“Seasonality based style rotation strategy in major stock markets”

AUTHORS	Hyung-Suk Choi
ARTICLE INFO	Hyung-Suk Choi (2014). Seasonality based style rotation strategy in major stock markets. *Investment Management and Financial Innovations*, *11*(1-1)
RELEASED ON	Wednesday, 30 April 2014
JOURNAL	"Investment Management and Financial Innovations"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
0	0	0

Hyung-Suk Choi (Korea)

Seasonality based style rotation strategy in major stock markets

Abstract

This paper examines seasonality in returns to style portfolios in major stock markets – Germany, Japan, the U.K., and the U.S. Kwon and Choi (2014) find that style returns in the U.S. markets exhibit substantial variations across calendar months and that the seasonal pattern of the style returns is not limited to January or the end of each quarter as reported in the previous literature. The author extends their analysis to major stock markets in the world by examining monthly returns on the style portfolios classified by the six size/book-to-market sorting and the six size/prior-return sorting over the sample period of 1982-2006. The empirical results show that substantial seasonal patterns in style returns in each of these markets and the seasonal style rotation strategy yields economically and statistically significant profits in all of these stock markets.

Keywords: style portfolio, seasonal trading strategies, size effect, value effect, momentum effect.
JEL Classification: G11, G15, G20.

Introduction

In financial markets, investors group assets into different classes based on some similarity among them. They categorize stocks into broad classes such as small versus large stocks, value versus growth stocks, prior winners versus losers, or categorized by different industry sectors. These asset classes are called "styles" and the process allocating money among styles is called "style investing" (see Barberis and Shleifer, 2003). Sometimes investors must consider styles because portfolio allocation among different styles is required by law. Also, as Barberis and Shleifer (2003) argue, it would be human nature to classify objects with the benefit of simplifying problems of choice. Peng and Xiong (2006) show that investors tend to process more market and sector-wide information than firm-specific information, because attention is a scarce resource and an enormous amount of new information comes into the market at lightning speeds.

Kwon and Choi (2014) examine seasonal patterns in the cross-section of expected returns on twelve style portfolios in the U.S. They find that style returns exhibit substantial variations across calendar months and that the seasonal pattern of the style returns is not limited to January or the end of each quarter as reported in the previous literature. We extend their analysis to major stock markets in the world. Historically, small-cap stocks outperformed large-cap stocks and growth stocks performed poorly relative to value stocks. However, the relative performance between these styles is not stable over time. Chan, Karceski and Lakonishok (2000), for example, show that large-cap (growth) stocks outperform small-cap (value) stocks in 13 years (8 years) out of their 29 year sample period from 1970 to 1998. Thus, we will examine whether the relative performance of style portfolios are seasonally affected not only in the U.S. but also major stock markets such as Germany, Japan, and the U.K.

Also, we propose a style rotation strategy using the seasonal pattern among style returns. We take the long positions of styles with good performance in a specific calendar month and the short positions of styles that have done poorly in the same calendar month. For example, we rank the twelve style portfolios according to their average returns during the previous five Januaries to construct a zero investment portfolio for the next January. The focus of this study is not to explain or predict the relative style performance but to utilize the seasonal patterns in the style returns that we observe in major stock markets. Our seasonal style rotation strategy yields economically and statistically significant profits in all the major stock markets. The strategy yields 11.1% in Germany, 11.4 % in Japan, 17.9 % in the U.K., and 16.2 % in the U.S. per year over 1987-2006.

1. Review of literature

Much of academic literature has shown that certain styles outperform other styles in the long run. Banz (1981) finds that smaller firms have had higher risk adjusted returns, on average, than larger firms for the 1936-1977 period in the U.S. Statman (1980) and Rosenberg, Reid, and Lanstein (1985) find that U.S. firms with higher ratio of book-value of common equity to their market value would generate higher returns. Fama and French (1992) also find the similar results that small-cap stocks outperform large-cap stocks and that high book-to-market ratio stocks outperform low book-to-market ratio stocks. Also, Jegadeesh and Titman (1993) show that strategies which buy stocks that have performed well in the past and sell stocks that have performed poorly in the past generate positive returns.

However, the relative performance between these styles is not stable over time. As reported by Chan, Karceski and Lakonishok (2000), which suggests that style rotation strategy, switching from one style to another, could generate additional returns when we can forecast the relative performance between styles. Kwon and Choi (2014) find that style returns

exhibit substantial variations across calendar months. For example, over the sample period of January 1927 to December 2006, in January the mean return of the *Small/Down* portfolio is 6.2 percent and that of the *Big/Up* portfolio is only 1.3 percent. However, in March the mean return of the Small/Down portfolio is 0.03 percent and that of the *Big/Up* portfolio is 1.26 percent. This is consistent with previous literature on seasonality in stock returns which suggests the outperformance of some style against another in a specific calendar month. For example, Keim (1983), Reinganum (1983), and Roll (1983) find that small-cap stocks outperform large-cap stocks in January. Branch (1977) and Dyl (1977) suggest that tax-loss selling creates a downward price pressure on loser stocks in December and a price rebound in January. Lakonishok, Shleifer, Thaler and Vishny (1991) find that pension funds dump prior loser stocks at the end of every quarter.

Based on the seasonal pattern among style returns, Kwon and Choi (2014) propose a style rotation strategy that takes the long positions of styles with good performance in a specific calendar month and that takes the short positions of styles that have done poorly in the same calendar month. For example, we rank the twelve style portfolios according to their average returns during the previous five Januaries to construct a zero investment portfolio for the next January. The strategy yields profits across all calendar months. Specifically, the mean profit in January alone is 4.5 percent. Overall, this seasonal strategy in the U.S. stock market yields economically and statistically significant profits of 18.7 percent per year. We apply this zero cost investment strategy with style portfolios to major stock markets in each of twelve calendar months. This strategy is not to explain or predict the relative style performance but to utilize the seasonal patterns in the style returns that we observe. The style premium is not exclusively present in the U.S. It has also been noticed to be strong in the major stock markets such as the U.K., Japan, and Germany. Capaul, Rowley and Sharpe (1993) find that value stocks outperformed growth stocks on average in France, Germany, Switzerland, the U.K., Japan, and the U.S. over the period between 1981 and 1992. Arshanapalli, Coggin, and Doukas (1998) find that the annual difference between the average returns on portfolios of value stocks is 12.94% in North America, 10.42% in Europe, and 17.26% in Pacific-Rim over the sample period of 1975-1995.

