Anomaly Returns at Night and Day

Austin H. Hill-Kleespie*

Department of Finance
G. Brint Ryan College of Business
University of North Texas

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Abstract

I investigate variation in anomaly premiums using night and day returns. Return anomalies experience an decrease in daytime returns and an increase in nighttime returns after publication and post-2003. Despite day and night returns experiencing these changes simultaneously, they are uncorrelated on average and reflect two different forms of risk: investor mispricing and systematic risk. I provide evidence that the observed changes to day and night returns are driven by increases in arbitrage activity related to both of these risks. These dynamics are largely predicted by Daniel, Hirshleifer, and Subrahmanyam (2001) and provide strong support for their model.

*Electronic Address: Austin.Hill-Kleespie@unt.edu

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Conflict-of-Interest Disclosure Statement

Austin H. Hill-Kleespie

I have nothing to disclose.

Introduction

As important as the discovery of return anomalies used in asset pricing models is, the causes of their variation across time is equally important. Two widely cited examples, the publication effect documented by McLean and Pontiff (2016) and the post-2003 period from Green, Hand, and Zhang (2017), are marked by decreases in the return premiums earned by a number anomalies. As problematic as these decreases are for market participants trying to replicate these strategies, academic research that incorporates these anomalies into asset pricing models will encounter significant problems as right hand side variables approach zero and models lose their explanatory power.[1] I utilize day and night returns to examine mechanical and theoretical explanations for variation in anomaly returns.

My analysis focuses on the anomalies deployed as factors in Fama and French (1993) and Fama and French (2015). These include the market factor (Sharpe (1964), Lintner (1965), Mossin (1966)), size factor (Banz (1981)), value factor (Basu (1983)), investment factor (Cooper, Gulen, and Schill (2008)), and profitability factor (Novy-Marx (2013)). Collectively Fama and French (1993) and Fama and French (2015) have over 37,000 citations and the Fama-French three and five factor models are widely used in both asset pricing and corporate finance research. Given their prevalence in the literature, decreases in the premiums earned by the constituents of the Fama and French (2015) model should be of keen interest to researchers. McLean and Pontiff (2016) document a decrease in anomaly returns after publication due in large part to increases in arbitrage activity. Green, Hand, and Zhang (2017) however, document a puzzling phenomena: many anomalies experience a substantial decrease in their premiums after 2003. An explanation for this post-2003 decrease is less obvious as no structural changes to financial markets or unusual amount of academic research occurred around this time.

Day and night returns offer a unique perspective on variation in anomaly premiums. As far back as Fama (1965) it has been documented that night and day returns have important and distinct attributes when compared to the more commonly used close-to-close return. Fama (1965), Granger

[1]Commonly deployed tests of model efficacy such as a Gibbons, Ross, and Shanken (1989) test evaluate asset pricing models based on the intercept term (alpha) test assets earn when using the model. As right hand side variables approach zero the intercept term will naturally increase leading the models to lose a significant amount of their explanatory power. This effect has the potential to generate incorrect inferences when asset pricing models are evaluated on alpha values alone.

and Morgenstern (1970), and French (1980) observe that the volatility of nighttime returns is substantially lower than daytime returns. Cliff, Cooper, and Gulen (2008) find that over 100% of the market premium is earned overnight despite limitations to trading during this period. Interestingly, daytime market returns are found to be either slightly negative or insignificant. This pattern of insignificant daytime returns and large positive overnight returns holds for a wide variety of indices and even individual securities (Branch and Ma (2008), Branch and Ma (2012), and Berkman et al. (2012)). In more recent research Lou, Polk, and Skouras (2019) document that many characteristic based long-short trading strategies earn positive CAPM alphas during the day and negative CAPM alphas at night. The lone exception to this pattern is the Jegadeesh and Titman (1993) momentum anomaly, which earns its positive premium at night. Similar, return patterns have also been observed for portfolios sorted on beta (Hendershott, Livdan, and Rösch (2020)) and measures of investor mispricing (Bogousslavsky (2021)).

I follow Hendershott, Livdan, and Rösch (2020) in separating daily close-to-close returns into their respective night and day portions and then aggregate returns to the monthly level. To generate anomaly returns I employ the Fama and French (2015) methodology and calculate returns for each anomaly, as well as its constituent long and short portfolios, across night and day.[2] Consistent with Lou, Polk, and Skouras (2019), I observe that returns to the value, profitability, and investment anomalies demonstrate positive daytime returns and negative overnight returns. In looking at the returns to the long and short portfolios comprising these factors, I find that during the day long portfolios experience large positive returns and short portfolio produce statistically insignificant returns. Conversely at night short portfolios earn premiums which significantly exceed those of the long portfolio generating overnight reversals for most anomalies.

My analysis of changes to anomaly premiums begins with the publication effect identified in McLean and Pontiff (2016). Within my sample period the asset growth anomaly[3] from Cooper, Gulen, and Schill (2008) and profitability anomaly from Novy-Marx (2013) were discovered. I investigate changes to close-to-close, daytime, and nighttime returns around the time of publication. I find that both the asset growth anomaly and profitability anomaly experienced a decrease in day-

[2]Daytime returns are calculated as the change in value for the underlying stock from market open to market close on day t. Nighttime returns are considered to be the return earned from the market close on day $t-1$ to the market open on day t.

[3]Fama and French (2015) refer to this as the investment factor in their model.

time returns and an increase in nighttime returns after the publication of the underlying research.

Next I examine the differences in anomaly returns before and after the 2003 decrease in anomaly premiums identified in Green, Hand, and Zhang (2017). The results mirror the changes observed for day and night returns following publication. Specifically, post-2003 daytime anomaly returns decreased and nighttime returns increased. The magnitude of the change to daytime returns was between 0.79% and 1.84% per month and significant at greater than the 5% level for all four anomalies and greater than the 1% level for three of the four anomalies. The increase in monthly overnight returns was between 0.38% and 1.52% with all changes significant above the 1% level.

McLean and Pontiff (2016) identify arbitrage as a key mechanism driving return premiums lower after academic publication. Arbitrage is also a likely explanation for the changes in anomaly returns after 2003 given the identical pattern of changes to day and night returns. To investigate the increased arbitrage hypothesis I perform two sets of tests. The first test examines changes to the cross-sectional level of short-selling for assets held in the short portfolios for any of the Fama and French (2015) anomalies. I find that after 2003 the percentage of market capitalization sold short more than doubles for stocks held short in anomaly portfolios. Similar increases in the amount of short selling are observed after the publication of the asset growth and profitability anomalies.

I also replicate the tests of increased arbitrage activity from McLean and Pontiff (2016). My results indicate changes in three of the four indicators of arbitrage activity used in their analysis in directions that agree with their findings. After 2003 there are statistically significant increases in average trading volume and dollar volume for securities held in anomaly portfolios. The spread in short interest between short and long portfolios also increases post-2003. Increased arbitrage activity should naturally decrease daytime returns when investors are most active yet an explanation for the contemporaneous increase in nighttime returns is less clear.

Given the conflicting sign of changes in night and day returns, I examine the average spread and correlation of day and night returns. If day and night returns are derived from the same return generating process they should have a large positive correlation. However, if day and night returns are reflective of two separate sources of risk they should be uncorrelated. The correlation between night and day returns is observed to be near zero for all of the anomalies. This lack of correlation, and possibility that day and night returns reflect different risks, is consistent with the Oldfield and Rogalski (1980) equilibrium model. In this equilibrium returns from different times of the day come from different sources of risk. Daniel, Hirshleifer, and Subrahmanyam (2001) examine a similar theoretical setting where returns are influenced by two distinct sources: investor mispricing and systematic risk.

Based on Daniel, Hirshleifer, and Subrahmanyam (2001), a decrease in daytime returns following publication could be explained through an increase in arbitrage activity associated with investors mispricing firm fundamentals. Consistent with this hypothesis Bogousslavsky (2021) finds stock level mispricing is significantly higher during the day. In the Daniel, Hirshleifer, and Subrahmanyam (2001) model then, the most likely explanation for variation in overnight returns would be changes in the real macroeconomy. The success of the CAPM overnight documented in Hendershott, Livdan, and Rösch (2020) provides anecdotal evidence in support of this hypothesis. To examine if the Daniel, Hirshleifer, and Subrahmanyam (2001) model applies to this setting, I conduct a series of tests aimed at identifying whether changes in measures of economic risk and investor sentiment lead to predictable variation in day and night returns.

I begin by examining NBER economic expansion and contraction periods. The results indicate that during contraction periods monthly overnight returns for the market factor are 2.23% lower than during expansion periods.[4] Next I examine the impact that economic uncertainty has on nighttime returns using the macroeconomic uncertainty index from Jurado, Ludvigson, and Ng (2015). I find that during periods of high economic uncertainty overnight returns are higher for the size, value, and investment factors by between 0.70% and 1.28% per month. I find no evidence of changes to daytime returns between periods of high and low economic uncertainty providing more support for the hypothesis that day and night returns reflecting different sources of risk and consistent with Daniel, Hirshleifer, and Subrahmanyam (2001).

To test the daytime mispricing hypothesis, I examine the role investor sentiment plays in night and daytime returns using the Baker and Wurgler (2006) index. Stambaugh, Yu, and Yuan (2012) finds this index is highly related to the premiums earned by a number of anomalies. During periods of high investor sentiment my findings show daytime anomaly returns are significantly larger for the value, investment, and profitability factors indicating a higher degree of investor mispricing. Nighttime returns are statistically significantly more negative for the size, value and investment

[4] Similar results are observed for the long and short portfolios for each anomaly with most experiencing an approximately 2% decrease in monthly overnight returns during contraction periods.

factors during periods of high investor sentiment.[5] This decrease in nighttime time returns is indicative of the mispricing of fundamental risk as in Daniel, Hirshleifer, and Subrahmanyam (2001).

In addition I examine how economic policy uncertainty affects daytime and nighttime returns using the Baker, Bloom, and Davis (2016) index. This index is compiled using news stories and thus captures the effect informational uncertainty has on investors. Given both the investor attention channel and relation to macroeconomic risk, variation in this index should affect both daytime and nighttime returns. Consistent with this intuition I interpret the findings as evidence that during periods of high policy uncertainty, daytime (nighttime) returns are lower (higher) indicating investors focus primarily on economic risk during these periods.

The research presented here contributes to several branches of the asset pricing literature. First, and foremost, I contribute to the literature on day and night returns. I find that the day-night reversals experienced by anomalies occur because overnight returns for short portfolios are significantly higher than those of the long portfolios. Additionally, I document that day and night returns are uncorrelated with each other and reflective of two distinct sources of risk: fundamental macroeconomic risk and investor mispricing. These facts, as far as I am aware, are new to the literature. Furthermore I contribute to the literature investigating variation in anomaly premiums. I observe events known to attenuate anomaly returns decrease daytime returns and increase nighttime returns. I also find that the post-2003 decrease from Green, Hand, and Zhang (2017) is driven by an increase in arbitrage activity. Finally, I provide strong empirical support for Daniel, Hirshleifer, and Subrahmanyam (2001) by documenting a number of features predicted by their model.

