On the Consistency Between the Fama-French Daily and Monthly Factors

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Abstract

From 1961 to 1993, what is the total return for holding a Fama-French *SMB* (small minus big) portfolio? The answer is 151% if we use the monthly factor, but 76% if we apply the daily factor instead**.** The application of the daily *SMB* factor underestimates the size effect by half, about 2.51% per year. Behind such an inconsistency are the impacts of bid-ask bounce and non-synchronous trading. Based on the *BHMD* (Buy-and-Hold Multi Day) method developed by Yan (2008), we regenerate the daily Fama-French factors which are consistent with the monthly factors and free from the impact of the market microstructure. In addition, we discuss the research implications by comparing the old and new daily Fama-French daily factors.

JEL Classification: C13, G10, G11

Keywords: Fama-French factors, systematic bias, bid-ask bounce, size effect, unbiased factors

Ever since the seminal papers by Fama and French (1992, 1993), their 3-factor model has been widely used within the academia and by practitioners (e.g., Loughran and Ritter 1995; Brav and Gompers 1997; Carhart 1997; Liew and Vassalou 2000; Fama and French 2003, 2005, 2006; Liu 2004; Ahn et al. 2006; Kosowski et al. 2006; Lo and Wang 2006; Gutierrez and Kelley 2007; Petkova 2007). The Fama-French factors are calculated for annual, monthly, weekly and daily frequencies. Among those time series, the monthly factors are most frequently used followed by the daily factors.[1]

In conducting their own research, almost all researchers simply download the factors and apply them without ever thinking about and questioning their validity mainly because of the fact that those factors have been employed by numerous researchers and are believed to be of high quality. In addition, there are other reasons for their wide application among researchers. For example, when the Fama-Fench 3-factor model is applied, their data follows. Using Fama-French data is quite convenient for most researchers, and particularly for those who have difficulty to generate those factors themselves. Another reason is that in developing a new asset pricing model, it has to be compared with published ones. To avoid the complexity caused by different data sets, the same data has to be reused. The last but not least is that no valid method had been made available to estimate unbiased equal-weighted portfolio daily returns until recently (Yan 2008).

This research paper, motivated by a growing interest in the Fama-French 3-factor model,[2] and its author's observation of the problematic daily factors, shows that the daily

[1] Thanks to Kenneth French at Dartmouth University, those factors are downloadable at his web site with no cost - http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html.

[2] There are at least 176 papers published in first-tier journals have cited Fama and French (1992): JF (73), RFS (14), JFQA(19), JB(9), JAR, JPE, AR, MS, AER and MS.

Fama-French factors are inconsistent with their monthly factors and plagued with the microstructure effects, a critical issue that has not been acknowledged in the existing related literature. Here is the first piece of evidence of the inconsistency between the monthly and the daily *SMB* (Small Minus Big) factors. For the period of 1964 to 1993, what is the total return for holding such a portfolio? Unexpectedly, two quite different answers emerge: 151.19% and 75.79%, based on the monthly and the daily *SMB*, respectively. The application of the daily *SMB* underestimates the total return by 49.7%, 2.51% per year. Another way to look at the issue is to assume the initial value of *SMB* portfolio to be 100 on January 2, 1964. Then what will be the portfolio values on each day afterwards? Since both monthly and daily *SMB* factors are available, it seems to be an easy task because the formula of $V_t=V_{t-1}(1+SMB_t)$ could be applied recursively ($V_0=100$). Unfortunately, the current *SMB* factors do not warrant a coherent answer. Here is a contradiction, which is true for any day after January 2, 1964. For example, on December 30, 1977, the portfolio value was 174.32 when the monthly *SMB* was compounded, but 153.55 when the daily one was applied. In short, the current daily and monthly *SMB* factors fail to generate *consistent* daily *SMB* portfolio values[3], therefore the validity and reliability of those three daily factors must be acknowledged and addressed accordingly.

It is in fact not surprising for the inconsistency to be detected in the daily Fama-French factors. Canina et al. (1998) demonstrate that compounding the equal-weighted CRSP (the Center for Research in Security Prices) daily index will result in an annual bias of 6%. The related literature states that the microstructure exerts a profound impact

[3] If daily factor levels were available, users could easily calculate daily and monthly factors. The key is that those daily and monthly (or other frequencies) factors estimated based on daily levels will always be consistent with each other.

on equal-weighted market indices, but has little consequence on value-weighted ones. Despite the seven building blocks, *MKTRF*, *SL*, *SM*, *SH*, *BL*, *BM* and *BH* [4], of the Fama-French factors are value-weighted, the construction of *SMB* and *HML* (High Minus Low) are equal-weighted. This design unavoidably leads to inconsistent daily factors if the conventional method of taking simple average is employed. Although other equal-weighted indices such as the CRSP daily equal-weighted market indices suffer the same deficiency, the inconsistency embedded in the daily *SMB* and *HML* are particularly troublesome. What appears to be the most disturbing and damaging fact is that there is no alternative to the *SMB* and *HML* daily factors. When concerned with the biases embedded in a CRSP equal-weighted index, researchers could always apply the corresponding value-weighted index.[5] Unfortunately, such a luxury does not exist for the daily *SMB* and *HML*. Second, an annual bias of 2.51% for *SMB* is a quite significant amount for assets pricing. Third, since *SMB* and *HML* are always applied simultaneously, the unexpected correlation between their biases may have a graver consequence.

The paper will proceed in the following way. The next section presents the evidence of inconsistency between the daily and monthly factors. Section 2 explains the *BHMD* (Buy-and-Hold Multi Day) method, developed by Yan (2008), on generating daily factors which are free from the influence of bid-ask bounce and non-synchronous trading, and consistent with the monthly factors. To conclude the paper, research implications are discussed and future directions are suggested.

[4] *MKTRF* (excess market return), *SL* (Small with Low book-to-market), *SM* (Small with Median book-to-market), *SH* (Small with High book-to-market), *BL* (Big with Low book-to-market), *BM* (Big with Median book-to-market) and *BH (*Big with High Book-to-market*).*

[5] After issuing a warning about the biased CRSP equal-weighted market indices, Canina et al. (1998) recommend to use value-weighted indies instead (p. 414).

1 Inconsistency between daily and monthly *SMB* and *HML* factors

On the criteria established by Loughran and Ritter (1995), and Canina et al. (1998), the difference between two total returns based on compounding monthly and daily factors are compared. Table 1 presents the performance of 3 Fama-French daily factors: *MKTRF*, *SMB*, *HML*, and *UMD* (i.e., the momentum factor). In all, there are 10 short periods (4-year windows) and 2 longer periods (30-year and 12-year windows). To facilitate the comparison with the prior study (Canina et al. 1998), a long period from 1964 to 1993 was chosen, during which the difference between total returns by compounding daily and monthly *MKTRF* is found to be only 0.9%. The absence of a significant deviation over 30 years can be interpreted as a proof of compatibility of the daily *MKTRF* with its monthly counterparty. This is consistent with what is given in the literature that value-weighted market indices are less likely to be contaminated by the microstructure effects. On the other end of the spectrum, the daily *SMB* undervalues the size effect by 49.7%, the daily *HML* overvalues the book-to-market effect by 23%, and the daily *UMD* undervalues the momentum effect by 201%, a figure that is stunning and shocking. Thus a tentative conclusion can be drawn that except the *MKTRF*, the daily *SMB* and *HML* factors, plus *UMD*, are not consistent with their monthly factors.

