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Massively Confused Investors Making Conspicuously Ignorant Choices (MCI-MCIC)

MICHAEL S. RASHES*

ABSTRACT

This paper examines the comovement of stocks with similar ticker symbols. For one such pair of firms, there is a significant correlation between returns, volume, and volatility at short frequencies. Deviations from "fundamental value" tend to be reversed within several days, although there is some evidence that the return comovement persists for longer horizons. Arbitrageurs appear to be limited in their ability to eliminate these deviations from fundamentals. This anomaly allows the observation of noise traders and their effect on stock prices independent of changes in information and expectations.

RECENT EMPIRICAL ANALYSES of security returns challenge the traditional view that security prices react only to innovations in publicly available information. Price variation unrelated to information has been attributed to the activities of noise traders by, among others, Shiller (1984), Glosten and Milgrom (1985), Kyle (1985), Black (1986), DeLong et al. (1990), and Campbell and Kyle (1993). Shiller (1981) and French and Roll (1986) provide evidence that the process of trading itself moves security prices. DeLong et al. (1990) and Shleifer and Vishny (1997) discuss the importance of institutional constraints on arbitrageurs for this failure of arbitrage to remedy the irrational influences of noise traders on prices. The limited ability of arbitrageurs to eliminate mispricings in financial markets is suggested by the relative performance of value and glamour stocks (Lakonishok, Shleifer, and Vishny (1994)), deviations between the prices of closed-end funds and the value of their underlying assets (Pontiff (1996)), and the excess returns on stocks added to the Standard & Poor's 500 Index (Harris and Gurel (1986), Shleifer (1986), Wurgler and Zhuravskaya (1999)).

One heretofore unstudied example of limited arbitrage is the comovement of stocks with similar ticker symbols.¹ Ticker symbol confusion leads to interesting price movements in stocks for which there is no new information

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¹ Malkiel (1996) discusses periods during which unusually high valuations were assigned to stocks with names that conjured up dreams of ever-growing profits and unlimited future prospects.

introduced to the market. This paper examines situations in which the influences of noise traders are unadulterated by other factors that may be driving securities prices, such as changes in risk or expectations. Any observed price effects can only be attributed to noise trading.

This paper finds that genuine shifts in sentiment due to misunderstanding of information about a single stock can lead to deviations of security prices from fundamental values. The sentiment changes examined in this paper are relatively small, yet these changes affect stock prices significantly and persistently, providing a presage of what might occur in the event of a large shock. This paper also highlights the comovement due to shifts in sentiment among a small group of noise traders. The effect on prices would presumably be larger if a group of correlated noise traders with significant capital at their disposal were to decide that they are interested in a single stock or group of stocks. Moreover, the fact that arbitrage fails to eliminate the price effect of something as obvious as ticker symbol confusion raises considerable doubt about its effectiveness in other, more complex circumstances.

The next section of this paper presents an in-depth look at an example of investor confusion between a well-known stock and a lesser-known one that have little in common besides their similar ticker symbols. Moreover, the ticker symbol of the latter is the commonly used name for the more widely recognized firm. This confusion leads to an unusual amount of comovement between the stocks of these companies.

The second section presents anecdotal evidence of other instances in which ticker symbol confusion has resulted in investor behavior inconsistent with the tenets of rationality.

The third section discusses some of the explanations for these oddities and considers whether financial and behavioral economists should be surprised by or concerned with these potential deviations from rationality.

The fourth section concludes.

I. MCI and MCIC

MCI Communications is one of the largest telecommunications companies in the world. From the end of 1996 through 1997, it engaged in merger negotiations with several other major telecommunications firms and was eventually acquired by Worldcom for more than \$20 billion. Until the merger, it traded on the Nasdaq under the ticker symbol MCIC.

Massmutual Corporate Investors is a closed-end mutual fund that trades on the New York Stock Exchange under the ticker symbol MCI. The fund has approximately \$200 million of net assets. The fund invests most of its assets in long-term corporate debt obligations and convertible securities, many of which are fairly illiquid. It does not hold, nor has it held in the past, the securities of MCIC or other major telecommunications companies.

Table I
Summary Statistics

Daily return and volume information is shown for Massmutual Corporate Investors fund (MCI), MCI Communications (MCIC), and AT&T (T) for the sample period 11/21/94–11/13/97. The return for security j is expressed in percentages and defined as $\text{Log}[(P_{j,t+1} + D_{j,t+1})/P_{j,t}]$, where $P_{j,t}$ and $D_{j,t}$ are the price and dividend, respectively, for security j on day t .

	Mean (Return)	SD (Return)	Mean (Volume)	SD (Volume)	Mean (Price)
MCI	0.078	0.7136	4,155	4,497	36.14
MCIC	0.087	2.3645	4.154×10^6	4.713×10^6	28.97
T	0.055	1.6440	4.810×10^6	2.837×10^6	38.64

Summary statistics for these two stocks along with those of another major telephone company, AT&T, which trades on the New York Stock Exchange under the ticker symbol T, are presented in Table I. The two telephone stocks have daily volume approximately 1,000 times that of MCI and display considerably higher volatility.

