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Industry momentum effect and autocorrelation: evidence from Taiwan

Abstract

The investigation of the momentum effect is important because this phenomenon indicates the predictability of the future return, which means that the momentum strategy can make profits. Past literature has found the industry momentum effect in American, European countries and indicated that the industry momentum effect mainly comes from the return autocorrelations. Little literature documents the industry momentum effect in emerging markets. Thus, the first purpose of this paper is to investigate whether the industry momentum effect also exists in the Taiwan stock market which is an emerging one toward maturity. The second purpose of this study is to compare the industry momentum effect between the all-industry group and the positive-autocorrelation industry group. This study contributes on that the positive-autocorrelation industry momentum strategy has higher returns and more of the formation and holding cells are significantly positive compared with the all-industry momentum strategy in Taiwan. Although past studies have verified that autocorrelation is one of the important sources of industry momentum profits, they did not explore the industry momentum effect of the positive-autocorrelation industries. Therefore, we supplement past studies by focusing on the positive-autocorrelation industries. We find that the industry momentum effect does not disappear; rather, it hides in the positive-autocorrelation industries. Moreover, the positive autocorrelation is related to the transfer of funds. The turnover rate which is the proxy of the transfer of funds can explain the positive autocorrelation of the industry returns.

Keywords: industry momentum, style investing, autocorrelation, turnover rate.
JEL Classification: G10, G11.

Introduction

The momentum effect is the phenomenon that winners perform better than losers in the future. The investigation of the momentum effect is important in that this phenomenon indicates the predictability of the future return, which means that the momentum strategy can make profits. Moreover, the momentum strategy can reduce the systematic and total risk of the investment portfolio because the momentum strategy holds the long and short positions simultaneously. Past literature has found the stock momentum effect in American, European and Asian countries. Jegadeesh and Titman (1993) investigating the momentum effect of American stock returns find that the momentum strategy can make profits especially in the mid term (three to twelve months). They conjecture that the momentum effect may be due to the under-reaction of investors to the firm-specific information. Later literature (e.g., Chan, Jegadeesh and Lakonishok, 1996; Conrad and Kaul, 1998; Rouwenhorst, 1998 and Schiereck, De Bondt and Weber, 1999) also indicates that the momentum effect occurs in American and European stocks in the mid term. Regarding the momentum effect of the emerging stock markets, Rouwenhorst (1999) finds that only six countries out of twenty have the mid-term price momentum effect in the emerging markets. Chui, Titman and Wei (2000) investigate the momentum effect of eight Asian stock markets. And the result demonstrates that only Hong Kong shows the significant momentum effect both before and after the Southeast Asia financial crisis. As for industry momentum effect, only American and European markets are found to have such phenomenon. Bacmann, Dubois, and Isakov (2001) investigating the momentum effect of G7 countries find that all the G7 countries except Japan show the industry momentum effect. Moreover, the result of Swinkels (2002) indicates that there exists the industry momentum effect in America and Europe, except Japan. Most of the above literature focusing on the industry momentum investigates American and European markets. As for Asian countries, only Japan is included. However, the literature result shows that there is no industry momentum in Japan. Although Japan is one of the Asian countries, it is a developed country market not an emerging market. Little literature documents the industry momentum effect in emerging markets. Thus, the first purpose of this paper is to employ the industry stocks' data of Taiwan[1] to investigate whether the industry momentum effect also exists in the emerging market.

Although the literature documents that some countries do not exhibit industry momentum effect, we wonder whether the momentum effect exists in

[1] Regarding developed countries, Moskowitz and Grinblatt (1999) employ 20 industries of American stock market to investigate the industry momentum effect in America, and Cleary, Doucette and Schmitz (2005) employ 10 industries of Canadian stock market to investigate the industry momentum effect in Canada. Regarding emerging countries, Taiwan is an emerging market toward maturity. Taiwan Stock Exchange Corporation had added to its database the 19 industry stocks since January, 1995, and thus making the sample period long enough for this study to investigate the industry momentum effect.

some industries rather than in all of them. Because the success of momentum strategy is based on the fact that when the winner and loser returns persist, investors will make profits by buying winners and selling losers if this momentum effect exists. Thus, whether the past stock return and future stock return are positively correlated leads to the success of the momentum strategy. Moskowitz and Grinblatt (1999) demonstrate that the industry stock return autocorrelation plays a more important role in momentum strategy profits than cross-serial covariance. Pan, Liano and Huang (2004) supporting the claim of Moskowitz and Grinblatt (1999) show that the significant industry momentum effect only exists in the case of significant positive return autocorrelation. Their conclusion is also consistent with Barberis, Shleifer and Vishny (1998), Daniel, Hirshleifer and Subrahmanyam (1998), and Hong and Stein(1999). That is, the main factor affecting the industry momentum is the industry return autocorrelation. The above literature has indicated that the industry momentum effect mainly comes from the autocorrelation of the returns. Thus, the second purpose of this study is to investigate whether stronger industry momentum effect exists in the higher-autocorrelation industries rather than in other industries. The case of this study is intriguing in that although past studies have verified that autocorrelation is one of the important sources of industry momentum profits, they did not explore the industry momentum effect of the positive-autocorrelation industries. Therefore, we supplement past studies by focusing on the positive-autocorrelation industries.

