide with conventional sector rotation. Lynch, Wachter, and Boudry (2004) also note that fund manager performance varies over business cycles. Avramov and Wermers (2006) show that predictable variation in fund performance relates to a manager's skill in timing industry rotation with NBER business-cycle turning points. Jiang, Yao, and Yu (2007) also observe that fund managers adjust industry allocations

based on common business cycle proxies. In a related study, Beber, Brandt, and Kavajecz (2010) conclude that active order flows, defined as flows in excess of market capitalization, directly link to economic news. Notably, for the motivation of this study, Beber, Brandt, and Kavajecz (2010) observe that aggregate sector rebalancing emulates a conventional sector rotation strategy, one that exploits the relative outperformance of certain sectors at different business-cycle stages. Moreover, and of further interest for this study, they find institutional order flows into certain sectors predict economic direction. For instance, order flows into the basic materials sector predict economic expansion while order flows into the telecommunication, consumer discretionary, and financial sectors predict economic contraction. Such investment flows also coincide with popular belief on the sequence of sector performance.

An empirical examination of cyclical sector performance is topical for both financial researchers and investors. According to Hong and Stein (1999), informed arbitrage traders can generate excess returns with simple trading strategies based on the release of economic news. Sector- and industry-level investing also constitutes a dynamic growth segment in financial markets. Cavaglia, Brightman, and Aked (2000) and Conover, Jensen, Johnson, and Mercer (2008) document the increased importance of industry-level versus country-level investing. Kacperczyk, Sialm, and Zheng (2005) find that active managers with concentrated industry positions generate the greatest outperformance. From a practitioner's perspective, the widespread availability of sector funds and ETFs makes sector allocation strategies more feasible than ever. Nonetheless, there is an apparent absence of empirical research on sector performance over business cycles.

Related literature does describe the performance of alternative business-cycle timing strategies. For instance, Siegel (1991) illustrates the potential of profitably timing allocations between

equities and cash. The author documents 12 percent annual market outperformance switching between equity and cash at NBER business-cycle turning points. Brocato and Steed (1998) similarly observe market outperformance rebalancing portfolios at NBER turning points. Further, Levis and Liodakis (1999) and Ahmed, Lockwood, and Nanda (2002) report outperformance to rotation strategies based on firm characteristics (such as earnings, value, and capitalization) conditioned by well-known business-cycle variables. Conover, Jensen, Johnson, and Mercer (2008) show 3.4 percent annual outperformance to a strategy that times investments in cyclical and non-cyclical stocks with Federal Reserve monetary policy. While closely related, this study fundamentally differs from previous research, by thoroughly analyzing sector and industry performance across different measures of business-cycle stages. Additionally, as Fama and French (1997) and Lochstoer (2009) identify time-variant industry-risk premiums related to business cycles, this study also evaluates industry performance using different risk correction measures. Some more recent work on sector rotation profitability includes Sarwar et al. (2018), Guris and Pala (2014), Chava et al. (2018).

The above discussion leads to a formal statement of this study's null and alternative hypotheses.

H_0: Industry returns are unrelated to the stage of a business cycle stage.

H_1: There is a systematic relationship between industry performance and stages of the business cycle.

H_2: Rotating sector investments with business cycle stages generates systematic excess returns.

Answering these hypotheses tests the fundamental assumption of sector rotation investors that timing industry allocations with the business cycle is a profitable investment strategy.

3. Business Cycles

3.1.NBER business cycle dates

Our analysis covers 10 business cycles from January 1948 to July 2018.[2] The official U.S. Government agency responsible for dating business cycles is the NBER. While academics and practitioners widely accept NBER cycle reference dates, other business-cycle measures are also available.[3] The NBER dates cycle peaks and cycle troughs that broadly define phases of economic expansion and economic recession. Panel A of Table 1 reports business cycle durations from business cycle peak to business cycle peak. The sample covers the 10 business cycles enumerated in the far left column of Panel A. Each business cycle spans the first month following a peak to the subsequent peak. Business cycles average 70 months over the sample. Earlier business cycle durations are much shorter than recent cycles, particularly during phases of economic expansion.[4]

3.2.Business cycle stages

While the NBER defines broad economic phases, researchers and investment practitioners commonly divide expansions and recessions into more discrete stages. Investment professionals and practitioner guides, such as Stovall (1996), commonly divide expansions into three equal stages (early/middle/late) and recessions into two equal stages (early/late). Three stages of expansion allow for the longer duration of expansions relative to recessions. Other research, such as DeStefano (2004), divides both expansions and recessions into two equal stages. Our analysis evaluates sector/industry performance across five business cycle stages. Subsequent analysis further evaluates performance across two-stage and four-stage business cycle partitions.

[2] Eleventh business cycle is still ongoing, with the latest peak recorded on December 2017. However, the 11th business cycle already has all five stages – 9 months each of early and late contractions, 40 each of early and middle expansions, and 29 of late expansion.
[3] For a survey of business cycle dating methodologies, see Cover and Pecorino (2005).
[4] Moore (1974) provides a detailed discussion of post-1948 differences in business cycle dynamics.

The analysis measures expansions from the first month following a cycle trough to the subsequent cycle peak and recessions from the first month following a cycle peak to the subsequent cycle trough. The analysis also delineates three equal stages of expansion and two equal stages of recession. The five business cycle stages are early expansion (Stage I), middle expansion (Stage II), late expansion (Stage III), early recession (Stage IV), and late recession (Stage V). Panel B of Table 1 reports the duration of expansions, recessions, and stages over 10 business cycles occurring from 1948 to 2018. Recessions average approximately 10 months and expansions approximately five years.

3.3. Evaluation of business cycle proxies

The analysis first investigates whether the five NBER delineated stages are consistent with well-known business cycle proxies. The common business cycle proxies (BCP) in the literature are term-spread, default-spread, dividend yield, unemployment, and industrial production. Studies by Keim and Stambaugh (1986), Chen, Roll, and Ross (1986), Fama and French (1989), Schwert (1990), Campbell (1987), Chen (1991), Jensen, Mercer, and Johnson (1996), and Petkova (2006), among others, document the relation between these proxies and business-cycle conditions.

Panel A of Table 2 provides a summary of expected business cycle proxy changes over the five NBER delineated stages. For instance, term-spread, default-spread, and dividend yield are smallest near economic peaks and largest near economic troughs (Fama and French (1989)).[5] The expectation is that these variables will decrease across early, middle, and late stages of expansion. Conversely, these same variables should increase across stages of early and late recession. Other studies, such as Balvers, Cosimano, and McDonald (1990) and Chen (1991), document a close link between business cycles and both unemployment rates and industrial

[5] The term-spread, default-spread, and dividend yield data come from http://www.globalfinancialdata.com

production. Stock and Watson (1999) and Hamilton and Lin (1996) show, for example, that industrial production peaks and unemployment rates bottom out as the economy enters recession. Industrial production should increase across successive stages of expansion and decrease across successive stages of recession. Conversely, unemployment rates should decrease across early, middle, and late expansion, then increase across early and late recession.

Panel B of Table 3 reports proxy averages by business-cycle stage estimated with Equation 1, where D_s is a dummy variable that takes the value of one or zero dependent on the current business cycle stage.

$$BCP_t = \sum_{s=1}^{5} \gamma_s D_{s,t} + \varepsilon_t \qquad \text{(Eq. 1)}$$

Next, the table reports changes in business-cycle proxy values (γ_s-γ_{s-1}) between successive business-cycle stages. Panel B establishes that changes in the selected business-cycle variables track NBER delineated business-cycle stages and show the mostly expected signs as reported in Panel A. For instance, the results should indicate a significantly negative default-spread difference between early expansion and late recession. The analysis tests for statistical significance using a simple difference in means test. Panel B reports p-values under the null hypothesis of no difference in business-cycle proxies across successive stages, formally stated as H_o: $\gamma_s = \gamma_{s-1}$. Failure to reject the null would indicate no statistically significant difference in the business-cycle proxy across successive stages and would invalidate the stage delineations. For example, there is an average -0.5% difference between early expansion and late recession. The results document that changes in the business-cycle proxies across successive business-cycle stages, with few exceptions, have the expected sign and are highly significant.

4. Industry Performance across Business Cycles

4.1. Data Description

Monthly market, industry, and Treasury bill return data come from the Kenneth French website. Market returns represent the total value weighted returns for all NYSE, AMEX, and NASDAQ listed stocks. The analysis initially uses the Fama and French 49 industry portfolios. Fama and French map firms to industry groupings based on their standard industrial classification (SIC).[6] Firms mapped to the "other" industry come from a variety of sectors and industries. As such, the "other" industry holds no relevance in a sector rotation strategy. Consequently, the analysis omits the "other" industry, leaving 48 of the original Fama and French 49 industries.[7] The one-month Treasury bill serves as a proxy for the risk-free interest rate.

4.2. Popular guide on industry performance

Table 3 shows the particular stage of the business cycle where popular belief anticipates industries will perform best. We follow the popular Stovall (1996) practitioner guide to sector investing. Stovall (1996) divides all equities into 10 basic sectors. He then maps sectors and sub-sector industry groups to one of five business cycle stages.[8] For example, Stovall suggests that the technology and transportation sectors provide early expansion performance, basic materials and capital goods provide middle expansion performance, and so forth. As Table 3 illustrates, there are four technology sub-sector industries and two transportation sub-sector industries. Conventional guidance suggests each industry in those sectors provides early recession performance. Performance then shifts from sector to sector across business-cycle

[6] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html for further detail on the data and the formation of industry portfolios.
[7] The "other" industry group represents approximately 3.5 percent of total firms listed on NYSE, AMEX, and NASDAQ.
[8] Lofthouse (2001) traces a similar approach of mapping sectors to stylized stages of economic cycles back to Markese (1986). There are also different variants of mapping sector performance to business-cycle stages. Salsman (1997) uses dividend yield, short-term interest rates, and precious metal prices to map sector performance. The present study concludes with the total relaxation of any assumed sector rotation model.

stages. The analysis maps each of the 48 industry portfolios to a corresponding sector, then maps each sector to the business-cycle stage of anticipated sector performance.