The paper proceeds as follows, section one details data used and the calculation of day and night returns. Section two explores the average returns of close-to-close, daytime, and nighttime returns for the Fama and French (2015) anomalies. Section three analyzes the McLean and Pontiff (2016) publication effect and decrease in returns documented in Green, Hand, and Zhang (2017). Section four and section five investigate changes in arbitrage activity as well as the average spread and correlations between day and night returns respectively. Section six examines how macroeconomic risk and uncertainty affect nighttime returns. Section seven examines the role of investor sentiment and uncertainty in daytime and nighttime return variation and section eight concludes.

[5] The nighttime returns for the profitability factor also become slightly, but statistically insignificantly, more negative at night.

1 Data

To calculate day and night returns I begin by collecting daily and monthly return data for all common stocks[6] on CRSP. Opening prices are needed for the calculation of day and night returns as shown below. CRSP provides opening price data from mid 1993 forward as it retrieves these values from TAQ. Given that the addition of this variable occurred mid year I restrict my main sample to the period between 01/01/1994 and 12/31/2021. Firm level accounting data is collected from the CRSP-Compustat merged database and includes all of the variables detailed in Fama and French (2015). I follow the methodology laid out both in Fama and French (2015) and on Kenneth French's website[7] in calculating firm size, value, profitability, and investment. As in Fama and French (2015) I use a two by three sort for the value, profitability, and investment factors. I then generate the size factor by combining portfolios of large and small stocks sorted into their respective value, profitability, and investment portfolios. This process isolates the premium associated with each characteristic. I also retrieve short interest data from Compustat for use in evaluating changes in arbitrage activity.

I use multiple data sets from other sources as well. I retrieve the Fama and French (2015) factors as well as the risk free rate from Kenneth French's website. Information on economic expansion and contraction periods is collected from the NBER. Investor sentiment from Baker and Wurgler (2006) is collected from Jeffrey Wurgler's website. Data on economic policy uncertainty data from Baker, Bloom, and Davis (2016) is collected from the authors' joint website.[8] Economic uncertainty as in Bali, Brown, and Tang (2017) is identified using the index from Jurado, Ludvigson, and Ng (2015) available on Sydney Ludvigson's website. I thank all of the authors for making these data free and accessible.

1.1 Return Calculation

To calculate returns I follow Hendershott, Livdan, and Rösch (2020) and collect opening price information from CRSP for use in return calculations.[9] I then adjust prices by the CRSP provided

[6]Those with a sharecode of either 10 or 11.
[7]https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
[8]www.policyuncertainty.com
[9]Lou, Polk, and Skouras (2019) uses value weighted average prices collected from TAQ for their analysis but note their results are not sensitive to the use of CRSP opening prices.

cumulative factor to account for stock splits across time. To calculate nighttime returns I follow both Lou, Polk, and Skouras (2019) and Hendershott, Livdan, and Rösch (2020) and calculate these as:

$$RET_{day} = \frac{Price_{close} - Price_{open}}{Price_{open}} \tag{1}$$

I then use the daily close-to-close return (labeled as holding period return) from CRSP to calculate the nighttime return as:

$$RET_{night} = \frac{(1 + RET_{close-to-close})}{(1 + RET_{day})} - 1 \tag{2}$$

If the open price is missing I set the daytime return to zero and attribute the entire return to the overnight period as in Lou, Polk, and Skouras (2019).

To aggregate returns to the monthly level I take the sum of the natural log of one plus the daily return. I perform this procedure for each of the three periods for which I have measures of the return: close-to-close, daytime, and nighttime. I then subtract one from the exponential of that value as follows:

$$RET_{i,K,P} = \exp\left(\sum_{j=1}^{J} ln(1 + ret_{i,j,P})\right) - 1 \tag{3}$$

Where $RET_{i,K,P}$ is the return for security i in month K during trading period P. The values $j = 1 \ldots J$ represent the total number of trading days for i in month K. This is equal to the sum of the natural log of one plus the daily period P return for security i on all days day $j = 1 \ldots J$.

To ensure the accuracy of calculated returns and subsequent analysis I use two additional filters. First, I drop any security whose calculated monthly close-to-close return deviates from the CRSP monthly return by more than 0.05%. I additionally drop any security with a monthly day or night return greater than 200%. I find that this calculation and cleaning procedure generates factors that have an correlation between 0.94 and 0.99 and statistically insignificant differences in returns when compared to the factors available on Kenneth French's website.

2 Average Day and Night Returns

Table 1 contains the average returns across close-to-close, daytime and nighttime periods for each total factor as well as it's constituent long and short portfolios. In examining the returns I find that total anomaly portfolio returns largely follow the patterns from Cliff, Cooper, and Gulen (2008) and Lou, Polk, and Skouras (2019). The market factor has a monthly daytime return of 0.01% that is insignificant from 1994 until the end of 2021. The monthly overnight return for the market factor however, is 0.76% and significant above the 1% level. This is consistent with both Cliff, Cooper, and Gulen (2008) and Hendershott, Livdan, and Rösch (2020) who observe large positive overnight premiums for the market portfolio and high beta stocks.

When examining the returns of the other four anomalies in the Fama and French (2015) factor model I find that the value, investment, and profitability factor display overnight reversals similar to those observed for the trading strategies in Lou, Polk, and Skouras (2019). Of note I find that the size factor displays positive overnight returns and insignificant daytime returns. The insignificant daytime returns for the size factor agrees with findings in Lou, Polk, and Skouras (2019).[10] What is particularly interesting is that the size factor displays positive overnight returns in contrast with the other factors which have negative overnight returns. In unshown results I find this pattern for the size factor is inconsistent across the sample period. From 1994 to 2007 the size factor has insignificant nighttime returns but statistically significant daytime returns. During the latter part of the sample from 2008 through 2021 I find the size factor has negative, but statistically insignificant, daytime returns and positive overnight returns which are significant above the 1% level.

To determine what causes the reversals for the value, profitability, and investment factors I examine the returns to the long and short portfolios to see if the overnight reversals are due to long portfolios experiencing negative returns or short portfolios outperforming long portfolios at night. I find evidence of the latter. For each of the anomalies I find that short portfolios generate significantly higher returns than long portfolios at night. For the value, profitability, and investment anomalies I find that the overnight outperformance of the short portfolios is significant above the

[10] Lou, Polk, and Skouras (2019) do not analyze average premiums. Instead they generate CAPM alphas for the trading strategies they investigate. Despite the difference in tests the sign of the daytime and nighttime returns I observe for the size factor are consistent with those for the long-short strategy in Lou, Polk, and Skouras (2019).

1% level. The higher overnight returns is consistent with a risk based explanation for nighttime returns as the short portfolios are generally comprised of firms with poor fundamentals compared to firms in the long portfolios. This likely indicates that investors require a higher rate of return in order to incentivize them to hold risky firms overnight. As such, the differences in overnight returns for long and short portfolios agrees with the average investor being risk averse rather than risk neutral or risk seeking.

There are additional interesting patterns across long and short portfolios for each of the four factors. To start, despite all four long portfolios experiencing positive and statistically significant daytime returns they actually experience much larger overnight returns indicating that the risk that generates overnight returns is more significant that the risk that generates daytime returns. Short portfolios also gain their entire return premium overnight and have a daytime return that is approximately zero. This lack of statistically significant daytime returns for short portfolios is the reason why anomalies earn such significant premiums during the day.

The difference in day and dnight return magnitudes for long and short portfolios is consistent with Oldfield and Rogalski (1980) who propose that returns can be broken into a series of constituent parts. In their equilibrium each portion of the close-to-close return is reflective of different risks being priced at different times of the day. A similar theoretical setting is found in Daniel, Hirshleifer, and Subrahmanyam (2001) who break returns into two distinct sources of risk: investor mispricing and fundamental risk. The results here intuitively indicate that firm fundamentals are priced during the day when investors are most active and a different form of risk is being priced at night. Based on Daniel, Hirshleifer, and Subrahmanyam (2001) the natural candidate for overnight risk is macroeconomic risk. This hypotheses is partially supported by the findings of Hendershott, Livdan, and Rösch (2020) who observe the CAPM is successful at explaining overnight returns, Bogousslavsky (2021) who finds that mispricing primarily occurs during the day, and Lou, Polk, and Skouras (2019) who document clientele effects in trading volume around market open and close.

3 Decreases in Anomaly Returns

I next focus on events that are known to lead to decreases in anomaly returns. The first is the publication effect observed in McLean and Pontiff (2016). The authors of that study find that after publication a large number of return anomalies see a decrease in their return premium and tie this change to increased arbitrage activity. For the profitability and investment factors I find that this decrease in return is driven by changes to both day and night returns. Specifically, I observe that daytime returns, when the positive premium is earned, decrease while nighttime returns, when reversals occur, experience significant increases. The resulting effect drives the anomaly return towards zero on a close-to-close basis.

I also examine the post-2003 decrease in anomaly returns observed in Green, Hand, and Zhang (2017). The cause of this decrease is not as readily apparent as the publication effect given there were no obvious changes in market conditions or the rate of academic publications around this time. Interestingly, I find that changes in anomaly returns that occur after 2003 are identical to those observed after publication indicating that increases in arbitrage activity is the most likely explanation. I test this hypothesis in section four and find strong evidence that this is the case.

3.1 McLean and Pontiff (2016) Publication Effect

I first examine the publication effect documented in McLean and Pontiff (2016). There the authors find that after the publication of academic research documenting return anomalies the premium associated with these anomalies decreases significantly. Within my sample period both the investment (or asset growth) anomaly from Cooper, Gulen, and Schill (2008) and profitability anomaly from Novy-Marx (2013) were published. For the Novy-Marx (2013) I use the date of 2013 as the publication date. For the asset growth anomaly of Cooper, Gulen, and Schill (2008) I use the year 2008 as the publication year. These are selected following McLean and Pontiff (2016) and are based on the publication of the original research in an academic journal. For robustness I also consider the date which the research was first posted on SSRN which is 2005 for Cooper, Gulen, and Schill (2008) and 2010 for Novy-Marx (2013).

Using this combination of dates allows me to identify the portions of the close-to-close return that are affected after publication. Based on the findings in Table 1 daytime returns seem most likely to be the portion of return affected by publication. This is because daytime is when positive returns for the anomaly are gained. To examine the effect of publication I follow Green, Hand, and Zhang (2017) and use a simple t-test of differences in mean returns before and after publication for close-to-close, daytime and nighttime returns. The results of these tests are shown in Table 2.

In Panel A of Table 2 I examine changes in returns using the year of publication in a major academic journal. In doing so I find that both close-to-close and daytime returns decrease following publication which is consistent with McLean and Pontiff (2016). Specifically, the profitability anomaly experiences a statistically insignificant 0.43% decrease in daytime returns. The investment anomaly experiences a decrease of 0.37% decrease in monthly close-to-close returns and an 1.14% decrease in monthly daytime returns both of which are statistically significant. Bogousslavsky (2021) finds that an mispricing factor accrues significant returns during daytime hours consistent with investors being more active during this time. The decrease in daytime returns for the anomalies is also consistent arbitrage activity increasing once the anomaly is identified as shown in McLean and Pontiff (2016).

