Received: 16 March 2021 | Revised: 17 August 2023 | Accepted: 23 August 2023

DOI: 10.1002/ijfe.2882

RESEARCH ARTICLE

WILEY

# The myth of business cycle sector rotation

**Alexander Molchanov** | **Jeffrey Stangl**

School of Economics and Finance, Massey University, Auckland, New Zealand

**Correspondence**
Alexander Molchanov, School of Economics and Finance, Massey University, Auckland 0630, New Zealand.
Email: a.e.molchanov@massey.ac.nz

**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**

business cycle, industry investments, investments, market efficiency, return predictability, sector rotation

## 1 | INTRODUCTION

Business cycle sector rotation refers to a common investment strategy that targets investments in particular economic sectors at different stages of the business cycle. Bodie et al. (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, p. 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 based on a business cycle stage 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 applications. 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 (2010–2022) with the S&P 500 Index over the same period reveals roughly 8.1% underperformance per annum,[1] 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 business cycle sector rotation generate excess market performance? Bodie et al. (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 the performance of all sectors across all business cycle stages.

Investors can choose to implement sector rotation at a 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 providers, 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 follows a commonly accepted version of sector rotation, as defined in Stovall (1996) in Table 3 and illustrated in Figure 1. We document sector rotation outperformance—but only marginally so. The analysis investigates industry performance over 15 business cycles from 1948 to 2022. The NBER defines only broad phases of economic expansion and recession. The analysis first divides broad phases into additional subperiods. 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 in sector performance and with perfect foresight in timing business cycle stages, achieve a risk-adjusted return of 0.16% 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 0.18% outperformance. With transaction costs, sector rotation performance quickly dissipates.

The results are robust to a 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.

Finally, the study generalises the analysis to allow for all variations of business cycle sector rotation. Our results are subject to 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 generalised 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.

We need to be careful about what our results mean and not overstate our contribution. First, we only study the versions of sector rotation directly related to the business cycle, rather than a more general industry-level trading strategy based on other potentially predictive variables (e.g., dividend yield). Second, we are not claiming that a successful industry rotation strategy is impossible.[2] We are, however, saying that the likelihood of finding such a strategy is low. Therefore, if investors seek consistently superior returns on sector rotation strategies, they need to go beyond traditional NBER-based definitions.

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 et al. (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 et al. (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. Avramov and Wermers (2006) find that switching industry investments across business cycles drives equity fund performance. Jiang et al. (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

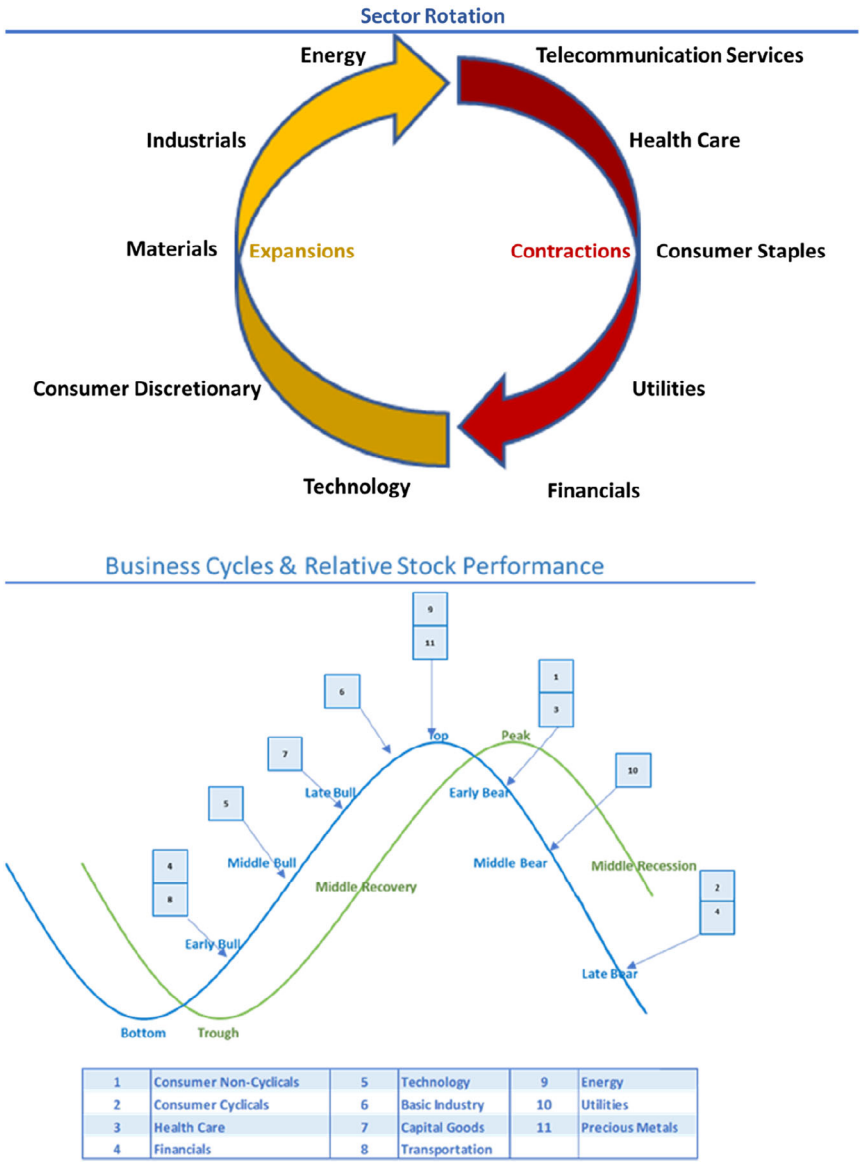


**FIGURE 1** Popular guidance on sector rotation. [Colour figure can be viewed at wileyonlinelibrary.com]

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 the 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 et al. (2007) empirically test the gradual information diffusion hypothesis with US industries. They conjecture that economic news affects 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 et al. (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 et al. (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 et al. (2007) also observe that fund managers adjust industry allocations based on common business cycle proxies. In a related study, Beber et al. (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 et al. (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 in 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 et al. (2000) and Conover et al. (2008) document the increased importance of industry-level versus country-level investing. Kacperczyk et al. (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% 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 et al. (2002) report outperformance to rotation strategies based on firm characteristics (such as earnings, value, and capitalization) conditioned by well-known business-cycle variables. Conover et al. (2008) show a 3.4% annual outperformance to a strategy that times investments in cyclical and non-cyclical stocks with Federal Reserve monetary policy. 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.

The popularity of sector-based investments has sparked several recent investigations into the merits of such strategies. McMillan (2021) finds that a sector rotation strategy based on the predictive power of default returns and stock return variance produces superior performance. Kinlaw et al. (2019) analyse a rotation strategy based on the identification of bubbles and show that rotation strategy produces superior returns in recessions. Karatas and Hirsa (2021) demonstrate the superiority of a rotation strategy based on machine learning. Other recent work on sector rotation profitability includes Sarwar et al. (2018), who base their strategy on a five-factor Fama–French alpha, Noble et al. (2021), who document sector rotation outperformance in SPDR ETFs. Fakhouri and Aboura (2021), however, does not document systematic outperformance.

While closely related, our study differs from the existing research in that we exclusively and exhaustively test sector rotation strategies based on NBER recession and expansion definitions and settle the argument whether any strategy based on such business cycle definition would result in superior performance.[3]

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

**Hypothesis 1.** Industry returns are unrelated to the stage of a business cycle stage.

**Hypothesis 2.** There is a systematic relationship between industry performance and stages of the business cycle.

**Hypothesis 3.** 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 | Business cycle dates

Our analysis covers 15 business cycles from January 1948 to May 2022. The official US 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.[4] The NBER dates cycle peaks and cycle troughs that broadly define phases of economic expansion and economic recession. The last NBER recession included in the sample is the COVID crisis of 2020. In addition, we consider several financial crises in our sample. Jorda et al. (2013) note that financial recessions are potentially more severe than economic recessions. More specifically, we identify recessions corresponding to the Greek financial crisis (May–August of 2010), bailouts of other European nations (June 2011–December 2012), and Brexit (July 2015–October 2016). Stracca (2015) points out that Euro area crises had sizeable effects on markets outside of the Euro area.[5] Panel A of Table 1 reports business cycle durations from business cycle peak to business cycle peak. The sample covers the 15 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 69 months over the sample.[6]

### 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 a 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, represented in Figure 2. The subsequent analysis further evaluates performance across two-stage and four-stage business cycle partitions.