4.3. Nominal industry performance

Table 4 provides industry descriptive industry statistics and nominal performance for the business-cycle stage popular belief anticipates outperformance will occur. The table reports the average number of firms, number of observations, mean returns, standard deviation of returns, and single-index betas by the indicated stage. For comparison, Table 4 reports mean returns, standard deviation of returns, and single-index betas for the full 1948–2018 sample. The table also reports industry averages and market statistics beneath each business-cycle stage.

The second column of Table 4 reports the average number of firms in an industry. Implementing sector rotation at industry level allows for more precise targeting of performance. The wide variety of available industry funds and ETFs reflects the popularity of industry-level investing. The increased precision targeting industry versus sector performance, however, comes at the cost of reduced diversification benefits. The defense, tobacco, and coal industries, for instance, comprise on average fewer than 10 firms. As such, investments in those industries are subject to a high level of firm-specific risk. It is unlikely, however, that sector rotation investors would invest in only one industry during a particular business-cycle stage. For example, there are 12 industries, including defense, expected to provide middle expansion performance. Overall, conventional sector rotation investors would thus hold a well-diversified middle expansion portfolio.[9]

We initially measure nominal industry performance to determine whether significant differences occur over business cycles. The analysis then observes whether industry

[9] For an overview of tradeoffs in implementing sector rotation strategies at sector, industries, and firm levels, see http://us.ishares.com/portfolio_strategies/investment_strategies/sector_strategies.htm

performance coincides with popular belief. Computer software, for instance, should provide early expansion performance and basic materials should provide middle expansion performance. Table 4 also reports p-values from a Wald test under the null hypothesis that industry returns are not significantly different across business-cycle stages. However, in most cases, the p-values reject the null, indicating that industry performance varies across business-cycle stages. Sector rotation investors would find this initial result encouraging. Failure to reject the null hypothesis of equal returns would question the basic premise of sector rotation from the start.

Table 4 also reports average market returns beneath each business cycle stage. The analysis compares industry and market returns to provide a simple relative return metric. As an example, Table 4 reports transportation industry returns 1.84 percent, compared with 1.30 percent average monthly market returns for early expansion. The transportation industry thus provides market outperformance, where conventional wisdom expects. However, the realization of expected outperformance does not always occur. Out of the 48 industries, 29 have nominal returns higher than market returns, in the stage of expected outperformance. Thus, 60 percent of industries offer the expected higher nominal performance. Market outperformance, however, comes at a price. All but one industry (communications) has higher return volatility than the market. Observing average industry performance for two stages reveals surprising results. The 1.12 percent average return for industries expected to perform well in early expansion actually underperforms the market by 0.18 percent. Similarly, average returns for industries expected to perform well in middle expansion earn 0.13 percent less than the market.

Based on the initial results, popular belief holds true in the remaining three stages. Industries on average outperform the market, as expected, in late expansion, early recession, and late

recession. Nominal sector performance coincides only partially with popular expectations. Moreover, industry standard deviations and betas indicate that risk-adjusted performance will coincide even less with popular expectations. For instance, in early and middle expansion, average industry underperformance coincides with average standard deviations higher than the market.

The nominal industry performance results are not encouraging for sector rotation investors. The next section investigates whether industries provide systematic risk-adjusted business-cycle performance.

4.4. Risk-adjusted industry performance measures

Table 5 reports industry excess market returns, Jensen's alphas, Fama and French (1992) three-factor alphas, and Carhart (1997) four-factor alphas by business-cycle stage. The table reports performance alphas estimated with Equations 2 to 5.

Equation 2 estimates excess market industry performance (α^m), with a regression of excess market industry returns (r_i-r_m) on the five business-cycle dummy variables (D_s). The regression coefficient α_{is}^{m} measures market outperformance for industry *i* during business cycle stage *s*. The results show that 7 of 48 industries, approximately one in seven, generate statistically significant excess market performance when expected. More than half of the significant excess market performance occurs in early and late recession. Notably, excess market performance comes before any adjustment for systematic exposure to known sources of risk, which the following analysis takes into account next.

$$r_{it} - r_{mt} = \sum_{s=1}^{5} \alpha_{is}^{m} D_{st} + \varepsilon_{it} \qquad \text{(Eq. 2)}$$

Equation 3 estimates a Jensen's alphas (α^J) attributable to each business-cycle stage with a modified single-index model.

$$r_{it} - rf_t = \sum_{s=1}^{5} \alpha_{is}^{J} D_{st} + \sum_{s=1}^{5} \beta_{m,is} (r_{mt} - rf_t) D_{st} + \varepsilon_{it} \qquad \text{(Eq. 3)}$$

Equation 3 runs a regression of industry returns in excess of the one-month Treasury bill (r_i-rf) on one of five business-cycle timing variables (D_s) and the conditional market risk premium (r_m-rf). The Fama and French market index represents the market proxy.

To ensure the results do not depend on exposure to other well-known risk factors, the analysis also estimates Fama and French three-factor alphas and Carhart four-factor alphas. The Fama and French alphas (α^F), estimated with Equation 4, control for size and value risk factors in addition to market risk. Lastly, the Carhart four-factor alphas (α^C), estimated with Equation 5, add a momentum factor to the Fama and French three-factor model.

$$r_{it} - rf_t = \sum_{s=1}^{5} \alpha_{is}^{F} D_{st} + \sum_{s=1}^{5} \left[\beta_{is}^{m} (r_{mt} - rf_t) + \beta_{is}^{s} SMB_t + \beta_{is}^{v} HML_t \right] D_{st} + \varepsilon_{it} \qquad \text{(Eq. 4)}$$

$$r_{it} - rf_t = \sum_{s=1}^{5} \alpha_{is}^{C} D_{st} + \sum_{s=1}^{5} \left[\beta_{is}^{m} (r_{mt} - rf_t) + \beta_{is}^{s} SMB_t + \beta_{is}^{v} HML_t + \beta_{is}^{c} MOM_t \right] D_{st} + \varepsilon_{it} \qquad \text{(Eq. 5)}$$

Regardless of the risk-adjusted alpha performance measure, there is scant evidence of statistically significant industry outperformance where popular belief would suggest. The performance results strengthen the earlier findings reported for nominal returns. Based on Jensen's alphas, there are four industries with significant outperformance. Based on the Fama and French three-factor model, and using the Carhart four-factor model, there are no industries with significant outperformance – only the ones with significant underperformance.

5. Sector Rotation Performance

Can conventional sector rotation still be profitable, despite limited evidence of systematic industry performance? This section focuses on strategy implementation, observing the performance of sector rotation across the last 10 business cycles. The strategy assumes investors perfectly time NBER business-cycle stages and rotate the 48 Fama-French industries following the conventional sector rotation strategy and compares the result with a simple market investment. Panel A of Table 6 provides mean monthly returns, as well as strategy Sharpe ratios and standard deviations.

Sector rotation outperformance amounts to an average of 0.11% per month, which, at first glance appears economically large. However, in perspective, this number presents the maximum outperformance. Only the investors who followed popular market wisdom over the last 70 years, ignored transaction costs, and perfectly timed the last 10 business cycles would have realized 0.11% per month outperformance. It is also important to note that sector rotation strategy has a higher standard deviation, higher beta, and lower Sharpe ratio than the simple market portfolio.

Siegel (1991) suggests a simpler market timing strategy, showing that shifting between equities and cash at business cycle turning points generates significant outperformance. However, Siegel (1991) also recognizes the difficulty in correctly timing business cycles. To provide perspective on sector rotation outperformance, the results also report the performance of the simpler market-timing strategy suggested by Siegel (1991). Here, the analysis assumes a theoretical investor who correctly times NBER recessions and expansions. Such an investor, shifting from equities to cash early recession and back to equities late recession, would have realized 0.15 percent average monthly outperformance. That same investor would have also held a more diversified market portfolio, subject to less industry-specific risk.

Under a more realistic assumption of transaction costs, the results for sector rotation strategy become even bleaker. Transaction costs, both explicit and implicit, are difficult to estimate precisely. Estimated transaction costs include commissions, bid-ask spread, and market impact. Actual costs depend on the stock, where it trades, and when it trades.[10] Estimates vary considerably and change over the sample.[11] As an allowance, we estimate transaction costs that range between 0.5 and 1.5 percent. Sector rotation has 53 round-trip transactions and the market-timing strategy has 21 round-trip transactions from 1948 to 2018. With the inclusion of transaction costs, the base-case sector rotation outperformance decreases to between 0.07 to 0.01 percent and becomes statistically indistinguishable from zero. The alternative market-timing strategy increases in relative outperformance, owing to fewer transactions.

Thus far, the results indicate only marginal sector rotation outperformance for sector rotation implemented in accordance with popular wisdom, even if one assumes investors can correctly time business cycles. Results for industries expected to perform well in early expansion and middle expansion are particularly disappointing. Still, it would be premature to conclude that sector rotation does not work. Investors may use different industry or sector classifications, different business-cycle indicators, or different business-cycle stages. Alternatively, investors may time business cycles in advance or with a delay, which could generate outperformance.