[insert Table 1 about here]

The second way of estimating a total bias over a specified time period is to compound monthly biases by what is called Method 2. For a small deviation or over a short period of time, this new method is indistinguishable with the conventional one used by Loughran and Ritter (1995), and Canina et al. (1998) as described above. For more serious biases or over a long period, Method 2 offers a more accurate estimation in

locating bias than the convention one. By the use of this method, the biases (D_2) for most cases are smaller than those with the conventional method (D_1). For *SMB* over the period from 1964 through 1993, D_2 is -30.5%, about -1% per year. For other shorter periods, the biases (D_2) vary, from -1.26% to -6.560% for *SMB* and from -1.60% to 2.46% for *HML*. This confirms further that the daily *SMB* and *HML* are inconsistent with their monthly counterparties even based on a stricter measure. Over different shorter periods, the daily *SMB* suffers from being under-priced to various degrees. For example, the daily *SMB* under-estimates the size effect by 12.2% for 1976-1979, but only 1.2% for 1992-1995 if based on the conventional method (D_1). There is, however, another problem called "switching effect", which is even more serious than just under-pricing. From 1972 to 1975, compounding the daily *HML* results in a positive 3.9% bias (over-pricing), while -0.9% (under-pricing) in the following adjacent 4-year window. The net difference is 4.8%, whose magnitude definitely has a devastating consequence if a researcher is not aware of the bias embedded in the daily *HML*. To clarify this, let us suppose that a researcher is doing an event study and the majority of events concentrate in these "switching" periods, the researcher may find a significant result. Unfortunately, such a statistically significant result may not necessarily reflect what is true since the 'switching-effect' dominates. On the other hand, a significant impact of the events can be dampened or even eliminated, if the direction of the impact is opposite of the switching effect.

[insert Table 2 about here]

Table 2 presents 20 largest absolute differences among the total returns based on monthly and daily factors. In October 1987, the monthly *SMB* was -0.082, but it will be -0.1155 if we compound the daily *SMB*, with the absolute percentage difference being

41%, which is a very high deviation. For the 20th value, it has an absolute percentage difference of 18%. For *HML* factor in December 1999, the absolute percentage difference was 15.6%. It is interesting to notice that 10 out of top 40 largest absolute differences among *SMB* and *HML* occurred in 2000. When a replicating method is good, the signs of the deviations should possess an equal probability of being either positive or negative. Table 3 provides the testing results for the *MARKET*, *SMB*, *HML* plus *UMD*. As expected, the market portfolio (*MRTKET*) has the best performance with 51.2% positive differences, which is consistent with the literature that value-weighted daily portfolios are less contaminated by the detrimental impacts of the microstructure. On the contrary, *SMB* has the worst performance with only 34.5% positive, a big difference from the ideal value of 50%. The corresponding values for *HML* and *UMD* are 46.0% and 46.2%, respectively. The correlation coefficient between biases for *SMB* and *HML* is 10.2%, and 27.7% for *SMB* and *UBD*. It is worthy noticing that the biases between *HML* and other three factors' are all positively correlated and this is true for *UMD*. Such positive correlations among biases may have a profound impact. Without double, the substantial evidence reveals the inconsistency between the daily and monthly factors.

[insert Table 3 about here]

The root of the inconsistency between the monthly and daily factors is the undesirable impact exerted by the microstructure and rebalancing frequency. In particular, non-synchronous trading and bid-ask bounce have a profound impact on small stocks. For a value-weighted portfolio, the small stock effect is eliminated because of their tiny weights. Unfortunately, with the Fama and French's design of a mixture of value-weighted and equal-weighted, this small stock effect is amplified considerably. To shed

further light on the true reason underlying the discrepancy, the impact of small stocks is investigated. As Table 4 shows, from the market portfolio (*MKTKET*) to a big portfolio (*BL*), the average weight increase in the first 10 large stocks was 34% for July 2001. In contrast, from the market portfolio to three small portfolios (*SL*, *SM* and *SH*), the average weight increase of the last 10 small stocks is 4,500%. The average weight jump for stocks in the three big portfolios (*BH*, *BM* and *ML*) is 904% for a total of 1,145 stocks, while the average weight jump for stocks in three small portfolios (*SH*, *SM* and *SL*) is 4,484% for 4,632 stocks. Such a gigantic jump of weights for small stocks makes the microstructure effect much more severe. This finding gets to the heart of why daily *SMB* and *HML* are plagued with small stock effects.

[insert Table 4 about here]

2 Generating consistent daily *SMB* and *HML* factors

To generate daily and monthly *SMB* and *HML* factors, Stock ID (CUSIP), Price (PRC), Shares outstanding (SHROUT), Return (RET), Share code (SHRCD) and Exchange code (EXCHCD) are retrieved from CRSP. And from Compustat, Common equity (Data item #60), Preferred stock – liquidating value (Data item #10), Preferred stock-redemption value (Data item #56), Preferred stock–carrying value (Data item #130), and Deferred tax credit (Data item #35) are used.[6] The monthly and daily factors are from Kenneth French's web site. The new method consists of three steps. The first one is to regenerate monthly factors by use of the Compustat and the CRSP monthly data in order to verify whether the methodology developed by Fama and French (1992, 1993) is applied accurately. The second is to produce monthly factors by use of Compustat and

[6] If the Compustat's new data format (XpressFeed) is used, the conversion formulae will be: Data60=CEQ, Data10=PKTKL, Data56=PSTKRV, Data130=PSTK and Data35=TXDITC.

the CRSP daily data, which should not be mistaken as redundant since it bridges the monthly factors with daily ones. The last one is to regenerate consistent daily factors with the Buy-and-Hold Multi-Day method (*BHMD*), created by Yan (2008). Details of these procedures are given as follows.

Step 1: Generating monthly factors. *SMB* is the average return on three small portfolios minus the average return on three big portfolios:

$$SMB = \frac{1}{3}(SH + SM + SL) - \frac{1}{3}(BH + BM + BL) \quad (1)$$

HML is the average return on two value portfolios minus the average return on two growth portfolios:

$$HML = \frac{1}{2}(SH + BH) - \frac{1}{2}(SL + BL) \quad (2)$$

SMB and *HML* are formed in June in year *t* and remain effect from July of year *t* to June of year *t+1*. Following Fama and French (1992, 1993), stocks included are those traded on NYSE, AMEX and NASDAQ with valid market equity data in December of year *t-1* and June of year *t*, and (positive) book equity data for *t-1*. The NYSE stocks are used to classify all stocks into portfolios of small, median and large sizes. For monthly factors, the replicating results are marvelous. For the period of 1964 to 2005, the correlation coefficients between the monthly replicates and the current monthly factors were 99.99%, 99.3% and 97.5% for *MARKET*, *SMB* and *HML*, respectively. The correlation coefficient between replicated monthly *SMB* and *HML* from the period of 1964 to 1991 was -9.4%, very close to -9.7% between the current monthly *SMB* and *HML*.

Step 2: Generating monthly factors by implementing the CRSP *DAILY* data. A monthly stock return (R^m) is estimated by $R^m = \prod_{s=1}^{T}(R_s^d + 1) - 1$, where $R_s^{\ d}$ is the daily

return on day *s* and *T* is the number of trading days within each month. After R^m is obtained, follow the procedure in Step 1. As expected, the replicating results are excellent as well.[7] Three correlation coefficients are 99.7%, 99.4% and 97.7% for *MARKET*, *SMB* and *HML* and the correlation coefficient between the new monthly *SMB* and *HML* over 1964 and 1991 is -9.6%.