Nighttime returns for both anomalies also change around publication. The profitability anomaly sees its overnight returns increase by 0.63% per month and the investment factor sees a similar 0.72% increase in returns after publication. This increase in overnight returns paired with the decreases in daytime returns leads to the an attenuation of close-to-close returns. Lou, Polk, and Skouras (2019) show that the spread between day and night returns can be used to predict future performance of trading strategies formed using characteristic sorts. Consistent with the notion that the combined changes in day and night returns leads to a decrease in close-to-close returns I find the spread between day and night returns decreases by 1.05% per month for the profitability factor and 1.86% for the investment factor. Both of these changes are significant at greater than the 1% level. Given that this day-night spread is predictive of future anomaly returns the decrease indicates that these premiums decrease significantly after publication which is exactly what is observed in McLean and Pontiff (2016).

In Panel B I repeat these tests based on the date for the circulation of working drafts of the papers on SSRN. These dates are 2005 for Cooper, Gulen, and Schill (2008) and 2010 for Novy-Marx (2013). When using these dates I find that the results are not only consistent with those presented in Panel A but in fact somewhat stronger. In Panel B the decrease in daytime returns after publication for both anomalies is statistically significant. The profitability anomaly sees a 0.51% decrease in monthly daytime returns while the investment anomaly sees a 1.13% decrease in monthly daytime returns. As in Panel A I also observe an increase in nighttime returns. The size of the change, 0.66% for the profitability anomaly and 0.73% for the investment anomaly, are approximately the same size as those in Panel A. Likewise the change in the day-night spread is of nearly identical size and statistical significance of that in Panel A.

The results in Hendershott, Livdan, and Rösch (2020) indicate, based on the theory underlying the CAPM, that overnight returns should be largely driven by macro-economic risk. If this is true the change in overnight returns following publication likely indicates that arbitrageurs are correcting mispriced macro-economic risk. Given the results in Bogousslavsky (2021) of increased mispricing during the day and the decrease in daytime returns following publication is consistent with increased arbitrage activity related to firm level mispricing. Different sources of risk generating returns at different times of day was proposed in Oldfield and Rogalski (1980) and the difference in sign of changes to night and day returns is consistent with such an equilibrium. The distinct separation of these two sources of these risks, macroeconomic risk and firm level mispricing, also provides support for the Daniel, Hirshleifer, and Subrahmanyam (2001) equilibrium. Based on Daniel, Hirshleifer, and Subrahmanyam (2001) the decrease in returns after publication is likely driven by the increase in arbitrage activity which is shown in McLean and Pontiff (2016) for a large number of characteristic driven trading strategies.

3.2 Green, Hand, and Zhang (2017) 2003 Anomaly Effect

Green, Hand, and Zhang (2017) find that after 2003 the returns to characteristic based anomalies experience a significant decrease in returns. Unlike the McLean and Pontiff (2016) publication effect, which is largely due to an increase in arbitrage activity, the 2003 decrease in close-to-close returns does not have a clear causal explanation. To begin examining this event I break the anomaly returns into their daytime and nighttime portions as well as the day-night spread. As in the prior section this allows me to identify the portfolio specific changes which drive this effect.

Again, I follow Green, Hand, and Zhang (2017) and use an simple t-test to examine the change in returns before and after 2003. Based on the results in Table 1 it should be expected that the change in returns is at least partially driven by a decrease in daytime returns which will attenuate close-to-close returns for all of the anomalies. Since the premiums decrease after 2003 but are not observed to be negative it is likely that nighttime returns change as well. Based on the results in Table 2 it is likely that nighttime returns will see an increase leading to the spread between day and night returns to approach zero. This combined effect would generate the decrease in close-to-close premium observed in Green, Hand, and Zhang (2017).

Results in Table 3 largely support these hypotheses. Though the market factor experiences no change before or after 2003 each of the four anomalies experiences a statistically significant decrease to daytime returns. The decrease in daytime returns for the entire group range from 0.79% per month to 1.84% and all are significant above the 5% level and three of four significant above the 1% level. As with the McLean and Pontiff (2016) publication effect I also observe increases to nighttime returns. This increase in nighttime returns is statistically significant for all four anomalies with increases ranging from 0.38% per month to 1.52% per month. The t-statistics for these changes range from 2.69 to 11.46. This combined effect leads the premiums anomalies earn on a close-to-close basis to approach zero. The results for the day-night spread in column four support this view as the spreads for all four factors experience significant decreases after 2003. The size of these changes ranges from 1.56% to 3.35% per month. All of the changes are statistically significant above 1% with t-statistics ranging from 3.96 to 10.32. As with the post-publication period from McLean and Pontiff (2016), the findings in Lou, Polk, and Skouras (2019) predict this decrease in the day-night spread will lead to lower close-to-close returns for these anomalies as observed in Green, Hand, and Zhang (2017).

Figures 1 and 2 explore the changes in daytime and nighttime factor premiums across time and reveal an interesting pattern. Up until 2003 daytime returns were, with the single exception of the size factor in 2008, uniformly positive across the sample period. Following 2003 daytime returns began to oscillate between positive and negative values with different anomalies experiencing positive and negative returns in the same year. A similar pattern is observed for nighttime returns in Figure 2. Here it is seen that prior to 2003 nighttime returns were primarily negative. After 2003 however nighttime returns decrease in magnitude and begin to change sign between positive and negative. The fact that the changes to daytime and nighttime returns occur nearly simultaneously provides qualitative evidence that there was an hereto unobserved change in the market environment around this time.

Taken together the results presented in this section present consistent evidence that decreases to returns occur through both the daytime and overnight return channels. This lowers the spread between day and night returns which ultimately lowers the close-to-close return for each anomaly. This decrease in spread is significant in practical terms as well. As mentioned above, Lou, Polk, and Skouras (2019) demonstrate that the spread between day and night returns, which they refer to as a "tug-of-war" predicts future return premiums for characteristic based trading strategies. The attenuation of both daytime and nighttime returns decreases this spread and predicts a decrease in future returns for these anomalies. This is exactly what is observed in McLean and Pontiff (2016) and Green, Hand, and Zhang (2017). Given the consistency in results between the changes to day and night returns after publication and post-2003 the most likely candidate for the mechanism driving the post-2003 changes is an increase in arbitrage activity as presented in McLean and Pontiff (2016). I explore this hypothesis in depth in the next section.

4 Increases in Arbitrage Activity

Results in the prior section demonstrate that after publication and post-2003 anomalies in the Fama and French (2015) model experience decreases in daytime returns and increases in nighttime returns. A plausible explanation for the changes after each event is an increase in arbitrage activity which corrects investor mispricing and leads to lower factor premiums. McLean and Pontiff (2016) examine this possibility after the publication of a number of return anomalies and find evidence consistent with this explanation. I reexamine this hypothesis in the context of my setting and look to see if changes in short selling activity around publication mirror the changes that are observed post-2003. If increased arbitrage does explain these changes to day and night returns then securities sorted into anomaly portfolios should see an increase in both short selling intensity and variables associated with arbitrage activity after publication of the anomaly and post-2003.

I begin by performing panel regressions of the percentage of shares sold short on indicators related to whether the security is included in a short portfolio, if the period is pre- or post-event date, as well as an interaction of the two. I find that after 2003 securities held in the short portfolio of any of the Fama and French (2015) factors experience an increase in short selling activity of 1.77% compared to securities in the long and neutral portfolios. This is a substantial increase given the unconditional average across securities during my sample period is 4.31% with a median of 2.31%. I find similar increases in short selling activity after publication for the investment and profitability anomalies. I also explore the changes in the arbitrage linked variables used by McLean and Pontiff (2016). After 2003 I find increases in the trading volume and dollar volume of securities held in anomaly portfolios. I also find the spread in short interest between long and short portfolios increases in the post-2003 period. These results are consistent with an increase in arbitrage driving anomaly returns towards zero after 2003.

4.1 Increases in Short Selling Intensity

To measure short sale activity I collect the number of shares held short from Compustat. I follow Rapach, Ringgenberg, and Zhou (2016) in calculating this variable and divide the number of shares held short by the number of shares outstanding and then take the natural logarithm of this value. I merge this data with CRSP and my tabulated daytime and nighttime returns. As before I drop any security whose calculated monthly return has difference greater than a 0.05% from the monthly return recorded in CRSP or with a monthly day or night return greater than 200%. To control for differences in margin fee levels I also drop any stock with a prior monthly closing price less than five dollars. This procedure ensures my sample of stocks is similar to those selected for construction of the Fama and French (2015) factors and captures the changes observed in the previous section. Rather than keeping only stocks sorted into long or short portfolios I select stocks in the long, short, and neutral portfolios. This is because a stock may be held in the short portfolio of one anomaly but held in the neutral portfolio for another anomaly.[11] For this analysis I additionally exclude the size factor. The construction of the size factor is such that it is a reconstitution of the other characteristic based long and short portfolio which makes it's inclusion redundant and could upwardly bias the results.

In examining changes to short portfolio stocks before and after 2003 I find that prior to 2003 stocks in short portfolios had approximately 2.52% of their shares outstanding sold short. After 2003 though, this number more than doubles to 5.78%. However, changes in the level of short selling intensity may be explained by firm level considerations. To address this possibility I employ panel regressions incorporating firm fixed effects.

For these regression I also create a series of indicator variables. The first is an indicator equal to one if the stock is held short in any of the short portfolios used to construct the Fama and French (2015) factors. This indicator allows me to find out whether stocks theoretically held short

[11] In unshown tests I find that excluding neutral portfolios from the analysis strengthens the effects observed in the tests of the post-2003 period. Excluding neutral portfolios from the publication tests generates inferences that are largely similar to those shown here.

actually experience more short selling. Next I create three time based indicators. The first is equal to 1 if the year is 2003 or after to capture the Green, Hand, and Zhang (2017) effect. I then also create indicators equal to one if the year is after the publication of the anomalies identified by Cooper, Gulen, and Schill (2008) and Novy-Marx (2013). As in Table 2 I use 2008 for the post-publication indicator for the Cooper, Gulen, and Schill (2008) investment factor and 2013 for the Novy-Marx (2013) profitability factor. These three indicators allow me to evaluate how short selling generally changes around these dates. I also generate three interaction terms. The first is the interaction between being held in a short portfolio and the post-2003 indicator. The next interaction is the short portfolio indicator and the post-publication dummy based on Cooper, Gulen, and Schill (2008). Finally, I interact the short portfolio indicator with the indicator for the publication of Novy-Marx (2013). I then regress the percentage short sale variable onto these indicators and interactions. In all regressions I control for firm level heterogeneity using firm fixed effects and I additionally cluster my standard errors at the firm and date level following guidance from Petersen (2009). The results from these panel regressions are shown in Table 4.