The robustness tests also investigate whether the results improve if investors anticipate changes in business-cycle turning points earlier or later. In addition to NBER business cycles, the analysis tests business-cycle stages constructed from the CFNAI. The analysis concludes with

[10] See for example Goyenko, Holden, and Trzcinka (2009) and Hasbrouck (2009).
[11] Estimates of total trading costs vary greatly depending on the study. For instance, Lesmond, Schill, and Zhou (2004) estimate round-trip transaction costs of 1 to 2 percent for most large-cap trades while Keim and Madhavan (1998) estimate total round-trip transaction costs as low as 0.2 percent.

the total relaxation of any specific sector rotation model, testing for the systematic performance of any sector across any business-cycle stage.

6. Robustness Checks

The analysis thus far has focused on a fairly specific version of a sector rotation strategy – a five stage, 48-industry model based on Stovall's (1996) rotation logic. While this particular model is widely used, it is one of potentially thousands of sector rotation models available for an investor. We now gradually relax the assumptions. We start by considering alternative industry groupings. We then consider alternative business cycle stage delineations, an alternative way to measure the business cycle, as well as timing the cycle in advance or with a delay. We then deviate from Stovall's model and consider every possible form of a sector rotation strategy. We then relax the assumptions even further, looking if any industry's performance can act as a predictor of any other industry's returns irrespective of the business cycle.

6.1. Alternative sector/industry groups

There are alternative sector and industry classifications available to sector rotation investors. As such, our analysis might merely reflect a particular industry grouping. The following analysis investigates the performance of two alternative sector and industry groups. The analysis maps the original Fama and French 49 industries to 10 sector portfolios and 23 major industry portfolios, as listed in Table A1. The 10 sector portfolios are constructed following the Kacperczyk, Sialm, and Zheng (2005) mapping of the Fama and French 48 portfolios. The additional computer software industry included in the Fama and French 49 industry portfolios goes into the business equipment and services sector. Additionally, the analysis maps the Fama and French 49 industries to one of 23 GICS major industry groups. The Global Industry Classification Standard (GICS), first introduced in 1999, provides a widely accepted alternative

to SIC classifications.[12] Bhojraj, Lee, and Oler (2003) report GICS classifications are superior to alternative classification schemes.

The results are presented in Panel B of Table 6. Both 10-sector and 23-industry groupings generate similar mean monthly sector rotation returns to the ones generated by 49 Fama-French industries (1.03% and 0.99% vs. 1.00%). Neither grouping generates mean returns higher than a simple market timing strategy. Sector rotation performance based on alternative industry groupings is also inferior to market timing in terms of volatility, beta, and Sharpe ratio. This leads us to believe that our results are not driven by a particular industry classification[13].

6.2. Alternative business cycle stage delineation

Arguably, business cycle stage delineations are arbitrary. Although the five-stage analysis follows a common approach, one can potentially construct any number of business cycle partitions. As a result, the base-case results face criticism that they are specific to particular delineation of business cycle stages. The NBER officially dates the U.S. business cycle peaks and troughs, delineating one stage of expansion and one stage of contraction. DeStefano (2004) further separates the NBER stages of expansion and contraction into two equal halves, four stages in all. The following analysis considers both NBER two-stage and DeStefano (2004) four-stage partitions, to verify that the results are robust to alternative business cycle stage definitions. The two-stage analysis uses NBER cycle dates to delineate one stage of expansion and one stage of recession. The two-stage analysis maps early, middle, and late expansion industries into one stage expansion, and early and late recession industries into one stage of recession. The four-stage analysis further divides expansions and recessions in halves. Early

[12] For details, see http://www2.standardandpoors.com/spf/pdf/index/GICS_methodology.pdf

[13] We have also produced tables similar to that of Tables 4 and 5 (descriptive statistics and risk adjusted performance measures) for alternative industry classifications. The results are equally unimpressive and are not reported to save space. They are available from the corresponding author upon request.

and late expansion stages last on average 302 and 314 months. Early and late recessions last on average 53 and 51 months, identical to the five-stage analysis.

The results for sector rotation strategy performance based on two- and four-stage business cycle delineations are reported in Panel C of Table 6.[14] The strategy based on two-stage delineation underperforms the market portfolio across all dimensions. Although the strategy based on four-stage delineation marginally outperforms the five-stage strategy, it is still inferior to the market timing strategy reported in Panel A, having lower outperformance (0.12% vs. 0.15%), higher standard deviation (4.85% vs. 3.99%), higher beta (1.04 vs. 0.89), and lower Sharpe ratio (0.21 vs. 0.26). Overall, alternative specifications of business cycle partitions provide no improvement on the base case and the previous results continue to hold.

6.3. Alternative way to measure the business cycle

This section considers the Chicago Federal Reserve National Activity Index (CFNAI) and Conference Board Leading Indicator as alternatives to NBER cycle dates. As results for these two indicators are similar, the analysis focuses on the CFNAI.[15] In contrast to static NBER defined phases of expansion or recession, the CFNAI provides a continuous measure of business cycle conditions. The CFNAI incorporates 85 economic variables that cover four broad categories: production and income; employment, unemployment, and hours; personal consumption and housing; and sales, orders, and inventories. CFNAI construction follows the methodology of Stock and Watson (1989), who create an index based on the first principal components of a large number of variables that track economic activity. By construction, the CFNAI has a zero mean and unit standard deviation. Positive (negative) CFNAI values indicate

[14] Just as with alternative industry groupings, we have produced industry descriptive statistics and risk-adjusted performance measures. Just as with base-case results, we find very limited evidence of systematic industry outperformance across business cycles. The results are not reported to save space. They are available from the corresponding author upon request.
[15] The CFNAI and detrended Conference Board leading indicator have a 78 percent correlation coefficient. Both indices thus reveal similar business cycle information. The study focuses on the CFNAI because it is freely available to the public and released monthly by the Chicago Federal Reserve Bank.

above (below) trend economic activity. Publication of the CFNAI began in 2001 with data available from 1967.[16] Figure 4 overlays the CFNAI on NBER delineated phases of economic expansion and contraction (shaded area). The CFNAI closely tracks NBER cycle dates, with some variation. The variation may better reflect investor uncertainty when attempting to pinpoint real-time changes in business-cycle stages.

The analysis partitions CFNAI business cycles into five equal stages. CFNAI values of 0.702, 0.312, -.0113, and -.637 delineate stages of early expansion through late recession. We then proceed as with the five-stage NBER business cycle delineation. Sector rotation strategy results are presented in the last line of Table 6 (Panel C). Such a strategy underperforms across the board. All performance characteristics are inferior to market, market timing, as well as all previously reported sector rotation strategies.

6.4. Timing the business cycle in advance or with a delay

Investors might profit from consistently timing the business cycle incorrectly. Suppose that investors consistently assume that turning points occur earlier or with a delay from actual NBER business cycle dates. If so, the base-case scenario might underestimate actual sector rotation outperformance. To explore that possibility, the analysis advances the implementation of sector rotation by one month, two months, and three months prior to NBER business-cycle turning points. Similarly, the analysis considers delays from one to three months. Table 7 presents results before transactions costs.

There appears to be some benefit to anticipating business cycle one and two months in advance when it comes to sector rotation strategy. However, (1) the improvement is very marginal and (2) strategy performance remains inferior to that of simple market timing.

[16] More information is available at http://www.chicagofed.org/economic_research_and_data/cfnai.cfm

6.5. Analyzing all possible sector rotation strategies

While the preceding robustness checks have relaxed a number of assumptions, the basic model is still based on the one described in Stovall (1996). Conventional sector rotation presupposes the sequential performance of sectors across business cycle stages. For instance, Standard & Poor's sequencing in Figure 1 shows that performance in the technology sector follows the performance in the financial sector, which in turn follows performance in the utilities sector. Figure 1 further illustrates other representative sequential patterns of sector performance. While it depicts largely congruent beliefs on sequential sector performance, other variations are possible. After all, throughout the analysis we have assumed that agricultural sector, however defined, performs better in expansions, however defined. This assumption is reasonable, but it is an assumption nonetheless. One could come up with a plausible argument that agricultural sector should outperform in recession.

We now explicitly address this by analyzing every possible combination of sector rotation strategy using a 10-sector industry definition and a two-stage business cycle partition. This gives us 1,022 possible strategies. Return distribution of all of the possible strategies are presented in Figure 4.

The results provide even more discouragement for a potential sector rotation investor. Average return of these strategies is 0.86% per month, actually lower than that of a buy-and-hold strategy of 0.89% (coincidentally, a two-stage partitioning model based on Stovall (1996) also provides a raw return of 0.89%). A market-timing strategy based on a two-stage business cycle partition (invest in an index during booms and in T-bills during recessions) yields an average monthly return of 0.91%

Not surprisingly, some sector rotation strategies outperform both a buy-and-hold and a market timing strategy. Only 35 out of 1,022 strategies (3.4%) outperform the market timing strategy, and only 132 out of 1,022 (12.9%) outperform the buy-and-hold. Accounting for transaction

costs will make these strategies even less attractive. The mean of sector rotation strategies is significantly lower than that of a buy-and-hold, providing strong evidence that any outperformance of sector rotation strategies is due to data snooping.

6.6. Sequential industry performance

Although our analysis considers alternative stages, the actual progression of sector performance across business cycles may not fully align with those partitions. To overcome such obstacles, we next relax any assumed pattern of sequential performance and completely ignore business cycle stages. The analysis tests whether the excess market returns of one sector predict future excess market returns of other sectors at different lags. The analysis examines lags from one to 24 months, to allow for different performance sequencing and business cycle stage durations.