2. Relative performance of style portfolios in major stock markets

To study the seasonality in style returns, we use monthly returns on six size/book-to-market sorted portfolios and six size/prior-return sorted portfolios in Germany, Japan, the U.K., and the U.S. over the sample period of January 1982-December 2006. First, we collect the monthly return data, the market values, and the market-to-book ratios for the all of the individual equities listed in the stock exchanges in each sample country from DataStream. We then construct the six size/book-to-market sorted portfolios and six size/prior-return sorted portfolios. At the end of each June, firms are sorted independently along size and book-to-market ratios to construct *Small*, *Big*, *Value*, *Neutral*, and *Growth* portfolios. The median stock market equity in each country is the size breakpoint and the 30th and 70th book-to-market percentiles are the book-to-market breakpoints. Thus the first six style portfolios used in this study are *Small/Value*, *Small/Neutral*, *Small/Growth*, *Big/Value*, *Big/Neutral*, and *Big/Growth*. In addition, at the end of each month *t*, firms are sorted independently along size at month *t*-1, and prior returns over month *t*-12 through *t*-2 to construct *Small*, *Big*, *Up*, *Lateral*, and *Down* portfolios. The monthly size breakpoint is the median stock market equity and the monthly prior return breakpoints are 30th and 70th percentiles. Thus, the next six style portfolios used in this study are *Small/Up*, *Small/Lateral*, *Small/Down*, *Big/Up*, *Big/Lateral*, and *Big/Down*.

We compute the mean return by calendar month for each of the twelve style portfolios over the period from January 1982 to December 2006. The results are presented in Figure 1 (see Appendix). Style returns exhibit substantial seasonal variations across calendar months in each major stock market. Figure 1 presents that the strong size effect in January is prevalent across all major stock markets. The *Small/Up* portfolio is the best performing style portfolio in Germany and the U.K. and the *Small/Down* portfolio is the best performing one in Japan and the U.S. The worst performing style portfolio in January is also one of the *Big* portfolios: *Big/Down*, *Big/Up*, *Big/Growth*, and *Big/Neutral* in Germany, Japan, the U.K., and the U.S., respectively. However, the performance of these style portfolios is reversed in December; the *Big* portfolios outperform the *Small* portfolios. Although the *Small* (*Big*) portfolios outperform the *Big* (*Small*) portfolios at the beginning (at the end) of the year, the overall performance of these style portfolios are comparable[1]. This is consistent with Cochrane (1999, 2005) and Campbell (2000) who find that the size effect has disappeared in the 1980's.

An interesting finding is that the relative style portfolio performance caused by the tax-loss selling or the window dressing in December does not seem to be reversed in January in European countries. In Germany (the U.K.), the size controlled *Up*

[1] The Size premium (Small – Big) in Germany, Japan, the U.K., and the U.S. is -0.19%, 0.18%, 0.17%, and 0.02% per month, respectively.

portfolios outperform the *Down* portfolios up to 3.9 percent (3.0 percent) in December and the *Up* portfolios still outperform the *Down* portfolios up to 2.8 percent (3.2 percent) in January. However, in the U.S., the size controlled *Up* portfolios outperforms the *Down* portfolios up to 3.2 percent in December but the *Down* portfolios outperform the *Up* portfolios up to 1.1 percent in January. Most style portfolios have been the best or the worst performing style portfolios in some month, in a specific country. For example, the *Small/Value* portfolio is the best performing style portfolio in February and April in Germany, in February and June in Japan, in June in the U.K., and in March in the U.S. Also it is the worst performing style portfolio in November in the U.K. The only exceptions are the *Big/Lateral* and the *Small/Up* portfolios; the *Big/Lateral* portfolio has never been the best performing style and the *Small/Up* has never been the worst performing style in any sample countries over the sample period. Overall, style portfolios tend to have relatively high (or low) returns in a specific calendar month across all the major stock markets. In the next section, we will test whether this relative performance among style returns in each month is statistically significant and persistent. In addition, we will apply the style rotation strategy based on the seasonality in style returns to see if we can collect abnormal returns in major stock markets.

In Table 1, we report the correlation coefficients between style portfolio returns in each sample country. Overall, the correlations between style returns are relatively high as they are diversified portfolio returns. However, we find that the magnitude of correlations varies across styles in each country. For example, the highest correlation in German style portfolio return is between *Big/Growth* and *Big/Lateral* portfolio returns, 0.876, and the lowest correlation is between *Small/Down* and *Big/Up* portfolio returns, 0.415. In Japan, however, the highest correlation in style portfolio return is between *Small/Value* and *Small/Lateral* portfolio returns, 0.969, and the lowest correlation is between *Small/Down* and *Big/Up* portfolio returns, 0.554. This various co-movement of style portfolio return suggests a profitable investment strategy that we will examine in the later section.

Table 1. Correlation coefficients between monthly style portfolio returns in the major stock markets

	Small/ Growth	Small/ Neutral	Small/ Value	Big/ Growth	Big/ Neutral	Big/ Value	Small/ Down	Small/ Lateral	Small/ Up	Big/ Down	Big/ Lateral
Panel A. Germany											
Small/Neutral	0.684										
Small/Value	0.616	0.803									
Big/Growth	0.632	0.659	0.645								
Big/Neutral	0.597	0.667	0.670	0.831							
Big/Value	0.530	0.616	0.643	0.761	0.818						
Small/Down	0.630	0.715	0.648	0.551	0.508	0.557					
Small/Lateral	0.669	0.817	0.810	0.621	0.644	0.690	0.684				
Small/Up	0.568	0.646	0.685	0.539	0.527	0.460	0.492	0.645			
Big/Down	0.525	0.626	0.600	0.688	0.664	0.696	0.693	0.640	0.419		
Big/Lateral	0.599	0.671	0.665	0.876	0.870	0.827	0.601	0.661	0.491	0.733	
Big/Up	0.554	0.630	0.641	0.800	0.806	0.729	0.415	0.599	0.554	0.507	0.750
Panel B. Japan											
Small/Neutral	0.955										
Small/Value	0.919	0.966									
Big/Growth	0.688	0.681	0.653								
Big/Neutral	0.720	0.760	0.754	0.886							
Big/Value	0.723	0.766	0.785	0.731	0.887						
Small/Down	0.908	0.933	0.930	0.606	0.688	0.726					
Small/Lateral	0.918	0.967	0.969	0.644	0.730	0.741	0.940				
Small/Up	0.918	0.934	0.925	0.655	0.711	0.721	0.842	0.917			
Big/Down	0.748	0.756	0.738	0.754	0.791	0.776	0.801	0.733	0.634		
Big/Lateral	0.731	0.767	0.768	0.857	0.908	0.855	0.730	0.757	0.699	0.833	
Big/Up	0.626	0.637	0.637	0.888	0.861	0.743	0.520	0.609	0.651	0.574	0.791
Panel C. United Kingdom											
Small/Neutral	0.896										
Small/Value	0.794	0.885									
Big/Growth	0.601	0.620	0.611								
Big/Neutral	0.552	0.616	0.661	0.815							
Big/Value	0.486	0.565	0.606	0.724	0.780						
Small/Down	0.778	0.821	0.793	0.544	0.554	0.540					