In Panel A I first consider the Green, Hand, and Zhang (2017) decrease in anomaly returns. In column 1 I regress the percentage of shares sold short onto the indicator for the stock being held in one of the short portfolios. I find that being sorted into one of the short portfolios increases the percentage of shares sold short by 1.19%[12] which is nearly a third the size of the cross-sectional average of 4.31%. This indicates that on average stocks held short based on the Fama and French (2015) methodology experience greater short selling than their peers. In column 2 I regress the percentage of shares sold short on the post-2003 indicator. I find that after 2003 short selling activity increased by 2.61% as measured by the percentage of shares sold short. This provides strong evidence of an increase in arbitrage activity in the post-2003 period. The interaction of the indicators in column 3 demonstrates that this is particularly true for securities held in short portfolios. This coefficient implies that stocks held in the short portfolios of the Fama and French (2015) model not only experienced an increase in short selling after 2003 but did so at a statistically significantly higher rate of 1.77% when compared to other stocks during the same period. This result combined with those in columns 1 and 2 provide strong evidence in favor of an arbitrage

[12] I obtain this value, as well as others in this section, by raising the coefficient to the base of the natural logarithm in order to interpret the change in level of shares held short, rather than the percentage change in this value.

based explanation for the decrease in anomaly premiums after 2003.

I examine the publication effect in Panels B and C. In each panel I restrict the sample to stocks sorted into one of the six portfolios used to build the relevant factor as determined using the Fama and French (2015) methodology.[13] In panel B I examine how short selling activity changed around the publication of Cooper, Gulen, and Schill (2008). I once again observe a positive and significant coefficient on the post-publication dummy and the interaction between short portfolio and post-publication. These results indicate that stocks held in the short portfolio experienced a 1.25% increase in short selling activity following publication. This again provides consistent evidence that the changes to returns after publication are due to increased arbitrage activity. Panel C contains the results for the regressions of percentage short sale on the short portfolio indicator, post-publication indicator for Novy-Marx (2013) as well as the interaction between the two. Here I find that following publication stocks held short in the profitability factor see a 1.17% higher level of short sale compared to stocks held in the long and neutral portfolios.

4.2 McLean and Pontiff (2016) Tests of Arbitrage Activity

The increases in short selling activity found in Table 4 provide evidence that there is an increase in arbitrage activity post-2003 and after the publication of academic research. However, Figure 3 shows that short selling activity generally increases starting in 2001 and remains elevated through the end of 2021 for stocks in my main sample. This increase in short selling intensity implies there was generally an increase in arbitrage activity during my sample period. However, the increase in short selling activity could also be correlated with the decrease in anomaly premiums and not prescriptive of actual increases in arbitrage activity during this time. To investigate this further I rely on variables used in McLean and Pontiff (2016) to examine changes in arbitrage activity before and after publication. These variables include variance (squared monthly return), trading volume, and dollar volume calculated as the prior month closing price multiplied by monthly volume. For these variables, following McLean and Pontiff (2016), I use the natural logarithm of each value. I also calculate the spread between the level of short interest in the short portfolio and long portfolio. This is calculated as the percentage of shares outstanding sold short. All four of the variables

[13] This includes both the high and low characteristic portfolios as well as the neutral portfolio. The high and low characteristic portfolios are the top and bottom three deciles respectively. The neutral portfolio is comprised on the four deciles in between.

are calculated as the average within the long or short anomaly portfolio. Stocks with a prior monthly close less than five dollars are excluded from the sample given the higher stock lending fees associated with prices below this level.

I regress each of these variables on an indicator for the post-2003 period or an indicator for the publication of Cooper, Gulen, and Schill (2008) and Novy-Marx (2013) respectively. The results are presented in Table 5. In Panel A I calculate the average for the short and long portfolios across all stocks. In Panel B I calculate the averages at the size sorted long and short portfolio level. This means the values are calculated for the large value portfolio, small value portfolio, large investment portfolio etc. For the difference in short interest in Panel B I use the long and short legs of the same size to account for differences in barriers to arbitrage across firms of different market capitalization. For tests involving the post-2003 period I include predictor fixed effects as in McLean and Pontiff (2016). I also cluster standard errors at the date (i.e., year-month) level consistent with guidance from Petersen (2009).

Results from the post-2003 period are largely consistent with the findings of McLean and Pontiff (2016). For the results in Panel A, which averages the values at the total long or short portfolio level, I find that trading volume, dollar volume, and the spread in short interest between long and short portfolios increase after the 2003 period consistent with an increase in arbitrage activity during this period. In fact the increase in the spread in long and short trading activity indicates an increase in short selling of 0.235% which is substantial given the unconditional percentage of market capitalization sold short at the stock level is 4.31% and is approximately the same size as the increase observed in McLean and Pontiff (2016). I also find increases in trading volume and dollar volume after publication of the Cooper, Gulen, and Schill (2008) investment factor and Novy-Marx (2013) profitability factor. For these post-publication tests I do observe that the spread in short interest between long and short portfolios is insignificant after publication of the investment factor and, in fact, negative and statistically significant after the publication of the profitability factor. I also find increases in the variance of returns of securities held in the portfolios in Panel A. However, when using the size matched portfolios in Panel B I find that the differences between my results and those from McLean and Pontiff (2016) largely disappear.

For variance in Panel B I find no statistically significant differences in pre- and post-periods for any of the three dates. The spread in short interest between long and short portfolios that are matched on size shows statistically significant increases after 2003 and after the publication of the Cooper, Gulen, and Schill (2008) investment factor. The magnitude of these changes is significant in economic terms as well. Short interest rises by 0.224% following 2003 and by 0.524% for stocks held in the long and short portfolios of the investment factor after publication. The spread in short selling interest between the long and short portfolios of the profitability factor remains negative and statistically significant.

In unshown tests I examine the differences in my results for variance and the spread between short and long portfolio short interest from the results presented in McLean and Pontiff (2016). I find that variance is largely influenced by the last two years in my sample which include the COVID-19 pandemic in which markets experienced high levels of volatility. I also find that for large capitalization stocks, those above the NYSE median, variance does decrease post-2003 and following the publication of the investment and profitability factors. Further I observe the spread in short interest between short and long portfolios increases after the publication of the Cooper, Gulen, and Schill (2008) investment factor for large capitalization stocks. These differences in results between large and small stocks is consistent with smaller capitalization stocks having higher barriers to arbitrage and thus experiencing less arbitrage activity.

Results in this section provide ample evidence that after publication, and especially after 2003, increases in arbitrage activity lead to changes to both day and night returns of the factors in the Fama and French (2015) model. Based on findings in Bogousslavsky (2021) it seems likely that these changes in arbitrage activity lead to a decrease in daytime returns driven by corrections of firm level mispricing. Nighttime returns however, experience an increase in returns. It is not clear from prior research what risk is being arbitraged and why night and day returns move in different directions. Based on Oldfield and Rogalski (1980) and Daniel, Hirshleifer, and Subrahmanyam (2001) one possibility is that different types of risks exist at day and night and both are being traded on by arbitrageurs.

5 Day Night Spreads and Correlation

The results presented in the prior section indicate that changes to daytime and nighttime anomaly returns are driven by increases in arbitrage activity. Results in Section 3 also present a puzzling feature: the changes in daytime and nighttime returns move in opposite directions. This contemporaneous change would seem to indicate that day and night returns are derived from the identical return generating process and should be highly correlated. However, based on the success of the CAPM overnight (Hendershott, Livdan, and Rösch (2020)) theory indicates that nighttime return variation should be related to macroeconomic risk. Likewise daytime returns have been empirically linked to sources of firm level risk and investor mispricing (Lou, Polk, and Skouras (2019), Bogousslavsky (2021)) and thus it is possible that day and night returns reflect different risks. If this hypothesis is correct then day and night returns should be uncorrelated with each other on average. To test this I calculate the spread in day and night returns as well as the correlation between the two for each of the five factors in the Fama and French (2015) factor model. The results from these tests are in Table 6.

The spread in returns between day and night returns was found by Lou, Polk, and Skouras (2019) to have predictive power over future returns for a select number of trading strategies. I find that for all factors except the size factor the spread between day and night returns is significant above the 1% level. In absolute terms the magnitude of these spreads ranges from 0.71% to 1.71% per month. What is unclear from the mean of the spread between day and night returns is whether the returns occurring during each time of day are driven by the same or different risks. Results in the prior section show that post-2003 and after publication returns for anomalies in the Fama and French (2015) model experience increases in nighttime returns and decreases in daytime returns. The simultaneity of the change could be suggestive of them coming from the same risk but the difference in the direction of the change would seem to indicate they stem from different sources of priced risk.

To examine this further I calculate the correlation of daytime and nighttime returns to determine if the observed spreads are constant or if the spread is reflective of idiosyncratic variation in each return component. In examining the correlation between night and day returns I find no evidence of a consistent spread between night and day returns. Instead I find that daytime and nighttime returns are largely uncorrelated with each other meaning the spread is transitory. The lack of correlation implies that if clientele effects do explain the day night reversals observed in Table 1 they are unlikely to do so on average. Instead clientele effects explanation put forth by Berkman et al. (2012), Lou, Polk, and Skouras (2019), and Bogousslavsky (2021) appears to reflect different clientele pursuing returns generated by different sources of risk across time.

The reason the spreads are transitory is because the lack of correlation implies that the reversals are not mechanical and do not occur on a day to day basis. Instead the day-night spread may be due to different risks being priced at different times of day as proposed theoretically in Oldfield and Rogalski (1980). This hypothesis is consistent with the findings in Table 1 as well given that short portfolios for each of the factors only earn positive premiums at night when macroeconomic risk is priced per the theory of the CAPM and it's success overnight (Hendershott, Livdan, and Rösch (2020)). During the day these short portfolios experience no statistically significant returns indicating that mispricing is being corrected by arbitrageurs which is consistent with findings in Bogousslavsky (2021).

The findings in this section provide important information on the returns earned by factors in the Fama and French (2015) factor model. On average, as seen in Table 1, the market factor and both the long and short portfolios used to generate the Fama and French (2015) factors earn the majority of their premium during the overnight period. It is also this fact that drives the overnight reversals for many factors as the short portfolio generates significantly higher overnight returns than the long portfolio. These reversals have been partially explained through clientele effects based on findings in Berkman et al. (2012), Lou, Polk, and Skouras (2019), and Bogousslavsky (2021).

I find evidence supporting this hypothesis while also providing important context to this explanation. Specifically, I show that despite day-night spreads being statistically significant on average there is no correlation between day and night returns. The lack of correlation indicates that returns experienced at night and day may be due to different sources of risk as in Oldfield and Rogalski (1980) and Daniel, Hirshleifer, and Subrahmanyam (2001). This also implies that the clientele effect is unlikely to be a regularly occurring phenomena. Rather the lack of correlation between day and night returns indicates that nighttime reversals occur on average but are likely the results of different clienteles tilting their portfolios towards different forms of risk across time.

In particular Daniel, Hirshleifer, and Subrahmanyam (2001) presents a theoretical environment that seems to reflect the pattern in day and night anomaly returns and the changes anomalies experience after 2003 and post-publication. In their model security returns include two sources of risk: fundamental risk and investor based mispricing. In Daniel, Hirshleifer, and Subrahmanyam (2001) arbitrageurs act to correct not only the mispricings of firm level characteristics but also fundamental risk. Results in the prior section show that changes in return premiums associated with increased arbitrage activity after publication are identical, if not stronger, in the post-2003 period identified by Green, Hand, and Zhang (2017).