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 15 business cycles occurring from 1948 to 2022. Recessions average approximately 11 months and expansions approximately 4 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 et al. (1986), Fama and French (1989), Schwert (1990), Campbell (1987), Chen (1991), Jensen et al. (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 & French, 1989).[7] The expectation is that these variables will decrease across the 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 et al. (1990) and Chen (1991), document a close link between business cycles and both unemployment rates and industrial 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 a 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 2 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 depending on the current business cycle stage.

$$\mathrm{BCP}_t = \sum_{s=1}^{5} \gamma_s D_{s,t} + \varepsilon_t \quad (1)$$

**TABLE 1** NBER reference business cycle dates and stage partitions. Panel A of the table reports 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 15 business cycles from 1948 to 2022, enumerated in the first column. The last column reports the total months in a business cycle from 1 month after a peak to the next peak. Panel B of the table 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: Business cycle dates from January 1948 through May 2022**

| 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 |
| 11 | 12/07 | 06/09 | 04/10 | 28 |
| 12 | 04/10 | 08/10 | 05/11 | 14 |
| 13 | 05/11 | 12/12 | 06/15 | 48 |
| 14 | 06/15 | 10/16 | 02/20 | 56 |
| 15 | 02/20 | 04/20 | - | - |

**Panel B: Number of months in business stage cycles**

| | Periods of recession | | | Periods of expansion | | | |
|---|---|---|---|---|---|---|---|
| Business 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 |
| 11 | 9 | 9 | 18 | 3 | 3 | 4 | 10 |
| 12 | 2 | 2 | 4 | 3 | 3 | 4 | 10 |
| 13 | 9 | 9 | 18 | 10 | 10 | 10 | 30 |
| 14 | 8 | 8 | 16 | 13 | 13 | 14 | 40 |
| 15 | 1 | 1 | 2 | 8 | 9 | 8 | 25 |
| Average | 5 | 5 | 11 | 16 | 16 | 16 | 48 |

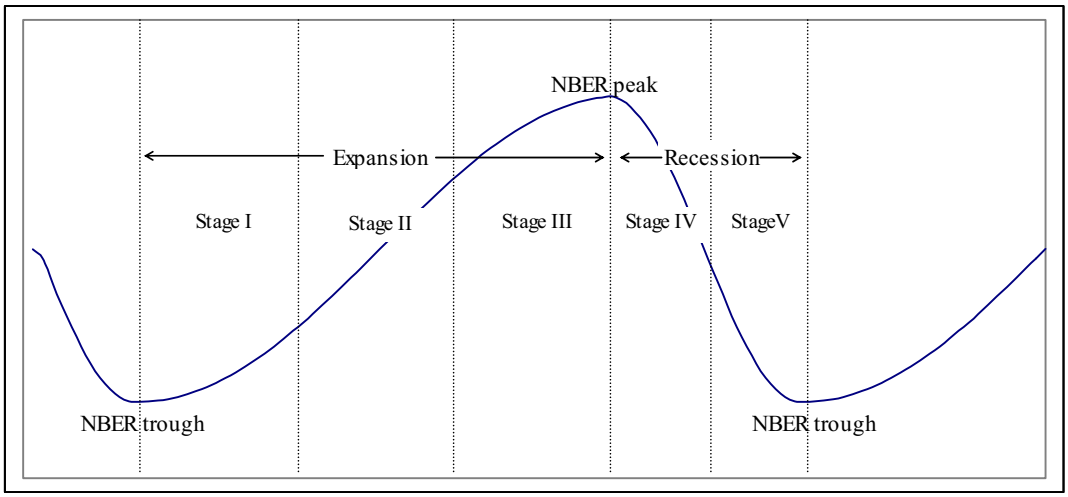


**FIGURE 2** Stylized business cycles with stage partitions. The figure illustrates a stylized business cycle. The official government agency responsible for dating US business cycles is the National Bureau of Economic Research (NBER). The NBER publishes dates for business cycle peaks and troughs. Phases 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). [Colour figure can be viewed at wileyonlinelibrary.com]

Next, the table reports changes in business-cycle proxy values ($\gamma_s - \gamma_{s-1}$) 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 $H_1$: $\gamma_s = \gamma_{s-1}$. 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).[8] 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.[9] 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.[10] 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 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.

**TABLE 2** Business cycle proxies across business cycle stages. Panel A of the table lists the expected change in business cycle proxies from one business cycle stage to the next. Panel B of the table 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 ($\gamma_1 - \gamma_5$). Finally, 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 $H_1$: $\gamma_s = \gamma_{s-1}$.

| 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 |

| | Early expansion | | | Middle expansion | | | Late expansion | | | Early recession | | | Late recession | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Panel B** | **Mean** | **Change** | ***p*-value** | **Mean** | **Change** | ***p*-value** | **Mean** | **Change** | ***p*-value** | **Mean** | **Change** | ***p*-value** | **Mean** | **Change** | ***p*-value** |
| Term-spread | 0.020 | 0.003 | 0.02 | 0.014 | −0.006 | 0.00 | 0.006 | −0.008 | 0.00 | 0.012 | 0.006 | 0.00 | 0.017 | 0.005 | 0.00 |
| Default-spread | 0.010 | −0.005 | 0.00 | 0.008 | −0.002 | 0.00 | 0.008 | 0.000 | 0.07 | 0.012 | 0.003 | 0.00 | 0.014 | 0.003 | 0.00 |
| Dividend yield | 0.034 | −0.005 | 0.01 | 0.030 | −0.003 | 0.01 | 0.030 | 0.000 | 0.98 | 0.037 | 0.006 | 0.00 | 0.038 | 0.001 | 0.57 |
| Unemployment | 1.884 | −0.051 | 0.08 | 1.668 | −0.216 | 0.00 | 1.501 | −0.167 | 0.00 | 1.723 | 0.223 | 0.00 | 1.935 | 0.211 | 0.00 |
| Industrial production | 6.129 | 0.049 | 0.93 | 8.434 | 2.304 | 0.00 | 10.836 | 2.402 | 0.00 | 9.178 | −1.658 | 0.01 | 6.081 | −3.097 | 0.00 |

In other words, during the early expansion stage, an investor holds an equally-weighted portfolio of six industries presented in the first column of Table 3. As the business cycle stage shifts to middle expansion, an investor shifts into an equally-weighted portfolio of 12 industries presented in the second column of Table 3 and so on.

## 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 1948–2022 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 the industry level allows for more precise targeting of performance. The wide variety of available

**TABLE 3** Business cycle stages of expected industry performance. The table 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 and electrical utilities | Apparel |
| Measuring and control equipment | Chemicals | Beer and liquor | Telecom | Automobiles and trucks |
| Computers | Steel works etc. | Candy and soda | | Business supplies |
| Electronic equipment | Non-metallic and metal mining | Food products | | Construction |
| *Transportation* | *Capital goods* | Healthcare | | Construction materials |
| General transportation | Fabricated products | Medical equipment | | Consumer goods |
| Shipping containers | Defence | Pharmaceutical products | | Entertainment |
| | Machinery | Tobacco products | | Printing and publishing |
| | Ships and railroad equipment | *Energy* | | Recreation |
| | Aircraft | Coal | | Restaurants, hotels, motels |
| | Electrical equipment | Petroleum and natural gas | | Retail |
| | *Services* | | | Rubber and plastic products |
| | Business services | | | Textiles |
| | Personal services | | | Wholesale |
| | | | | *Financial* |
| | | | | Banking |
| | | | | Insurance |
| | | | | Real estate |
| | | | | Trading |

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 defence, 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 defence, expected to provide middle expansion performance. Overall, conventional sector rotation investors would thus hold a well-diversified middle expansion portfolio.[11]