This study contributes on that the positive-autocorrelation industry momentum strategy has significantly positive returns and has higher returns compared with the all-industry momentum strategy in Taiwan. Although there exists little industry momentum effect in Taiwan when employing all the industries' data, we find that the significant industry momentum effect appears in the positive autocorrelation group, while the significant industry reversal effect emerges in the negative autocorrelation group. Moreover, the positive autocorrelation is related to the transfer of funds. That is, the turnover rate which is the proxy of the transfer of funds can explain the positive autocorrelation of the industry returns.

The rest of this paper is organized as follows. Section 1 is the data description and autocorrelation analysis. Section 2 presents the industry momentum effect in Taiwan and the influence of turnover rate on industry return autocorrelation. Finally, the last section presents conclusions.

1. Data and autocorrelation analysis

1.1. The data. Monthly data of industry stock returns in Taiwan were obtained from the Taiwan Economic Journal (TEJ). Taiwan Stock Exchange Corporation had added to its database the nineteen industry stocks since January 1995, and thus the sample period ran from January 1995 through December 2007. Table 1 is the summary statistics of the data. Whichever the industry stock is, the average monthly return is positive during the sample period. The top three industries with the highest average returns are electronics, plastics and rubber industries and with the highest standard deviations are construction, electronics and paper industries. The electronics, rubber and construction industries are the top three industries with the highest average turnover rates. Among them, the average monthly turnover rate of electronics industry is up to 30% over the sample periods. The systematic risk (β) in Table 1 is calculated from the CAPM model. The values of β of 19 industries in Taiwan are between 0.6 and 1.5 and all of them are significantly different from zero. Unreported statistics shows that the standard deviation and the systematic risk of the industry momentum strategy are much lower than those of 19 industries in Table 1. We take three momentum strategies involving nineteen industries for example. The standard deviation of momentum strategy of (6, 6), (12, 12) and (24, 24)[1] cases are 0.037, 0.024 and 0.016, respectively, and the systematic risk of these three momentum strategies are 0.26, 0.07 and -0.10, respectively. That means the industry momentum effect is worth of exploration because the risk of the industry momentum strategy is much lower than that of buying and holding the industry ETFs (Exchange Traded Funds).

Table 1. Summary statistics

	Average monthly return	Standard deviation	Systematic risk (β)	Average turnover rate	Autocorrelation (1995/1-2007/12)	Autocorrelation (1995/1-2000/12)	Autocorrelation (2001/1-2007/12)
Construction	0,40%	0,12	1,51	21%	0,15	0,18	0,11
Electronics	1,47%	0,11	0,99	30%	0,13	0,15	0,20
Electric & Machinery	0,28%	0,07	0,85	16%	0,09	0,02	0,16

[1] The number (n,m) means that the formation and holding periods of the momentum strategy are n and m months, respectively.

Table 1 (cont.). Summary statistics

	Average monthly return	Standard deviation	Systematic risk (β)	Average turnover rate	Autocorrelation (1995/1-2007/12)	Autocorrelation (1995/1-2000/12)	Autocorrelation (2001/1-2007/12)
Others	0,52%	0,08	0,83	14%	0,08	0,12	0,01
Electrical & Cable	0,16%	0,10	1,28	17%	0,08	0,08	0,08
Steel & Iron	0,61%	0,08	0,74	17%	0,08	0,04	0,06
Foods	0,56%	0,09	0,94	12%	0,07	0,11	0,01
Paper & Pulp	0,04%	0,11	1,15	17%	0,01	0,04	-0,03
Chemical	0,46%	0,08	0,96	20%	0,01	0,03	-0,06
Textiles	0,45%	0,09	1,08	15%	0,01	0,08	-0,08
Tourism	0,47%	0,09	0,71	17%	-0,00	0,00	-0,02
Automobile	0,52%	0,09	0,61	11%	-0,01	-0,01	-0,02
Rubber	0,84%	0,10	0,95	22%	-0,02	-0,01	-0,07
Cement	0,72%	0,10	0,98	10%	-0,03	-0,02	-0,07
Trading & Consumers' goods	0,49%	0,07	0,76	13%	-0,08	-0,09	-0,07
Shipping & Transportation	0,55%	0,09	0,82	14%	-0,08	-0,11	-0,09
Glass & Ceramics	0,12%	0,08	0,79	14%	-0,09	-0,21	-0,04
Plastics	1,07%	0,09	0,86	17%	-0,10	-0,08	-0,12
Finance & Insurance	0,08%	0,09	1,08	10%	-0,20	-0,18	-0,27

Notes: This table is the summary statistics of 19 industries in Taiwan. The study period is January 1995 to December 2007.