Table 1 (cont.). Correlation coefficients between monthly style portfolio returns in the major stock markets

	Small/ Growth	Small/ Neutral	Small/ Value	Big/ Growth	Big/ Neutral	Big/ Value	Small/ Down	Small/ Lateral	Small/ Up	Big/ Down	Big/ Lateral
Panel C. United Kingdom											
Small/Lateral	0.789	0.845	0.839	0.525	0.560	0.509	0.781				
Small/Up	0.817	0.855	0.787	0.494	0.482	0.455	0.712	0.733			
Big/Down	0.523	0.564	0.570	0.663	0.720	0.669	0.615	0.523	0.413		
Big/Lateral	0.623	0.655	0.659	0.854	0.831	0.749	0.586	0.551	0.494	0.712	
Big/Up	0.671	0.681	0.629	0.758	0.709	0.615	0.520	0.571	0.603	0.469	0.697
Panel D. United States											
Small/Neutral	0.930										
Small/Value	0.867	0.966									
Big/Growth	0.793	0.769	0.718								
Big/Neutral	0.658	0.772	0.766	0.846							
Big/Value	0.576	0.709	0.743	0.757	0.914						
Small/Down	0.886	0.870	0.855	0.745	0.710	0.661					
Small/Lateral	0.894	0.968	0.957	0.791	0.808	0.754	0.892				
Small/Up	0.949	0.939	0.895	0.762	0.662	0.587	0.779	0.886			
Big/Down	0.662	0.673	0.656	0.801	0.806	0.759	0.824	0.731	0.554		
Big/Lateral	0.659	0.729	0.716	0.902	0.941	0.881	0.703	0.783	0.644	0.844	
Big/Up	0.770	0.786	0.750	0.902	0.819	0.740	0.624	0.772	0.829	0.596	0.806

3. Seasonality test of style portfolio returns

We now set a framework to test seasonality in style returns. To formally test the null hypothesis that the style returns in each calendar month are not different from the unconditional mean monthly return, we use the following time series regression model for the return (R_{it}) on the ith style portfolio in month t:

$$R_{it} = \alpha_i + \beta_{i1}M_{1t} + \beta_{i2}M_{2t} + \ldots + \beta_{i12}M_{12t} + e_{it}, \quad (1)$$

where α_i is the unconditional monthly mean return, M_{jt} is the calendar month dummy variable that is to equal one if the month t is the jth month of the year and zero otherwise, and e_{it} is the error term. We impose the restriction that the sum of the coefficients of the calendar month dummy variable is to be zero for each style portfolio i (i.e. $\sum_{j=1}^{12}\beta_{ij} = 0$).

Under this restriction, the OLS estimate of the regression intercept, $\hat{\alpha}_i$, now becomes the cross-month average return whereas the estimated coefficient for each month dummy, $\hat{\beta}_{ij}$, indicates how the mean return for the month differs from the cross-month average return. Note that this paper is concerned with establishing overall seasonal patterns in each style portfolio, rather than narrowly focusing on the January effect.

Table 2 (see Appendix) reports the seasonality test of style portfolio returns in the major stock markets. We run the OLS regression model in equation (1) for the twelve style portfolio returns in Germany, Japan, the U.K., and the U.S. First, the intercept shows that the *Small/Up* is the best performing style in countries other than Japan, in general. In Japan, the *Small/ Value* is the best one. The *Big/Down* is the worst performing style in Germany and the *Small/Down* is the worst performing one in the U.K. and the U.S. In Japan, the *Big/Growth* is the worst performing style over the last twenty five years. Thus the momentum strategy, buying the winner and selling the loser, appears to work profitably in most major stock markets with the exception of Japan. In Germany, the *Big* portfolios outperform the *Small* portfolios after controlling for the book-to-market ratio. On average, the *Big/Growth*, *Big/Neutral*, and *Big/Value* portfolios yield 0.37%, 2.9%, and 0.3% more than the *Small/Growth*, *Small/Neutral*, and *Small/Value* portfolios per month, respectively. This is quite the opposite result in other countries where the *Small* portfolios generally outperform the *Big* portfolios.

The January small firm effect is much stronger in Japan and the U.K. than in Germany and the U.S. In Japan and the U.K., the *Small* portfolios yield January returns at least three times greater than the average monthly return of the style portfolio. However, the *Small/Growth* portfolio return in Germany or the *Small/Neutral* portfolio return in the U.S. is not significantly different from the unconditional mean return of the portfolio. Notably, September is the worst month for most of the style portfolios in all countries examined. The September dummy is negative for each of the style portfolios in all countries and most of them are significant at the 10-percent level or better. October appears to be a poorly performing month for each style portfolio but the effect is rather marginal.

4. Seasonality based style rotation strategies

Figure 1 and Table 2 show the various seasonal patterns of each style portfolio returns in each country. Utilizing this we form the following relative strength strategy to exploit the effect of lagged returns at distinct annual intervals. The portfolio weights in this

strategy depend on the relative performance of the style portfolio during the same calendar month in previous years. For example, the trading strategy that is formed based on past January returns during year 1 through 5 ranks the twelve style portfolio returns according to their average returns during the previous five Januaries. More specifically, consider buying or selling style portfolios at the beginning of each month t based on their performance in the same calendar month j over the previous k year(s). For example, at the beginning of January 2005, the portfolios are constructed based on the performance in five Januaries from year 2000 to 2004 considering k of 5. The performance of a style portfolio is determined relative to the average performance of the twelve style portfolios in this study. Finally, let $w_{ijt}(k)$ denote the fraction of the trading strategy portfolio devoted to a style portfolio i over a calendar month j, that is,

$$w_{ijt}(k) = (\mu_{ijt}(k) - \overline{\mu}_{jt}(k))/12, \quad (2)$$

where $\mu_{ijt}(k)$ is the average calendar month j return of the style portfolio i over the past k years and $\overline{\mu}_{jt}(k)$ is the mean of $\mu_{ijt}(k)$'s of the twelve style portfolios. The following numerical example illustrates the process. To get the portfolio weight for January in 2006, we measure the historical average January return for each style portfolio over the last five years between 2001 and 2005. Suppose the average January return of the first portfolio, say *Small/Growth* portfolio, is 10 percent and the return for each portfolio increases by 1 percent up to 21 percent for the twelfth portfolio, say *Big/Up* portfolio. Then the mean of those average January returns of the style portfolio ($\overline{\mu}_{jt}(k)$) is 15.5 percent and the weight for the *Small/Growth* portfolio is -0.0046 implying a short position and the weight for the *Big/Up* portfolio is 0.0046 implying a long position. The holding period is one month and we use two different portfolio formation periods k years, i.e., 1 and 5, due to the data availability.