We initially measure nominal industry performance to determine whether significant differences occur over business cycles. The analysis then observes whether industry 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 of 2.18%, compared with 1.57% average monthly market returns for early expansion. The transportation industry thus provides market outperformance, where conventional wisdom expects. However, the realisation of expected outperformance does not always occur. Out of the 48 industries, 36 have nominal returns higher than market returns, in the stage of expected outperformance. Thus, 75% of industries offer the expected higher nominal performance. Market outperformance, however, comes at a price. All but two industries (communications and utilities) have higher return volatility than the market. Observing average industry performance for two stages reveals surprising results. The 1.52% average return for industries expected to perform well in early expansion underperforms the market by 0.05%. Similarly, average returns for industries expected to perform well in middle expansion earn 0.05% 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 ($\alpha^m$), with a regression of excess market industry returns ($r_i - r_m$) on the five business-cycle dummy variables ($D_s$). The regression coefficient $\alpha_{is}^m$ measures market outperformance for industry $i$ during business cycle stage $s$. The results show that four of 48 industries generate statistically significant excess market performance when expected. This is virtually offset by three industries significantly underperforming in business cycle stages they are expected to outperform in.

$$r_{it} - r_{mt} = \sum_{s=1}^{5} \alpha_{is}^m D_{st} + \varepsilon_{it} \tag{2}$$

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

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

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 ($\alpha^F$), estimated

**TABLE 4** Industry summary statistics by business cycle stages. The table 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 1948–2012. The table reports equally weighted industry averages and market returns beneath each business cycle stage.

| | Business cycle stage | | | | | | Full sample 1948:01–2022:05 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sector/Industries** | **No. firms** | **No. obs.** | **Mean** | ***SD*** | **Beta** | **Wald *p*-value** | **Mean** | ***SD*** | **Beta** |
| **Early expansion – Stage I** | | | | | | | | | |
| Computers | 85 | 238 | 1.27 | 6.38 | 1.36 | 0.00 | 0.96 | 6.77 | 1.21 |
| Computer software | 156 | 167 | 0.68 | 9.02 | 1.54 | 0.01 | 0.42 | 10.83 | 1.57 |
| Electronic equipment | 169 | 238 | 1.73 | 6.88 | 1.45 | 0.00 | 0.96 | 7.24 | 1.38 |
| Measuring and control | 69 | 238 | 1.28 | 5.84 | 1.25 | 0.00 | 1.01 | 6.52 | 1.23 |
| Shipping containers | 24 | 238 | 1.61 | 4.69 | 0.93 | 0.00 | 0.93 | 5.37 | 0.99 |
| Transportation | 92 | 238 | 2.18 | 4.82 | 1.01 | 0.00 | 0.83 | 5.64 | 1.08 |
| Industry averages | | | 1.52 | 5.02 | 1.24 | 0.00 | 0.89 | 5.79 | 1.23 |
| Market | | 238 | 1.57 | 3.72 | 1.00 | 0.00 | 0.89 | 4.30 | 1.00 |
| **Middle expansion – Stage II** | | | | | | | | | |
| Chemicals | 74 | 240 | 0.90 | 4.82 | 1.11 | 0.00 | 0.85 | 5.38 | 1.06 |
| Steel works | 69 | 240 | 1.15 | 6.51 | 1.26 | 0.00 | 0.63 | 7.28 | 1.33 |
| Precious metals | 13 | 204 | 0.45 | 9.01 | 0.62 | 0.21 | 0.48 | 10.18 | 0.60 |
| Mining | 21 | 240 | 0.81 | 6.67 | 1.15 | 0.00 | 0.83 | 7.07 | 1.10 |
| Fabricated products | 14 | 204 | 1.09 | 5.90 | 0.97 | 0.00 | 0.54 | 7.52 | 1.14 |
| Machinery | 131 | 240 | 1.28 | 5.26 | 1.21 | 0.00 | 0.87 | 5.93 | 1.21 |
| Electrical equipment | 59 | 240 | 1.31 | 5.52 | 1.27 | 0.00 | 1.00 | 6.15 | 1.23 |
| Aircraft | 24 | 240 | 1.41 | 5.98 | 1.14 | 0.01 | 1.03 | 6.77 | 1.14 |
| Shipbuilding and railroad | 10 | 240 | 0.83 | 5.75 | 1.19 | 0.00 | 0.78 | 6.75 | 1.09 |
| Defence | 6 | 204 | 1.09 | 6.01 | 1.08 | 0.02 | 0.98 | 6.51 | 0.82 |
| Personal services | 35 | 240 | 0.99 | 6.05 | 1.16 | 0.00 | 0.63 | 6.50 | 1.06 |
| Business services | 160 | 240 | 1.09 | 4.57 | 1.05 | 0.00 | 0.86 | 5.29 | 1.08 |
| Industry averages | | | 1.03 | 4.64 | 1.10 | 0.02 | 0.81 | 5.15 | 1.08 |
| Market | | 240 | 1.08 | 3.77 | 1.00 | 0.00 | 0.89 | 4.30 | 1.00 |
| **Late expansion – Stage III** | | | | | | | | | |
| Agriculture | 11 | 242 | 0.80 | 6.33 | 0.78 | 0.00 | 0.73 | 6.29 | 0.87 |
| Food products | 74 | 242 | 0.66 | 4.23 | 0.61 | 0.00 | 0.94 | 4.12 | 0.68 |
| Candy and soda | 9 | 206 | 0.64 | 6.43 | 0.68 | 0.00 | 0.96 | 6.19 | 0.81 |
| Beer and liquor | 14 | 242 | 0.83 | 5.31 | 0.77 | 0.00 | 0.97 | 4.88 | 0.76 |
| Tobacco products | 8 | 242 | 1.20 | 5.79 | 0.42 | 0.20 | 1.10 | 5.71 | 0.63 |
| Healthcare | 50 | 176 | 0.68 | 8.74 | 1.17 | 0.00 | 0.68 | 8.16 | 1.14 |
| Medical equipment | 88 | 242 | 0.90 | 5.02 | 0.87 | 0.00 | 1.07 | 5.47 | 0.93 |
| Pharmaceutical | 162 | 242 | 0.82 | 4.50 | 0.69 | 0.00 | 1.04 | 4.87 | 0.82 |
| Coal | 8 | 242 | 0.84 | 10.22 | 1.01 | 0.00 | 0.70 | 9.91 | 1.16 |
| Petroleum and natural gas | 145 | 242 | 0.79 | 5.47 | 0.74 | 0.00 | 0.94 | 5.73 | 0.88 |
| Industry averages | | | 0.80 | 4.15 | 0.77 | 0.01 | 0.92 | 4.25 | 0.87 |
| Market | | 242 | 0.53 | 4.20 | 1.00 | 0.00 | 0.89 | 4.30 | 1.00 |

(Continues)

TABLE 4 (Continued)