1.2. Grouping the industries based on the return autocorrelation. Table 1 lists the monthly return autocorrelation[1] of 19 industry stock indexes in Taiwan. We divide industries into three groups based on the industry return autocorrelation in the sample period. To confirm the stability of return autocorrelation of the 19 industries, we divide the sample period into two subperiods (1995/1-2000/12 and 2001/1-2007/12), 6 to 7 years for each. During the two subperiods, all of the industries in the group with higher positive autocorrelations (including construction, electronics, electric & machinery, others, electrical & cable, steel & iron and foods) maintain positive autocorrelation in the two subperiods. In the meanwhile, all of the industries in the group with stronger negative autocorrelations (including automobile, rubber, cement, trading & consumers' goods, shipping & transportation, glass & ceramics, plastics and finance & insurance) maintain negative autocorrelation during the two subperiods. In general, the industries in positive and negative autocorrelation groups maintain stable return autocorrelation during the sample periods. However, the autocorrelation of industries in the third group (including paper & pulp, chemical, textiles and tourism) is not stable. These four industries have the change of autocorrelation from a positive value during the first subperiod into negative during the second subperiod.

1.3. Methodology. Following the momentum strategy of Lo and Mackinlay (1990), we divide nineteen industries into two groups based on their returns during the formation period. The industries are labeled as winner (loser) group when their returns are greater (less) than the average return of all the industries in the formation period. The investment weight of every industry depends on the difference between the return of every industry and that of the average return of all the industries. The greater the difference is, the greater the investment weight is. The zero-cost portfolio is built by buying winner and selling loser group and its return[2] is calculated during the holding period. We then eliminate one period and add another new period and duplicate the process. The performance of the momentum strategy comes from the average return of the zero-cost portfolio in every holding period. We adopt 1, 3, 6, 12, 24 and 36 months as our formation and holding periods.

[1] The value of autocorrelation in Table 1 is the first-order autocorrelation.

[2] The profit of the momentum strategy is the return of winners minus that of losers in the holding period.

Besides the momentum strategy proposed by Lo and Mackinlay (1990) (LM thereafter), Jegadeesh and Titman (1993) (JT thereafter) brought forth another method. The LM and JT methods are similar but different in the definition of winners and losers. Jegadeesh and Titman (1993) divide the stocks into deciles based on their returns during the formation period. They equally weigh the returns of the industries in the winner (loser) group. According to the definition of Jegadeesh and Titman (1993), only part of the stocks is included in the winner and loser deciles. In addition to the same investment weight of stocks, the numbers of stocks in the winner and loser deciles are pretty close. However, according to the definition of Lo and Mackinlay (1990), all the industries are included in the winner and loser groups. Neither the investment weight of industries nor the numbers of industries in the winner and loser groups are equal. The advantage of the LM method is that all the industries are included in the winner or loser portfolio. Thus, if the industries are not sufficient, LM is a valid tool for testing whether the momentum effect exists. This study employs the LM method to test the momentum effect and adopts the JT method[1] in the robustness test.

2. Empirical results

2.1. The industry momentum effect in Taiwan. This study first employs the momentum strategy (Lo and Mackinlay, 1990) to investigate the existence of industry momentum effect in Taiwan. Table 2 lists the industry momentum test result by employing all the industries' data. The statistics in Table 2 are the average monthly returns of the zero-cost portfolio. The data in the left part of Table 2 show positive value but only one cell reveals the significant momentum effect, while five cells demonstrate the significant reversal effect in the lower right part. This result shows that the industry momentum effect in Taiwan is not noticeable.

Table 2. The industry momentum effect in Taiwan

Formation period	Holding period					
	1	3	6	12	24	36
1	-0,00% (-0,22)	0,00% (0,54)	0,00% (0,54)	0,00% (0,69)	-0,00% (-0,45)	-0,00% (-0,01)
3	0,01% (0,56)	0,01% (0,75)	0,01% (1,12)	0,00% (0,59)	-0,00% (-0,40)	-0,00% (-0,03)
6	0,02% (0,65)	0,02% (1,26)	0,02% (2,30*)	0,00% (0,01)	-0,00% (-0,34)	-0,00% (-0,06)
12	0,05% (1,08)	0,03% (0,97)	0,01% (0,57)	-0,02% (-2,47#)	-0,01% (-0,79)	-0,01% (-1,32)
24	-0,01% (-0,19)	-0,01% (-0,35)	-0,01% (-0,37)	-0,01% (-1,02)	-0,01% (-0,89)	-0,02% (-2,09#)
36	0,02% (0,34)	0,01% (0,23)	-0,00% (-0,03)	-0,05% (-2,35#)	-0,04% (-3,37#)	-0,04% (-3,79#)

Notes: This table presents industry momentum returns in Taiwan from January 1995 to December 2007. All industries are ranked based on their lagged returns during formation period. The zero-cost portfolios are established by buying winner and selling loser and held in holding period. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level, # significantly negative at 0.05 level.