Figure 5 illustrates the distribution of t-statistics for cross-sector predictability of excess sector performance. First, the analysis maps the Fama-French 49 industries to 10 equally weighted sector portfolios following Table A1. Next, the analysis runs individual regressions of excess market sector returns on the excess market returns of the remaining sectors at lags from one to 24 months. In total, there are 2,160 (10 x 9 x 24) t-statistics, covering all possible combinations of sectors and lags. Figure 5 compares the resultant t-statistic distribution against an expected normal distribution. The figure illustrates that the distribution of t-statistics for excess market predictability follows a normal distribution. Under a normal distribution and a 10 percent significance level, the estimations should indicate 5 percent positive significance and 5 percent negative significance – even in the absence of actual excess market predictability. In total, t-statistics are significantly positive 6 percent of the time and significantly negative 5 percent of the time. Most significant predictability occurs at a one-month lag, indicating some short-term cross-sector momentum. Cross-sector predictability is only marginally higher than a normal

distribution. As such, the results suggest that cross-sector predictability occurs only randomly, without indicating any real evidence of statistically significant sequential sector performance.

7. Conclusion

Despite thorough empirical tests, there is scant evidence that conventional sector rotation across business cycles generates systematic excess returns. The analysis assumes that sector rotation investors perfectly time business cycles and rotate sectors in accordance with popular belief on sector performance. Even then, sector rotation generates, at best, 0.11 percent monthly outperformance. Performance quickly diminishes with the introduction of transaction costs or business cycle mistiming. In comparison, a similar investor, with perfect market timing ability, would realize 0.15 percent monthly outperformance by simply switching to cash during early recession.

The analysis generalizes the base case to allow for all possible sector rotation variations. The analysis explores whether any industry provides systematic performance across any business-cycle stage. The general results again provide limited evidence of systematic industry performance over business cycles. The results suggest that no variation of sector rotation provides systematic outperformance, questioning the popular belief that timing sector investments with business cycles generate excess returns. The results do not necessarily preclude investors from profiting through sector rotation. Different investments in sector and industry funds, beyond the scope of this study, may outperform the market. The results simply show that sectors fail to provide systematic performance across the business cycle and question the viability of popular sector rotation.

References

Ahmed, P., L. Lockwood, and S. Nanda, 2002, Multi-style rotation strategies, *Journal of Portfolio Management* 28, 17-29.

Avramov, D. and R. Wermers, 2006, Investing in mutual funds when returns are predictable, *Journal of Financial Economics* 81, 339-377.

Balvers, R., T. Cosimano, and B. McDonald, 1990, Predicting stock returns in an efficient market, *The Journal of Finance* 45, 1109-1128.

Beber, A., M. Brandt, and K. Kavajecz, 2010, What does equity sector order flow tell us about the economy? *Review of Financial Studies* 24, 3688-3730.

Bhojraj, S., C. Lee, and D. Oler, 2003, What's my line? A comparison of industry classification schemes for capital market research, *Journal of Accounting Research* 41, 745-774.

Bodie, Z., A. Kane, and A. Marcus, 2009. Investments (McGraw Hill Irwin)

Boyd, J., J. Hu, and R. Jagannathan, 2005, The stock market's reaction to unemployment news: Why bad news is usually good for stocks, *Journal of Finance* 60, 649-672.

Brocato, J. and S. Steed, 1998, Optimal asset allocation over the business cycle, *The Financial Review* 33, 129-148.

Campbell, J., 1987, Stock returns and the term structure, *Journal of Financial Economics* 18, 373-399.

Carhart, M., 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57-82.

Cavaglia, S., C. Brightman, and M. Aked, 2000, The increasing importance of industry factors, *Financial Analysts Journal* 56, 41-54.

Chava, S., A. Hsu, and L. Zeng, 2018. Does history repeat itself? Business cycle and industry returns. *SSRN working paper.*

Chen, N., 1991, Financial investment opportunities and the macroeconomy, *Journal of Finance* 46, 529-554.

Chen, N., R. Roll, and S. Ross, 1986, Economic forces and the stock market, *The Journal of Business* 59, 383-403.

Conover, M., G. Jensen, R. Johnson, and J. Mercer, 2008, Sector rotation and monetary conditions, *Journal of Investing* 34-46.

Cover, J. and P. Pecorino, 2005, The length of u.S. Business expansions: When did the break in the data occur?, *Journal of Macroeconomics* 27, 452-471.

DeStefano, M., 2004, Stock returns and the business cycle, *Financial Review* 39, 527-547.

Elton, E., M. Gruber, and C. Blake, 2011, An examination of mutual fund timing ability using monthly holding data, *Review of Finance* 3, 619-645.

Fabozzi, F., 2007. Fixed income analysis (Wiley).

Fama, E. and K. French, 1989, Business conditions and expected returns on stocks and bonds, *Journal of Financial Economics* 25, 23-49.

Fama, E. and K. French, 1992, The cross-section of expected stock returns, *Journal of Finance* 47, 427-465.

Fama, E. and K. French, 1997, Industry costs of equity., *Journal of Financial Economics* 43, 153-193.

Goyenko, R., C. Holden, and C. Trzcinka, 2009, Do liquidity measures measure liquidity?, *Journal of Financial Economics* 92, 153-181.

Guris, S., and A. Pala, 2014. Equity returns, firm-specific characteristics and sector rotation: Evidence from Turkey. *International Journal of Economics and Financial Issues* 4, 264-276.

Hamilton, J. and G. Lin, 1996, Stock market volatility and the business cycle, *Journal of Applied Econometrics* 11, 573-593

Hasbrouck, J., 2009, Trading costs and returns for U.S. Equities: Estimating effective costs from daily data, *Journal of Finance* 64, 1445-1477.

Hong, H. and J. Stein, 1999, A unified theory of underreaction, momentum trading, and overreaction in asset markets, *Journal of Finance* 54, 2143-2184.

Hong, H., W. Torous, and R. Valkanov, 2007, Do industries lead stock markets?, *Journal of Financial Economics* 83, 367-396.

Jensen, G., J. Mercer, and R. Johnson, 1996, Business conditions, monetary policy, and expected security returns, *Journal of Financial Economics* 40, 213-237.

Jiang, G., T. Yao, and T. Yu, 2007, Do mutual funds time the market? Evidence from portfolio holdings, *Journal of Financial Economics* 86, 724-758.

Kacperczyk, M., C. Sialm, and L. Zheng 2005, On the industry concentration of actively managed equity mutual funds, *Journal of Finance* 60, 1983-2011.

Keim, D. and A. Madhavan, 1998, The cost of institutional equity trades, *Financial Analysts Journal* 54, 50-69.

Keim, D. and R. Stambaugh, 1986, Predicting returns in the stock and bond markets, *Journal of Financial Economics* 17, 357-390.

Lesmond, D., M. Schill, and C. Zhou, 2004, The illusory nature of momentum profits, *Journal of Financial Economics* 71, 349-380.

Lofthouse, S., 2001. Investment management (Wiley).

Levis, M. and M. Liodakis, 1999, The profitability of style rotation strategies in the United Kingdom, *Journal of Portfolio Management*.

Lochstoer, L., 2009, Expected returns and the business cycle: Heterogeneous goods and time-varying risk aversion, *Review of Financial Studies* 22, 5251-5294.

Lynch, A., J. Wachter, and W. Boudry, 2004, Does mutual fund performance vary over the business cycle?, AFA 2004 San Diego Meetings.

Markese, J., 1986, The stock market and business cycles, *AAII Journal* 8, 30-32.

McQueen, G. and V. Roley, 1993, Stock prices, news, and business conditions., *Review of Financial Studies* 6, 683.

Moore, G., 1974, Some secular changes in business cycles, *The American Economic Review* 64, 133-137.

Petkova, R., 2006, Do the fama-french factors proxy for innovations in predictive variables, *The Journal of Finance* 61, 581-612.

Salsman, R., 1997, Using market prices to guide sector rotation, (CFA Institute).

Sarwar, G, C. Mateus and N. Todorovic, 2018. US sector rotation with five-factor Fama-French alphas, *Journal of Asset Management* 19, 116-132.

Siegel, J., 1991, Does it pay stock investors to forecast the business cycle, *Journal of Portfolio Management* Fall, 27-34.

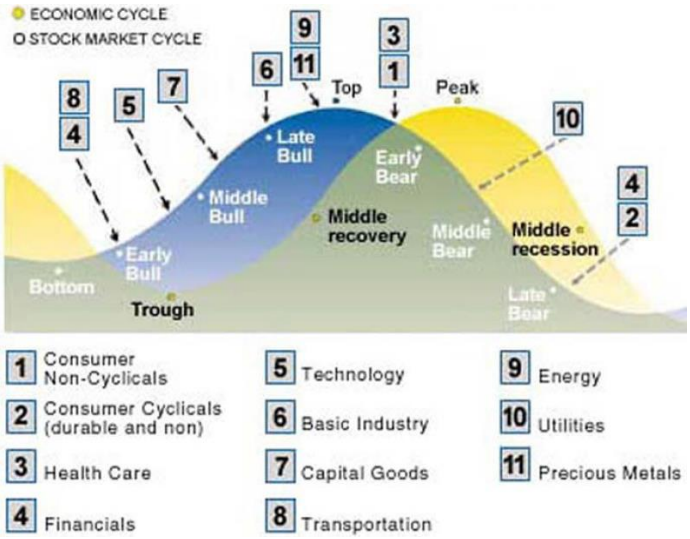
Schwert, W., 1990, Stock returns and real activity: A century of evidence., *Journal of Finance* 45, 1237.

Stock, J. and M. Watson, 1989, New indexes of coincident and leading economic indicators, *NBER macroeconomics annual* 351-394.