Table 3 shows the average profit for trading strategies separately implemented for each calendar month during the period January 1987 through December 2006. The last column reports the annual average cumulative return from the strategy. The corresponding Newey-West p-values are also reported in parenthesis. Although our seasonal strategy performs better in the U.K. and the U.S. than Germany and Japan, the annual cumulative returns are all positive and economically and statistically significant. The strategy that uses one year to form the portfolio yields 12.6% in Germany, 9.1% in Japan, 16.5% in the U.K., and 16.1% in the U.S. per year. The strategy that uses five years to form the portfolio yields 11.1% in Germany, 11.4% in Japan, 17.9% in the U.K., and 16.2% in the U.S. per year. The annual returns from our zero cost investment strategy are statistically significant at 5-percent level in all sample countries based on both one year and five years previous returns in the same calendar month except Japan when we use only one year to form the portfolio.

The strategy yields notably high profits in the turn-of-the-year months in each country. However, they are not the only months producing profit. In Germany and the U.K., the best performing month is February with the profit of 2.9% and 4.5%, respectively. The seasonal strategy yields a loss, albeit insignificant, in September in each country. Not only do all style portfolios perform poorly in September, but also their relative performance is difficult to predict. Overall this section has examined a seasonal pattern in style portfolio returns in the major stock markets and the performance of the seasonal strategy within them. The results show that such strong patterns exist in the style returns in the U.S. as well as the major foreign stock markets. The strategy utilizing this seasonal pattern yields considerable profits in each of the major stock markets.

Table 3. Seasonal strategy returns with the style portfolios in the major stock markets

Country	Strategy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Dec
Germany	Year 1	2.78 (0.03)	2.77 (0.04)	0.49 (0.56)	2.34 (0.08)	1.80 (0.10)	1.12 (0.32)	1.22 (0.29)	-1.36 (0.22)	-1.96 (0.14)	1.46 (0.39)	1.02 (0.38)	0.86 (0.35)	12.56 (0.03)
	Year 1-5	1.91 (0.06)	2.90 (0.01)	0.58 (0.51)	1.64 (0.00)	1.79 (0.05)	1.37 (0.18)	0.61 (0.58)	-1.36 (0.23)	-2.41 (0.16)	0.91 (0.65)	0.75 (0.48)	2.38 (0.01)	11.07 (0.02)
Japan	Year 1	3.16 (0.06)	1.64 (0.27)	2.96 (0.96)	1.52 (0.26)	2.99 (0.05)	1.51 (0.30)	-1.09 (0.38)	-0.60 (0.70)	-1.45 (0.33)	-0.24 (0.86)	-1.43 (0.34)	0.14 (0.90)	9.11 (0.16)
	Year 1-5	3.75 (0.02)	1.37 (0.20)	2.31 (0.13)	2.16 (0.01)	3.56 (0.07)	1.66 (0.36)	-0.21 (0.83)	-1.20 (0.42)	-1.40 (0.16)	-0.91 (0.51)	-0.69 (0.69)	1.00 (0.39)	11.39 (0.05)
UK	Year 1	3.51 (0.01)	3.78 (0.01)	0.74 (0.46)	2.30 (0.07)	1.27 (0.21)	1.21 (0.40)	1.71 (0.20)	-0.35 (0.76)	-1.69 (0.27)	-0.19 (0.91)	1.25 (0.41)	2.91 (0.00)	16.45 (0.00)
	Year 1-5	4.11 (0.00)	4.49 (0.00)	0.86 (0.29)	1.83 (0.01)	1.11 (0.16)	0.55 (0.63)	1.59 (0.14)	0.03 (0.98)	-0.63 (0.70)	0.26 (0.90)	0.87 (0.56)	2.83 (0.00)	17.90 (0.00)
USA	Year 1	3.19 (0.01)	1.00 (0.37)	1.44 (0.15)	0.92 (0.31)	1.76 (0.11)	1.52 (0.15)	-0.15 (0.90)	-0.09 (0.95)	-0.01 (0.99)	0.43 (0.75)	2.85 (0.08)	3.21 (0.00)	16.08 (0.00)
	Year 1-5	2.25 (0.03)	1.01 (0.50)	1.66 (0.02)	1.16 (0.08)	1.98 (0.01)	1.69 (0.13)	0.46 (0.67)	-0.04 (0.97)	-0.02 (0.99)	0.47 (0.77)	2.20 (0.04)	3.37 (0.00)	16.18 (0.00)

Notes: The corresponding Newey-West p-values are also reported in parenthesis.

Conclusion

This paper examines seasonal patterns in style portfolio returns in major stock markets – Germany, Japan, the U.K., and the U.S. Style returns exhibit substantial seasonal variations across calendar months in each major stock market. The *Small/Up* portfolio is the best performing style portfolio in Germany and the U.K. and the *Small/Down* portfolio is the best performing one in Japan and the U.S. The January small firm effect is much stronger in Japan and the U.K. than in Germany and the U.S. In Japan and the U.K., the *Small* portfolios yield January returns at least three times greater than the average monthly return of the style portfolio. However, the *Small/Growth* portfolio return in Germany or the *Small/Neutral* portfolio return in the U.S. is not significantly different from the unconditional mean return of the portfolio.

We also develop a style rotation strategy to exploit these patterns in style returns. Style returns exhibit substantial variations across calendar months. Some of the variations could be explained by the previously examined hypotheses such as tax-loss selling, window dressing or turn-of-the-year effect. The seasonal rotation strategy yields 11.1% in Germany, 11.4% in Japan, 17.9% in the U.K., and 16.2% in the U.S. per year. The strategy yields notably high profits in the turn-of-the-year months in each country. However, they are not the only months producing profit. In Germany and the U.K., the best performing month is February with the profit of 2.9% and 4.5%, respectively. Collectively, the relative performance of style portfolios depends on the calendar month and this is prevalent in the major stock markets.