Step 3: What is utilized below is the *BHMD* method (Yan, 2008), which is slightly modified in the context of the Fama-French framework. We define a *t*-period buy-and-hold (*BH*) portfolio return from day 1 to day *t* as:

$$Y_{BH}^{t} = \sum_{i=1}^{N} w_i [\prod_{s=1}^{t} (R_{i,s} + 1) - 1] \tag{3}$$

where, Y_{BH}^{t} is a buy-and-hold value-weighted portfolio return from days 1 to *t*, *Y=SH*, *SM*, *SL*, *BH*, *BM*, *BL* and *MARKET*; *N* is the number of stocks in each portfolio, *t* is number of trading days from the beginning of a month, w_i is the weight of stock *i*, defined as the stock's market capitalization (abs(PRC)*SHROUT) at the end of the previous month over the summation of all stocks' market capitalizations. Finally, daily *SMB* ($SMB^{t}{}_{daily}$) and *HML* ($HML^{t}{}_{daily}$) factors on day *t* are estimated according to the formulae:

$$SMB_{BH}^{t} = \frac{1}{3}(SH_{BH}^{t} + SM_{BH}^{t} + SL_{BH}^{t}) - \frac{1}{3}(BH_{BH}^{t} + BM_{BH}^{t} + BL_{BH}^{t}) \tag{4}$$

$$HML_{BH}^{t} = \frac{1}{2}(SH_{BH}^{t} + BH_{BH}^{t}) - \frac{1}{2}(SL_{BH}^{t} + BL_{BH}^{t}) \tag{5}$$

$$SMB_{daily}^{t} = \frac{1 + SMB_{BH}^{t}}{1 + SMB_{BH}^{t-1}} - 1 \tag{6}$$

[7] Yan (2008) offers empirical evidence and several reasons why daily stock data will generate the same monthly equal-weighted or value-weighted market indices as monthly stock data.

$$HML_{daily}^{t} = \frac{1 + HML_{BH}^{t}}{1 + HML_{BH}^{t-1}} - 1 \tag{7}$$

$$MARKET_{daily}^{t} = \frac{1 + MARKET_{BH}^{t}}{1 + MARKET_{BH}^{t-1}} - 1 \tag{8}$$

Based on the *BHMD* method, the regenerated daily factors are *free* from the microstructure influence and consistent with their corresponding monthly ones. The new daily factors are superior to the current daily factors for a number of reasons. First, while the estimations of the current daily *SMB* and *HML* are based on the conventional method which has no ability to filter out the impact of the microstructure, the new method removes all the biases caused by bid-ask bounce and nonsynchonous trading. For an equal-weighted portfolio, if we calculate individual stock's buy-and-hold returns first and then take averages, the impact of bid-ask bounce will be dramatically reduced or even eliminated (Blume and Stambaugh, 1983, Yan, 2008). Second, users can convert a daily factor to a monthly one without fear of making any errors. The conventional wisdom tells us that a total return over any investment period should always be the same whether we compound monthly or daily factors (returns). This will always be true for any new factor that might emerge. Third, for the conventional method to estimate those daily factors, one of the inconsistency contributors is the rebalancing frequency: daily factors depend on daily rebalancing, while monthly factors on monthly rebalancing. For the new method, the daily factors are based on the monthly rebalancing as well. Our intuition is that since the new daily factors are consistent with the monthly factors, and the latter is not contaminated by the microstructure, the former should possess the same properties.[8]

[insert Table 5 here]

[8] For a detailed documentation on evidence, see Yan (2008).

To buttress the claim that new daily factors are bias-free, their deviations from the monthly *SMB* and *HML* are analyzed (see Table 5). When compared with the current monthly *SMB*, the new daily *SMB* for the period of 1964 through 1993 has an annual deviation of 0.39%, which is considerably smaller than 2.51% based on the current daily *SMB*. Over the same period, the new daily *HML* is also found to be less biased annually. The magnitudes of the biases, over other shorter periods, have the same property: much better than converting the current daily factors.[9] Despite the inconsistency of the magnitude is much smaller now, is it still possible for these biases to be further reduced? Since the current monthly Fama-French factors are used as the benchmark, we'd like to point out that each of 3 Steps mentioned above could be a potential bias contributor. Below, we show that the major portion of the bias of the newly generated daily *SMB* or *HML* comes from Step 1 of replicating monthly Fama-French factors. Along the line, new daily factors and our *newly* generated monthly factors are compared in order to have a fair appraisal of the new methodology. When benchmarking the new daily *SMB* on our newly generated monthly *SMB*, the annual bias is found to be a tiny 0.0033%. This can be interpreted as the evidence that generating monthly factor counts for about 99% of the inconsistency,[10] while the methodology of generating bias-free *SMB* counts for less than 1% of the error. Our unreported analysis shows that for *HML*, Step 1 counts for a major proportion of total inconsistency as well.

For a robust check, differences between the monthly and compounding daily factors are examined on the basis of the criteria set up by Canina et al. (1998). As

[9] To save space, those results will not be discussed any further. Interested readers or researchers are welcome to contact the author for them.

[10] The original annual deviation is 2.51% from 1964 to 1993 by using the current daily *SMB* portfolio. Now the deviation of the new daily *SMB* benchmarked on the new monthly *SMB* is 0.0033%. The reduction (explained part) is (2.51-0.0033)/2.51=99.87%.

mentioned before that for a good replication, the deviations of the replicates from the original values are expected to behave like a random variable. The empirical evidence (in Panel C in Table 3) shows the results of the comparisons. This panel is similar to Panel B (presented in the same table) with one exception: the current monthly and daily Fama-French factors are replaced by the newly generated monthly and daily factors. The results are quite striking since the percentages of positive and negative values are close to the ideal value of 50%: 49.5%, 51.3% and 52.5% for the *MARKET*, *SMB* and *HML*, respectively. This outcome further confirms the superior performance of the new methodology.

[insert Table 6 about here]

It is quite often that researchers apply the Fama-French 3-factor model or its variations in their research. As argued before, the inconsistency between daily and monthly factors vary over the years. A severer deviation of daily *SMB* and *HML* from their monthly counterparties might distort and contaminate a research result. To test this hypothesis, we randomly choose a 4-year window and 15 stocks. The 4-year window chosen is from 1968 to 1971 and the first 15 stocks, based on sorting of PERMNO, are randomly chosen. The coefficients (β_{SMB}, β_{HML}) of *SMB* and *HML* are from running the 3-factor model over the period of 1968 to 1971, based on two sets of monthly time series: converted from the daily factors, vs. the current monthly factors. Table 6 reveals that the impact of the biases varies among different stocks, some of which have a huge percentage differences. For instance, for the stock with PERMNO=10102 its *SMB* beta has a 214% difference, while the difference is 7.6% in terms of *HML* beta. For the stock with PERMNO=10161, the beta percentages are 75% and -115% for *SMB* and *HML*.

Panel B in this table shows the 20 highest beta percentage deviations for both *SMB* and *HML*. For $\beta_{SMB,}$ our first observation is that those deviations (biases) are huge: varying from 99% to 1022%. For example, for the 10^{th} stock (PERMNO=10102), the β_{SMB} changes from -0.034 to 0.039. This means that the β_{SMB} not only has a 215% change (in an absolute term), but also switches its sign. And our second observation is that 7 stocks' β_{SMB} have switched from being negative to positive, while the opposite is true for only two stocks. It is known already that the biased daily *SMB* and *HML* is positively correlated which might play a critical role in related research. The mean of percentage deviation is 1793% for β_{HML} with 1,813 stocks. After we delete the top and bottom 50 stocks, the mean of the percentage deviations is still at 27%. If the absolute percentage is used for β_{SMB} , the mean deviation will be 9.9% for a total of 1,183 stocks. When we take off the top 50 and bottom 50 observations (stocks), the mean error will remain at 6%. Both Panels A and B show a huge deviation for many stock's beta estimation. Hence, these results confirm that the impact of biased daily Fama-French factors on the beta estimation should not be neglected any more. Instead, these problems must be taken seriously.