Consistent with both Oldfield and Rogalski (1980) and Daniel, Hirshleifer, and Subrahmanyam (2001) results in this section provide evidence that daytime and nighttime returns are not derived from the same return generating process. Based on the equilibrium in Daniel, Hirshleifer, and Subrahmanyam (2001) one of either day or night returns should reflect macroeconomic risk and one should reflect investor mispricing. Based on the findings in Hendershott, Livdan, and Rösch (2020) it seems likely that nighttime returns are reflective of macroeconomic risk. Similarly based on evidence in Lou, Polk, and Skouras (2019) and Bogousslavsky (2021) it is likely daytime returns are driven by investor mispricing. The lack of correlation between day and night returns provides evidence in support of this hypothesis. To investigate the dual risk hypothesis further I examine how day and night returns vary with changes in both the macroeconomic environment and measures of investor sentiment.

6 Macroeconomic Environment

To test the hypothesis that nighttime returns are linked to the macroeconomic environment I perform two sets of tests. In the first I split my sample based on the NBER expansion/contraction classification. Though ex-post, this test allows me to see how daytime and nighttime returns for the market portfolio in particular are affected by changes to the real economy. Hendershott, Livdan, and Rösch (2020) finds that the CAPM works as predicted overnight and under theoretical arguments from Sharpe (1964), Lintner (1965), and Mossin (1966) the market factor should vary with changes in the real economy. I find that this is the case with the market factor experiencing negative and statistically significant decrease in overnight returns during periods of economic contraction. I next examine how economic uncertainty alters daytime and nighttime returns. An increase in uncertainty related to the real economy should lead to investors demanding an increase in the returns they perceive to be related to those risks. Consistent with this hypothesis I find that during periods of high economic uncertainty investors demand significantly higher overnight returns.

6.1 NBER Expansion and Contraction Periods

To examine how variation in macro-economic risk is related to daytime and nighttime returns I collect data from the NBER website on expansion and contraction periods. I then perform a t-test of differences in mean return earned by each factor on a close-to-close, daytime and nighttime basis during economic expansions and contractions. If my hypotheses that nighttime returns are linked to the real macro economy is correct I should observe a severe decrease in nighttime returns for the market factor during contraction periods. If I find no change in the market factor's nighttime returns between expansions and contractions it would indicate that overnight returns for the market factor, and overnight returns more generally, do not represent systemic risk.

Consistent with my hypotheses that nighttime returns for the market factor are related real economic risk the findings in Table 7 show that during expansion periods overnight returns earned by the market factor during recession periods are negative. The difference in nighttime returns for the market factor between expansion and contraction periods is 2.23% per month and significant above the 1% level. Interestingly I find that, save the size factor, none of the other factors exhibit any statistically significant change between nighttime or daytime returns. For the size factor I find an increase in nighttime returns indicating that the spread between large and small firms becomes higher during these periods potentially indicating a stronger sensitivity to economic environment for these firms. However, given that, mechanically, the size factor is approximately the reverse of the market factor it could be that this is purely a reflection of this mechanical relation between the two.[14] The lack of variation in the other anomalies should not be surprising if the relative increase in returns attributable to economic risk increase proportionally in long and short portfolios. In unshown results I find that the difference in returns between expansion and contraction is almost identical for long and short portfolios of the value, profitability, and investment anomalies. This consistent increase in premium for both long and short portfolios provides additional supportive evidence that nighttime returns are related only to macroeconomic risk and not any form of risk captured by the Fama and French (2015) model.

[14]The reason the size anomaly experiences a significant change in nighttime returns between expansion and contraction periods is because the short portfolio experiences overnight returns that are statistically significantly higher during these periods. This is unsurprising given that larger firms, which by default are held in the short portfolio for the size factor, also constitute the largest portion of the market factor and so experience a greater decrease in returns compared to small capitalization stocks. In effect the change in nighttime returns for the size factor is merely the reverse of the effect observed for the market factor.

The effect of realized economic states on the nighttime return of the market factor with no relation to daytime returns provides strong evidence in support of the hypothesis that nighttime returns of the market factor capture macro economic risk and is consistent with findings in Hendershott, Livdan, and Rösch (2020). The lack of relation of economic state to daytime returns is also consistent with results that are presented in the prior section on the lack of correlation between nighttime and daytime returns. Under theoretical arguments from Oldfield and Rogalski (1980) and Daniel, Hirshleifer, and Subrahmanyam (2001) it is probable that daytime returns are driven by another form of risk and based on findings in Table 1, Lou, Polk, and Skouras (2019), and Bogousslavsky (2021) the most likely source of this risk is investor mispricing.

6.2 Macroeconomic Uncertainty

Given that I observe variation in nighttime returns is associated with changes in the macroeconomic environment I next turn my attention to how economic uncertainty affects factor premiums. To instrument for economic uncertainty I follow Bali, Brown, and Tang (2017) and use the Jurado, Ludvigson, and Ng (2015) economic uncertainty index. Bali, Brown, and Tang (2017) observe that stock returns are correlated with changes in this index. As opposed to the Baker, Bloom, and Davis (2016) index, which utilizes news articles, the Jurado, Ludvigson, and Ng (2015) index is based on variation in underlying economic fundamentals. As such the Jurado, Ludvigson, and Ng (2015) index does not directly rely on investor attention and information processing which mitigates the influence of behavioral factors on returns. I break my sample into quintiles based on the level of the index and compare returns across anomalies to determine how uncertainty affects anomaly returns. Doing so allows me to isolate how economic uncertainty, rather than investor uncertainty about economic policy, affects anomaly returns. These results are shown in Table 8.

In performing this test I find that across anomalies there are no major changes on a close-to-close basis during periods of high and low uncertainty. Under the hypothesis that daytime returns should be uncorrelated with economic environment I should find no relation between the level of economic uncertainty and daytime returns. Consistent with this I find no statistically significant difference in daytime returns for the majority of factors during periods of high and low economic uncertainty. The change in daytime returns for the investment factor is marginally significant however without consistent statistical significance across factors it is possible this is simply coincidence.

When examining overnight returns however, I find that overnight anomaly returns increase during periods of high economic uncertainty for three of the four factors. These changes range from 0.70% to 1.28% per month and are significant above the 1% level. This is consistent with nighttime returns capturing real economic risk. An change in the overnight spread between long and short portfolio returns during time of high economic uncertainty is unsurprising given investors are likely to focus more on economic risk rather than firm fundamentals during these periods.

Results in this section demonstrate that overnight returns of factors in the Fama and French (2015) five factor model are linked to real macroeconomic risk. During realized economic contractions the market factor sees a decrease in overnight returns of 2.23% when the economy transitions from expansion into contraction. In addition, overnight returns to the majority of factors increase during periods of economic uncertainty. This occurs because the spread in overnight returns between long and short portfolios narrows as investors focus on economic risk and demand higher compensation for holding securities overnight. In the theoretical environment from Daniel, Hirshleifer, and Subrahmanyam (2001) security returns contain two forms of risk: fundamental risk and investor mispricing. If nighttime returns are indeed linked to macroeconomic risk, as findings in this section suggest, then daytime returns should be linked to investor mispricing in order if the day-night return pattern reflects the Daniel, Hirshleifer, and Subrahmanyam (2001) model.

7 Investor Sentiment and Uncertainty

Results in the prior section show that nighttime returns are related to both the real macroeconomy as well as uncertainty surrounding the state of the economy. In the Daniel, Hirshleifer, and Subrahmanyam (2001) equilibrium however, returns contain two component parts: fundamental macro economic risk and investor mispricing. Given that, under a Oldfield and Rogalski (1980) equilibrium, returns occurring at different times of day can be traced to different sources of risk it is possible that daytime returns are related to investor mispricing. In fact both Bogousslavsky (2021) and results in Table 1 support this hypothesis. To test this further I examine how variation during the day is related to investor sentiment. I start by breaking the sample period into high and low investor sentiment periods based on the Baker and Wurgler (2006) investor sentiment index. I also consider how the economic policy uncertainty index from Baker, Bloom, and Davis (2016) affects daytime returns given it's investor centric construction. If my hypothesis is correct I should observe a increase in daytime returns when investor sentiment is highest as mispricing increases and a decrease in overnight returns due to increases in the mispricing of fundamental risk.

Variation in policy uncertainty from Baker, Bloom, and Davis (2016) should be linked to both daytime and nighttime returns. This is because investor mispricing generated by policy uncertainty should affect both fundamental and firm level mispricing in the Daniel, Hirshleifer, and Subrahmanyam (2001) model. If this is true it should be expected that nighttime returns increase during periods of high policy uncertainty as investors demand extra compensation related to macroeconomic risk. Similarly mispricing based factors should see a decrease in daytime returns during periods of high policy uncertainty as investors are likely to be focusing on economic risk meaning firm specific mispricing should become less apparent. I find results consistent with both of these hypotheses.

7.1 Investor Sentiment

As with the Jurado, Ludvigson, and Ng (2015) macroeconomic uncertainty measure I again break my sample period into quintiles based on the level of the Baker and Wurgler (2006) investor sentiment index. I then examine how daytime anomaly returns vary with the level of sentiment using a simple t-test. These results are shown in Table 9. In performing this analysis I am able to test whether daytime returns are reflective of a different set of risks, specifically investor driven mispricing. In support of my hypothesis I find that daytime returns to three of the four anomalies are higher during periods of high investor sentiment. These size of these changes range from 1.45% to 1.91% per month. All of these changes are statistically significant above the 1% level.

Consistent with Daniel, Hirshleifer, and Subrahmanyam (2001) who predict mispricing of fundamental risk I also observe changes to nighttime returns as well. Specifically, I find that nighttime returns are *lower* during periods of high investor sentiment. This indicates that investors are demand less compensation for holding securities overnight during this period. The size of these changes ranges from 0.50% to 1.23% per month and range in significance from 10% to 1%. Together these changes result in an increased spread between day and night returns during periods of high investor sentiment. This increased spread predicts higher future anomaly returns according to evidence presented in Lou, Polk, and Skouras (2019). The increased spread likely drives the results in Stambaugh, Yu, and Yuan (2012) who examine the relation between investor sentiment and anomaly returns.

7.2 Policy Uncertainty

I next consider the effect of policy uncertainty on anomaly returns in Table 10. I use the Baker, Bloom, and Davis (2016) index which examines news articles for words related to uncertainty and generates an index reflective of the amount of uncertainty displayed. This mechanism means that informed investors will be aware of this uncertainty while somewhat naive investors are likely unaware. Under an Daniel, Hirshleifer, and Subrahmanyam (2001) equilibrium it is likely that overnight returns will be higher as investors require a higher level of return for assuming macro-economic risk. Likewise, daytime returns should decrease during periods of high uncertainty as sentiment cools and investors focus on economic risk rather than firm level mispricing. I find results that agree with this hypothesis.

I again break my sample period into quintiles this time using the the Baker, Bloom, and Davis (2016) policy uncertainty index. I then examine the difference in returns during high and low policy uncertainty periods. I find that daytime returns are lower for three of the four anomalies during the day and that these decreases range from 0.59% to 1.43% per month and are significant above the 5% level. The lone exception is the profitability factor which sees no relation to policy uncertainty. Turning my attention to nighttime returns I find that for all four anomalies nighttime returns increase in a statistically significant manner. These increases range from 0.75% to 1.26% per month and are significant above the 5% level for all four anomalies and greater than 1% for three of the four anomalies.