| Sector/Industries | Business cycle stage | | | | | | Full sample 1948:01–2022:05 | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. firms | No. obs. | Mean | *SD* | Beta | Wald *p*-value | Mean | *SD* | Beta |
| **Early recession – Stage IV** | | | | | | | | | |
| Utilities | 131 | 82 | −0.39 | 4.76 | 0.69 | 0.02 | 0.86 | 3.81 | 0.53 |
| Communication | 68 | 82 | −0.85 | 4.82 | 0.80 | 0.01 | 0.78 | 4.32 | 0.74 |
| Industry averages | | | −0.62 | 4.47 | 0.74 | 0.01 | 0.82 | 3.54 | 0.64 |
| Market | | 82 | −1.55 | 4.97 | 1.00 | 0.00 | 0.89 | 4.30 | 1.00 |
| **Late recession – Stage V** | | | | | | | | | |
| Recreation | 32 | 80 | 2.64 | 9.37 | 1.29 | 0.00 | 0.68 | 7.31 | 1.19 |
| Entertainment | 46 | 80 | 2.17 | 10.79 | 1.51 | 0.01 | 0.96 | 7.42 | 1.34 |
| Printing and publishing | 32 | 80 | 2.34 | 8.18 | 1.22 | 0.00 | 0.82 | 5.92 | 1.10 |
| Consumer goods | 76 | 80 | 2.06 | 6.05 | 0.92 | 0.00 | 0.90 | 4.57 | 0.81 |
| Apparel | 57 | 80 | 2.29 | 8.48 | 1.16 | 0.00 | 0.83 | 6.00 | 1.06 |
| Rubber and plastic | 31 | 80 | 2.06 | 7.88 | 1.11 | 0.00 | 0.95 | 5.82 | 1.07 |
| Textiles | 36 | 80 | 1.79 | 11.64 | 1.57 | 0.00 | 0.71 | 6.98 | 1.14 |
| Construction materials | 103 | 80 | 2.25 | 8.89 | 1.36 | 0.00 | 0.87 | 5.89 | 1.18 |
| Construction | 40 | 80 | 3.01 | 9.53 | 1.43 | 0.00 | 0.83 | 7.04 | 1.29 |
| Automobiles and trucks | 63 | 80 | 1.95 | 10.23 | 1.41 | 0.00 | 0.89 | 6.87 | 1.20 |
| Business supplies | 39 | 80 | 2.00 | 7.37 | 1.14 | 0.00 | 0.81 | 5.61 | 1.01 |
| Wholesale | 119 | 80 | 1.84 | 7.08 | 1.06 | 0.00 | 0.86 | 5.40 | 1.05 |
| Retail | 188 | 80 | 2.61 | 6.69 | 1.01 | 0.00 | 0.95 | 5.04 | 0.96 |
| Restaurants and hotels | 62 | 80 | 2.42 | 7.67 | 1.10 | 0.00 | 0.98 | 5.86 | 1.02 |
| Banking | 283 | 80 | 1.87 | 8.53 | 1.27 | 0.00 | 0.89 | 5.71 | 1.03 |
| Insurance | 100 | 80 | 1.86 | 7.58 | 1.11 | 0.00 | 0.90 | 5.57 | 0.95 |
| Real estate | 33 | 80 | 2.10 | 12.16 | 1.62 | 0.00 | 0.61 | 7.34 | 1.24 |
| Trading | 192 | 80 | 2.57 | 8.00 | 1.27 | 0.00 | 0.98 | 5.94 | 1.23 |
| Industry averages | | | 2.21 | 7.69 | 1.25 | 0.00 | 0.86 | 5.09 | 1.11 |
| Market | | 80 | 1.94 | 5.82 | 1.00 | 0.00 | 0.89 | 4.30 | 1.00 |

with Equation 4, control for size and value risk factors in addition to market risk. Finally, the Carhart four-factor alphas ($\alpha^C$), estimated with Equation 5, add a momentum factor to the Fama and French three-factor model.

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

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

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 two industries with significant outperformance and one with significant underperformance. Based on the Fama and French three-factor model, there are 10 industries with significant outperformance and one with significant underperformance. Using the Carhart four-factor model, there are seven industries with significant outperformance and one with significant underperformance.

## 5 | SECTOR ROTATION PERFORMANCE

Can conventional sector rotation still be profitable, despite limited evidence of systematic industry

**TABLE 5** Industry performance measures by business cycle stage. The table 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% statistical significance estimated with White (1980) heteroskedasticity consistent *t*-statistics.

| | Excess market | | Jensen's alpha | | Fama–French alpha | | Carhart alpha | |
|---|---|---|---|---|---|---|---|---|
| **Sector/Industries** | **Alpha** | ***p*-value** | **Alpha** | ***p*-value** | **Alpha** | ***p*-value** | **Alpha** | ***p*-value** |
| **Early expansion – Stage I** | | | | | | | | |
| Computers | **−0.0087** | **0.00** | **−0.0076** | **0.00** | −0.0038 | 0.17 | −0.0009 | 0.74 |
| Computer software | **−0.0159** | **0.01** | **−0.0142** | **0.01** | **−0.0120** | **0.03** | **−0.0138** | **0.01** |
| Electronic equipment | −0.0055 | 0.07 | −0.0043 | 0.15 | −0.0001 | 0.98 | 0.0013 | 0.66 |
| Measuring and control | **−0.0068** | **0.01** | **−0.0062** | **0.01** | −0.0018 | 0.44 | −0.0026 | 0.29 |
| Shipping containers | 0.0016 | 0.47 | 0.0014 | 0.53 | 0.0034 | 0.13 | 0.0028 | 0.25 |
| Transportation | **0.0060** | **0.01** | **0.0060** | **0.00** | **0.0064** | **0.00** | 0.0041 | 0.05 |
| Industry averages | −0.0043 | | −0.0037 | | −0.0005 | | −0.0008 | |
| **Middle expansion – Stage II** | | | | | | | | |
| Chemicals | −0.0030 | 0.06 | −0.0026 | 0.10 | −0.0003 | 0.86 | −0.0008 | 0.62 |
| Steel works | −0.0022 | 0.47 | −0.0014 | 0.64 | −0.0015 | 0.57 | −0.0014 | 0.60 |
| Precious metals | −0.0021 | 0.74 | −0.0003 | 0.92 | −0.0025 | 0.69 | −0.0034 | 0.60 |
| Mining | −0.0044 | 0.20 | −0.0036 | 0.50 | −0.0029 | 0.36 | −0.0040 | 0.22 |
| Fabricated products | 0.0005 | 0.89 | 0.0004 | 0.91 | 0.0024 | 0.42 | 0.0023 | 0.46 |
| Machinery | −0.0003 | 0.87 | 0.0004 | 0.83 | 0.0029 | 0.08 | 0.0022 | 0.20 |
| Electrical equipment | −0.0006 | 0.74 | 0.0003 | 0.89 | 0.0032 | 0.09 | 0.0014 | 0.47 |
| Aircraft | 0.0017 | 0.53 | 0.0022 | 0.42 | 0.0039 | 0.15 | 0.0015 | 0.60 |
| Shipbuilding and railroad | −0.0046 | 0.06 | −0.0041 | 0.08 | −0.0022 | 0.34 | −0.0028 | 0.25 |
| Defence | −0.0006 | 0.85 | −0.0003 | 0.92 | 0.0014 | 0.64 | −0.0002 | 0.95 |
| Personal services | −0.0027 | 0.34 | −0.0022 | 0.44 | 0.0003 | 0.90 | 0.0003 | 0.90 |
| Business services | −0.0004 | 0.78 | −0.0002 | 0.87 | **0.0033** | **0.01** | **0.0027** | **0.05** |
| Industry averages | −0.0017 | | −0.0013 | | 0.0006 | | −0.0002 | |
| **Late expansion – Stage III** | | | | | | | | |
| Agriculture | 0.0038 | 0.27 | 0.0030 | 0.39 | **0.0067** | **0.05** | **0.0062** | **0.08** |
| Food products | 0.0034 | 0.11 | 0.0019 | 0.38 | **0.0051** | **0.01** | **0.0050** | **0.02** |
| Candy and soda | 0.0019 | 0.63 | 0.0006 | 0.89 | 0.0041 | 0.30 | 0.0038 | 0.35 |
| Beer and liquor | 0.0042 | 0.12 | 0.0033 | 0.21 | **0.0067** | **0.01** | **0.0066** | **0.01** |
| Tobacco products | **0.0097** | **0.01** | **0.0075** | **0.03** | **0.0108** | **0.00** | **0.0116** | **0.00** |
| Healthcare | −0.0001 | 0.98 | 0.0006 | 0.91 | 0.0053 | 0.31 | 0.0041 | 0.45 |
| Medical equipment | **0.0043** | **0.05** | 0.0038 | 0.08 | **0.0077** | **0.00** | **0.0058** | **0.01** |
| Pharmaceutical | **0.0045** | **0.04** | 0.0033 | 0.12 | **0.0072** | **0.00** | **0.0051** | **0.02** |
| Coal | 0.0031 | 0.60 | 0.0031 | 0.60 | 0.0062 | 0.28 | −0.0002 | 0.97 |
| Petroleum and natural gas | 0.0040 | 0.17 | 0.0030 | 0.29 | 0.0058 | 0.02 | 0.0037 | 0.14 |
| Industry averages | 0.0039 | | 0.0030 | | 0.0064 | | 0.0051 | |
| **Early recession – Stage IV** | | | | | | | | |
| Utilities | 0.0067 | 0.08 | 0.0056 | 0.15 | **0.0081** | **0.05** | 0.0062 | 0.13 |
| Communication | 0.0039 | 0.22 | 0.0030 | 0.36 | 0.0051 | 0.13 | 0.0043 | 0.21 |
| Industry averages | 0.0053 | | 0.0043 | | 0.0066 | | 0.0052 | |

(Continues)