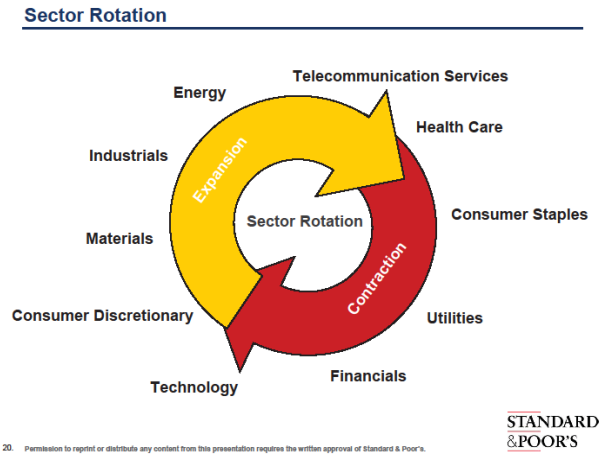
Stock, J. and M. Watson, 1999, Business cycle fluctuations in U.S. Macroeconomic time series, Handbook of Macroeconomics (Elsevier), Chapter 1.

Stovall, S., 1996. *Standard & poor's guide to sector investing* (McGraw-Hill).

Figure 1. Popular guidance on sector rotation



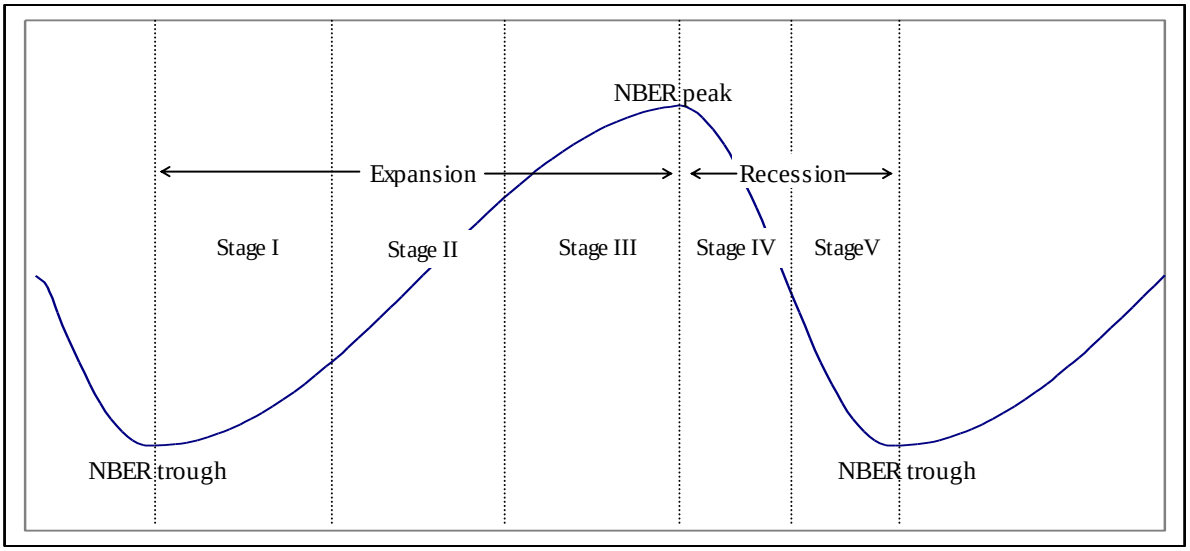
http://personal.fidelity.com/products/funds/content/sector/cycle.shtml



http://www2.standardandpoors.com/spf/pdf/index/Global_Sector_Investing.pdf

Figure 2. Stylized business cycles with stage partitions

Figure 2 illustrates a stylized 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 run from the month following a trough to the next peak and phases of recession run from the month following a peak to the next trough. Similar to Stovall (1996) and common practice, the analysis divides expansions into three equal stages (early/middle/late) and recessions into two stages (early/late).



Stages of Expansion	
Early Expansion (Stage I)	241 months
Middle Expansion (Stage II)	242 months
Late Expansion (Stage III)	242 months

Stages of Recession	
Early Recession (Stage IV)	62 months
Late Recession (Stage V)	60 months

Figure 3. CFNAI delineated business cycle stages

Figure 3 illustrates the CFNAI economic indicator over the period 1968–20018. Shaded areas indicate NBER defined periods of economic contraction. The analysis partitions the range of CFNAI values over 1968–2018 into five equal periods of economic activity. The five periods correspond to early expansion (SI), middle expansion (SII), late expansion (SIII), early recession (SIV), and late recession (SV). Business-cycle stage delineations are at CFNAI values of 0.702, 0.312, -.0113, and -.637 for boundaries SI|SII, SII|SIII, SIII|SIV, and SIV|SV respectively.

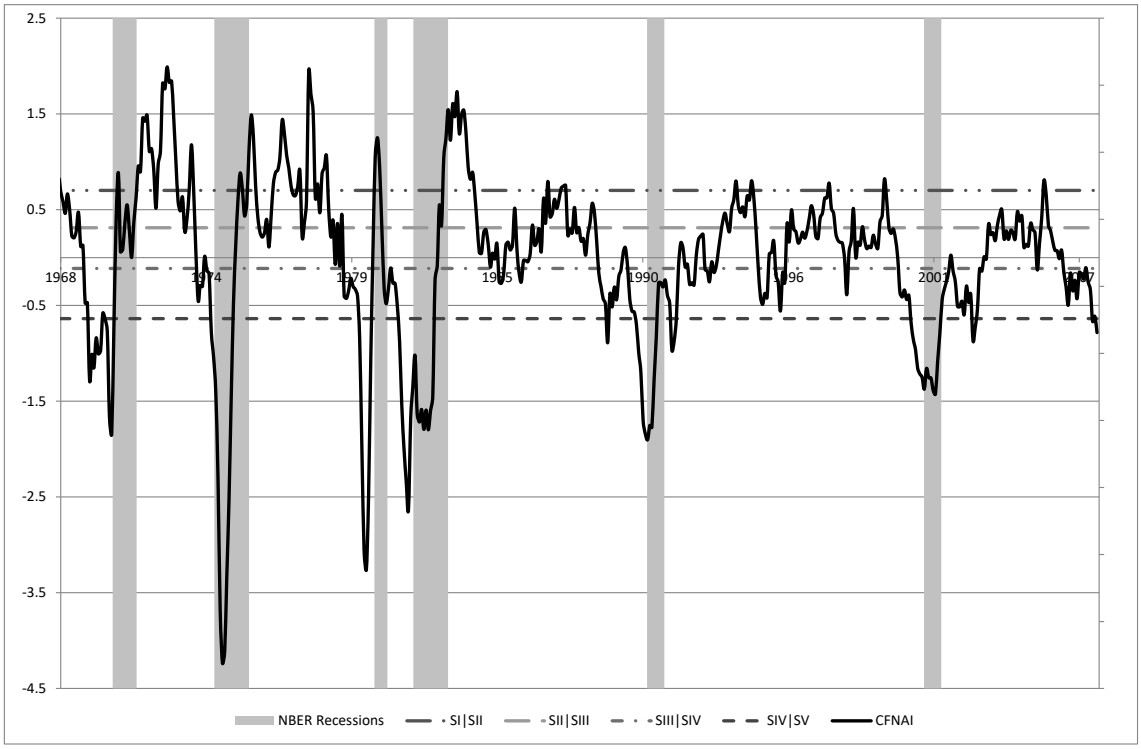


Figure 4. Distribution of all possible sector strategy returns

Figure 4 presents the distribution of returns of 1,022 sector rotation strategies formed by 10 sectors using a two-stage business cycle partition.

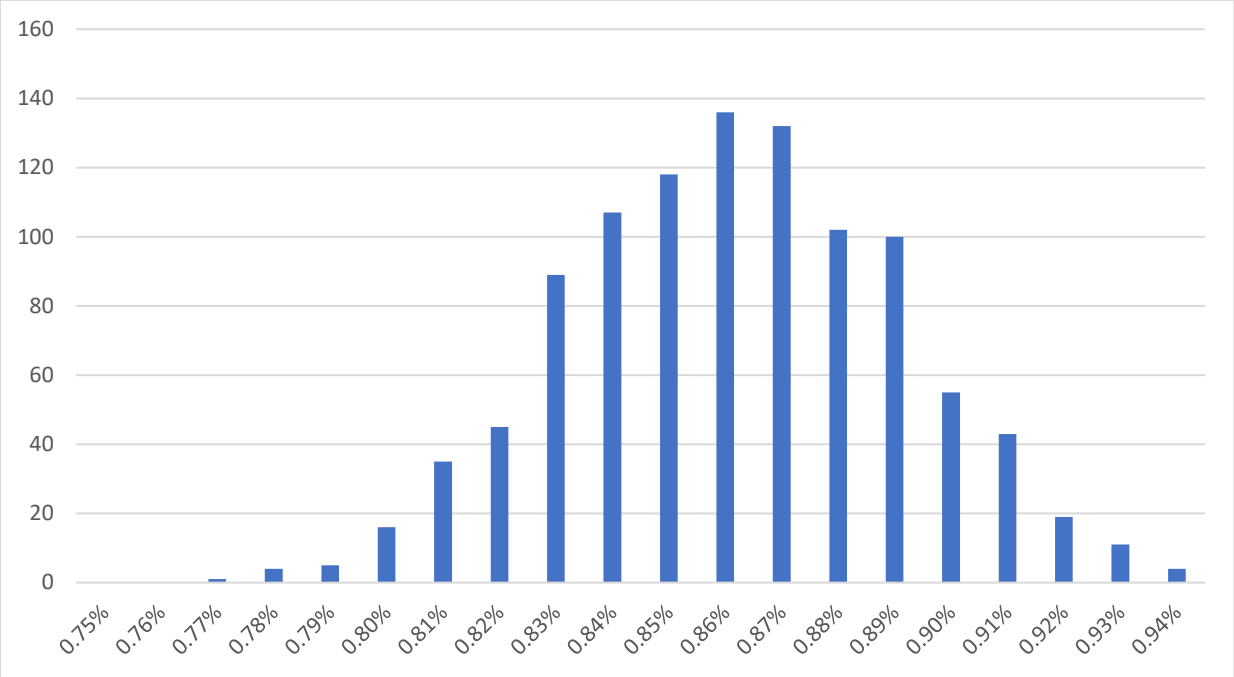


Figure 5. Predictability of excess industry performance

Figure 5 illustrates the distribution of t-statistics for cross-sector predictability of excess market performance. The analysis constructs sector rotation portfolios from the Fama and French 49 industries mapped to one of 10 GICS sectors reported in Table A1. The analysis tests lags from one to 24 months to allow for the possibility of different performance sequencing and business cycle stage durations. To illustrate, Figure 1 shows financial sector returns should predict subsequent technology sector returns. There are 2,160 t-statistics, covering all possible combinations of cross-sector predictability at up to 24 lags.