References

1. Arshanapalli, B., Coggin, T.D., Doukas, J. (1998). Multifactor Asset Pricing Analysis of International Value Investment Strategies, *Journal of Portfolio Management*, 24 (4), pp. 10-23.
2. Banz, R. (1981). The Relationship between Return and Market Value of Common Stock, *Journal of Financial Economics*, 9 (1), pp. 3-18.
3. Barberis, N., Shleifer, A. (2003). Style Investing, *Journal of Financial Economics*, 68 (2), pp. 161-199.
4. Branch, B. (1977). A Tax Loss Trading Rule, *Journal of Business*, 50 (2), pp. 198-207.
5. Campbell, J.Y. (2000). Asset Pricing at the Millennium, *Journal of Finance*, 55 (4), pp. 1515-1567.
6. Capual, C., Rowley, I., Sharpe, W.F. (1993). International Value and Growth Stock Returns, *Financial Analysts Journal*, 49 (1), pp. 27-36.
7. Chan, L., Karceski, J., Lakonishok, J. (2000). New Paradigm or Same Old Hype in Equity Investing? *Financial Analysts Journal*, 56 (4), pp. 23-36.
8. Cochrane, J.H. (1999). New Facts in Finance. Economic Perspective, *Ferderal Reserve Bank of Chicago*, 23 (3), pp. 36-58.
9. Cochrane, John H. (2005). *Asset Pricing – Revised Edition*, Princeton University Press, Princeton, NJ.
10. Dyl, E.A. (1977). Capital Gains Taxation and the Year-end Stock Market Behavior, *Journal of Finance*, 32 (1), pp. 165-175.
11. Fama, E.F., French, K.R. (1992). The Cross-Section of Expected Stock Returns, *Journal of Finance*, 47 (2), pp. 427-466.
12. Jegadeesh, N., Titman, S. (1993). Returns to Buying Winners and Selling Losers. Implications for Stock Market Efficiency, *Journal of Finance*, 48 (1), pp. 65-91.
13. Keim, D.B. (1983). Size-Related Anomalies and Stock Return Seasonality. Further Empirical Evidence, *Journal of Financial Economics*, 12 (1), pp. 13-32.
14. Kwon, K., Choi, H. (2014). Seasonality in Style Returns, Working paper.
15. Lakonishok, J., Shleifer, A., Thaler, R., Vishny, R. (1991). Window Dressing by Pension Fund Managers, *American Economic Review*, 81 (2), pp. 227-231.
16. Peng, L., Xiong, W. (2006). Investor Attention, Overconfidence, and Category Learning, *Journal of Financial Economics*, 80 (3), pp. 563-602.
17. Reinganum, M.R. (1983). The Anomalous Stock Market Behavior of Small Firms in January. Empirical Tests for Tax-Loss Selling Effects, *Journal of Financial Economics*, 12 (1), pp. 89-104.
18. Roll, R. (1983). Was ist Das? The Turn-of-the-Year Effect and the Return Premia of Small Firms, *Journal of Portfolio Management*, 9 (2), pp. 18-28.
19. Rosenberg, B., Reid, K., Lanstein, R. (1985). Persuasive Evidence of Market Inefficiency, *Journal of Portfolio Management*, 11 (3), pp. 6-16.
20. Stattman, D. (1980). Book Values and Stock Returns. The Chicago MBA, *A Journal of Selected Papers*, 4, pp. 25-45.

Appendix

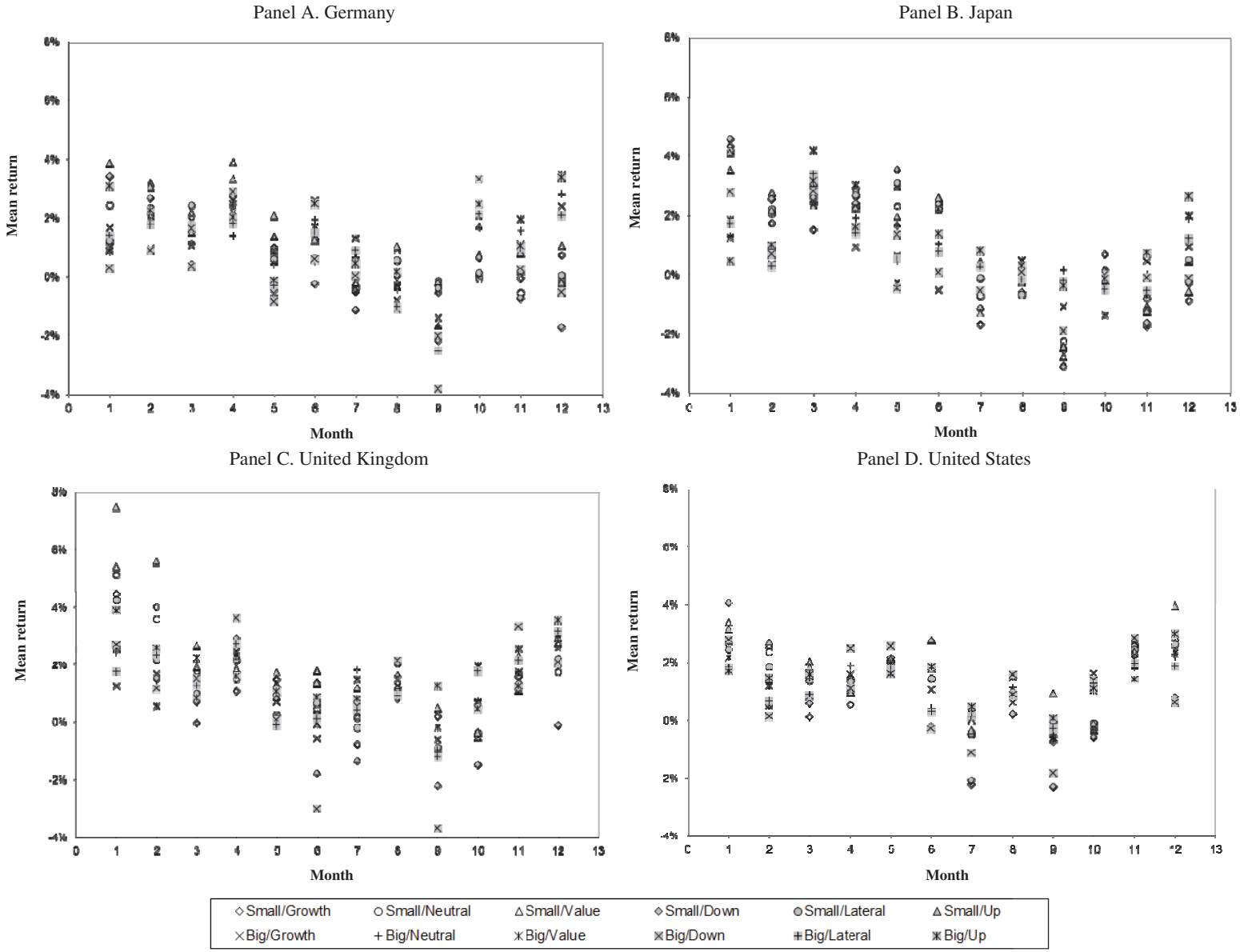

Fig. 1. Size/book-to-market and size/prior-return portfolio returns by month in the major stock markets