Past literature has indicated that the industry momentum effect mainly comes from the autocorrelation of the returns. Moreover, Table 1 has shown that the autocorrelations of industries in the positive and negative autocorrelation groups are stable. Thus, although the result of Table 2 reveals little industry momentum effect in Taiwan stock market, this study further tests whether the industry momentum effect exists in the positive-autocorrelation industries. Tables 3 and 4 show the industry momentum results of the positive-autocorrelation and negative-autocorrelation groups.

Table 3. The industry momentum effect of positive-autocorrelation industry portfolio

Formation period	Holding period					
	1	3	6	12	24	36
1	0,01% (0,63)	0,00% (0,35)	0,00% (0,68)	0,00% (0,56)	0,00% (0,87)	0,00% (1,46)
3	0,01% (0,47)	0,01% (0,65)	0,01% (1,36)	0,00% (0,17)	0,01% (1,83*)	0,01% (1,94*)
6	0,05% (0,84)	0,04% (1,16)	0,03% (1,83*)	-0,00% (-0,42)	0,03% (2,83*)	0,02% (2,34*)
12	0,07% (0,76)	0,02% (0,32)	-0,00% (-0,07)	-0,02% (-1,19)	0,06% (3,96*)	0,04% (2,43*)

[1] Regarding the JT method applied in the all-industry group, we divide 19 industries into deciles. The winner (loser) decile includes 2 industries. Regarding the positive (negative)-autocorrelation industry group, we divide the group into three subgroups because this group only includes 7 (8) industries. Both of winner and loser subgroups include two industries.

Table 3 (cont.). The industry momentum effect of positive-autocorrelation industry portfolio

Formation period	Holding period					
	1	3	6	12	24	36
24	0,08% (0,73)	0,08% (1,30)	0,10% (2,75*)	0,12% (4,06*)	0,13% (5,65*)	0,08% (4,06*)
36	0,21% (1,38)	0,18% (2,09*)	0,18% (2,77*)	0,11% (2,37*)	0,09% (3,10*)	0,02% (0,61)

Notes: This table is the test of industry momentum effect of positive-autocorrelation industry portfolio in Taiwan. Please refer to Table 2 for a complete description of the momentum strategy. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level.

Table 3 shows the test result of the momentum effect on 7 industries of strongest positive autocorrelation (including construction, electronics, electric & machinery, others, electrical & cable, steel & iron and foods). Most of the statistics in Table 3 are positive. 15 out of 36 cells reveal the significant industry momentum effect. Table 4 illustrates the test result of momentum effect on 8 industries of strongest negative autocorrelation (including automobile, rubber, cement, trading & consumers' goods, shipping & transportation, glass & ceramics, plastics and finance & insurance). Most of the statistics in Table 4 are negative. 17 out of 36 cells reveal the significant industry reversal effect. Although the result of Table 2 shows that only one cell demonstrates the significant industry momentum effect and five cells demonstrate the significant reversal effect, the results of Tables 3 and 4 suggest that the positive-autocorrelation group is prone to show the industry momentum effect, while the negative-autocorrelation group is prone to show the industry reversal effect. The results among Tables 2, 3 and 4 are very different, which shows that autocorrelation is an important factor affecting the industry momentum in Taiwan. The industry momentum effect in Taiwan does not disappear. This marked industry momentum effect exists in the industry group of positive autocorrelation[1].

Table 4. The industry momentum effect of negative-autocorrelation industry portfolio

Formation period	Holding period					
	1	3	6	12	24	36
1	-0,01% (-1,32)	0,00% (0,42)	0,00% (0,34)	0,00% (0,77)	-0,00% (-1,58)	-0,00% (-1,73#)
3	0,01% (0,35)	0,01% (0,76)	0,01% (1,41)	0,01% (1,45)	-0,01% (-2,53#)	-0,01% (-2,57#)
6	0,00% (0,14)	0,03% (1,50)	0,03% (2,94*)	0,01% (1,16)	-0,02% (-3,69#)	-0,02% (-3,20#)
12	0,05% (1,12)	0,05% (1,96*)	0,03% (1,72*)	-0,02% (-1,83#)	-0,05% (-7,13#)	-0,05% (-7,05#)
24	-0,06% (-0,95)	-0,06% (-1,59)	-0,07% (-2,48#)	-0,10% (-6,11#)	-0,11% (-9,81#)	-0,09% (-9,85#)
36	-0,07% (-1,16)	-0,06% (-1,69#)	-0,06% (-2,68#)	-0,11% (-7,03#)	-0,11% (-10,37#)	-0,07% (-8,80#)

Notes: This table is the test of industry momentum effect of negative-autocorrelation industry portfolio in Taiwan. Please refer to Table 2 for a complete description of the momentum strategy in the table. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level, # significantly negative at 0.05 level.