[insert Table 7 here]

Since consistent daily factors are made available now, obviously they should be compared or contrasted with the current ones. This comparison is conducted on a yearly basis (1964-2005). The daily difference is defined as a current daily factor minus newly generated one. In Table 7, several observable facts emerge. First, overpricing outnumbers under-pricing for both *SMB* and *HML*. The next one is that over many years the discrepancies are statistically significant, 13 years for *SMB* and 19 for *HML* (out of 42

years). Furthermore, although over a long period of time the daily *SMB* underestimates the size effect, the factor overestimates the same effect for particular years. This is in contrast to CRSP *EWRETD* which always overestimates its true value (Yan 2008). Finally, various combinations of significance and correlations between *SMB*'s and *HML*'s biases may lead to a result that is distorted even further. For a certain period of years, neither *SMB* nor *HML* is statistically different from its true values. But for other periods of years, one (or both) may deviate significantly from its (or their) true values. The worse case would be such when both of them significantly deviate from their true values, while their biases might be positively or negatively correlated. For example, in 1968 both *SMB* and *HML* statistically significantly overpriced their true effects, while in 1973, *SMB* statistically significantly overestimated but *HML* statistically significantly underestimated its true values.

[insert Table 8 here]

Almost without exception, these three factors (*MARKET*, *SMB* and *HML*) are applied simultaneously. To discover a combined impact, the following standard 3-factor model is run by using two sets of daily factors: the current daily factors and the newly generated ones: $R_t - R_{f,t} = \alpha + \beta_1 * MKTRF_t + \beta_2 * SMB_t + \beta_3 * HML_t + \varepsilon_t$. The difference of each coefficient is estimated: coefficient based on the current daily factors minus the coefficient based on the new daily factors. Table 8 offers the statistics of the mean differences of several variables. The most striking observation is that the differences in α (intercept) are all statistically different from zeros. For example, the mean difference of alpha estimations is about 1.1 basis points per day in 2002 based on 6,725 stocks, suggesting that an application of the current daily factors be likely to

overestimate Jensen's alpha, on average, by 2.7% in 2002. The second observation is that although for the majority of years (37 out of 43 years), differences in alpha are positive, but for some given years they are negative (6 out of 43). For 2003, the mean difference of alpha estimates was -0.5 basis points per day. This indicates that from 2002 to 2003, the differential in terms of mean deviation was 1.56 basis points per day, which has a direct research implication that a researcher will still find a falling Jensen's alpha, by 4% annually if nothing happens in these two years.

3. Conclusion

This empirical study makes two significant contributions to the existing literature on the assets pricing by 1) identifying and documenting the evidence of the inconsistency between the daily and monthly Fama-French factors, and 2) offering a corrective solution to this inconsistency. Specifically, it shows that the daily factors are not consistent with their monthly counterparties because of the influence of the microstructure. Daily *SMB* and *HML* that are regenerated by use of the *BHMD* method developed by Yan (2008) are free from the undesired impacts of the microstructure and consistent with the monthly factors. These empirical results have validated the new methodology. As a result, for any given period of time, the total return of any factor portfolio will be the same whether we compound a monthly factor or daily one. This feature makes many research results comparable when researchers utilize consistent monthly and daily factors. Based on the newly generated bias-free daily *SMB* and *HML*, we can explore several research implications of inconsistent daily factors. For example, Jensen's α is found to be overestimated by 2.7% in 2002 if the current Fama-French daily factors are applied.

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Appendix A

The following SAS program is used, on WRDS, to get Table 1.

```
libname ff '/wrds/ff/sasdata/';


%macro Table_1;

* - Loop for 4 factors: Mktrf, SMB, HML and UMD ------- *;
%do ii=1 %to 4;
    %if &ii=1 %then %let var1=Mktrf;
    %if &ii=2 %then %let var1=SMB;
    %if &ii=3 %then %let var1=HML;
    %if &ii=4 %then %let var1=umD;

    * - Loop for 12 periods --------------------------- *;
    %do j=1 %to 12;
        %let year1=%sysevalf(1964+&j*3+&j-4);
        %let year2=%sysevalf(1964+(&j+1)*3+&j-4);

    * -- 2 special periods ----------------------- *;
    %if &j=11 %then %do;
        %let year1=1964; %let year2=1993;
    %end;
    %if &j=12 %then %do;
        %let year1=1994; %let year2=2005;
    %end;

    * - Use monthly (i=1) and daily (i=2) ------------- *;
    %do i=1 %to 2;
        %let name=monthly;  %let name2=m;
        %let vars_in=year month;
        %let constraint=&year1<=year<=&year2;
        %if &i=2 %then %do;
            %let name=daily; %let name2=d;
            %let vars_in=date;
            %let constraint=&year1<=year(date)<=&year2;
        %end;

    * - Retrieve data from Fama-French data sets--- *;
    data temp;
         set ff.factors_&name(keep=&vars_in &var1);
         where &constraint;
         log_ret=log(&var1+1);run;

    * - Calculate total return -------------------- *;
    proc means data=temp noprint;
        var log_ret;
        output out=temp2(drop=_TYPE_ _FREQ_)sum(log_ret)=cumret
        n=n_&name2;
    data temp2(drop=cumret);
        set temp2;
        ret_&name2=exp(cumret)-1; *convet to normal return;
        group="&year1-&year2";
        k=&j;run;

    * - Append to a final data set ----------------- *;
    %if &i=1 %then %do;
        proc append data=temp2 base=final_m; run;
    %end;
    %if &i=2 %then %do;
        proc append data=temp2 base=final_d; run;
```

```
     %end;
   %end;
 %end;

    * - Merge data sets, get % difference & output ------- *;
    proc sort data=final_m; by k;run;
    proc sort data=final_d; by k;run;
    data final;
        merge final_m final_d;
        by k;
        diff=100*(ret_d-ret_m);
        diff2=100*(ret_d-ret_m)/ret_m; run;
    title " var=&var1";
    proc print data=final;
    format ret_m ret_d 9.4 diff diff2 6.1;
             var group ret_m n_m ret_d n_d diff diff2;run;

    * - Delete data sets --------------------------------- *;
    proc datasets library = work; delete final_m final_d final;

    %end;

%mend Table_1; * end of macro;

%Table_1;   * activate the macro;
```

Appendix B

If no access to WRDS, users can use the following codes to process data download from French web site, then run codes in Appendix A to get Table 1.