Together results in this section also provide strong support for an Daniel, Hirshleifer, and Subrahmanyam (2001) equilibrium. Whereas nighttime returns only vary with changes in the macroeconomy both daytime and nighttime returns are affected by changes in investor sentiment and uncertainty. The changes to both day and night returns during periods of high investor sentiment is consistent with investors mispricing both macroeconomic and firm level risk. Changes to returns during periods of high economic uncertainty are also consistent with investors focusing on macroeconomic risk rather than risks associated with individual firms.

8 Conclusion

In this paper I investigate changes to day and night returns around events known to decrease close-to-close anomaly returns using the factors from the Fama and French (2015) five factor model. I find that for both the publication effect (McLean and Pontiff (2016)) and post 2003-anomaly decrease (Green, Hand, and Zhang (2017)) daytime anomaly returns decrease and nighttime anomaly returns increase. The net result drives anomaly returns towards zero after both sets of events. I then provide evidence that these events, and subsequent changes to day and night returns, are driven by increases in arbitrage activity. In examining the covariance of day and night returns I find evidence that daytime and nighttime returns are unrelated to each other indicating that they are derived from different return generating processes as presented theoretically in Oldfield and Rogalski (1980) and Daniel, Hirshleifer, and Subrahmanyam (2001).

To examine this hypothesis further I test for differences in day and night returns around changes in macroeconomic risk and investor sentiment. Consistent with Daniel, Hirshleifer, and Subrahmanyam (2001) I find that close-to-close returns contain elements of both because nighttime returns are driven by changes to macroeconomic risk and daytime returns are related to investor mispricing. Specifically, I find that variation in macroeconomic risk leads to changes in both the market factor and nighttime anomaly returns in an economically intuitive manner. I additionally find that variation in investor sentiment and uncertainty lead to variation in daytime returns and generate mispricing in nighttime returns which is also consistent with Daniel, Hirshleifer, and Subrahmanyam (2001). Overall I find strong support for the hypotheses linking nighttime returns to macroeconomic risk and daytime returns to investor mispricing.

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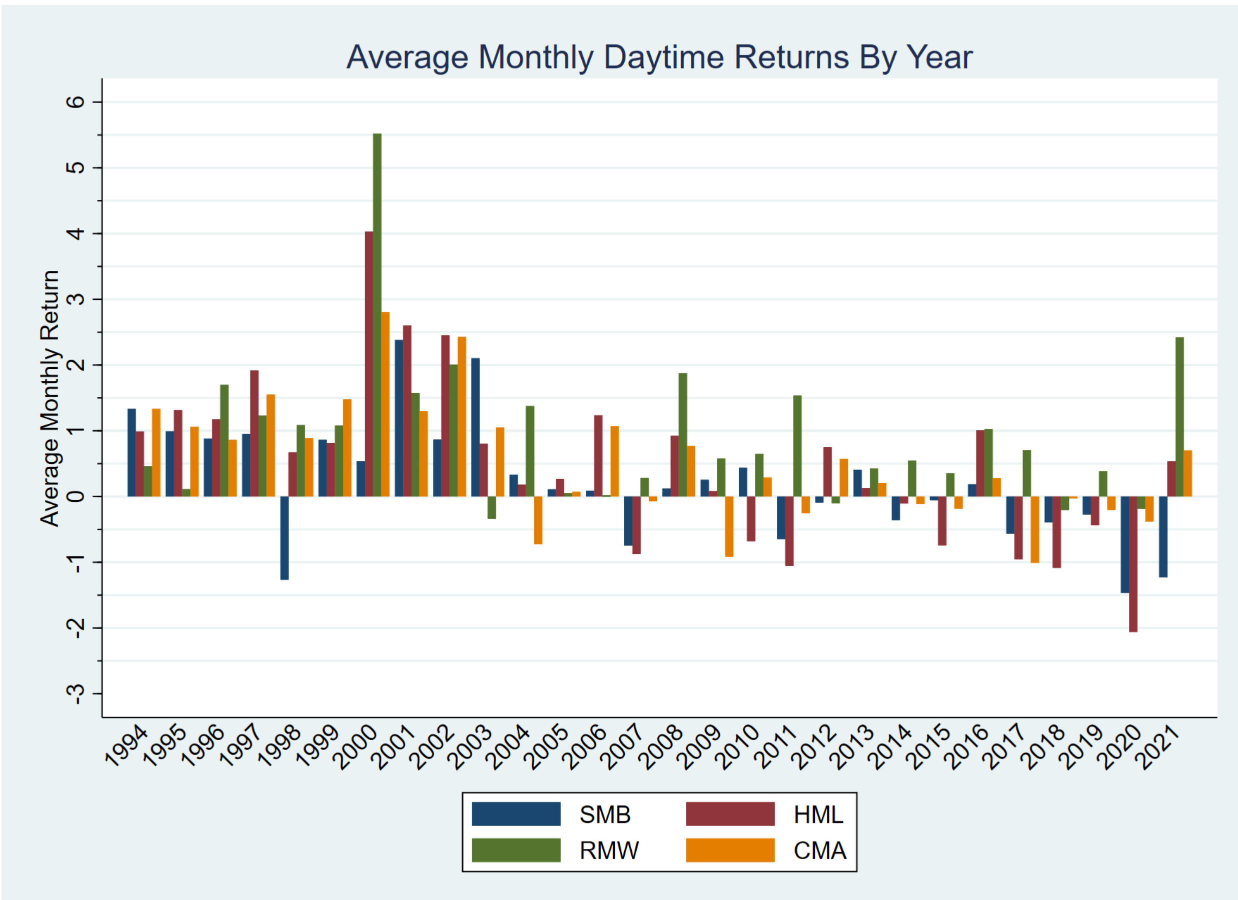

Figure 1: This figures shows the average monthly daytime returns by year for each of the anomalies included in the Fama and French (2015) factor model from 1994 through 2021.

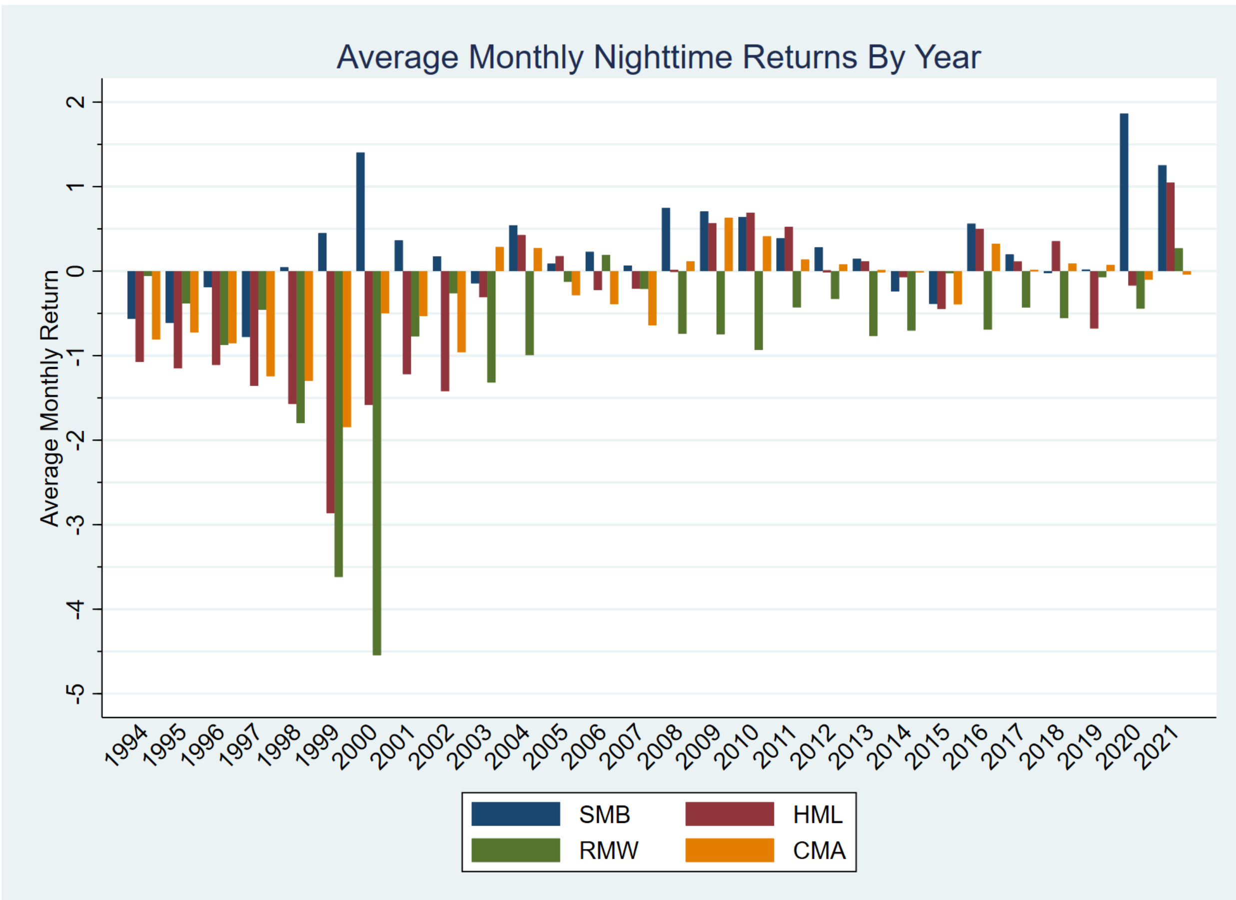

Figure 2: This figures shows the average monthly nighttime returns by year for each of the anomalies included in the Fama and French (2015) factor model from 1994 through 2021.