TABLE 5 (Continued)

| | Excess market | | Jensen's alpha | | Fama–French alpha | | Carhart alpha | |
|---|---|---|---|---|---|---|---|---|
| **Sector/Industries** | **Alpha** | ***p*-value** | **Alpha** | ***p*-value** | **Alpha** | ***p*-value** | **Alpha** | ***p*-value** |
| **Late recession – Stage V** | | | | | | | | |
| Recreation | 0.0013 | 0.84 | 0.0022 | 0.74 | 0.0026 | 0.66 | −0.0002 | 0.98 |
| Entertainment | −0.0075 | 0.32 | −0.0062 | 0.40 | −0.0045 | 0.50 | −0.0059 | 0.39 |
| Printing and publishing | −0.0002 | 0.97 | 0.0005 | 0.92 | 0.0034 | 0.44 | 0.0011 | 0.80 |
| Consumer goods | 0.0027 | 0.42 | 0.0025 | 0.45 | 0.0050 | 0.15 | 0.0022 | 0.52 |
| Apparel | 0.0003 | 0.96 | 0.4506 | 0.87 | 0.0019 | 0.70 | −0.0003 | 0.96 |
| Rubber and plastic | −0.0009 | 0.87 | **−0.0006** | **0.00** | 0.0011 | 0.81 | −0.0008 | 0.87 |
| Textiles | −0.0127 | 0.14 | −0.0110 | 0.19 | −0.0074 | 0.27 | −0.0089 | 0.19 |
| Construction materials | −0.0040 | 0.41 | −0.0030 | 0.53 | −0.0007 | 0.87 | −0.0030 | 0.49 |
| Construction | 0.0024 | 0.67 | 0.0035 | 0.53 | 0.0040 | 0.44 | 0.0014 | 0.79 |
| Automobiles and trucks | −0.0079 | 0.28 | −0.0068 | 0.34 | −0.0034 | 0.62 | −0.0044 | 0.51 |
| Business supplies | −0.0022 | 0.57 | −0.0018 | 0.63 | 0.0010 | 0.80 | −0.0010 | 0.80 |
| Wholesale | −0.0022 | 0.59 | −0.0019 | 0.64 | −0.0008 | 0.83 | −0.0030 | 0.46 |
| Retail | 0.0065 | 0.09 | 0.0067 | 0.08 | **0.0080** | **0.03** | 0.0051 | 0.15 |
| Restaurants and hotels | 0.0028 | 0.58 | 0.0031 | 0.53 | 0.0034 | 0.44 | 0.0011 | 0.81 |
| Banking | −0.0061 | 0.23 | −0.0053 | 0.29 | −0.0004 | 0.92 | −0.0038 | 0.38 |
| Insurance | −0.0029 | 0.54 | −0.0026 | 0.58 | 0.0011 | 0.82 | −0.0016 | 0.75 |
| Real estate | −0.0104 | 0.26 | −0.0087 | 0.34 | −0.0072 | 0.31 | −0.0097 | 0.18 |
| Trading | 0.0011 | 0.77 | 0.0018 | 0.62 | 0.0045 | 0.21 | 0.0028 | 0.44 |
| Industry averages | −0.0022 | | −0.0015 | | 0.0006 | | −0.0016 | |

performance? This section focuses on strategy implementation, observing the performance of sector rotation across the last 15 business cycles. The strategy assumes investors perfectly time business-cycle stages and rotates 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 0.16% 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 74 years, ignored transaction costs, and perfectly timed the last 14 business cycles would have realised 0.16% per month outperformance. It is also important to note that a sector rotation strategy has a higher standard deviation and a higher beta than a 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 recognises 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. In other words, an investor realises a risk-free rate during the early recession stage, and market return in the remaining four stages of the business cycle. Such an investor, shifting from equities to cash early recession and back to equities late recession, would have realised 0.18% average monthly outperformance. That same investor would have also held a more diversified market portfolio, subject to less industry-specific risk.[12]

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.[13] Estimates vary considerably and change over the sample.[14] We estimate effective bid-ask spread following Roll's (1984) methodology utilising market prices. Sector rotation has 75 round-trip transactions at an average effective spread of 0.75%. Transaction costs

**TABLE 6** Performance comparison of alternative investment strategies. The table 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** | ***SD*** | **Beta** | **Sharpe ratio** |
| Market | 0.89 | 4.30 | 1.00 | 0.21 |
| Sector rotation | 1.05 | 4.98 | 1.01 | 0.21 |
| Market-timing | 1.07 | 3.97 | 0.85 | 0.27 |
| **Panel B: Alternative sector/industry groupings** | | | | |
| **Strategy: Sector rotation** | **Mean** | ***SD*** | **Beta** | **Sharpe ratio** |
| 11 Sectors | 0.98 | 5.54 | 1.1 | 0.17 |
| 24 Industry groups | 0.96 | 5.35 | 1.08 | 0.18 |
| **Panel C: Alternative Business cycle stages** | | | | |
| **Strategy** | **Mean** | ***SD*** | **Beta** | **Sharpe ratio** |
| 2 NBER stages | 0.87 | 4.81 | 1.06 | 0.18 |
| 4 NBER stages | 1.02 | 4.89 | 1.02 | 0.21 |
| 5 CFNAI stages | 0.75 | 5.28 | 1.01 | 0.14 |

*Note*: *, **, and *** indicate statistical significance at 10%, 5%, and 1% level, respectively, based on a block bootstrap approach.

are subtracted every time the business cycle stage shifts, and an investor sells one portfolio of industries, and purchases another. There are five such transactions for reach business cycle. Market-timing strategy has 30 round-trip transactions from 1948 to 2022 at an average effective spread of 0.34%. Transaction costs are subtracted twice in each business cycle—first at the beginning of early recession, when market portfolio is sold and a risk-free asset is purchased, and then at the beginning of late recession when an opposite transaction takes place. With the inclusion of transaction costs, the base-case sector rotation outperformance decreases to 0.09% per month. The alternative market-timing strategy increases in relative outperformance, owing to fewer transactions and lower effective spread for the market index.

Next, we evaluate the economic significance of the sector rotation strategy. More specifically, we compare a hypothetical investor's payoffs for three alternative strategies. First, we consider a $1 invested into a market buy-and-hold strategy on January 1, 1948. Second, we consider a sector rotation strategy based on Stovall's (1996) classification. We consider a version that accounts for the transaction costs described above. Third, we consider $1 invested in a market timing strategy—S&P 500 index in all business cycle stages except in early recession, when funds are invested in a risk-free rate (also accounting for transaction costs). Results are presented in Figure 3 (Panel A). $1 invested in a buy-and-hold strategy in January of 1948 would grow to $1209.98 in May of 2022. In contrast, $1 invested in a sector rotation strategy would grow to $2140.01. While such a difference in terminal wealth is impressive, sector rotation strategy falls significantly behind a market timing strategy, which will grow investor's wealth to $5794.87 in May of 2022. Differences in terminal wealth are amplified by a long compounding period of 74 years. In Panel B of Figure 3, we 'zoom in' on a more recent time period and consider $1 invested in three alternative strategies in January of 2000. A buy-and-hold strategy would grow investor's wealth to $3.34 in May of 2022. Sector rotation strategy would result in a terminal wealth of $4.87 and the market timing strategy would yield $5.40. The results are consistent with those of the overall sample—while sector rotation outperforms a buy-and-hold, it falls short of the market timing strategy. We then further 'zoom in' and consider $1 invested in January of 2008—roughly corresponding to the GFC. Results are presented in Panel C of Figure 3 and are quite sobering—while buy-and-hold and market timing strategies would yield $3.09 and $5.23, respectively, sector rotation strategy only results in terminal wealth of $2.31—substantially less than that of a buy-and-hold strategy.

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. 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 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.