2.2. Robustness test. The above analysis demonstrates that significant industry momentum effect exists in nearly half of the 36 formation and holding cells in the positive-autocorrelation industry portfolio, while almost half of the cells show the significant industry reversal effect in the negative-autocorrelation industry portfolio. The significant industry momentum (reversal) effect of the positive (negative)-autocorrelation group is different from the little industry momentum effect of the all-industry group, which implies that the momentum effect is related to the autocorrelation of the industries. For robustness, we further adopt JT method (Jegadeesh and Titman, 1993) to re-investigate the industry momentum effect in Taiwan. Tables 5, 6 and 7 are the robustness test results of the industry momentum effect when adopting JT method in the all-industry, positive-autocorrelation industry and negative-autocorrelation industry groups. The results in Tables 5, 6 and 7 are similar to those in Tables 2, 3 and 4, respectively. Only two cells reveal the significant industry momentum effect in the all-industry group, while twelve (thirteen) cells reveal the significant industry momentum (reversal) effect in the positive (negative)-autocorrelation industry group.

[1] Complying with the suggestion of the anonymous referee, we have calculated the industry momentum effect of the three groups by employing the weekly data. The conclusion of weekly data is similar to that of monthly data. The result of weekly data shows that more cells of the positive-autocorrelation group show the industry momentum effect than the all-industry and the negative-autocorrelation groups. We also have investigated the industry momentum effect of the three groups to have the transaction cost deducted. The commission fee rate in Taiwan's stock market is 1.425/1000 and the transaction tax of ETF in Taiwan is 1/1000. To save space, we do not report the tables. The results of unreported tables are consistent with those of Tables 2, 3 and 4 after considering the transaction cost. The results of tables are available upon request.

Table 5. Robustness test of industry momentum effect in Taiwan – JT method

Formation period	Holding period					
	1	3	6	12	24	36
1	0,23% (0,38)	0,48% (1,37)	0,37% (1,47)	0,05% (0,29)	-0,11% (-0,89)	-0,02% (-0,20)
3	0,44% (0,69)	0,53% (1,43)	0,56% (2,18*)	0,08% (0,39)	-0,17% (-1,20)	-0,12% (-0,95)
6	0,34% (0,49)	0,64% (1,49)	0,70% (2,25*)	-0,00% (-0,02)	-0,10% (-0,70)	-0,10% (-0,79)
12	0,49% (0,75)	0,44% (1,14)	0,07% (0,27)	-0,40% (-1,90#)	-0,07% (-0,50)	-0,21% (-1,52)
24	0,78% (1,16)	0,58% (1,47)	0,31% (1,14)	-0,14% (-0,69)	-0,14% (-0,95)	-0,26% (-1,98#)
36	0,31% (0,43)	0,10% (0,24)	-0,08% (-0,30)	-0,51% (-2,57#)	-0,58% (-4,60#)	-0,48% (-4,58#)

Notes: This table presents average monthly returns for the momentum strategies (Jegadeesh and Titman, 1993) involving 19 industries in Taiwan. The zero-cost portfolios are established by buying winner and selling loser decile and held in holding period. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level, # significantly negative at 0.05 level.

Table 6. Robustness test of industry momentum effect of the positive-autocorrelation industry portfolio – JT method

Formation period	Holding period					
	1	3	6	12	24	36
1	0,49% (0,89)	0,27% (0,85)	0,28% (1,25)	0,07% (0,44)	-0,02% (-0,16)	0,13% (1,03)
3	0,28% (0,48)	0,41% (1,37)	0,45% (1,95*)	-0,01% (-0,06)	0,19% (1,53)	0,18% (1,43)
6	0,93% (1,57)	0,63% (1,94*)	0,46% (1,84*)	-0,11% (-0,58)	0,23% (1,84*)	0,18% (1,37)
12	0,54% (0,90)	0,18% (0,52)	0,07% (0,29)	-0,21% (-1,15)	0,28% (2,41*)	0,11% (0,96)
24	0,50% (0,77)	0,61% (1,61)	0,74% (3,01*)	0,60% (3,65*)	0,61% (5,71*)	0,31% (3,02*)
36	0,81% (1,24)	0,49% (1,39)	0,45% (2,07*)	0,38% (2,34*)	0,22% (2,46*)	0,05% (0,51)

Notes: This table presents average monthly returns for the momentum strategies (Jegadeesh and Titman, 1993) involving seven industry indexes that have positive return autocorrelation in Taiwan. All industries are ranked based on their lagged returns during formation period and divided into three equally-weighted portfolios. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level.

Since the results of Tables 3 and 6 show a remarkable industry momentum effect of positive-autocorrelation industries, we further investigate whether this phenomenon also holds when observing the risk-adjusted returns. We control for the three-factor risk (Fama and French, 1996) to investigate whether the significant industry momentum effect also holds after controlling for the market risk factor, size factor and book-to-market factor.

Table 8 is the robustness test of the industry momentum effect when adopting all the industries' data. The result in Table 8 is similar to that in Table 2. The result indicates that when we control for the three-factor risk to test the industry momentum effect of the 19 industries in Taiwan, only when the formation and holding periods are 6 months will there be significant positive returns. The result of Table 9 shows that most of the risk-adjusted returns are positive and significant. 19 out of 36 cells reveal the significant industry momentum effect. That is, significant industry momentum effect exists when employing the positive-autocorrelation industries' data after controlling for the three-factor risk in Taiwan. Table 10 is the test of the industry momentum effect when adopting the risk-adjusted returns in the negative-autocorrelation industries. 10 out of 36 cells reveal the significant industry reversal effect. In general, the results in Tables 9 and 10 are similar to those in Tables 3 and 4, respectively.