Step 1a: Go to http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html first. Then click "Fama/French Factors [Daily]" under "Research Returns Data (Downloadable)". The name of the file is "F-F_Research_Data_Factors_daily.txt". Below are 3lines from the file.

```
     Mkt-RF   SMB   HML   RF
19630701  -0.66  0.16  -0.33  0.012
19630702  0.78  -0.28  0.26  0.012
```

Step 1b: get monthly data by clicking "Fama/French Factors". The name of the text file is "F-F_Research_Data_Factors.txt". Below are 3lines from the file.

```
    Mkt-RF   SMB   HML   RF
192607  2.62  -2.39  -2.63  0.22
192608  2.55  -1.20  4.66  0.25
```

Step 2: run following codes

```
libname ff './';
data ff.factors_monthly;
     infile 'F-F_Research_Data_Factors.txt' firstobs=5 obs=968;
     format date date9.; *note:firstobs=5 to skip the header(5 lines);
     input yyyymm mktrf SMB HML RF;
     year=int(yyyymm/100);
     month=yyyymm-year*100;
     date=mdy(month,1,year);
     mktrf=mktrf/100;
     smb=smb/100;
     HML=HML/100;
     RF=RF/100;run;

data ff.factors_daily;
     infile 'F-F_Research_Data_Factors_daily.txt' firstobs=6 obs=10915;
     format date date9.; *note: firstobs=6 to skip header(6 lines);
     input date0 mktrf SMB HML RF;
     year=int(date0/10000);
     month=int(date0/100)-year*100;
     day=date0-year*10000-month*100;
     date=mdy(month,day,year);
     mktrf=mktrf/100;
     smb=smb/100;
     HML=HML/100;
     RF=RF/100;run;
```

Step 3: run macro Table1 in Appendix A.

```
%macro table1;
     * Note: change '%do ii=1 %to 4;' to '%do ii=1 %to 3;'
```

%table1;

Table 1

Discrepancies between daily and monthly Fama-French factors

The Table shows the cumulative total returns over various periods. *MKTRF* stands for the value-weighted market index minus the risk-free rate; *SMB* stands for Small Minus Big, *HML* for High Minus Low and *UMD* is the momentum factor. *N* is number of observations. R_mon and R_day refer to the total returns based compounding monthly or daily factor, respectively. D_1*=100*(R_day -R_mon*); D_2 is the total bias by compounding monthly biases: $D_2 = \prod_t (bias_t + 1) - 1$.

	MARRF						*SMB*			
PERIOD	R_mon	N	R_day	N	D_1	D_2	R_mon	R_day	D_1	D_2
4-year										
1964-1967	0.3308	48	0.3272	1008	-0.4	-0.28	0.7227	0.6686	-5.4	-3.32
1968-1971	-0.0518	48	-0.0493	983	0.3	0.22	-0.0104	-0.0337	-2.3	-2.56
1972-1975	-0.2589	48	-0.2600	1009	-0.1	-0.24	-0.2636	-0.2928	-2.9	-4.17
1976-1979	0.2720	48	0.2692	1010	-0.3	-0.25	0.8864	0.7641	-12.2	-6.56
1980-1983	0.2299	48	0.2312	1012	0.1	0.01	0.3470	0.2628	-8.4	-6.38
1984-1987	0.2044	48	0.2024	1011	-0.2	-0.25	-0.2317	-0.2810	-4.9	-6.15
1988-1991	0.4455	48	0.4477	1011	0.2	0.12	-0.0874	-0.1379	-5.0	-5.62
1992-1995	0.4037	48	0.4048	1011	0.1	0.07	0.0428	0.0305	-1.2	-1.24
1996-1999	0.9950	48	1.0009	1011	0.6	0.28	-0.1498	-0.1933	-4.3	-5.34
2000-2003	-0.2647	48	-0.2643	1004	0.0	0.02	0.4409	0.3877	-5.3	-4.63
Long-period										
1964-1993	1.9106	360	1.9018	7551	-0.9	-0.69	1.5119	0.7579	-75.4	-30.50
1994-2005	1.0974	144	1.1053	3023	0.8	0.32	0.1720	0.0594	-11.3	-10.76

	HML						*UMD*			
PERIOD	R_mon	N	R_day	N	D1	D2	R_mon	R_day	D1	D2
4-year										
1964-1967	0.0929	48	0.0760	1008	-1.7	-1.61	0.5712	0.5463	-2.5	-1.76
1968-1971	0.1364	48	0.1374	983	0.1	0.08	0.1068	0.2430	13.6	12.60
1972-1975	0.5076	48	0.5467	1009	3.9	2.38	0.4843	0.4264	-5.8	-4.05
1976-1979	0.2666	48	0.2579	1010	-0.9	-0.80	0.7404	0.4468	-29.4	-16.98
1980-1983	0.2966	48	0.3166	1012	2.0	1.40	0.4633	0.3644	-9.9	-7.01
1984-1987	0.2420	48	0.2720	1011	3.0	2.35	0.3000	0.3645	6.4	4.79
1988-1991	-0.1438	48	-0.1356	1011	0.8	0.85	0.5809	0.6608	8.0	4.70
1992-1995	0.4259	48	0.4170	1011	-0.9	-0.67	0.4884	0.3921	-9.6	-6.63
1996-1999	-0.2609	48	-0.2406	1011	2.0	2.46	0.8194	0.8460	2.7	1.45
2000-2003	0.8246	48	0.8515	1004	2.7	0.94	0.1031	0.3268	22.4	18.811
Long-period										
1964-1993	3.6741	360	3.9064	7551	23.2	4.21	15.9381	13.9278	-201.0	-12.77
1994-2005	0.5771	144	0.6342	3023	5.7	2.77	1.7308	2.2724	54.2	18.09

Table 2

Largest 20 biased values in terms of compounding daily *SMB* and *HML*

The time period is from 1964 to 2005. MONTH refers to the monthly Fama-French factor while DAY is the estimated monthly value by compounding daily Fama-French daily factors. DIFF is defined as DAY minus MONTH.

SMB				*HML*			
DATE	DAY	MONTH	DIFF	DATE	DAY	MONTH	DIFF
19871001	-0.1155	-0.0825	-0.0330	20000201	-0.1041	-0.1266	0.0225
20000301	-0.1454	-0.1658	0.0204	19991201	-0.0767	-0.0909	0.0142
19750101	0.0918	0.1089	-0.0171	19750101	0.0677	0.0813	-0.0136
20000601	0.1210	0.1346	-0.0136	20000601	-0.0856	-0.0982	0.0126
20000201	0.2055	0.2187	-0.0132	19741001	-0.0855	-0.0977	0.0122
19680401	0.0467	0.0577	-0.0110	19700401	0.0735	0.0622	0.0113
19991201	0.0577	0.0683	-0.0106	19801101	-0.0738	-0.0844	0.0106
19670101	0.0745	0.0849	-0.0104	19731101	0.0496	0.0401	0.0095
20000401	-0.0667	-0.0762	0.0095	19980801	0.0598	0.0506	0.0092
19970501	0.0383	0.0473	-0.0090	19760101	0.0748	0.0837	-0.0089
19731101	-0.0857	-0.0773	-0.0084	20001101	0.1326	0.1249	0.0077
19781001	-0.1079	-0.0995	-0.0084	19990401	0.0177	0.0252	-0.0075
19760101	0.0402	0.0481	-0.0079	19991101	-0.0708	-0.0779	0.0071
20020701	-0.0586	-0.0511	-0.0075	20001201	0.0536	0.0607	-0.0071
19980801	-0.0633	-0.0559	-0.0074	19740901	0.0618	0.0548	0.0070
19880601	0.0131	0.0200	-0.0069	20000401	0.0840	0.0907	-0.0067
20010101	0.0627	0.0689	-0.0062	20000301	0.0730	0.0794	-0.0064
19680501	0.0581	0.0640	-0.0059	19700901	-0.0503	-0.0561	0.0058
19821001	0.0174	0.0231	-0.0057	19850101	-0.0474	-0.0531	0.0057
19790301	0.0259	0.0316	-0.0057	20010201	0.1428	0.1371	0.0057

Table 3

Proportions of positive returns and correlations among biases

All values are based on the current Fama-French daily and monthly factors. Panel A shows the numbers of months that have positive returns are shown in the Table. DAILY refers to the monthly factor generated from compounding the corresponding daily factor, MONTHLY is the corresponding values downloaded directly from the monthly Fama-French dataset, DIFF is the difference between DAILY and MOTHLY. Panel B: Correlation coefficients between biases. A bias is defined as the difference between monthly value and the converted monthly value from the corresponding daily value.