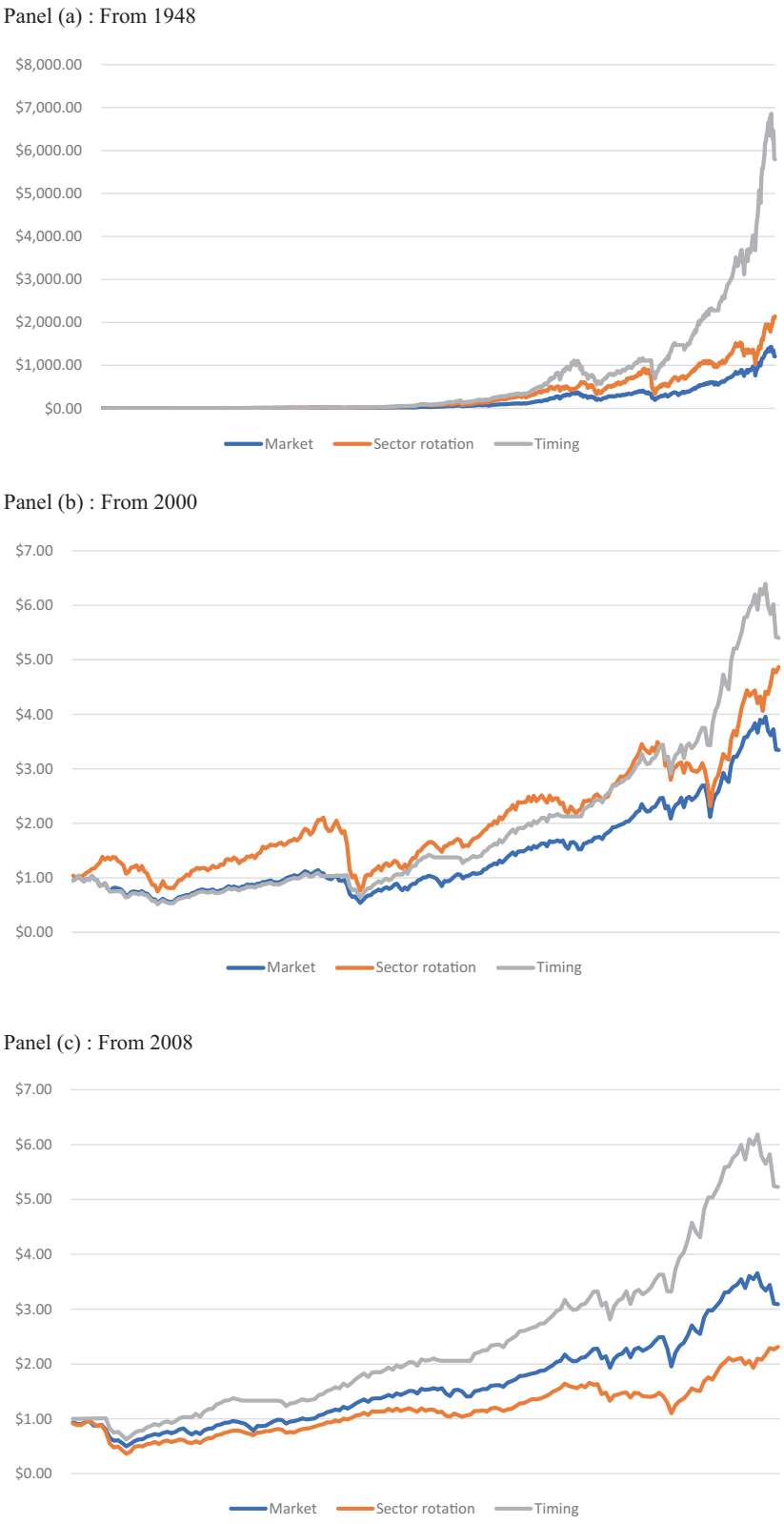


**FIGURE 3** Economic gains from alternative strategies. The figure represents wealth achieved by investing $1 in three alternative strategies at various points in time. The strategies are: (1) market buy-and-hold, (2) sector rotation, and (3) market timing. The latter two make allowance for transaction costs. [Colour figure can be viewed at wileyonlinelibrary.com]

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 11 sector portfolios and 24 major industry portfolios, as listed in Table A1. The 11 sector portfolios are constructed following the Kacperczyk et al. (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 24 GICS major industry groups. The Global Industry Classification Standard (GICS), first introduced in 1999, provides a widely accepted alternative to SIC classifications.[15] Bhojraj et al. (2003) report GICS classifications are superior to alternative classification schemes.

The results are presented in Panel B of Table 6. Both 11-sector and 23-industry groupings generate similar mean monthly sector rotation returns to the ones generated by 49 Fama–French industries (0.98% and 0.96% vs. 1.05%). 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.[16]

## 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 the particular delineation of business cycle stages. The NBER officially dates the US 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 of expansion, and early and late recession industries into one stage of recession. The four-stage analysis further divides expansions and recessions into halves.

The results for sector rotation strategy performance based on two- and four-stage business cycle delineations are reported in Panel C of Table 6.[17] The strategy based on two-stage delineation underperforms the market portfolio across all dimensions. The strategy based on four-stage delineation is inferior to the market timing strategy reported in Panel A, having lower outperformance (0.13% vs. 0.18%), higher standard deviation (4.89% vs. 3.97%), higher beta (1.02 vs. 0.85), and lower Sharpe ratio (0.21 vs. 0.27). 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 the results for these two indicators are similar, the analysis focuses on the CFNAI.[18] 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 above (below) trend economic activity. Publication of the CFNAI began in 2001 with data available from 1967.[19] 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, −0.0113, and −0.637 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 1, 2, and 3 months prior to NBER business-cycle turning points. Similarly, the analysis considers delays from one to 3 months. Table 7 presents results before transaction costs.

There appears to be some benefit to anticipating business cycles one and 2 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.

## 6.5 | Analysing 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 the 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 the agricultural sector should outperform in recession.

We now explicitly address this by analysing every possible combination of sector rotation strategy using an 11-sector industry definition and a two-stage business cycle partition. This gives us 2046 possible strategies. The return distribution of all the possible strategies is presented in Figure 4.

**TABLE 7** Comparison of strategy performance with different timing. The table 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. The table reports mean returns, standard deviations, and Sharpe ratios. Beta estimates come from a single-index model. The reported performance results are before transaction costs.

| Strategy implementation | Mean | *SD* | Beta | Sharpe ratio |
|---|---|---|---|---|
| Market | 0.89 | 4.30 | 1.00 | 0.21** |
| Sector rotation | | | | |
| −3 months | 0.98 | 4.86 | 0.97 | 0.20** |
| −2 months | 1.05 | 4.86 | 0.97 | 0.22** |
| −1 months | 1.04 | 4.94 | 0.99 | 0.21** |
| At turning point | 1.05 | 4.98 | 1.01 | 0.21** |
| +1 months | 1.03 | 5.01 | 1.01 | 0.21** |
| +2 months | 1.00 | 5.04 | 1.02 | 0.20** |
| +3 months | 1.00 | 4.96 | 1.01 | 0.20** |
| Market timing | | | | |
| −3 months | 0.90 | 3.94 | 0.84 | 0.23** |
| −2 months | 0.97 | 3.96 | 0.85 | 0.25** |
| −1 months | 0.99 | 3.95 | 0.85 | 0.25** |
| At turning point | 1.07 | 3.97 | 0.85 | 0.27** |
| +1 months | 1.07 | 3.98 | 0.86 | 0.27** |
| +2 months | 1.03 | 4.02 | 0.69 | 0.26** |
| +3 months | 0.97 | 4.04 | 0.88 | 0.24** |

*Note*: *, **, and *** indicate statistical significance at 10%, 5%, and 1% level, respectively, based on a block bootstrap approach.

The results provide even more discouragement for a potential sector rotation investor. The average return of these strategies is 0.86% per month, actually lower than that of a buy-and-hold strategy 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 0.92%.

Not surprisingly, some sector rotation strategies outperform both a buy-and-hold and a market timing strategy. Only 170 out of 2046 strategies (8.3%) outperform the market timing strategy, and only 529 out of 2046 (25%) outperform the buy-and-hold. At a first glance, this presents evidence of potential sector rotation strategy profitability. However, several issues need to be considered. First, transaction costs need to be considered—they are 0.06% per month for the sector rotation strategy and only 0.01% per month for a market timing strategy. Only 11 sector rotation strategies outperform market timing and only 17 outperform a buy-and-hold when transaction costs are accounted for. Second, the sector rotation strategy is riskier than the two alternatives, being the least diversified of the three. Therefore, we find essentially no evidence of sector rotation outperformance.

## 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 11 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 2640 ($11 \times 10 \times 24$) *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% significance level, the estimations should indicate 5% positive significance and 5% negative significance—even in the absence of actual excess market predictability. In total, *t*-statistics are significantly positive 6% of the time and significantly negative 5% 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.