Table 7. Robustness test of industry momentum effect of the negative-autocorrelation industry portfolio – JT method

Formation period	Holding period					
	1	3	6	12	24	36
1	-0,19% (-0,43)	0,06% (0,22)	0,21% (1,03)	0,24% (1,57)	-0,05% (-0,47)	-0,06% (-0,82)
3	-0,02% (-0,03)	0,09% (0,29)	0,25% (1,18)	0,16% (0,97)	-0,22% (-1,88#)	-0,19% (-2,22#)
6	0,33% (0,61)	0,54% (1,82*)	0,74% (3,38*)	0,19% (1,22)	-0,33% (-3,19#)	-0,26% (-2,98#)

Table 7 (cont.). Robustness test of industry momentum effect of the negative-autocorrelation industry portfolio – JT method

Formation period	Holding period					
	1	3	6	12	24	36
12	0,50% (0,97)	0,49% (1,68*)	0,34% (1,55)	-0,18% (-1,14)	-0,54% (-5,63#)	-0,43% (-5,42#)
24	0,48% (0,95)	0,29% (0,89)	-0,05% (-0,22)	-0,53% (-3,49#)	-0,77% (-6,94#)	-0,65% (-7,84#)
36	-0,46% (-0,86)	-0,42% (-1,26)	-0,52% (-2,22#)	-0,94% (-5,43#)	-0,98% (-9,14#)	-0,67% (-9,16#)

Notes: This table presents average monthly returns for the momentum strategies involving eight industry indexes that have negative autocorrelation in Taiwan. Please refer to Table 6 for a complete description of momentum strategy. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level, # significantly negative at 0.05 level.

Table 8. Robustness test – the industry momentum profit of risk-adjusted returns in Taiwan

Formation period	Holding period					
	1	3	6	12	24	36
1	0,00% (0,12)	0,01% (1,11)	0,01% (1,64)	0,00% (0,96)	0,00% (0,73)	0,00% (1,56)
3	0,02% (0,87)	0,02% (1,60)	0,01% (1,96)	0,01% (0,98)	0,00% (1,02)	0,01% (1,99)
6	0,03% (1,03)	0,03% (1,86)	0,03% (2,62*)	0,00% (0,13)	0,01% (1,50)	0,01% (1,83)
12	0,06% (1,36)	0,04% (1,34)	0,01% (0,69)	-0,02% (-2,05#)	0,01% (1,41)	0,00% (0,50)
24	0,01% (0,21)	0,01% (0,32)	0,01% (0,63)	0,01% (0,50)	0,01% (1,22)	-0,00% (-0,21)
36	0,06% (0,91)	0,04% (1,03)	0,02% (0,59)	-0,04% (-1,57)	-0,03% (-2,33#)	-0,01% (-0,91)

Notes: The statistics in this table are the monthly returns for momentum strategies after controlling for the three-factor risk (Fama and French, 1996). The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level, # significantly negative at 0.05 level.

Table 9. Robustness test – the industry momentum profit of risk-adjusted returns of positive-autocorrelation industry portfolio

Formation period	Holding period					
	1	3	6	12	24	36
1	0,01% (0,78)	0,01% (0,70)	0,01% (1,37)	0,01% (1,09)	0,01% (1,80)	0,01% (2,88*)
3	0,02% (0,62)	0,02% (1,15)	0,02% (2,24*)	0,01% (1,27)	0,02% (2,88*)	0,03% (3,82*)
6	0,05% (1,05)	0,05% (1,57)	0,04% (2,45*)	0,01% (0,42)	0,04% (4,45*)	0,05% (4,24*)
12	0,08% (0,99)	0,03% (0,62)	0,01% (0,55)	-0,00% (-0,21)	0,10% (6,46*)	0,08% (4,42*)
24	0,12% (1,28)	0,12% (2,33*)	0,15% (4,49*)	0,18% (7,16*)	0,19% (10,09*)	0,13% (9,95*)
36	0,27% (1,95)	0,23% (2,91*)	0,20% (3,58*)	0,15% (3,28*)	0,15% (6,86*)	0,12% (5,72*)

Notes: This table is the robustness test of industry momentum effect of positive-autocorrelation industry portfolio in Taiwan. The statistics in this table are the monthly returns for momentum strategies after controlling for the three-factor risk (Fama and French, 1996). The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level.