Table 2. Seasonality test of style portfolio returns in the major stock markets

	Small/Growth	Small/Neutral	Small/Value	Big/Growth	Big/Neutral	Big/Value	Small/Down	Small/Lateral	Small/Up	Big/Down	Big/Lateral	Big/Up
Panel A. Germany												
Intercept	0.61** (2.07)	0.762*** (2.98)	1.349*** (4.39)	0.984*** (2.69)	1.048*** (3.14)	1.376*** (3.70)	0.238 (0.63)	0.832*** (3.29)	1.572*** (4.91)	0.214 (0.45)	0.865** (2.45)	1.388*** (3.77)
Jan	0.497 (0.51)	1.672** (1.98)	1.761* (1.73)	0.679 (0.56)	-0.207 (-0.19)	-0.508 (-0.41)	3.171** (2.53)	0.364 (0.44)	2.271** (2.15)	0.064 (0.04)	0.519 (0.44)	1.67 (1.37)
Feb	1.421 (1.45)	1.575* (1.86)	1.838* (1.81)	-0.03 (-0.03)	0.845 (0.77)	0.875 (0.71)	2.438* (1.95)	1.052 (1.26)	1.472 (1.39)	0.661 (0.42)	0.898 (0.77)	0.845 (0.69)
Mar	0.499 (0.50)	1.022 (1.19)	0.733 (0.71)	0.191 (0.15)	0.533 (0.47)	0.505 (0.40)	0.105 (0.08)	1.582* (1.86)	-0.032 (-0.03)	0.225 (0.14)	0.862 (0.72)	0.248 (0.20)
Apr	1.189 (1.22)	1.073 (1.27)	2.579** (2.54)	1.374 (1.14)	0.357 (0.32)	1.11 (0.90)	2.492** (1.99)	1.253 (1.50)	1.762* (1.66)	2.698 (1.71)	0.947 (0.81)	0.626 (0.51)
May	0.378 (0.39)	0.094 (0.11)	0.024 (0.02)	-1.708 (-1.41)	-0.622 (-0.56)	-0.568 (-0.46)	-0.71 (-0.57)	-0.247 (-0.30)	0.503 (0.48)	-1.065 (-0.67)	-1.185 (-1.01)	-1.532 (-1.26)
Jun	-0.06 (-0.06)	0.335 (0.39)	0.107 (0.10)	1.482 (1.20)	0.846 (0.75)	0.363 (0.29)	-0.649 (-0.51)	-0.18 (-0.21)	-0.334 (-0.31)	0.499 (0.31)	0.621 (0.52)	0.993 (0.80)
Jul	-1,115 (-1.14)	-1,177 (-1.39)	-1,551 (-1.53)	-0,495 (-0.41)	-0,394 (-0.36)	-0,064 (-0.05)	-1,378 (-1.10)	-0,832 (-0.99)	-0,951 (-0.90)	-0,189 (-0.12)	0,027 (0.02)	-0,947 (-0.78)
Aug	-0.586 (-0.60)	-0.613 (-0.72)	-0.451 (-0.44)	-1.788 (-1.48)	-1.484 (-1.34)	-1.683 (-1.37)	-0.482 (-0.39)	-0.283 (-0.34)	-0.545 (-0.51)	-1.306 (-0.83)	-1.873 (-1.60)	-1.244 (-1.02)
Sep	-1.148 (-1.18)	-0.914 (-1.08)	-2.999*** (-2.95)	-2.388** (-1.98)	-2.754** (-2.49)	-3.384*** (-2.75)	-2.436* (-1.95)	-1.223 (-1.46)	-1.754* (-1.66)	-4.016 (-2.54)	-3.379*** (-2.89)	-3.384*** (-2.78)
Oct	-0.549 (-0.56)	-0.826 (-0.98)	-0.592 (-0.58)	1.152 (0.95)	0.608 (0.55)	0.701 (0.57)	0.409 (0.33)	-0.722 (-0.86)	0.167 (0.16)	3.129 (1.98)	1.277 (1.09)	1.098 (0.90)
Nov	-0.65 (-0.66)	-1.298 (-1.53)	-1.144 (-1.13)	0.113 (0.09)	0.511 (0.46)	0.577 (0.47)	-0.988 (-0.79)	0.036 (0.04)	-0.773 (-0.73)	0.06 (0.04)	0.08 (0.07)	-0.346 (-0.28)
Dec	0.125 (0.13)	-0.943 (-1.11)	-0.305 (-0.30)	1.418 (1.17)	1.76 (1.59)	2.077* (1.69)	-1.972 (-1.58)	-0.799 (-0.96)	-1.787* (-1.69)	-0.759 (-0.48)	1.205 (1.03)	1.974 (1.62)
N	300	300	300	300	300	300	300	300	300	300	300	300
Adj. R^2	-0.012	0.020	0.042	0.005	0.003	0.009	0.033	0.002	0.015	0.009	0.014	0.018
F value	0,67	1,56	2,18**	1,14	1,09	1,23	1,93**	1,04	1,41	1,25	1,37	1,49

Table 2 (cont.). Seasonality test of style portfolio returns in the major stock markets