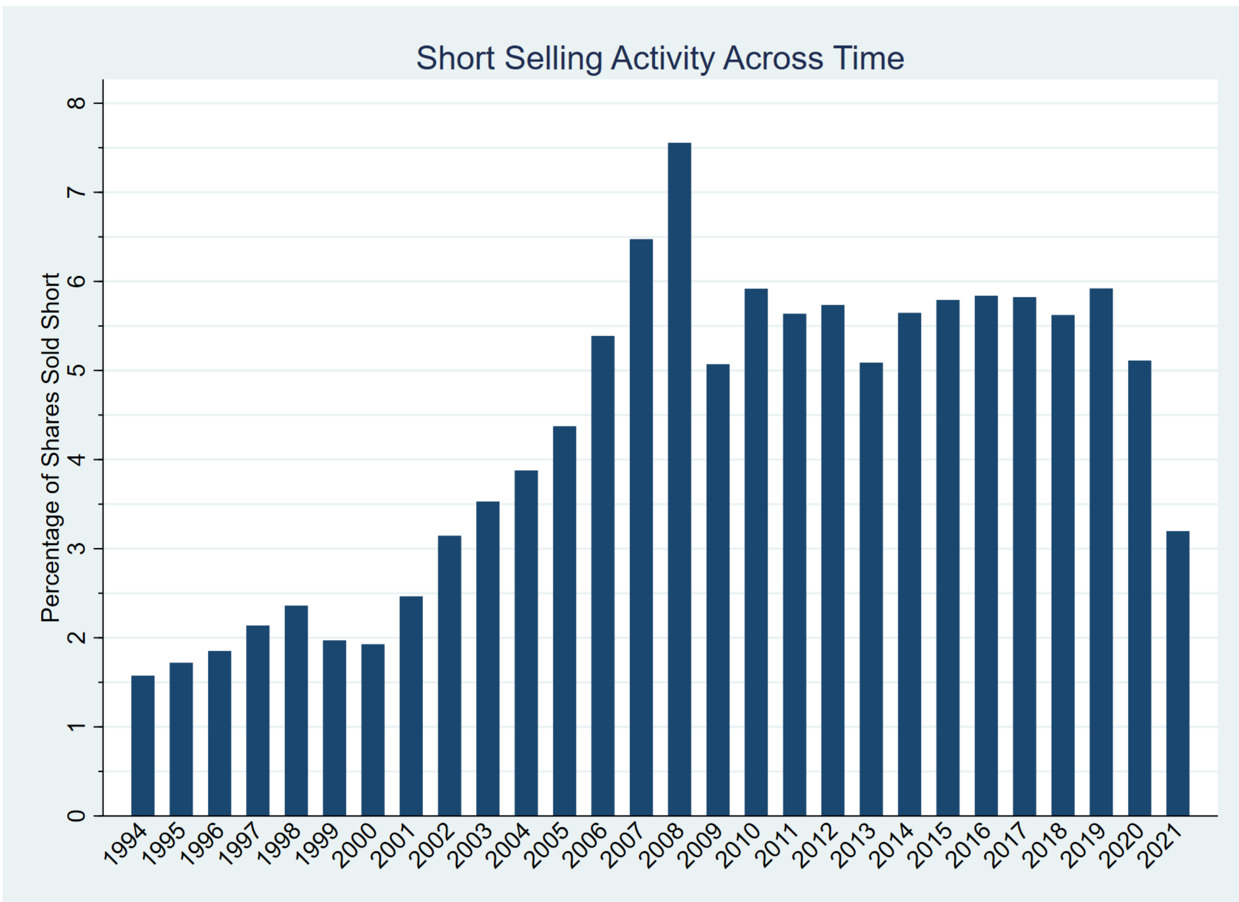

Figure 3: This figures shows the unconditional average in percentage of shares sold short for securities sorted into at least one Fama and French (2015) anomaly portfolios from 1994 through 2021.

Table 1: Monthly Factor Returns at Day and Night

This table contains returns to the five factors from the Fama and French (2015) factor model across close-to-close, daytime, and nighttime periods for the factor as well as its long and short portfolios. Columns 1 to 3 contain the returns to the total factor. Columns 4 to 6 contain the long portfolio returns and Columns 7 to 9 contain short portfolio returns. Columns 1, 4, and 7 contain close-to-close returns, Columns 2, 5, and 8 contain daytime returns and Columns 3, 6, and 9 contain nighttime returns. Returns are monthly and in percentage format with t-statistics on average returns shown in parentheses and statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

	Total Factor Returns			Long Portfolios			Short Portfolios		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Return Window:	Close-Close	Daytime	Nighttime	Close-Close	Daytime	Nighttime	Close-Close	Daytime	Nighttime
Mkt-Rf	0.76***	0.01	0.76***						
t-stat	(3.03)	(0.04)	(4.82)						
Size	0.15	0.21	0.26***	1.08***	0.45*	1.05***	0.93***	0.25	0.79***
t-stat	(0.84)	(1.21)	(3.79)	(3.32)	(1.67)	(6.68)	(3.95)	(1.32)	(5.46)
Value	0.09	0.50***	-0.39***	1.06***	0.61***	0.75***	0.97***	0.12	1.14***
t-stat	(0.54)	(3.24)	(-5.23)	(3.73)	(2.65)	(4.72)	(3.39)	(0.51)	(7.50)
Profitability	0.40**	0.93***	-0.78***	1.14***	0.60***	0.72***	0.74**	-0.34	1.5***
t-stat	(2.38)	(6.23)	(-9.62)	(4.51)	(2.94)	(5.10)	(2.20)	(-1.24)	(8.72)
Investment	0.18*	0.53***	-0.29***	1.11***	0.50**	0.95***	0.93***	-0.03	1.24***
t-stat	(1.67)	(5.19)	(-5.5)	(4.00)	(2.19)	(6.31)	(3.12)	(-0.12)	(7.85)

Table 2: McLean and Pontiff (2016) Publication Effect

Results in this table reflect changes in return premiums after publication as identified by McLean and Pontiff (2016). Returns are measured across three different time frames. Close-to-close returns are shown in Column 1, daytime returns are shown in Column 2 and nighttime returns are show in Columns 3. The spread between day and night returns, which Lou, Polk, and Skouras (2019) finds can predict future anomaly performance, is shown in Column 4. Average returns pre-publication and post-publication are shown for both the profitability factor (Novy-Marx (2013)) and the investment factor (Cooper, Gulen, and Schill (2008)). In Panel A the difference in returns before and after publication in an academic journal is calculated and the t-statistic on this difference is shown in parentheses. Pre-publication for the profitability factor represents returns occurring before 2014. For the investment factor pre-publication is considered to be the period prior to 2009. These dates are selected to reflect the publication of these anomalies in academic journals. In Panel B the pre-publication period is selected based on the year the research was first published on SSRN. For Cooper, Gulen, and Schill (2008) this is 2005 and for Novy-Marx (2013) this is 2010. Returns are monthly and shown in percentage format. Statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

Panel A: Publication Date

	(1)	(2)	(3)	(4)
Return Window:	Close-Close	Daytime	Nighttime	Day-Night Spread
Profitability				
Pre-Publication	0.41	1.06	-0.96	2.01
Post-Publication	0.37	0.63	-0.33	0.96
Pre-Post	0.04	0.43	-0.63***	1.05***
t-stat	(0.11)	(1.28)	(-3.56)	(2.68)
Investment				
Pre-Publication	0.35	1.06	-0.63	1.68
Post-Publication	-0.02	-0.08	0.09	-0.17
Pre-Post	0.37*	1.14***	-0.72***	1.86***
t-stat	(1.75)	(5.83)	(-7.25)	(8.15)

Panel B: SSRN Draft Date

	(1)	(2)	(3)	(4)
Return Window:	Close-Close	Daytime	Nighttime	Day-Night Spread
Profitability				
Pre-Publication	0.46	1.13	-1.04	2.17
Post-Publication	0.32	0.63	-0.38	1.01
Pre-Post	0.14	0.51*	-0.66***	1.16***
t-stat	(0.42)	(1.65)	(-4.06)	(3.22)
Investment				
Pre-Publication	0.39	1.18	-0.71	1.88
Post-Publication	0.02	0.04	0.02	0.03
Pre-Post	0.38*	1.13***	-0.73***	1.86***
t-stat	(1.76)	(5.73)	(-7.25)	(8.06)

Table 3: Green, Hand, and Zhang (2017) 2003 Anomaly Decrease

This table investigates the decrease to anomaly returns after 2003 documented in Green, Hand, and Zhang (2017). Returns are measured across three time periods: close-to-close (Column 1), daytime (Column 2), and nighttime (Column 3). Given the importance of the spread between day and night returns in predicting future anomaly returns in Lou, Polk, and Skouras (2019) I also calculate changes in this spread in Column 4. I tabulate the returns to each factor in the Fama and French (2015) factor model and consider their returns pre- and post-2003. Pre-2003 refers to 2003 and prior and post-2003 represents 2004 and after. Differences in returns between these periods are also calculated and the t-statistic on this difference is shown in parentheses. Returns are monthly and shown in percentage format. Statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

	(1)	(2)	(3)	(4)
Return Window:	Close-Close	Daytime	Nighttime	Day-Night Spread
Mkt-Rf				
Pre-2003	0.58	-0.19	0.70	-0.90
Post-2003	0.86	0.12	0.73	-0.61
Pre-Post	-0.28	-0.31	-0.03	-0.29
t-stat	(-0.53)	(-0.75)	(-0.08)	(-0.55)
Size				
Pre-2003	0.32	0.96	0.02	0.95
Post-2003	0.06	-0.22	0.39	-0.61
Pre-Post	0.26	1.18***	-0.38***	1.56***
t-stat	(0.70)	(3.37)	(-2.69)	(3.96)
Value				
Pre-2003	0.41	1.68	-1.37	3.04
Post-2003	-0.09	-0.16	0.15	-0.31
Pre-Post	0.50	1.84***	-1.52***	3.35***
t-stat	(1.47)	(6.04)	(-11.46)	(10.25)
Profitability				
Pre-2003	0.50	1.44	-1.41	2.85
Post-2003	0.35	0.65	-0.43	1.08
Pre-Post	0.16	0.79**	-0.98***	1.77***
t-stat	(0.44)	(2.55)	(-6.09)	(4.90)
Investment				
Pre-2003	0.56	1.48	-0.85	2.32
Post-2003	-0.04	0.00	0.02	-0.01
Pre-Post	0.59***	1.47***	-0.86***	2.34***
t-stat	(2.72)	(7.45)	(-8.57)	(10.32)

Table 4: Changes in Short Sale Intensity

This table features panel regressions of the percentage of shares outstanding sold short on a series of indicator variables. Percentage of shares sold short is calculated following Rapach, Ringgenberg, and Zhou (2016) and is the natural logarithm of the number of shares sold short divided by shares outstanding. The first indicator in each panel is equal to 1 if the stock is in one of the short portfolios for the factors in the Fama and French (2015) five factor model. This indicator is in Column 1. Column 2 contains indicators for either the post-2003 period or the publication of Cooper, Gulen, and Schill (2008) and Novy-Marx (2013). Panel A interacts this indicator with a indicator equal to 1 if the year is 2003 or later. In Panel B the short portfolio indicator is interacted with a publication indicator equal to 1 if the year is 2009 or later. In Panel C the short portfolio indicator is interacted with a publication indicator variable equal to 1 if the year is 2014 or later. All specifications contain firm level fixed effects and standard errors are clustered at the firm and date level following guidance from Petersen (2009). Panel A contains all stocks within the sample, Panel B is limited to stocks that have been sorted into an investment anomaly portfolio, Panel C contains stocks sorted into an profitability anomaly portfolio. All stocks have a trailing monthly close greater than $5 USD to account for changes in margin requirements at this level. Statistical significance is given by the t-statistics in parentheses and denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

Panel A: Post-2003

	(1)	(2)	(3)
Intercept	0.303***	-0.174***	0.166***
	(13.425)	(-3.821)	(7.260)
Short Portfolio	0.178***		
	(8.475)		
Post-2003		0.959***	
		(14.811)	
Short Portfolio*Post-2003			0.572***
			(17.606)
Fixed Effects:	Firm	Firm	Firm
Standard Errors	Firm&Date	Firm&Date	Firm&Date
N	344,340	344,340	344,340
R^2	0.572	0.594	0.582

Panel B: Investment Publication Effect

	(1)	(2)	(3)
Intercept	0.411***	0.373***	0.412***
	(16.824)	(11.765)	(16.904)
Short Portfolio	0.0724***		
	(3.109)		
Post-Publication		0.285***	
		(5.115)	
Short Portfolio*Post-Publication			0.222***
			(5.122)
Fixed Effects:	Firm	Firm	Firm
Standard Errors	Firm&Date	Firm&Date	Firm&Date
N	328,354	328,354	328,354
R^2	0.579	0.582	0.580