Panel A: proportions of signs of differences (1964-1993)						
	SMB			*HML*		
	DAILY	MOHTHLY	DIFF	DAILY	MOHTHLY	DIFF
# of months return>0	258	264	174	298	301	232
Percentage Positive	51.2%	52.4%	34.5%	59.1%	59.7%	46.0%
	UMD			MKTRF		
	DAILY	MOHTHLY	DIFF	DAILY	MOHTHLY	DIFF
# of months return>0	307	326	233	296	295	258
Percentage Positive	60.9%	64.7%	46.2%	58.7%	58.5%	51.2%

Panel B: Correlation coefficients between biases of *SMB*, *HML* and *UMD*			
	ρ(bias_*SMB*,bias_*HML*)	ρ(bias_*SMB*,bias_*UMD*)	ρ (bias_*HML*,bias_U*MD*)
1963-1967	0.1109	0.0892	-0.1304
1968-1972	0.0309	0.1009	0.2461
1973-1977	0.4552	0.0373	0.3125
1978-1982	0.0225	0.3143	-0.1545
1983-1987	-0.2893	0.0527	0.1136
1988-1993	0.0703	-0.1701	-0.2736
1964-1993	0.0832	0.091	0.063

Table 4

Weight changes from the market portfolio to big or small portfolios

The month of July 2001 is randomly selected. *RANK* is the rank in terms of the CAP (market capitalization, abs(PRC)*SHROUT), *PERMNO* is the CRSP stock *ID*, *SIX_PORT* has 6 values: *BL* (Big stock with Low book-to-market), *BM* (Big stock with Median book-to-market), *BH* (Big stock with High book-to-market), *SL* (Small stock with Low book-to-market), *SM* (Small stock with Median book-to-market), *SH* (Small stock with High book-to-market), W_1 is the weight of individual stock for the whole market, W_2 is the weight in one of the six portfolios. For an easy presentation, both W_1 and W_2 are increased by 10,000.

Panel A: weight change of the first 10 largest and last 10 smallest stocks						
RANK	PERMNO	CAP	SIX_PORT	W_1	W_2	$(W_2-W_1)/W_1$
1	12060	432165801.00	BL	323.78962	457.22177	
2	10107	356300783.14	BL	266.94961	376.95827	
3	11850	288133631.94	BL	215.87705	304.83895	
4	21936	260215725.93	BL	194.96024	275.30243	
5	70519	252744331.84	BL	189.36249	267.39786	
6	55976	249926559.02	BL	187.25134	264.41672	
7	59328	200561676.41	BL	150.26591	212.18978	
8	66800	194057248.50	BL	145.39263	205.30824	
9	77418	193590051.40	BL	145.04259	204.81395	
10	12490	182793746.19	BL	136.95373	193.39170	
5798	86592	1151.84	SL	0.00086	0.03537	
5799	86423	1113.89	SL	0.00083	0.03421	
5800	76510	1051.84	SM	0.00079	0.03020	
5801	87665	1000.89	SL	0.00075	0.03074	
5802	41399	985.78	SL	0.00074	0.03027	
5803	55044	645.70	SL	0.00048	0.01983	
5804	87084	587.21	SL	0.00044	0.01803	
5805	66545	544.89	SH	0.00041	0.02373	
5806	79443	467.88	SH	0.00035	0.02038	
5807	83770	384.30	SH	0.00029	0.01674	

Panel B: average weight changes for 6 portfolios						
Portfolio	n	CAP	W1	W2	R=(w2-w1)/w1	Average of R
BH	104	5,521,716	4.1195	96.15	22.34	
BL	406	6,167,645	4.6096	24.63	4.35	904%
MH	635	14,837,554	11.0696	15.75	0.42	(n=1,145)
ML	2,046	113,557	0.0847	4.89	56.69	
SH	1,391	247,593	0.1847	7.19	37.92	4,487%
SL	1,195	273,595	0.2041	8.37	40.00	(n=4632)

Table 5

Comparisons of compounding the new monthly and daily factors

Table shows the cumulative total returns over different lengths of periods. *MKTRF* stands for the value-weighted market index minus the risk-free rate; *MKTRF* can be treated as *VWRETD* in CRSP since their correlation coefficient is 0.99891 between 1964 and 2005. SMB stands for Small Minus Big, *HML* for High Minus Low and *UMD* is the momentum factor. N is number of observations. *MONTH* refers the total return based compounding monthly factor; DAY refers to the total return based on daily factor, D_1=100*(DAY-MONTH); D_2 is the total return difference by compounding monthly differences.

	Rm						*SMB*			
PERIOD	MONTH	N	DAILY	N	D1	D2	MONTH	DAY	D1	D2
4-year										
1964-1967	0.5601	48	0.5279	1008	-3.2	-2.18	0.7115	0.7180	0.6	0.34
1968-1971	0.1797	48	0.1912	983	1.1	0.74	0.0045	0.0041	-0.0	-0.04
1972-1975	-0.0574	48	-0.0314	1009	2.6	2.76	-0.2481	-0.2467	0.1	0.17
1976-1979	0.6428	48	0.6136	1010	-2.9	-1.78	0.8102	0.8065	-0.4	-0.22
1980-1983	0.9130	48	0.9188	1012	0.6	0.07	0.3812	0.3772	-0.4	-0.30
1984-1987	0.6258	48	0.6308	1011	0.5	0.21	-0.2131	-0.2094	0.4	0.43
1988-1991	0.9214	48	0.9427	1011	2.1	1.09	-0.0929	-0.0944	-0.2	-0.19
1992-1995	0.6648	48	0.6697	1011	0.5	0.26	0.0589	0.0555	-0.3	-0.33
1996-1999	1.4762	48	1.4493	1011	-2.7	-1.34	-0.1106	-0.1108	-0.0	-0.10
2000-2003	-0.1849	48	-0.1442	1004	4.1	4.63	0.3814	0.3832	0.2	-0.05
Long-period										
1964-1993	19.7659	360	19.9314	7551	16.6	0.07	1.6276	1.6282	0.1	-0.08
1994-2005	2.2716	144	2.4382	3023	16.7	4.46	0.1736	0.1679	-0.6	-0.76

	HML					
PERIOD	MONTH	N	DAILY	N	D1	D2
4-year						
1964-1967	0.1804	48	0.1758	1008	-0.5	-0.40
1968-1971	0.1091	48	0.1102	983	0.1	0.10
1972-1975	0.4961	48	0.4912	1009	-0.5	-0.33
1976-1979	0.3599	48	0.3619	1010	0.2	0.14
1980-1983	0.3009	48	0.2957	1012	-0.5	-0.42
1984-1987	0.2413	48	0.2437	1011	0.2	0.19
1988-1991	-0.0988	48	-0.0965	1011	0.2	0.25
1992-1995	0.3898	48	0.3866	1011	-0.3	-0.24
1996-1999	-0.2774	48	-0.2757	1011	0.2	0.15
2000-2003	1.0370	48	1.0172	1004	-2.0	-1.11
Long-period						
1964-1993	4.4213	360	4.3945	7551	-2.7	-0.54
1994-2005	0.7072	144	0.6784	3023	-2.9	-1.92

Table 6

Comparisons of β based on monthly and converted monthly time series

Coefficients from running a Fama-French 3-factor model based on the current monthly factors (*MONTH*) and the converted monthly factors from daily factors (under *DAY*), over 1968 to 1971. *Diff =DAY-MONTH*, and *Diff(%)=100*(DAY-MONTH)/ ABS(MONTH)*.