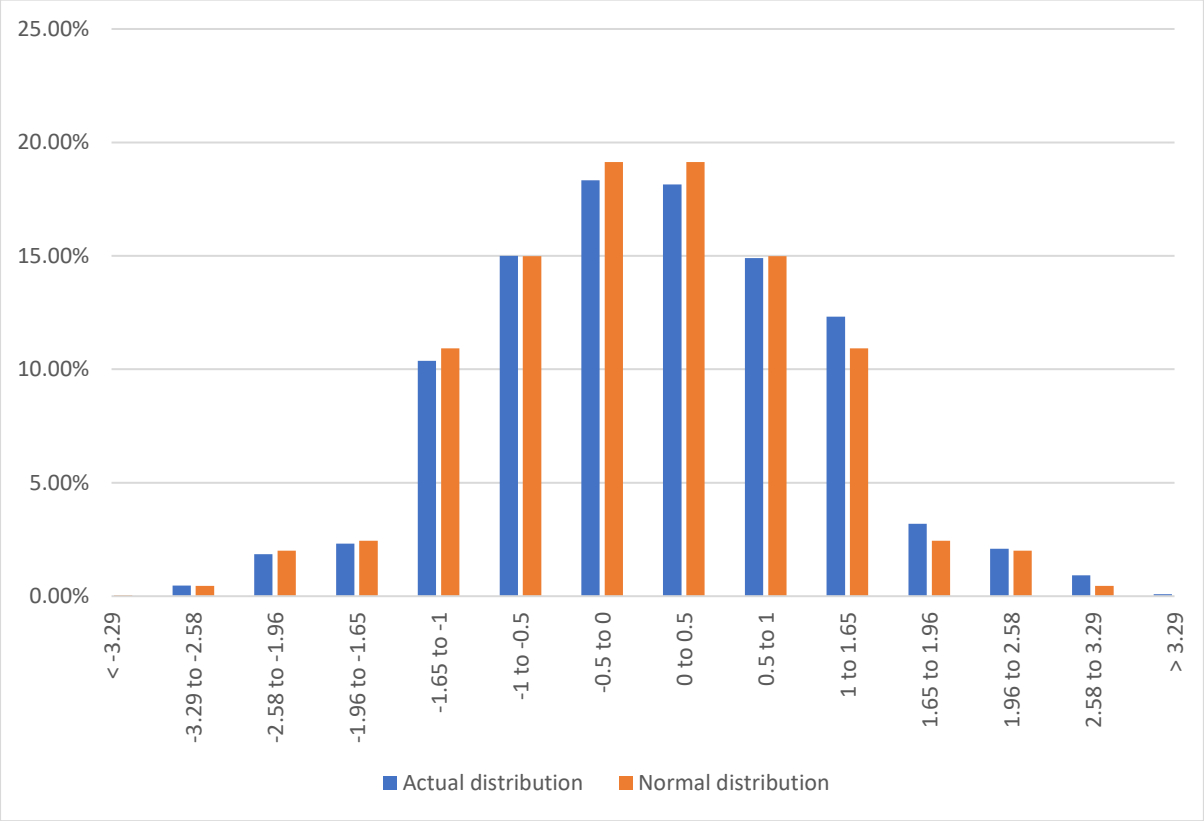


Table 1. NBER reference business cycle dates and stage partitions

Panel A of Table 1 reports NBER published business cycle peak and trough reference dates. Periods of recession run from the first month following a cycle peak to the subsequent trough, and periods of expansion run from the first month following a cycle trough to the subsequent peak. The sample covers 10 business cycles from 1948 to 2007, enumerated in the first column. The last column reports the total months in a business cycle from one month after a peak to the next peak. The last recorded NBER business cycle date is the economic peak dated December 2007. Panel B of Table 1 reports the duration in months for stages of expansion and recession that correspond with the business cycles reported in Panel A. The analysis partitions NBER defined periods of expansion into three equal stages (early, middle, and late) and NBER defined periods of recession into two equal stages (early and late). The bottom of Panel B reports the average duration of each business cycle stage.

Panel A:	NBER business cycle dates from Jan 1948 - Dec 2007			
Business Cycle	Peak Date	Trough Date	Peak Date	Total Months
1	11/48	10/49	07/53	56
2	07/53	05/54	08/57	49
3	08/57	04/58	04/60	32
4	04/60	02/61	12/69	116
5	12/69	11/70	11/73	47
6	11/73	03/75	01/80	74
7	01/80	07/80	07/81	18
8	07/81	11/82	07/90	108
9	07/90	03/91	03/01	128
10	03/01	11/01	12/07	81

Panel B:	Number of months in NBER delineated business cycle stages						
Business	Periods of Recession			Periods of Expansion			
Cycle	Early Stage Months	Late Stage Months	Total Months	Early Stage Months	Middle Stage Months	Late Stage Months	Total Months
1	6	5	11	15	15	15	45
2	5	5	10	13	13	13	39
3	4	4	8	8	8	8	24
4	5	5	10	35	35	36	106
5	6	5	11	12	12	12	36
6	8	8	16	19	19	20	58
7	3	3	6	4	4	4	12
8	8	8	16	30	31	31	92
9	4	4	8	40	40	40	120
10	4	4	8	25	25	23	73
stage average:	5	5	10	20	20	20	60

Table 2. Business cycle proxies across business cycle stages

Panel A of Table 2 lists the expected change in business cycle proxies from one business cycle stage to the next. Panel B of Table 2 reports business cycle proxy means by business cycle stage and changes in means from the preceding stage estimated with Equation 1, where business cycle dummy variables (D_s) take the value of one or zero depending on the current business cycle stage. The analysis then calculates the difference in proxy means between successive business cycle stages. As an example, Panel B reports an average 0.3% difference in term-spread between the stages of early expansion and late recession (γ_1-γ_5). Lastly, the analysis performs a simple difference in means test, to verify the statistical significance of the difference in means between the current and preceding stage. The table reports p-values under a null hypothesis of no difference in proxies across successive business cycle stages, formally stated as Ho: $\gamma_s=\gamma_{s-1}$.

Panel A:	Change Early Expansion	Change Middle Expansion	Change Late Expansion	Change Early Recession	Change Late Recession
Term-spread	negative	negative	negative	positive	positive
Default-spread	negative	negative	negative	positive	positive
Dividend yield	negative	negative	negative	positive	positive
Unemployment	negative	negative	negative	positive	positive
Industrial production	positive	positive	positive	negative	negative

Panel B:	Stage I Early Expansion			Stage II Middle Expansion			Stage III Late Expansion			Stage IV Early Recession			Stage V Late Recession		
Factor	Mean	Change	p-value	Mean	Change	p-value	Mean	Change	p-value	Mean	Change	p-value	Mean	Change	p-value
Term-spread	0.021	0.003	0.00	0.014	-0.007	0.00	0.006	-0.009	0.00	0.098	0.004	0.00	0.018	0.008	0.00
Default-spread	0.009	-0.005	0.00	0.007	-0.002	0.00	0.008	0.001	0.32	0.010	0.002	0.00	0.014	0.004	0.00
Dividend yield	0.033	-0.010	0.00	0.030	-0.003	0.02	0.030	0.000	0.38	0.041	0.010	0.00	0.043	0.002	0.23
Unemployment	1.934	-0.001	0.51	1.684	-0.250	0.00	1.482	-0.202	0.00	1.662	0.180	0.00	1.936	0.274	0.00
Industrial production	-2.280	0.284	0.32	0.219	2.500	0.00	2.357	2.138	0.00	1.290	-1.064	0.14	-2.560	-3.850	0.00

Table 3. Business cycle stages of expected industry performance

Table 3 reports the business cycle stage of anticipated sector/industry outperformance following the Stovall (1996) classification and the investment websites illustrated in Figure 1. The table divides the periods of expansion into three equal stages (early/middle/late) and periods of recession into two equal stages (early/late). The Fama and French 49 industry portfolios (excluding "other") are mapped to corresponding sectors.

Period of Expansion			Period of Recession	
Early Expansion - Stage I	Middle Expansion - Stage II	Late Expansion - Stage III	Early Recession - Stage IV	Late Recession - 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 Mining	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		Restaurants, Hotels, Motels
	Electrical Equipment	Petroleum & Natural Gas		Retail
	Services:			Rubber & Plastic Products
	Business Services			Textiles
	Personal Services			Wholesale
				Financial:
				Banking
				Insurance
				Real Estate
				Trading

Table 4. Industry summary statistics by business cycle stages

Table 4 reports industry summary statistics for the business cycle stage popular belief anticipates outperformance will occur, as listed in Table 3. The table also reports Wald p-values under a null hypothesis of equal industry returns across all five business cycle stages. For comparative purposes, the table provides industry summary statistics for the full sample 1948-2018. The table reports equally weighted industry averages and market returns beneath each business cycle stage.