	Small/Growth	Small/Neutral	Small/Value	Big/Growth	Big/Neutral	Big/Value	Small/Down	Small/Lateral	Small/Up	Big/Down	Big/Lateral	Big/Up
Panel B. Japan												
Intercept	0.564 (1.34)	0.951** (2.58)	1.201*** (3.35)	0.314 (0.92)	0.902*** (2.87)	1.081*** (3.19)	0.926** (2.28)	1.133*** (3.15)	0.833** (2.25)	0.533 (1.30)	0.662* (1.90)	0.91** (2.50)
Jan	3.761*** (2.70)	3.151** (2.58)	2.316* (1.95)	0.924 (0.81)	0.373 (0.36)	0.739 (0.66)	3.634*** (2.69)	3.052** (2.56)	3.279*** (2.67)	2.25* (1.65)	1.036 (0.90)	-0.469 (-0.39)
Feb	1.165 (0.83)	1.114 (0.91)	1.554 (1.31)	0.03 (0.03)	-0.079 (-0.08)	-0.24 (-0.21)	1.615 (1.20)	1.07 (0.90)	1.311 (1.07)	0.144 (0.11)	-0.408 (-0.35)	0.057 (0.05)
Mar	0.919 (0.66)	1.462 (1.20)	1.863 (1.57)	2.025* (1.78)	2.041* (1.95)	3.106*** (2.76)	1.659 (1.23)	1.721 (1.44)	1.506 (1.23)	2.252* (1.66)	2.712** (2.35)	2.235* (1.85)
Apr	1.656 (1.19)	1.323 (1.08)	1.739 (1.46)	0.611 (0.54)	0.995 (0.95)	1.939* (1.72)	1.475 (1.09)	1.542 (1.29)	1.405 (1.15)	0.902 (0.66)	0.707 (0.61)	0.679 (0.56)
May	1.085 (0.78)	1.352 (1.11)	1.789 (1.50)	-0.609 (-0.54)	-0.447 (-0.43)	-0.461 (-0.41)	2.612* (1.94)	1.952 (1.64)	1.121 (0.91)	0.803 (0.59)	-0.141 (-0.12)	-1.378 (-1.14)
Jun	1.626 (1.16)	1.489 (1.22)	1.384 (1.16)	-0.835 (-0.73)	0.135 (0.13)	1.09 (0.97)	1.438 (1.07)	1.059 (0.89)	1.732 (1.41)	-0.464 (-0.34)	0.098 (0.08)	0.443 (0.37)
Jul	-2.266 (-1.62)	-1.701 (-1.39)	-0.759 (-0.64)	-0.901 (-0.79)	-0.628 (-0.60)	-0.763 (-0.68)	-2.085 (-1.55)	-1.262 (-1.06)	-2.137* (-1.74)	-1.086 (-0.80)	-0.42 (-0.36)	-0.124 (-0.10)
Aug	-0.66 (-0.47)	-0.838 (-0.69)	-1.458 (-1.23)	-0.037 (-0.03)	-0.582 (-0.56)	-0.606 (-0.54)	-1.52 (-1.13)	-1.822 (-1.53)	-0.765 (-0.62)	-0.482 (-0.35)	-0.85 (-0.74)	-0.612 (-0.51)
Sep	-3.646*** (-2.61)	-3.201*** (-2.62)	-3.956*** (-3.33)	-1.39 (-1.22)	-0.752 (-0.72)	-1.457 (-1.30)	-4.034*** (-2.99)	-3.608*** (-3.02)	-3.267*** (-2.67)	-2.438* (-1.79)	-0.899 (-0.78)	-1.305 (-1.08)
Oct	0.126 (0.09)	-0.825 (-0.68)	-1.413 (-1.19)	-0.57 (-0.50)	-1.161 (-1.11)	-2.451** (-2.18)	-0.986 (-0.73)	-1.14 (-0.95)	-0.715 (-0.58)	-0.56 (-0.41)	-1.177 (-1.02)	-1.066 (-0.88)
Nov	-2.307* (-1.65)	-2.152* (-1.76)	-2.293* (-1.93)	0.137 (0.12)	-0.895 (-0.86)	-1.802 (-1.60)	-2.584* (-1.92)	-1.924 (-1.61)	-2.066* (-1.69)	-0.65 (-0.48)	-1.214 (-1.05)	-0.184 (-0.15)
Dec	-1.46 (-1.05)	-1.173 (-0.96)	-0.766 (-0.64)	0.615 (0.54)	0.999 (0.96)	0.906 (0.81)	-1.225 (-0.91)	-0.64 (-0.54)	-1.405 (-1.15)	-0.67 (-0.49)	0.557 (0.48)	1.725 (1.43)
N	300	300	300	300	300	300	300	300	300	300	300	300
Adj. R^2	0.039	0.043	0.058	-0.014	-0.009	0.031	0.063	0.055	0.050	-0.003	-0.005	-0.007
F value	2.11**	2.21**	2.69***	0.64	0.76	1.88**	2.83***	2.58***	2.41***	0.92	0.87	0.8

Table 2 (cont.). Seasonality test of style portfolio returns in the major stock markets

	Small/Growth	Small/Neutral	Small/Value	Big/Growth	Big/Neutral	Big/Value	Small/Down	Small/Lateral	Small/Up	Big/Down	Big/Lateral	Big/Up
Panel C. United Kingdom												
Intercept	1.197*** (2.80)	1.422*** (4.18)	1.591*** (4.56)	1.088*** (3.69)	1.241*** (4.00)	1.492*** (4.65)	0.372 (0.96)	1.125*** (3.61)	2.31*** (6.28)	0.807 (1.62)	1.171*** (3.60)	1.605*** (4.50)
Jan	3.254** (2.30)	3.461*** (3.08)	3.107*** (2.69)	0.07 (0.07)	0.693 (0.68)	0.671 (0.63)	3.763*** (2.94)	3.066*** (2.97)	4.75*** (3.91)	1.489 (0.91)	0.113 (0.10)	2.138* (1.81)
Feb	2.823** (2.00)	2.541** (2.26)	3.543*** (3.07)	0.815 (0.84)	0.315 (0.31)	-0.847 (-0.80)	1.092 (0.85)	1.215 (1.18)	3.219*** (2.65)	0.573 (0.35)	1.561 (1.45)	1.398 (1.19)
Mar	-1.243 (-0.88)	-0.625 (-0.56)	-0.674 (-0.58)	0.11 (0.11)	0.672 (0.65)	0.458 (0.43)	0.054 (0.04)	-0.608 (-0.59)	0.245 (0.20)	0.306 (0.19)	-0.392 (-0.36)	-0.976 (-0.83)
Apr	-0.126 (-0.09)	0.389 (0.35)	0.789 (0.68)	1.425 (1.46)	1.078 (1.05)	0.741 (0.70)	2.656** (2.07)	0.994 (0.96)	0.155 (0.13)	2.885* (1.75)	1.631 (1.52)	-0.079 (-0.07)
May	0.282 (0.20)	-0.423 (-0.38)	-0.123 (-0.11)	0.001 (0.00)	-0.507 (-0.49)	-0.069 (-0.06)	0.589 (0.46)	0.571 (0.55)	-0.259 (-0.21)	-0.616 (-0.37)	-0.876 (-0.81)	-0.003 (0.00)
Jun	0.158 (0.11)	-0.602 (-0.54)	0.647 (0.56)	-1.365 (-1.40)	-0.981 (-0.96)	-1.395 (-1.32)	-1.804 (-1.41)	-0.388 (-0.38)	-1.06 (-0.87)	-4.149** (-2.52)	-0.843 (-0.78)	-0.735 (-0.62)
Jul	-1.981 (-1.37)	-1.184 (-1.03)	-1.477 (-1.26)	-0.56 (-0.56)	0.988 (0.94)	0.385 (0.36)	-1.864 (-1.43)	-1.479 (-1.41)	-1.211 (-0.98)	0.027 (0.02)	-0.856 (-0.78)	-0.417 (-0.35)
Aug	-0.851 (-0.59)	-0.08 (-0.07)	-0.879 (-0.75)	-0.072 (-0.07)	-0.873 (-0.83)	-0.839 (-0.78)	0.154 (0.12)	-0.312 (-0.30)	-0.835 (-0.67)	-0.568 (-0.34)	-0.633 (-0.58)	-0.292 (-0.24)
Sep	-0.997 (-0.71)	-2.633** (-2.34)	-2.729** (-2.37)	-1.725* (-1.77)	-2.493** (-2.43)	-1.774* (-1.67)	-2.643** (-2.06)	-2.243** (-2.18)	-2.03* (-1.67)	-4.827*** (-2.94)	-2.528** (-2.35)	-0.506 (-0.43)
Oct	-2.673* (-1.89)	-1.46 (-1.30)	-2.044* (-1.77)	-0.419 (-0.43)	-0.536 (-0.52)	0.456 (0.43)	-1.885 (-1.47)	-1.617 (-1.57)	-2.638** (-2.17)	1.102 (0.67)	0.664 (0.62)	-1.167 (-0.99)
Nov	0.37 (0.26)	0.157 (0.14)	-0.745 (-0.65)	0.297 (0.30)	0.159 (0.16)	0.778 (0.73)	0.719 (0.56)	0.004 (0.00)	-0.696 (-0.57)	2.425 (1.48)	0.454 (0.42)	-1.001 (-0.85)
Dec	0.983 (0.70)	0.459 (0.41)	0.584 (0.51)	1.423 (1.46)	1.487 (1.45)	1.434 (1.35)	-0.832 (-0.65)	0.798 (0.77)	0.36 (0.30)	1.354 (0.82)	1.704 (1.58)	1.64 (1.39)
N	300	300	300	300	300	300	300	300	300	300	300	300
Adj. R^2	0.016	0.038	0.055	-0.005	0.004	-0.008	0.042	0.032	0.065	0.034	0.011	-0.008
F value	1.41	1.99**	2.45***	0.89	1.1	0.8	2.09**	1.82*	2.71***	1.88**	1.28	0.81