Panels A: first 15 socks are chosen according to PERMNO								
	SMB				*HML*			
PERMNO	MONTH	DAY	Diff	Diff(%)	MONTH	DAY	Diff	Diff(%)D[2]
10006	0.22138	0.22080	-0.0006	-0.264	0.16748	0.19117	0.0237	14.143
10014	2.86810	2.95147	0.0834	2.907	1.06357	0.91941	-0.1442	-13.555
10057	0.82104	0.81817	-0.0029	-0.350	0.61624	0.61386	-0.0024	-0.385
10065	-0.25070	-0.25750	-0.0068	-2.712	0.46297	0.46887	0.0059	1.274
10102	-0.03434	0.03949	0.0738	214.986	1.06944	1.15121	0.0818	7.645
10137	-0.37281	-0.38191	-0.0091	-2.441	0.46092	0.45826	-0.0027	-0.577
10145	0.15636	0.17890	0.0225	14.413	0.94958	0.92229	-0.0273	-2.874
10153	1.22520	1.28373	0.0585	4.778	0.72943	0.83088	0.1014	13.908
10161	0.05502	0.09619	0.0412	74.819	-0.05701	-0.12231	-0.0653	-114.542
10188	0.60677	0.58856	-0.0182	-3.001	-0.19671	-0.13699	0.0597	30.360
10225	-0.26203	-0.28328	-0.0213	-8.110	0.23126	0.25371	0.0225	9.710
10233	0.36962	0.39263	0.0230	6.225	-0.66005	-0.67271	-0.0127	-1.918
10241	-0.11935	-0.13473	-0.0154	-12.886	0.60246	0.64575	0.0433	7.186
10268	1.94286	2.06990	0.1270	6.539	-0.22869	-0.10181	0.1269	55.480
10276	0.48839	0.49897	0.0106	2.167	0.66123	0.64789	-0.0133	-2.018

Panel B: 20 largest deviation for *SMB* and *HML*									
SM B					***HML***				
PERMNO	**MONTH**	**DAY**	**Diff**	**Diff(%)**	**PERMNO**	**MONTH**	**DAY**	**Diff**	**Diff (%)**
17750	0.00340	-0.03133	-0.0347	-1022.85	24598	0.00034	0.08374	0.0834	24713.08
19131	-0.00430	-0.03785	-0.0336	-780.45	20474	-0.00059	0.02027	0.0209	3511.31
24045	-0.00592	-0.03550	-0.0296	-499.66	39546	0.00303	0.09214	0.0891	2943.02
19377	-0.00617	0.02270	0.0289	467.63	31579	0.00502	0.10520	0.1002	1997.29
10698	0.00821	0.04251	0.0343	417.48	26075	0.00410	-0.03613	-0.0402	-980.89
12167	-0.01130	0.03143	0.0427	378.08	15560	0.00540	-0.04172	-0.0471	-873.08
42884	-0.01415	-0.05731	-0.0432	-304.91	28935	0.00135	0.01144	0.0101	746.98
10743	-0.01993	0.02501	0.0449	225.51	40205	0.02253	-0.13504	-0.1576	-699.30
44206	-0.00341	-0.01082	-0.0074	-217.12	37698	-0.00413	-0.03215	-0.0280	-678.44
10102	-0.03434	0.03949	0.0738	214.99	27596	-0.02265	-0.16375	-0.1411	-622.87
11674	0.01362	0.04261	0.0290	212.87	30277	0.01562	0.10989	0.0943	603.66
38578	-0.00957	0.00613	0.0157	164.11	43078	0.02181	-0.09232	-0.1141	-523.32
16029	0.03739	0.08740	0.0500	133.73	39829	0.03332	-0.11254	-0.1459	-437.79
36695	-0.04012	0.00756	0.0477	118.85	33232	-0.04596	0.13544	0.1814	394.69
11949	0.05744	-0.00731	-0.0647	-112.72	44759	-0.02618	0.06791	0.0941	359.37
38893	-0.01626	-0.03369	-0.0174	-107.14	17961	-0.00788	0.01925	0.0271	344.36
23552	-0.05750	-0.11776	-0.0603	-104.81	40571	0.01412	-0.03267	-0.0468	-331.37
22648	-0.02325	0.00107	0.0243	104.62	21178	0.01917	0.08233	0.0632	329.46
43350	-0.05159	-0.10413	-0.0525	-101.83	31077	-0.01895	-0.08026	-0.0613	-323.49
25750	-0.06247	-0.12483	-0.0624	-99.81	45380	0.02796	0.11425	0.0863	308.67

Table 7

Comparisons between Fama-French daily factors and our newly generated ones

The comparisons are conducted on a yearly basis from 1964 to 2005. The daily Fama-French *SMB* and *HML* are Ken French's web site and the new daily factors are based on the formulae 3-7. T-value is for the difference which is defined as FF factor – the new factor. *, ** and *** indicate significant at 10%, 5% and 1% levels, respectively. Means and standard deviation are increased by 100 for an easy presentation and DIFF is in base-point, i.e., increased by 10,000.

	SMB				*HML*			
year	μ_{FF}	μ_{NEW}	Diff	T-value	μ_{FF}	μ_{NEW}	Diff	T-value
1964	-0.0124	-0.0085	-0.3928	-0.77	0.0324	0.0326	-0.0169	2.00**
1965	0.0799	0.0679	1.1996	4.13***	0.0309	0.0233	0.7616	1.63
1966	0.0189	0.0139	0.4971	0.57	0.0105	-0.0036	1.4110	-0.17
1967	0.1313	0.1322	-0.0901	6.67***	-0.0081	-0.0220	1.3847	-1.32
1968	0.0940	0.0817	1.2345	3.68***	0.0575	0.0600	-0.2467	2.82***
1969	-0.0676	-0.0631	-0.4502	-3.35***	-0.0418	-0.0469	0.5081	-1.98**
1970	-0.0406	-0.0426	0.1992	-1.65*	0.0747	0.0844	-0.9676	2.22**
1971	0.0279	0.0209	0.6990	1.09	-0.0404	-0.0377	-0.2710	-2.49**
1972	-0.0400	-0.0431	0.3071	-2.69***	0.0034	0.0085	-0.5048	0.46
1973	-0.1214	-0.1212	-0.0208	-4.47***	0.0904	0.0938	-0.3476	3.57***
1974	-0.0016	-0.0069	0.5305	-0.19	0.0469	0.0498	-0.2934	1.69*
1975	0.0542	0.0371	1.7065	1.47	0.0208	0.0237	-0.2901	1.06
1976	0.0359	0.0386	-0.2696	2.18**	0.0862	0.0694	1.6822	3.97***
1977	0.0827	0.0824	0.0336	5.53***	0.0339	0.0296	0.4295	2.26**
1978	0.0532	0.0481	0.5173	1.67*	-0.0065	-0.0017	-0.4832	-0.09
1979	0.0651	0.0583	0.6817	2.65***	0.0099	-0.0053	1.5194	-0.39
1980	0.0296	0.0144	1.5169	0.40	-0.0777	-0.0766	-0.1141	-2.73***
1981	0.0297	0.0243	0.5385	0.92	0.0879	0.0920	-0.4133	2.83***
1982	0.0286	0.0225	0.6064	0.64	0.0406	0.0367	0.3918	1.05
1983	0.0442	0.0360	0.8210	1.36	0.0562	0.0613	-0.5067	2.53**
1984	-0.0268	-0.0323	0.5426	-1.20	0.0705	0.0739	-0.3418	2.73***
1985	0.0046	-0.0029	0.7458	-0.14	-0.0020	0.0025	-0.4510	0.12
1986	-0.0335	-0.0373	0.3826	-1.27	0.0315	0.0323	-0.0835	1.65*
1987	-0.0300	-0.0495	1.9482	-0.73	-0.0107	-0.0104	-0.0305	-0.33
1988	0.0225	0.0102	1.2262	0.28	0.0532	0.0455	0.7653	2.70***
1989	-0.0430	-0.0432	0.0138	-1.56	-0.0105	-0.0171	0.6608	-1.27
1990	-0.0582	-0.0640	0.5807	-2.02**	-0.0499	-0.0439	-0.6001	-1.71*
1991	0.0445	0.0431	0.1419	1.47	-0.0309	-0.0402	0.9297	-1.92*
1992	0.0239	0.0247	-0.0758	1.02	0.0748	0.0767	-0.1942	3.05***
1993	0.0277	0.0203	0.7456	0.82	0.0589	0.0642	-0.5323	2.48**
1994	-0.0054	-0.0051	-0.0329	-0.21	-0.0096	-0.0035	-0.6031	-0.21
1995	-0.0221	-0.0254	0.3260	-1.09	0.0075	0.0027	0.4719	0.12
1996	-0.0040	-0.0101	0.6156	-0.34	0.0119	0.0088	0.3080	0.31
1997	-0.0159	-0.0206	0.4778	-0.57	0.0360	0.0348	0.1208	1.12
1998	-0.0756	-0.0901	1.4479	-2.17**	-0.0477	-0.0351	-1.2666	-0.92
1999	0.0562	0.0426	1.3627	1.09	-0.1210	-0.1110	-0.9966	-2.34**
2000	-0.0150	-0.0097	-0.5343	-0.15	0.1563	0.1426	1.3659	1.88*
2001	0.0763	0.0675	0.8775	1.79	0.0542	0.0615	-0.7364	1.03
2002	0.0054	0.0101	-0.4652	0.25	0.0728	0.0461	2.6731	1.22
2003	0.0746	0.0738	0.0761	2.16**	0.0101	0.0092	0.0918	0.44
2004	0.0181	0.0184	-0.0341	0.58	0.0297	0.0311	-0.1383	1.36
2005	-0.0074	-0.0063	-0.1134	-0.24	0.0295	0.0315	-0.2004	1.70*