	Business Cycle Stage						Full Sample 1948:01-2007:12		
Sectors/Industries	no. firms	no. obs.	mean	std.dev.	beta	Wald p-value	mean	std.dev.	beta
Early Expansion - Stage I:									
Computers	90	241	1.17	6.48	1.34	0.00	0.97	6.75	1.22
Computer Software	175	169	0.27	9.08	1.48	0.01	0.38	11.11	1.63
Electronic Equipment	157	241	1.20	6.96	1.43	0.00	0.91	7.21	1.39
Measuring & Control	70	241	0.92	6.23	1.31	0.00	0.98	6.64	1.28
Shipping Containers	26	241	1.32	5.10	0.99	0.01	0.94	5.39	1.00
Transportation	93	241	1.84	4.93	1.00	0.00	0.85	5.54	1.07
Industry Averages			1.12	6.46	1.26	0.00	0.84	7.11	1.27
Market		241	1.30	3.90	1.00	0.00	0.89	4.23	1.00
Middle Expansion - Stage II:									
Chemicals	79	242	0.91	4.88	1.14	0.00	0.87	5.30	1.06
Steel Works	78	242	0.83	6.06	1.22	0.00	0.62	7.04	1.33
Precious Metals	20	206	0.11	9.97	0.61	0.29	0.44	10.26	0.62
Mining	24	242	0.55	6.72	1.17	0.00	0.81	6.96	1.09
Fabricated Products	20	206	0.64	6.74	1.03	0.00	0.51	7.25	1.13
Machinery	149	242	1.16	5.16	1.20	0.00	0.86	5.85	1.21
Electrical Equipment	68	242	1.30	5.43	1.27	0.00	1.02	6.02	1.23
Aircraft	25	242	1.43	5.80	1.14	0.00	1.09	6.54	1.13
Shipbuilding & Railroad	11	242	0.77	5.65	1.17	0.01	0.82	6.67	1.07
Defense	7	205	1.42	5.66	0.99	0.03	0.99	6.53	0.84
Personal Services	38	242	0.91	6.01	1.18	0.00	0.65	6.48	1.06
Business Services	166	242	1.11	4.48	1.04	0.00	0.85	5.26	1.08
Industry Averages			0.93	6.05	1.10	0.03	0.79	6.68	1.07
Market		242	1.06	3.72	1.00	0.00	0.89	4.23	1.00
Late Expansion - Stage III:									
Agriculture	11	242	0.89	6.29	0.81	0.00	0.71	6.29	0.89
Food Products	80	242	0.52	4.23	0.61	0.00	0.95	4.11	0.69
Candy & Soda	12	195	0.44	6.41	0.77	0.00	0.96	6.25	0.83
Beer & Liquor	15	242	0.78	5.35	0.80	0.00	0.98	4.89	0.77
Tobacco Products	9	242	1.07	5.73	0.39	0.22	1.12	5.66	0.63
Healthcare	74	165	0.79	8.75	1.17	0.00	0.70	8.18	1.13
Medical Equipment	87	242	1.07	4.87	0.85	0.02	1.08	5.43	0.92
Pharmaceutical	130	242	0.83	4.54	0.71	0.00	1.05	4.89	0.83
Coal	8	242	1.84	9.49	1.04	0.00	0.70	9.54	1.16
Petroleum & Natural Gas	136	242	0.96	5.07	0.75	0.00	0.95	5.23	0.84
Industry Averages			0.92	6.07	0.79	0.02	0.92	6.05	0.87
Market		242	0.65	4.06	1.00	0.00	0.89	4.23	1.00

Table 4 continued:

	Business Cycle Stage						Full Sample 1948:01-2007:12		
Sectors/Industries	**no. firms**	**no. obs.**	**mean**	**std.dev.**	**beta**	**Wald p-value**	**mean**	**std.dev.**	**beta**
Early Recession - Stage IV:									
Utilities	137	62	-0.32	4.92	0.79	0.02	0.85	3.77	0.53
Communication	43	62	-0.71	4.60	0.77	0.02	0.80	4.27	0.74
Industry Averages			-0.52	4.76	0.78	0.02	0.83	4.02	0.64
Market		62	-1.58	4.65	1.00	0.00	0.89	4.23	1.00
Late Recession - Stage V:									
Recreation	32	60	3.05	10.36	1.32	0.00	0.70	7.09	1.16
Entertainment	33	60	2.26	11.79	1.56	0.04	1.06	7.30	1.34
Printing & Publishing	32	60	2.87	8.81	1.22	0.00	0.85	5.81	1.09
Consumer Goods	82	60	2.39	6.70	0.94	0.00	0.89	4.58	0.83
Apparel	57	60	3.18	9.11	1.20	0.00	0.85	5.91	1.05
Rubber & Plastic	29	60	1.99	8.59	1.11	0.00	0.94	5.78	1.07
Textiles	46	60	1.81	13.18	1.67	0.00	0.77	6.64	1.12
Construction Materials	125	60	2.37	9.86	1.40	0.00	0.87	5.74	1.16
Construction	32	60	3.14	10.48	1.45	0.00	0.81	6.92	1.29
Automobiles & Trucks	65	60	1.94	10.77	1.37	0.00	0.79	6.37	1.15
Business Supplies	32	60	2.13	8.08	1.15	0.00	0.87	5.61	1.03
Wholesale	96	60	2.28	7.71	1.07	0.00	0.86	5.35	1.05
Retail	172	60	2.96	7.27	1.09	0.00	0.96	4.99	0.97
Restaurants & Hotels	48	60	2.95	8.14	1.09	0.00	0.98	5.81	1.02
Banking	151	60	1.98	9.34	1.30	0.06	0.90	5.60	1.02
Insurance	77	60	2.06	8.37	1.13	0.00	0.89	5.56	0.96
Real Estate	32	60	2.35	14.14	1.75	0.00	0.57	7.37	1.23
Trading	186	60	2.89	8.45	1.25	0.00	0.99	5.86	1.23
Industry Averages			2.48	9.51	1.28	0.01	0.86	6.02	1.10
Market		60	2.10	6.29	1.00	0.00	0.89	4.23	1.00

Table 5. Industry performance measures by business cycle stage

Table 5 reports industry excess market returns, Jensen's alphas, Fama and French (1992) three-factor alphas, and Carhart (1997) four-factor alphas for the business-cycle stages of expected outperformance listed in Table 3. Equations 2-5 estimate excess market returns, Jensen's alphas, Fama and French alphas, and Carhart alphas by business-cycle stage. Emboldened alpha performance indicates 10 percent statistical significance estimated with White (1980) heteroskedasticity consistent t-statistics.

	Excess Market		Jensen's alpha		Fama-French alpha		Carhart alpha	
Industries	α^m	**p-value**	α^J	**p-value**	α^F	**p-value**	α^C	**p-value**
Early Expansion - Stage I:								
Computers	-0.0029	0.37	**-0.0065**	**0.04**	**-0.0088**	**0.02**	**-0.0060**	**0.10**
Computer Software	-0.0052	0.45	-0.0091	0.20	-0.0117	0.12	-0.0114	0.14
Electronic Equip.	-0.0015	0.64	**-0.0060**	**0.07**	**-0.0084**	**0.04**	-0.0063	0.11
Measuring & Control	**-0.0065**	**0.03**	**-0.0097**	**0.00**	**-0.0119**	**0.00**	**-0.0110**	**0.00**
Shipping Containers	-0.0004	0.87	-0.0003	0.89	-0.0050	0.12	-0.0051	0.12
Transportation	**0.0080**	**0.00**	**0.0080**	**0.00**	0.0022	0.45	0.0010	0.72
Industry Average:	-0.0014		-0.0039		-0.0073		-0.0065	
Middle Expansion - Stage II:								
Chemicals	-0.0018	0.35	-0.0029	0.15	**-0.0081**	**0.01**	**-0.0069**	**0.02**
Steel Works	0.0006	0.84	-0.0009	0.77	**-0.0069**	**0.08**	-0.0055	0.15
Precious Metals	-0.0081	0.32	-0.0053	0.54	-0.0108	0.23	-0.0088	0.35
Mining	-0.0060	0.13	**-0.0072**	**0.08**	**-0.0139**	**0.01**	**-0.0129**	**0.01**
Fabricated Products	-0.0012	0.79	-0.0012	0.78	0.0000	0.99	0.0018	0.74
Machinery	0.0017	0.40	0.0002	0.90	**-0.0059**	**0.06**	-0.0048	0.11
Electrical Equip.	0.0016	0.48	-0.0003	0.87	**-0.0060**	**0.06**	**-0.0064**	**0.04**
Aircraft	0.0024	0.44	0.0013	0.68	-0.0042	0.26	-0.0057	0.13
Shipbuilding/Railroad	-0.0030	0.35	-0.0043	0.18	**-0.0057**	**0.01**	**-0.0095**	**0.02**
Defense	0.0029	0.46	0.0029	0.48	-0.0009	0.84	-0.0024	0.59
Personal Services	0.0012	0.71	0.0001	0.97	-0.0052	0.15	-0.0045	0.22
Business Services	0.0013	0.47	0.0009	0.59	-0.0036	0.16	-0.0032	0.20
Industry Average:	-0.0007		-0.0014		-0.0059		-0.0057	
Late Expansion - Stage III:								
Agriculture	0.0059	0.14	0.0064	0.11	-0.0006	0.87	0.0000	0.90
Food Products	-0.0026	0.32	-0.0017	0.51	**-0.0090**	**0.00**	**-0.0085**	**0.00**
Candy & Soda	-0.0021	0.60	-0.0011	0.77	**-0.0119**	**0.02**	**-0.0111**	**0.03**
Beer & Liquor	0.0007	0.83	0.0120	0.70	**-0.0059**	**0.07**	-0.0051	0.13
Tobacco Products	0.0026	0.55	0.0041	0.30	-0.0032	0.44	-0.0021	0.66
Healthcare	0.0019	0.76	0.0015	0.81	-0.0028	0.56	-0.0017	0.75
Medical Equipment	0.0032	0.23	0.0036	0.18	-0.0032	0.32	-0.0043	0.17
Pharmaceutical	-0.0030	0.40	0.0010	0.68	**-0.0056**	**0.06**	**-0.0069**	**0.03**
Coal	**0.0192**	**0.00**	**0.0191**	**0.00**	**0.0113**	**0.08**	0.0073	0.26
Petroleum & Natural Gas	0.0036	0.24	0.0042	0.16	-0.0035	0.26	-0.0041	0.21
Industry Average:	0.0029		0.0049		-0.0034		-0.0037	
Early Recession - Stage IV:								
Gas & Electric	**0.0139**	**0.00**	**0.0095**	**0.02**	0.0020	0.62	0.0004	0.93
Communication	**0.0104**	**0.01**	0.0054	0.12	-0.0027	0.45	-0.0024	0.55
Industry Average:	0.0122		0.0075		-0.0004		-0.0010	