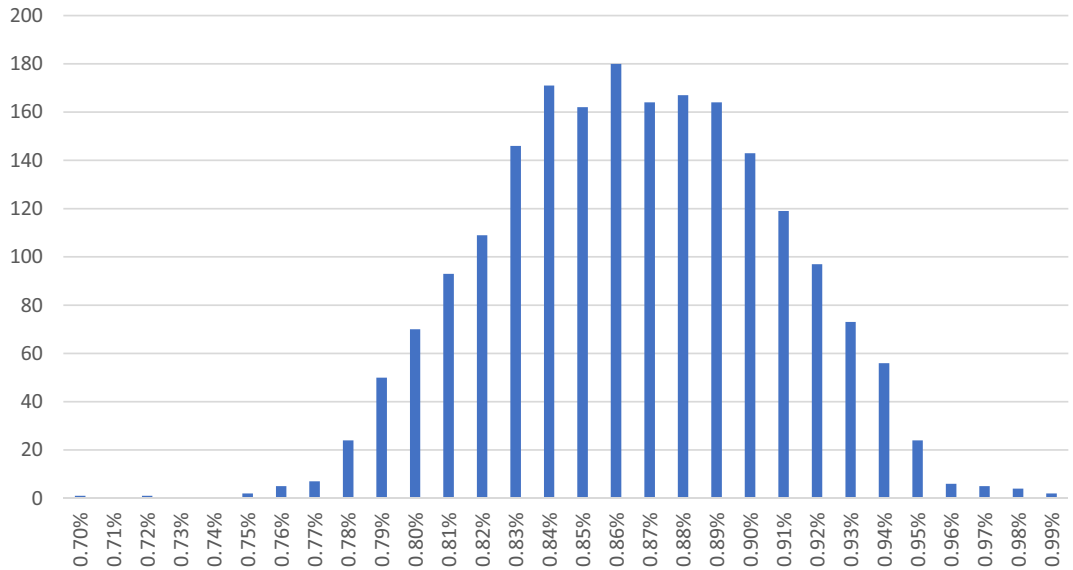


**FIGURE 4** Distribution of all possible sector strategy returns. The figure presents the distribution of returns of 2046 sector rotation strategies formed by 11 sectors using a two-stage business cycle partition. [Colour figure can be viewed at wileyonlinelibrary.com]

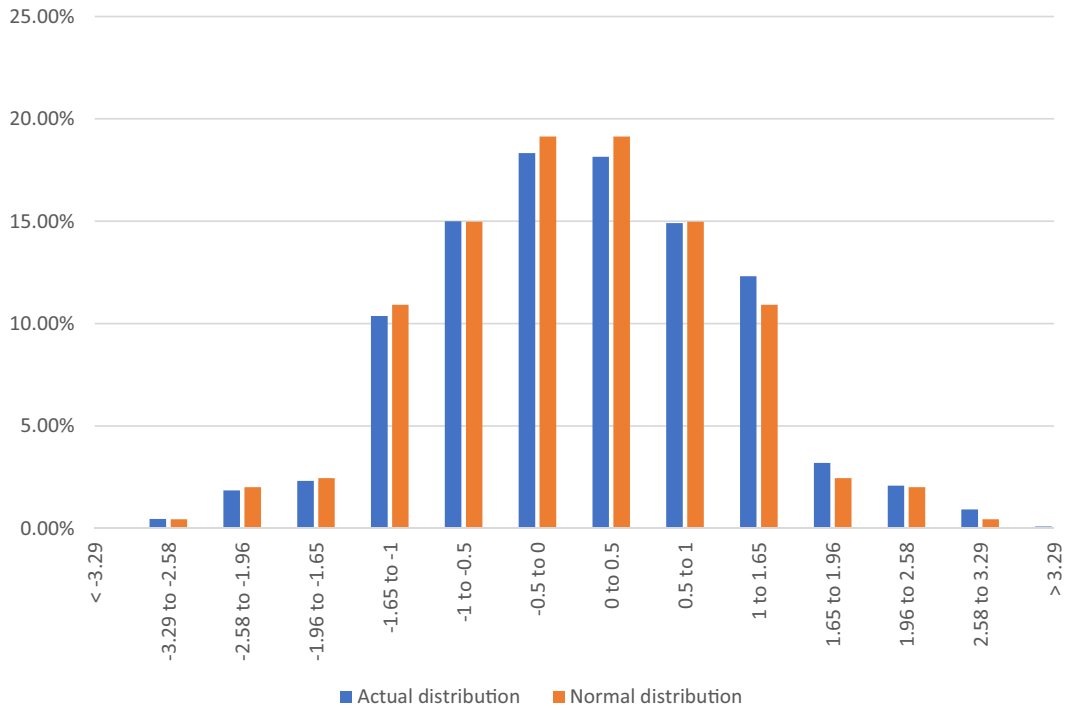


**FIGURE 5** Predictability of excess industry performance. The figure illustrates the distribution of *t*-statistics for cross-sector predictability of excess market performance. The analysis constructs sector rotation portfolios from the Fama and French 49 industries mapped to one of 11 GICS sectors 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 2640 *t*-statistics, covering all possible combinations of cross-sector predictability at up to 24 lags. [Colour figure can be viewed at wileyonlinelibrary.com]

## 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, 0.16% monthly outperformance. The performance quickly diminishes with the introduction of transaction costs or business cycle mistiming. In comparison, a similar investor, with perfect market timing ability, would realise 0.18% monthly outperformance by simply switching to cash during an early recession.

The analysis generalises the base case to allow for all possible business cycle 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 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.

## ACKNOWLEDGEMENTS

The authors would like to thank the anonymous referee for valuable comments that have been instrumental in improving the quality of the paper. Open access publishing facilitated by Massey University, as part of the Wiley - Massey University agreement via the Council of Australian University Librarians.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ORCID

*Alexander Molchanov* https://orcid.org/0000-0003-0133-3811

## ENDNOTES

[1] NAVFX did not fare better during the COVID-19 crisis either, with the returns lagging S&P 500 by approximately 0.22%.

[2] Alexiou and Tyagi (2020), Chava et al. (2019), and Rapach et al. (2019) provide good examples of successful industry rotation strategies.

[3] Based on the referee's suggestion, we also consider financial crises in our sample. Our findings are robust if only NBER cycles are considered.

[4] For a survey of business cycle dating methodologies, see Cover and Pecorino (2005).

[5] We thank the anonymous referee for this suggestion.

[6] Moore (1974) provides a detailed discussion of post-1948 differences in business cycle dynamics.

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

[8] 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.

[9] The 'other' industry group represents approximately 3.5 percent of total firms listed on NYSE, AMEX, and NASDAQ.

[10] 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.

[11] For an overview of trade-offs in implementing sector rotation strategies at sector, industry, and firm levels, see http://us.ishares.com/portfolio_strategies/investment_strategies/sector_strategies.htm

[12] We also consider whether financial crises had a significant impact on performance of sector rotation and market timing strategies and, if yes, which crisis had a more noticeable effect. We consider several scenarios. (1) dataset ending in 2007 before the US subprime crisis (original dataset); (2) dataset that includes all crises; (3) original + US crisis only; (4) original + COVID; (5) original + US crisis + COVID; (6) original + US crisis + COVID + Greek crisis; (7) original + US crisis + COVID + Brexit; (8) original + US crisis + COVID + European bailouts; (9) new dataset—Brexit. The results are available from the corresponding author upon request. the results are largely consistent across all nine specifications, with minimal differences in sector rotation or market timing performances. Second, while sector rotation strategies provide higher average returns than the market portfolio, they are characterised by higher volatilities—Sharpe ratios are, in fact, virtually identical to the market portfolio Sharpe ratio. Second, market timing strategy (investing in a risk-free rate in early recessions and in market portfolio in other periods) consistently outperforms both the market portfolio and sector rotation strategies. Analysis of different crisis combinations may not paint a full picture, as the marginal impact of each individual crisis is small, given that our data starts in 1948. we consider the combinations above starting from December of 2001 (end of NBER recession of 2001). Not surprisingly, there is more variability in the performance of sector rotation strategies, with combination (9) exhibiting the best performance. The main conclusions remain unchanged though—(a) Sector rotation strategies do not outperform the market portfolio on risk-adjusted basis and (b) market timing strategy exhibits superior performance.