Table 8

Impact of inconsistent daily factors on coefficient estimates in a 3-factor model

The regression is based current Fama-French and the new daily factors.

$R_t - R_{f,t} = \alpha + \beta_1 * MKTRF_t + \beta_2 * SMB_t + \beta_3 * HML_t + \varepsilon_t$. The difference=Fama-French coefficient minus mine. *N* is the number of stocks (min obs>240). INTERCEPT (100,000's).

		INTERCEPT			*SMB*			*HML*		
YEAR	N	MEAN	STD	T	MEAN	STD	T	MEAN	STD	T
1964	2007	0.190	.00016	5.3	0.0470	.58981	3.6	-0.0493	.54021	-4.1
1965	2036	0.667	.00024	12.7	-0.0108	.38559	-1.3	0.0238	.80846	1.3
1966	2067	0.536	.00014	17.8	0.0349	.19691	8.1	0.0507	.55422	4.2
1967	2060	-.660	.00028	-11	-0.0055	.24380	-1.0	0.0444	.58280	3.5
1968	2060	-.660	.00028	-11	-0.0055	.24380	-1.0	0.0444	.58280	3.5
1969	2098	0.755	.00023	15.2	-0.0226	.20179	-5.1	0.0350	.24187	6.6
1970	2245	0.334	.00025	6.4	-0.0064	.13833	-2.2	-0.0460	.28267	-7.7
1971	2355	0.363	.00018	10.0	-0.0256	.19067	-6.5	-0.0425	.44626	-4.6
1972	2479	0.255	.00013	9.7	0.0171	.18516	4.6	-0.0349	.28828	-6.0
1973	4930	0.725	.00029	17.6	-0.0553	.12619	-31	-0.0831	.29114	-20
1974	4679	0.534	.00014	26.9	-0.0185	.18860	-6.7	-0.0662	.31726	-14
1975	4610	1.359	.00020	46.5	0.0565	.27180	14.1	-0.0742	.34186	-15
1976	4679	0.298	.00013	15.4	0.0213	.32005	4.5	-0.0393	.38363	-7.0
1977	4663	0.213	.00012	11.9	-0.0027	.26502	-0.7	-0.0518	.58862	-6.0
1978	4541	0.455	.00010	31.6	-0.0191	.15009	-8.6	-0.0468	.80426	-3.9
1979	4517	0.345	.00012	19.3	-0.0193	.12221	-11	-0.0423	.45939	-6.2
1980	4482	1.076	.00014	53.3	-0.0547	.06755	-54	-0.0311	.22324	-9.3
1981	4699	0.638	.00013	33.0	-0.0096	.07204	-9.1	0.0112	.19675	3.9
1982	4953	1.092	.00018	42.5	0.0261	.11851	15.5	-0.0327	.20958	-11
1983	5138	1.021	.00026	27.9	-0.0058	.12081	-3.4	-0.0333	.26491	-9.0
1984	5684	0.771	.00015	38.6	-0.0324	.14623	-17	-0.0036	.25527	-1.0
1985	5678	0.802	.00018	34.4	-0.0360	.20073	-14	-0.0548	.32040	-13
1986	5642	0.437	.00012	27.1	-0.0236	.12301	-14	-0.0378	.30947	-9.2
1987	6155	1.190	.00013	70.3	-0.2109	.18957	-87	0.0348	.38704	7.1
1988	6420	0.661	.00033	16.2	-0.0075	.13059	-4.6	-0.0151	.49668	-2.4
1989	6319	0.482	.00017	23.1	-0.0067	.13853	-3.9	-0.0734	.57239	-10
1990	6238	0.355	.00036	7.7	-0.0272	.14350	-15	-0.0293	.47045	-4.9
1991	6192	0.538	.00012	34.9	-0.0157	.11221	-11	-0.0282	.31741	-7.0
1992	6148	0.375	.00022	13.6	-0.0244	.12504	-15	-0.0304	.24734	-9.6
1993	6587	0.287	.00020	11.9	-0.0304	.11596	-21	-0.0236	.24788	-7.7
1994	7276	0.218	.00010	19.3	-0.0474	.13499	-30	-0.0706	.64660	-9.3
1995	7574	0.472	.00026	15.6	-0.0245	.19160	-11	-0.0506	.48555	-9.1
1996	7872	0.521	.00017	26.8	-0.0168	.17770	-8.4	-0.0436	.42620	-9.1
1997	8272	0.420	.00028	13.9	0.0027	.11208	2.2	-0.0024	.36105	-0.6
1998	8046	1.239	.00015	75.5	0.0057	.08536	6.0	-0.0522	.40560	-12
1999	7620	-.162	.00017	-8.1	-0.0045	.17398	-2.3	0.0291	.29662	8.6
2000	7375	0.731	.00036	17.5	-0.0335	.15860	-18	0.0485	.30130	13.8
2001	7101	0.425	.00014	25.3	0.0097	.09741	8.4	0.0467	.16517	23.8
2002	6725	1.077	.00029	30.1	-0.0237	.09930	-20	-0.0208	.27125	-6.3
2003	6404	-.487	.00007	-56	-0.0017	.05566	-2.5	-0.0155	.30364	-4.1
2004	6246	-.125	.00005	-18	-0.0362	.06218	-46	-0.0592	.12366	-38
2005	6242	-.232	.00006	-32	-0.0336	.07054	-38	-0.0758	.14816	-40