Table 5 continued:

			Jensen's alpha		Fama-French alpha		Carhart alpha	
Industries			α^J	**p-value**	α^F	**p-value**	α^C	**p-value**
Late Recession - Stage V:								
Recreation	0.0000	0.99	-0.0098	0.24	-0.0017	0.82	-0.0019	0.81
Entertainment	0.0122	0.15	0.0067	0.42	**-0.0158**	**0.06**	**-0.0153**	**0.08**
Printing & Publishing	0.0088	0.14	0.0049	0.32	0.0019	0.70	0.0020	0.68
Consumer Goods	0.0032	0.43	0.0041	0.38	-0.0008	0.87	-0.0011	0.82
Apparel	**0.0121**	**0.08**	0.0087	0.17	0.0020	0.68	0.0021	0.66
Rubber & Plastic	-0.0017	0.79	-0.0035	0.59	-0.0091	0.15	-0.0088	0.17
Textiles	-0.0018	0.88	-0.0134	0.20	**-0.0145**	**0.05**	**-0.0137**	**0.06**
Construction Materials	0.0031	0.64	-0.0038	0.55	-0.0085	0.16	-0.0083	0.18
Construction	0.0120	0.12	0.0041	0.56	-0.0048	0.47	-0.0048	0.47
Automobiles & Trucks	-0.0005	0.95	-0.0069	0.44	-0.0091	0.31	-0.0084	0.36
Business Supplies	0.0006	0.90	-0.0020	0.65	-0.0059	0.22	-0.0057	0.24
Wholesale	0.0023	0.64	0.0012	0.80	-0.0057	0.18	-0.0057	0.19
Retail	**0.0085**	**0.07**	**0.0084**	**0.07**	0.0020	0.68	0.0017	0.71
Restaurants & Hotels	0.0082	0.16	0.0066	0.30	-0.0018	0.77	-0.0018	0.77
Banking	-0.0014	0.83	-0.0066	0.37	-0.0074	0.18	-0.0075	0.19
Insurance	-0.0004	0.95	-0.0026	0.71	-0.0055	0.44	-0.0057	0.42
Real Estate	0.0061	0.63	-0.0070	0.55	-0.0072	0.47	-0.0066	0.52
Trading	**0.0075**	**0.10**	0.0031	0.53	0.0030	0.51	0.0032	0.49
Industry Average:	0.0044		-0.0004		-0.0049		-0.0048	

Table 6. Performance comparison of alternative investment strategies

Table 6 reports means, standard deviations, betas, and Sharpe ratios for market timing and sector rotation strategies under different assumptions.

Panel A: Base-case specification

Strategy	mean	std.dev.	beta	Sharpe ratio
Market	0.89%	4.23%	1.00	0.21
Sector rotation	1.00%	5.02%	1.04	0.20
Market-timing	1.04%	3.99%	0.89	0.26

Panel B: Alternative sector/industry groupings

Strategy: Sector rotation	mean	std.dev.	beta	Sharpe ratio
10 Sectors	1.03%	5.36%	1.08	0.19
23 Industry groups	0.99%	5.09%	1.05	0.20

Panel C: Alternative business cycle stages

Strategy	mean	std.dev.	beta	Sharpe ratio
2 NBER stages	0.89%	4.69%	1.05	0.18
4 NBER stages	1.01%	4.85%	1.04	0.21
5 CFNAI stages	0.73%	5.25%	1.05	0.14

Table 7. Comparison of strategy performance with different timing

Table 7 reports the performance of sector rotation and market timing with advanced or delayed strategy implementation at business cycle stage turning points by the indicated months. The strategy rotates the Fama and French 49 industry portfolios according to Table 3. Table 7 reports mean returns, standard deviations, and Sharpe ratios. Beta estimates come from a single-index model. The reported performance results are before transaction costs.

	Full Period 1948-2018			
Strategy Implementation	**mean**	**std.dev.**	**beta**	**Sharpe ratio**
Market	0.89%	4.23%	1.00	0.21
Sector Rotation:				
- 3 months	0.97%	4.88%	0.99	0.20
- 2 months	1.02%	4.90%	1.00	0.21
- 1 month	1.01%	4.98%	1.02	0.20
at turning point	1.00%	5.02%	1.04	0.20
+ 1 month	0.98%	5.01%	1.03	0.20
+ 2 months	0.93%	5.07%	1.05	0.18
+ 3 months	0.93%	5.00%	1.04	0.19
Market Timing:				
- 3 months	0.95%	3.90%	0.85	0.24
- 2 months	1.01%	3.94%	0.87	0.26
- 1 month	1.02%	3.95%	0.88	0.26
at turning point	1.04%	3.99%	0.89	0.26
+ 1 month	1.05%	3.98%	0.88	0.26
+ 2 months	1.04%	3.99%	0.89	0.26
+ 3 months	0.98%	4.01%	0.90	0.24

Table A1. Alternative industry definitions

Table A1 provides a mapping of the Fama and French 49 industry portfolios to 23 Global industrial Classification Standard (GICS) industry groups and 10 sector classifications.

49 Fama-French Industries		23 GICS Major Industry Groups		10 Sectors	
Code	**Industry Description**	**Code**	**Industry Group Description**	**Code**	**Sector Description**
01	Agriculture	3020	Consumer Staples	01	Consumer Non-Durable
24	Aircraft	2010	Industrials	04	Manufacturing
10	Apparel	2520	Consumer Discretionary	01	Consumer Non-Durable
23	Automobiles & Trucks	2510	Consumer Discretionary	02	Consumer Durable
45	Banking	4010	Financials	10	Finance
04	Beer & Liquor	3020	Consumer Staples	01	Consumer Non-Durable
34	Business Services	2020	Industrials	08	Business Equipment & Services
39	Business Supplies	2020	Industrials	04	Manufacturing
03	Candy & Soda	3020	Consumer Staples	01	Consumer Non-Durable
14	Chemicals	1510	Materials	04	Manufacturing
29	Coal	1010	Energy	05	Energy
32	Communication	5010	Telecommunication Services	07	Telecom
36	Computer Software	4510	Information Technology	08	Business Equipment & Services
35	Computers	4520	Information Technology	08	Business Equipment & Services
18	Construction	2550	Consumer Discretionary	04	Manufacturing
17	Construction Materials	1510	Materials	04	Manufacturing
09	Consumer Goods	2530	Consumer Discretionary	02	Consumer Durable
26	Defense	2010	Industrials	04	Manufacturing
22	Electrical Equipment	2010	Industrials	04	Manufacturing
37	Electronic Equipment	4530	Information Technology	08	Business Equipment & Services
07	Entertainment	2540	Consumer Discretionary	01	Consumer Non-Durable
20	Fabricated Products	2010	Industrials	04	Manufacturing
02	Food Products	3010	Consumer Staples	01	Consumer Non-Durable
11	Healthcare	3510	Healthcare	03	Healthcare
46	Insurance	4030	Financials	10	Finance
21	Machinery	2010	Industrials	04	Manufacturing
38	Measuring & Control	4520	Information Technology	08	Business Equipment & Services
12	Medical Equipment	3510	Healthcare	03	Healthcare
28	Mining	1510	Materials	05	Energy
33	Personal Services	2530	Consumer Discretionary	01	Consumer Non-Durable
30	Petroleum & Natural Gas	1010	Energy	05	Energy
13	Pharmaceutical	3520	Healthcare	03	Healthcare
27	Precious Metals	1510	Materials	05	Energy
08	Printing & Publishing	2540	Consumer Discretionary	01	Consumer Non-Durable
47	Real Estate	4040	Financials	10	Finance
06	Recreation	2520	Consumer Discretionary	02	Consumer Durable
44	Restaurants & Hotels	2530	Consumer Discretionary	09	Wholesale & Retail
43	Retail	2550	Consumer Discretionary	09	Wholesale & Retail
15	Rubber & Plastic	2550	Consumer Discretionary	04	Manufacturing
25	Shipbuilding & Railroad	2010	Industrials	04	Manufacturing
40	Shipping Containers	2030	Industrials	04	Manufacturing
19	Steel Works	1510	Materials	04	Manufacturing
16	Textiles	2520	Consumer Discretionary	01	Consumer Non-Durable
05	Tobacco Products	3020	Consumer Staples	01	Consumer Non-Durable
48	Trading	4020	Financials	10	Finance
41	Transportation	2030	Industrials	04	Manufacturing
31	Utilities	5510	Utilities	06	Utilites
42	Wholesale	2550	Consumer Discretionary	09	Wholesale & Retail