Table 10. Robustness test – the industry momentum profit of risk-adjusted returns of negative-autocorrelation industry portfolio

Formation period	Holding period					
	1	3	6	12	24	36
1	-0,01% (-1,16)	0,00% (0,67)	0,01% (1,36)	0,00% (1,02)	-0,00% (-0,29)	-0,00% (-0,76)
3	0,01% (0,40)	0,02% (1,87)	0,02% (1,46)	0,01% (1,48)	-0,00% (-0,83)	-0,00% (-1,51)
6	0,03% (0,87)	0,04% (2,75*)	0,04% (3,96*)	0,01% (0,97)	-0,01% (-1,92)	-0,01% (-2,39#)
12	0,07% (1,51)	0,07% (2,85*)	0,04% (2,15*)	-0,01% (-1,12)	-0,05% (-6,10#)	-0,04% (-5,69#)
24	-0,02% (-0,33)	-0,03% (-0,78)	-0,04% (-1,56)	-0,09% (-5,81#)	-0,09% (-8,48#)	-0,07% (-7,71#)
36	-0,05% (-0,89)	-0,04% (-1,23)	-0,05% (-1,99#)	-0,09% (-6,62#)	-0,10% (-10,47#)	-0,07% (-7,62#)

Notes: This table is the robustness test of industry momentum effect of negative-autocorrelation industry portfolio in Taiwan. Please refer to Table 9 for a complete description of the statistics in the table. The numbers in parentheses are t-statistics based on Newey-West standard errors. * significantly positive at 0.05 level, # significantly negative at 0.05 level.

2.3. The influence of turnover rate on autocorrelation. The above analysis shows that autocorrelation is an important factor affecting the industry momentum effect in Taiwan. Barberis and Shleifer (2003) demonstrate that the return autocorrelation comes from the style investing. Barberis and Shleifer show that a new style is derived from a promising fundamental value. Then the new style becomes mature because the good performance attracts more funds into this style, which makes the stock price of this style increase. At last, this style collapses due to the arbitrage or bad fundamental news. However, the same style will reappear in the future.

Barberis and Shleifer (2003) document that industries are the most important styles. According to Barberis and Shleifer, the fundamental change of industry causes the alteration of styles and the circulation of funds, which will make the good performance of hot industry persist and the bad performance of cold industry persist, too. Thus the stock return of these industries reveals the positive autocorrelation and the industry momentum effect appears. Under such circumstances, investors will make profits when adopting momentum strategy.

According to Barberis and Shleifer (2003), the return autocorrelation is attributed to the style investing, which we can observe from the transfer of funds. When the fund transfers from one style to another, the turnover rate will change. Several recent studies (e.g., Baker and Stein, 2004; Kaniel, Saar and Titman, 2004 and Baker and Wurgler, 2006) employ stock turnover rate as the sentiment proxy for investors. Thus, we can observe the rotation of styles according to the change of turnover rate among different industries.

We employ the turnover rate[1] to reflect what investors are interested in and the flow of the funds. Thereby, we can discover whether the turnover rate will affect the positive autocorrelation of the industry stock returns. Models (1) and (2) are two models to investigate the relation between industry turnover rate and autocorrelation. The dependent variable stands for the current monthly return of industry i ($R_{i,t}$). The independent variables are the previous month return of industry i ($R_{i,t-1}$), market risk factor ($R_{m,t}$-$R_{f,t}$), size factor (SMB_t) and book-to-market factor (HML_t)[2] and the current month turnover rate of industry i ($TR_{i,t}$). Lee and Swaminathan (2000) demonstrate that past trading volume (turnover) can predict the persistence and magnitude of momentum. That is, the stock turnover rate is the proxy for investors' interest in stocks, which is related to the speed of information spreading to the price. Thus, this study takes the turnover rate of the industry as the proxy for the flow of funds. The regression models are as follows:

$$R_{i,t} = a + b_1 R_{i,t-1} + b_2 \left(R_{m,t} - R_{f,t}\right) + \\ + b_3 SMB_t + b_4 HML_t + \varepsilon_{i,t}, \quad (1)$$

$$R_{i,t} = a + b_5 R_{i,t-1} + b_6 \left(R_{m,t} - R_{f,t}\right) + \\ + b_7 SMB_t + b_8 HML_t + b_9 TR_{i,t} + \varepsilon_{i,t}. \quad (2)$$

Table 11 shows the influence of turnover rate on the industry autocorrelation of the positive-autocorrelation industries. The result of Model (1) in Table 11 reveals that after controlling for the three-factor risk the industry return is significantly and positively influenced by the previous month industry return for all the industries in the positive-autocorrelation group[3]. That is, the autocorrelation is very significant. However, we find that the phenomenon of autocorrelation disappears when adding the turnover rate as an independent variable into the regression model. The result of Model (2) shows that only the market return, HML and turnover rate significantly and positively influence the current industry return. The coefficient of the previous month return ($R_{i,t-1}$) is no longer significant in Model (2).

The analysis above shows that autocorrelation is related to the transfer of funds. When funds move into (from) the hot (cold) industry, the trading volume and turnover rate increase (decrease) and the return of the hot industry persists to perform better than that of the cold industry. The results of Tables 2 to 10 have shown that the industry momentum effect in Taiwan is related to the industry autocorrelation. Table 11 provides further evidence that the positive autocorrelation is related to the transfer of funds (turnover rate). These results are consistent with the study of Barberis and Shleifer (2003). The rotation of styles results in the transfer of funds. Such transfer from cold industry to the hot industry will make the performance of the former worse and that of the latter better. Thus, the good performance of hot industry persists and the bad performance of cold industry persists, too. Then the momentum effect occurs.