[13] See for example Goyenko et al. (2009) and Hasbrouck (2009).

[14] Estimates of total trading costs vary greatly depending on the study. For instance, Lesmond et al. (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%.

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

[16] 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.

[17] 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.

[18] The CFNAI and detrended Conference Board leading indicator has a 78% 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.

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

## REFERENCES


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

Alexiou, C., & Tyagi, A. (2020). Gauging the effectiveness of sector rotation strategies: Evidence from the USA and Europe. *Journal of Asset Management*, *21*, 239–260.

Avramov, D., & Wermers, R. (2006). Investing in mutual funds when returns are predictable. *Journal of Financial Economics*, *81*, 339–377.

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

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

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

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

Boyd, J., Hu, J., & Jagannathan, R. (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., & Steed, S. (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., Brightman, C., & Aked, M. (2000). The increasing importance of industry factors. *Financial Analysts Journal*, *56*, 41–54.

Chava, S., Hsu, A., & Zeng, L. (2019). Does history repeat itself? Business cycle and industry returns. *Journal of Monetary Economics*, *116*, 201–218.

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

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

Conover, M., Jensen, G., Johnson, R., & Mercer, J. (2008). Sector rotation and monetary conditions. *Journal of Investing*, *17*, 34–46.

Cover, J., & Pecorino, P. (2005). The length of US 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., Gruber, M., & Blake, C. (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.

Fakhouri, S., & Aboura, P. (2021). Sector rotation over business cycle: A real time investment strategy? Working paper.

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

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

Fama, E., & French, K. (1997). Industry costs of equity. *Journal of Financial Economics*, *43*, 153–193.

Goyenko, R., Holden, C., & Trzcinka, C. (2009). Do liquidity measures measure liquidity? *Journal of Financial Economics*, *92*, 153–181.

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

Hasbrouck, J. (2009). Trading costs and returns for US equities: Estimating effective costs from daily data. *Journal of Finance*, *64*, 1445–1477.

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

Hong, H., Torous, W., & Valkanov, R. (2007). Do industries lead stock markets? *Journal of Financial Economics*, *83*, 367–396.

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

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

Jorda, O., Schilarick, M., & Taylor, A. M. (2013). When credit bites back. *Journal of Money, Credit, and Banking*, *45*, 3–28.

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

Karatas, T., & Hirsa, A. (2021). Two-stage sector rotation methodology using machile learning and deep learning techniques. Working paper.

Keim, D., & Madhavan, A. (1998). The cost of institutional equity trades. *Financial Analysts Journal*, *54*, 50–69.

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

Kinlaw, W., Kritzman, M., & Turkington, D. (2019). Crowded trades: Implications for sector rotation and factor timing. *Journal of Portfolio Management*, *45*, 46–57.

Lesmond, D., Schill, M., & Zhou, C. (2004). The illusory nature of momentum profits. *Journal of Financial Economics*, *71*, 349–380.

Levis, M., & Liodakis, M. (1999). The profitability of style rotation strategies in the United Kingdom. *Journal of Portfolio Management*, *26*, 73–86.

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

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

Lynch, A., Wachter, J., & Boudry, W. (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.

McMillan, D. (2021). Forecasting sector stock market returns. *Journal of Asset Management*, *22*, 291–300.

McQueen, G., & Roley, V. (1993). Stock prices, news, and business conditions. *Review of Financial Studies*, *6*, 683–707.

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

Noble, C., Dillon, S., Locatelli, S., Mento, D., & Solow, K. (2021). Understanding the intersection between style exposure, sector rotation, and the business cycle. *Journal of Financial Planning*, *34*, 88–102.

Petkova, R. (2006). Do the Fama–French factors proxy for innovations in predictive variables. *The Journal of Finance*, *61*, 581–612.

Rapach, D., Strauss, J., Tu, J., & Zhou, G. (2019). Industry return predictability: A machine learning approach. *Journal of Financial Data Science*, *1*(3), 9–28.

Roll, R. (1984). A simple implicit measure of the effective bid-ask sperad in an efficient market. *Journal of Finance*, *39*, 1127–1139.

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

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

Schwert, W. (1990). Stock returns and real activity: A century of evidence. *Journal of Finance*, *45*, 1237–1257.

Siegel, J. (1991). Does it pay stock investors to forecast the business cycle. *Journal of Portfolio Management Fall*, *18*, 27–34.

Stock, J., & Watson, M. (1989). New indexes of coincident and leading economic indicators. *NBER Macroeconomics Annual*, *4*, 351–394.

Stock, J., & Watson, M. (1999). Chapter 1: Business cycle fluctuations in US macroeconomic time series. In *Handbook of Macroeconomics*. Elsevier.

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

Stracca, L. (2015). Our currency, your problem? The global effects of the euro debt crisis. *European Economic Review*, *74*, 1–13.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, *48*, 817–838.

**How to cite this article:** Molchanov, A., & Stangl, J. (2023). The myth of business cycle sector rotation. *International Journal of Finance & Economics*, 1–24. https://doi.org/10.1002/ijfe.2882

## APPENDIX A

**TABLE A1** Alternative industry definitions. The table provides a mapping of the Fama and French industry portfolios to 24 Global Industry Classification Standard (GICS) industry groups and 11 sector classifications.

| Sectors | GICS | Fama–French industries |
|---|---|---|
| 10 Energy | 1010 Energy | Coal |
| | 10110 Energy | Petroleum and Natural Gas |
| 15 Materials | 1510 Materials | Chemicals |
| | 1510 Materials | Construction Materials |
| | 1510 Materials | Mining |
| | 1510 Materials | Precious Metals |
| | 1510 Materials | Steel Works |
| | 1510 Materials | Business Supplies |
| | 1510 Materials | Rubber and Plastic |
| 20 Industrials | 2010 Capital Goods | Defence |
| | 2010 Capital Goods | Electrical Equipment |
| | 2010 Capital Goods | Machinery |
| | 2010 Capital Goods | Fabricated Products |
| | 2010 Capital Goods | Construction |
| | 2020 Commercial and Professional Services | Business Services |
| | 2020 Commercial and Professional Services | Printing and Publishing |
| | 2030 Transportation | Aircraft |
| | 2030 Transportation | Transportation |
| | 2030 Transportation | Shipping Containers |
| | 2030 Transportation | Shipbuilding and Railroad |
| 25 Consumer Discretionary | 2510 Automobiles and Components | Automobiles and Trucks |
| | 2520 Consumer Durables and Apparel | Apparel |
| | 2520 Consumer Durables and Apparel | Textiles |
| | 2520 Consumer Durables and Apparel | Recreation |
| | 2530 consumer Services | Restaurants and Hotels |
| | 2530 consumer Services | Personal Services |
| | 2550 Retailing | Wholesale |
| | 2550 Retailing | Retail |
| 30 Consumer Staples | 3010 Food and Staples Retailing | Food Products |
| | 3020 Food, Beverage and Tobacco | Agriculture |
| | 3020 Food, Beverage and Tobacco | Beer and Liquor |
| | 3020 Food, Beverage and Tobacco | Candy and Soda |
| | 3020 Food, Beverage and Tobacco | Tobacco Products |
| | 3030 Household and Personal Products | Consumer Goods |
| 35 Health Care | 3510 Health care Equipment and Services | Healthcare |
| | 3510 Health care Equipment and Services | Medical Equipment |
| | 3520 Pharmaceuticals, Biotechnology and Life Sciences | Measuring and Control |
| | 3520 Pharmaceuticals, Biotechnology and Life Sciences | Pharmaceutical |
| 40 Financials | 4010 Banks | Banking |
| | 4020 Diversified Financials | Trading |
| | 4030 Insurance | Insurance |

(Continues)

**TABLE A1** (Continued)

| Sectors | GICS | Fama–French industries |
|---|---|---|
| 45 Information Technology | 4510 Software and Services | Computer Software |
| | 4520 Technology Hardware and Equipment | Computers |
| | 4530 Semiconductors and Semiconductor Equipment | Electronic Equipment |
| 50 Communication Services | 5010 Telecommunication Services | Communication |
| | 5020 Media and Entertainment | Entertainment |
| 55 Utilities | 5510 Utilities | Utilities |
| 60 Real Estate | 6010 Real Estate | Real Estate |