(Table Continued on Next Page)

Panel C: Profitability Publication Effect

	(1)	(2)	(3)
Intercept	0.393***	0.436***	0.437***
	(15.559)	(22.138)	(23.760)
Short Portfolio	0.0809***		
	(3.293)		
Post-Publication		0.131***	
		(2.630)	
Short Portfolio*Post-Publication			0.160***
			(3.472)
Fixed Effects:	Firm	Firm	Firm
Standard Errors	Firm&Date	Firm&Date	Firm&Date
N	319,659	319,659	319,659
R^2	0.578	0.578	0.578

Table 5: McLean and Pontiff (2016) Tests of Arbitrage Activity

This table contains tests before and after the 2003 decrease in anomaly returns (Green, Hand, and Zhang (2017)) and publication of the investment factor (Cooper, Gulen, and Schill (2008)) and profitability factor (Novy-Marx (2013)). For each of these I generate a dummy variable based on whether or not the period is before or after the date associated with the decrease in return premiums. For the post-2003 period this is in in the first row. Publication dummies are shown in the next two rows and the dates are calculated using the publication in an academic journal which is 2009 and later for the investment factor (Cooper, Gulen, and Schill (2008)) and 2014 and later for the profitability factor (Novy-Marx (2013)). I calculate the *Variance* of long and short portfolios as monthly return squared. In Columns 2 and 3 I include *Trading Volume* and *Dollar Volume* (volume times lagged monthly closing price). For these three variables I take the natural logarithm of each following McLean and Pontiff (2016). In Column 4 I calculate *Short-Long Short Interest* which is the spread in short interest (measured as shares sold short over shares outstanding) between the short and long legs of the anomaly. In Panel A these variables are calculated at the total long and short portfolio level. In Panel B I calculate the variables at the size sorted portfolio level (i.e., large value). For Column 4 in Panel B I match the long and short portfolios based on their size to control for differences in barriers to arbitrage associated with differences in market capitalization. For the regressions on the post-2003 dummy I follow McLean and Pontiff (2016) and include predictor fixed effects. Standard errors are clustered at the year-month level per Petersen (2009). All factors from the Fama and French (2015) model are included in the tests of the post-2003 period except for the size factor which is a reconstituted version of the other factors. Tests of the publication effect are limited to the long and short portfolios associated with that predictor only. All stocks have a trailing monthly close greater than \$5 USD to account for changes in margin requirements at this level. Statistical significance is given by the t-statistics in parentheses and denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

		Panel A: All Stocks		
	(1)	(2)	(3)	(4)
	Variance	Trading Volume	Dollar Volume	Short-Long Short Interest
Post-2003	0.102*	1.314***	1.178***	0.235***
	(1.958)	(25.257)	(23.193)	(3.556)
	Variance	Trading Volume	Dollar Volume	Short-Long Short Interest
Investment Publication	0.128**	1.423***	1.327***	0.0316
	(2.476)	(22.515)	(20.545)	(0.191)
	Variance	Trading Volume	Dollar Volume	Short-Long Short Interest
Profitability Publication	0.157**	0.553***	0.704***	-0.687***
	(2.477)	(11.830)	(17.663)	(-5.022)
		Panel B: Size Matched Portfolios		
	(1)	(2)	(3)	(4)
	Variance	Trading Volume	Dollar Volume	Short-Long Short Interest
Post-2003	-0.084	1.520***	1.492***	0.224***
	(-1.508)	(29.199)	(30.196)	(2.423)
	Variance	Trading Volume	Dollar Volume	Short-Long Short Interest
Investment Publication	-0.003	1.117***	1.119***	0.524**
	(-0.048)	(18.422)	(19.058)	(2.067)
	Variance	Trading Volume	Dollar Volume	Short-Long Short Interest
Profitability Publication	-0.019	0.814***	1.067***	-0.667***
	(-0.263)	(14.266)	(20.474)	(-5.570)

Table 6: Correlation and Spread

This table measures the spread and correlation between night and day returns for each of the five factors in the Fama and French (2015) factor model. The correlation between night and day returns is shown in Column 1 and the spread, or difference between night and day returns, is shown in Column 2 in percentage format. Statistical significance for the spread between day and night returns is measured by the t-statistics in Column 3 and significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021

	(1)	(2)	(3)
Factor	Correlation	Spread	t-stat
Mkt-Rf	-0.0019	-0.71***	(-2.86)
Size	-0.1531	-0.05	(-0.27)
Value	-0.1388	0.89***	(4.94)
Profitability	-0.1242	1.71***	(9.57)
Investment	-0.2036	0.82***	(6.61)

Table 7: NBER Expansion and Contraction Periods

This table calculates the average returns to the factors in the Fama and French (2015) five factor model during periods of economic expansion and contraction. Expansion and contraction periods are determined by the National Bureau of Economic Research. Returns for the factors are measured across three time frames. Close-to-close returns are contained in Column 1. Daytime and nighttime returns are shown in Columns 2 and 3 respectively. The difference in returns between expansion and contraction periods is shown with the t-statistic on this difference in parentheses. Returns are monthly and shown in percentage format. Statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

	(1)	(2)	(3)
Return Window:	Close-Close	Daytime	Nighttime
Mkt-Rf			
Expansion	1.01	0.02	0.93
Contraction	-1.67	-0.15	-1.30
Difference	2.67***	0.18	2.23***
t-stat	(3.13)	(0.26)	(4.42)
Size			
Expansion	0.12	0.22	0.20
Contraction	0.45	0.05	0.80
Difference	-0.33	0.17	-0.60**
t-stat	(-0.54)	(0.29)	(-2.55)
Value			
Expansion	0.15	0.53	-0.39
Contraction	-0.51	0.16	-0.42
Difference	0.66	0.37	0.03
t-stat	(1.17)	(0.70)	(0.11)
Profitability			
Expansion	0.34	0.92	-0.79
Contraction	1.01	1.12	-0.67
Difference	-0.67	-0.20	-0.12
t-stat	(-1.15)	(-0.39)	(-0.42)
Investment			
Expansion	0.18	0.54	-0.30
Contraction	0.10	0.46	-0.21
Difference	0.08	0.08	-0.10
t-stat	(0.22)	(0.23)	(-0.52)

Table 8: Economic Uncertainty

Results in this table reflect differences in returns for factors in the Fama and French (2015) five factor model during periods of high and low economic uncertainty. Economic uncertainty is measured using the economic uncertainty index from Jurado, Ludvigson, and Ng (2015). To determine periods of high and low economic uncertainty months are broken into quintiles based on the level of this index and those in the top and bottom quintiles are retained. Returns are measured across three time frames. Close-to-close returns are shown in Column 1, daytime returns are in Column 2 and nighttime returns are in Column 3. I also report the difference in returns between high and low uncertainty periods and the t-statistic for this difference in parentheses. Returns are monthly and shown in percentage format. Statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

	(1)	(2)	(3)
Return Window:	Close-Close	Daytime	Nighttime
Mkt-Rf			
Low	1.44	0.60	0.71
High	0.65	0.12	0.62
Difference	0.79	0.48	0.08
t-stat	(0.95)	(0.75)	(0.15)
Size			
Low	-0.29	0.54	-0.39
High	0.49	-0.16	0.88
Difference	-0.78	0.70	-1.28***
t-stat	(-1.49)	(1.29)	(-6.08)
Value			
Low	0.26	0.90	-0.74
High	0.11	0.13	0.21
Difference	0.16	0.77	-0.96***
t-stat	(0.31)	(1.59)	(-4.33)
Profitability			
Low	0.50	0.79	-0.52
High	0.80	0.91	-0.38
Difference	-0.30	-0.12	-0.14
t-stat	(-0.71)	(-0.30)	(-0.76)
Investment			
Low	0.00	0.73	-0.67
High	0.07	0.14	0.03
Difference	-0.07	0.59*	-0.70***
t-stat	(-0.23)	(1.96)	(-4.68)

Table 9: Investor Sentiment

This table examines the role of investor sentiment in the variation of night and day returns for the factors in the Fama and French (2015) factor model. Monthly returns are broken into quintiles based on the level of the Baker and Wurgler (2006) investor sentiment index and the top and bottom quintiles are retained for examination of the difference in average returns. The size of the difference in returns is shown with t-statistics listed in parentheses. I measure returns across three distinct time periods: close-to-close (Column 1), daytime (Column 2), and nighttime (Column 3). All returns are monthly and shown in percentage format. Statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

	(1)	(2)	(3)
Return Window:	Close-Close	Daytime	Nighttime
Mkt-Rf			
Low	0.82	0.31	0.60
High	-0.14	-0.50	0.26
Difference	0.96	0.82	0.35
t-stat	(0.99)	(1.08)	(0.73)
Size			
Low	0.52	0.39	0.40
High	0.02	0.81	-0.10
Difference	0.51	-0.42	0.50*
t-stat	(0.81)	(-0.66)	(1.95)
Value			
Low	0.10	0.19	0.12
High	1.15	2.10	-1.11
Difference	-1.05*	-1.91***	1.23***
t-stat	(-1.67)	(-3.19)	(5.31)
Profitability			
Low	-0.09	0.57	-0.94
High	1.84	2.34	-1.04
Difference	-1.93***	-1.77***	0.10
t-stat	(-3.00)	(-2.82)	(0.36)
Investment			
Low	0.33	0.16	0.29
High	0.64	1.61	-0.91
Difference	-0.31	-1.45***	1.21***
t-stat	(-0.74)	(-3.70)	(7.41)

Table 10: Policy Uncertainty

This table examines the roles economic policy uncertainty plays in the returns of factors in the Fama and French (2015) five factor model. Economic policy uncertainty is measured using the Baker, Bloom, and Davis (2016) economic policy uncertainty index. Months are broken into quintiles based on the level of this index and top and bottom quintiles are retained for analysis. Differences in these periods is shown with the t-statistic shown in parentheses. Returns are measured across close-to-close (Column 1), daytime (Column 2) and nighttime (Column 3) time frames. Returns are monthly and shown in percentage format and statistical significance is denoted by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ respectively. Data period is 01:1994 to 12:2021.

	(1)	(2)	(3)
Return Window:	Close-Close	Daytime	Nighttime
Mkt-Rf			
Low	1.54	0.01	1.36
High	0.55	0.04	0.56
Difference	0.99	-0.02	0.80
t-stat	(1.12)	(-0.04)	(1.30)
Size			
Low	0.24	0.68	-0.02
High	-0.02	-0.75	0.91
Difference	0.26	1.43**	-0.93***
t-stat	(0.40)	(2.43)	(-4.01)
Value			
Low	-0.04	0.90	-1.04
High	-0.08	-0.16	0.22
Difference	0.04	1.07**	-1.26***
t-stat	(0.07)	(2.05)	(-4.88)
Profitability			
Low	-0.05	0.88	-1.23
High	0.77	1.08	-0.48
Difference	-0.82	-0.20	-0.75**
t-stat	(-1.32)	(-0.37)	(-2.57)
Investment			
Low	0.04	0.91	-0.83
High	0.39	0.32	0.14
Difference	-0.35	0.59**	-0.98***
t-stat	(-1.13)	(2.03)	(-6.13)