Table 2 (cont.). Seasonality test of style portfolio returns in the major stock markets

	Small/Growth	Small/Neutral	Small/Value	Big/Growth	Big/Neutral	Big/Value	Small/Down	Small/Lateral	Small/Up	Big/Down	Big/Lateral	Big/Up
Panel D. United States												
Intercept	0.824** (2.10)	1.443*** (5.24)	1.583*** (6.00)	1.104*** (4.03)	1.219*** (5.03)	1.267*** (5.35)	0.551 (1.45)	1.308*** (5.08)	1.768*** (5.17)	0.995*** (3.15)	1.019*** (4.29)	1.349*** (5.00)
Jan	1.884 (1.45)	1.177 (1.29)	1.814** (2.07)	0.598 (0.66)	0.446 (0.55)	0.897 (1.14)	3.505*** (2.78)	1.142 (1.34)	1.381 (1.22)	1.796* (1.71)	0.799 (1.01)	0.338 (0.38)
Feb	0.499 (0.38)	0.939 (1.03)	1.022 (1.17)	-0.596 (-0.66)	0.152 (0.19)	-0.09 (-0.11)	-0.032 (-0.03)	0.548 (0.64)	0.937 (0.83)	-0.858 (-0.82)	-0.37 (-0.47)	0.107 (0.12)
Mar	-0.714 (-0.55)	0.124 (0.14)	0.446 (0.51)	-0.248 (-0.27)	0.204 (0.25)	0.22 (0.28)	0.03 (0.02)	0.047 (0.05)	0.067 (0.06)	-0.174 (-0.17)	-0.124 (-0.16)	0.229 (0.26)
Apr	-0.278 (-0.21)	-0.029 (-0.03)	-0.28 (-0.32)	-0.069 (-0.08)	0.656 (0.82)	0.329 (0.42)	0.46 (0.36)	0.032 (0.04)	-0.805 (-0.71)	1.482 (1.41)	0.104 (0.13)	-0.249 (-0.28)
May	0.9 (0.69)	0.386 (0.42)	0.581 (0.66)	0.625 (0.69)	0.542 (0.67)	0.716 (0.91)	1.611 (1.28)	0.604 (0.71)	0.337 (0.30)	1.553 (1.48)	0.76 (0.97)	0.249 (0.28)
Jun	0.589 (0.45)	0.403 (0.44)	0.177 (0.20)	-0.046 (-0.05)	-0.802 (-1.00)	-0.94 (-1.20)	-0.785 (-0.62)	0.134 (0.16)	1.007 (0.89)	-1.306 (-1.24)	-0.74 (-0.94)	0.503 (0.56)
Jul	-3.055** (-2.35)	-1.942** (-2.12)	-1.599* (-1.83)	-0.985 (-1.08)	-0.885 (-1.10)	-1.069 (-1.36)	-2.657** (-2.11)	-1.762** (-2.06)	-2.133* (-1.88)	-2.114** (-2.01)	-0.908 (-1.15)	-0.889 (-0.99)
Aug	-0.614 (-0.47)	-0.561 (-0.61)	-0.54 (-0.62)	-0.497 (-0.55)	-0.084 (-0.10)	0.217 (0.28)	-0.344 (-0.27)	-0.404 (-0.47)	-0.845 (-0.74)	0.585 (0.56)	-0.19 (-0.24)	-0.458 (-0.51)
Sep	-1.575 (-1.21)	-1.444 (-1.58)	-1.84** (-2.10)	-1.765* (-1.94)	-1.75** (-2.18)	-1.952** (-2.48)	-2.887** (-2.29)	-1.372 (-1.61)	-0.856 (-0.75)	-2.832*** (-2.70)	-1.347* (-1.71)	-1.269 (-1.42)
Oct	-1.157 (-0.89)	-1.563* (-1.71)	-1.938** (-2.21)	0.514 (0.57)	-0.023 (-0.03)	-0,247 (-0.31)	-1.165 (-0.93)	-1.42* (-1.66)	-1.892* (-1.67)	0.407 (0.39)	0.241 (0.31)	-0.25 (-0.28)
Nov	1.738 (1.34)	1.169 (1.28)	1.045 (1.19)	1.167 (1.28)	0.585 (0.73)	0.85 (1.08)	2.008 (1.59)	1.142 (1.34)	0.611 (0.54)	1.844* (1.76)	0.928 (1.18)	0.064 (0.07)
Dec	1.783 (1.37)	1.341 (1.47)	1.11 (1.27)	1.303 (1.43)	0.959 (1.19)	1.07 (1.36)	0.257 (0.20)	1.31 (1.53)	2.191* (1.93)	-0.383 (-0.36)	0.847 (1.08)	1.626* (1.82)
N	300	300	300	300	300	300	300	300	300	300	300	300
Adj. R^2	0.009	0.016	0.031	-0.004	-0.005	0.009	0,.033	0.014	0.009	0.037	-0.006	-0.014
F value	1.25	1.43	1.88**	0.89	0.87	1.25	1.93**	1.39	1.25	2.03**	0.84	0.61

Notes: Significant at $p < 0.01$ (***), $p < 0.05$ (**), $p < 0.1$ (*).