[1] The definition of the turnover rate is the trading volume divided by the number of issued shares.

[2] $R_{m,t}$ is the current market return. SMB_t is the return of small stocks minus that of big stocks and HML_t is the return difference between the high book-to-market stocks and low book-to-market stocks.

[3] However, the unreported result shows that the industry return is negatively but insignificantly influenced by the previous month industry return for most of the industries in the negative-autocorrelation group.

Table 11. The influence of turnover rate on the industry autocorrelation of the positive-autocorrelation industries

	Foods		Electric & Machinery		Electrical & Cable		Steel & Iron		Electronics		Construction		Others	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Alpha	0,01 (2,59*)	0,00 (-0,45)	0,00 (1,06)	-0,02 (-2,70*)	0,01 (1,84*)	-0,03 (-3,98*)	0,01 (2,43*)	-0,01 (-0,86)	-0,01 (-1,55)	-0,04 (-6,10*)	0,02 (3,93**)	-0,01 (-0,64)	0,00 (0,88)	-0,02 (-2,44*)
$R_{i,t-1}$	0,09 (1,67*)	0,04 (0,60)	0,10 (1,91*)	0,01 (0,18)	0,11 (2,32*)	-0,02 (-0,45)	0,10 (1,71*)	0,03 (0,43)	0,06 (1,69*)	-0,02 (-0,49)	0,18 (3,66*)	0,09 (1,63)	0,11 (2,13*)	0,03 (0,51)
$R_{m,t}$-$R_{f,t}$	0,92 (9,89*)	0,90 (9,75*)	0,82 (12,06*)	0,79 (11,96*)	1,25 (14,82*)	1,16 (15,05*)	0,73 (7,38*)	0,70 (7,18*)	0,98 (13,86*)	0,97 (15,43*)	1,45 (13,74*)	1,38 (13,14*)	0,81 (11,41*)	0,79 (11,53*)
SMB_t	-0,20 (-0,79)	-0,18 (-0,70)	-0,02 (-0,10)	0,08 (0,43)	0,09 (0,36)	0,12 (0,55)	-0,51 (-1,90*)	-0,40 (-1,48)	0,05 (0,28)	0,16 (0,93)	0,02 (0,06)	0,10 (0,33)	-0,16 (-0,78)	-0,07 (-0,36)
HML_t	0,49 (4,09*)	0,48 (4,07*)	0,20 (2,21*)	0,15 (1,75*)	0,37 (3,32*)	0,34 (3,45*)	0,57 (4,57*)	0,50 (3,94*)	-0,48 (-5,29*)	-0,45 (-5,64*)	0,78 (5,75*)	0,70 (5,26*)	0,15 (1,66*)	0,13 (1,44)
$TR_{i,t}$		0,15 (2,50*)		0,17 (3,50*)		0,24 (5,92*)		0,13 (2,54*)		0,12 (6,20*)		0,14 (3,14*)		0,17 (3,35*)
n	154	154	154	154	154	154	154	154	154	154	154	154	154	154
Adjusted R^2	0,54	0,55	0,64	0,67	0,71	0,76	0,44	0,46	0,82	0,86	0,68	0,69	0,65	0,67

Notes: The dependent variable is the current month return of industry i ($R_{i,t}$). The independent variables are the previous month return of industry i ($R_{i,t-1}$), the market risk factor ($R_{m,t}$-$R_{f,t}$), the return of small stocks minus that of big stocks (SMB_t), the return difference between the high book-to-market stocks and low book-to-market stocks (HML_t) and the current month turnover rate of industry i ($TR_{i,t}$). The numbers in parentheses are t-statistics. * significant at 0.05 level.

Conclusions

This study investigates the industry momentum effect of the positive- and negative-autocorrelation industries. The result shows that although there exists little industry momentum effect in Taiwan, the industry momentum effect does not disappear but hides in the positive-autocorrelation industries which have the stable positive autocorrelation phenomenon. This is an evidence that autocorrelation affects the industry momentum in Taiwan. This study further finds that the turnover rate is an important factor affecting the positive autocorrelation of the positive-autocorrelation industries.

The result of this study is consistent with Barberis and Shleifer (2003) who proposed the style investing. Turnover rate is a proxy which reflects what investors are interested in, and the flow of funds. In the long term, the industry which fund transfers into performs better than the industry which fund transfers from and the better performance persists for a long time, which makes the high positive return autocorrelation of these industries.

The past literature investigates the industry momentum by observing all the industries. This study extends the industry momentum literature by observing some specific industries and finds that the industry momentum effect exists in the positive-autocorrelation industries. This is an interesting result from an emerging market. Whether the developed country markets also have the significant industry momentum effect of the positive-autocorrelation industries is worthy of further investigation.

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