A. Comovement

In spite of the fact that MCI and MCIC have little to do with each other, there has been an unusual amount of comovement between their stock prices, particularly within the period during which MCIC was engaged in merger negotiations. In addition to return correlation, the stocks have experienced an extreme degree of correlation with respect to their volume patterns and volatility levels.

Table II displays the highest trading volume days for MCI for the period November 1, 1996 through November 13, 1997. For each day, the returns of MCI and MCIC are shown along with any news from that day relevant to the MCIC merger battle. Of the 24 days during which 10,000 or more shares of MCI changed hands, 18 are days on or immediately before which significant news was released related to MCIC's merger plans. All of the highest volume days for MCI correspond to the days on which MCIC had significant news and high absolute returns (and high volume). There is an increased level of trading in MCI regardless of whether the MCIC news is negative or positive. The signs of the returns on these MCIC news days also tend to be correlated.

The large abnormal trading volume in MCI on significant MCIC news days is demonstrated in Table II. This observation is more generally observed during the three-year sample studied in this paper. Table III contains the correlation matrix for the daily volume of MCI, MCIC, AT&T, and the NYSE as a whole. Panels A and B show the correlations for the complete sample and for the period during which the MCIC merger battle took place, respectively. The daily volumes of MCI and MCIC are significantly more correlated with one another than with the stock market as a whole. The low level of correlation between MCI volume and T volume demonstrates that

Table II
Top MCI Volume Days

The highest volume days of Massmutual Corporate Investors fund (MCI) for the sample period 11/1/96–11/13/97 are displayed in descending order. For each day, the trading volume of MCI is shown along with the return on MCI and MCI Communications (MCIC). The return for security j is defined as $\text{Log}[(P_{j,t+1} + D_{j,t+1})/P_{j,t}]$, where $P_{j,t}$ and $D_{j,t}$ are the price and dividend, respectively, for security j on day t . All returns are expressed in percentages. Any news from these days relevant to MCIC merger discussions is also displayed.

MCI Volume	Date	MCI Return	MCIC Return	Merger News
59,200	11/1/96	0.68	18.56	British Telecom makes initial bid
45,500	10/1/97	2.35	18.41	Worldcom makes initial bid
40,200	8/21/97	-0.30	-18.27	British Telecom announces it is renegotiating original agreement
30,000	11/10/97	0.70	11.82	Worldcom announces definitive acquisition agreement
25,100	7/11/97	-0.31	-19.12	Rumors that British Telecom's bid may be renegotiated
24,600	10/2/97	-0.73	3.65	See 10/1/97
24,600	10/16/97	0.58	3.33	See 10/15/97
22,800	5/12/97	-1.30	2.28	European Union deems Boeing/McDonnell Douglas merger unacceptable; may place restrictions on British Telecom/MCIC combination
21,100	1/17/97	1.92	0.36	
17,300	11/4/96	0.34	1.64	See 11/1/96
16,600	4/30/97	-0.96	-0.33	See 4/29/97
16,300	11/11/97	0.42	0.00	See 11/10/97
14,600	5/30/97	-0.63	0.33	
14,300	4/29/97	2.25	0.99	Global One executive announces British Telecom/MCIC combination poses competitive "danger"
13,700	12/27/96	1.62	0.38	
13,600	7/14/97	0.46	7.07	See 7/11/97
11,900	7/28/97	0.30	-0.27	FCC says British Telecom acquisition should be approved
11,900	10/28/97	0.00	0.71	MCIC shareholders file suit over mishandling of British Telecom bid
11,700	12/26/96	0.63	0.77	
11,300	6/17/97	0.63	-0.56	
10,700	8/20/97	0.60	5.79	See 8/21/97
10,100	10/15/97	0.00	4.33	GTE announces initial bid
10,000	3/17/97	-2.56	-0.34	

MCI volume is correlated with that of MCIC alone, and not with that of other members of the broader telecommunications industry. The correlation is more pronounced in the latter part of the sample due to the extreme MCI trading volume days shown in Table II.

To test the explanatory power of MCIC returns, the regression specification

$$r_{\text{MCI}} = \alpha_0 + \alpha_1 r_{\text{MCIC}} + \alpha_2 r_{\text{LARGCAP}} + \alpha_3 r_{\text{SMALLCAP}} + \alpha_4 r_{\text{Bond}} + \epsilon \quad (1)$$

Table III
Daily Volume Correlation Coefficient Matrices

This table presents the correlation of daily volumes between Massmutual Corporate Investors fund (MCI), MCI Communications (MCIC), AT&T (T) and the New York Stock Exchange Composite Index (NYSE). The pairwise Pearson product-moment correlations are shown with the standard error of these coefficients in parentheses.

	MCI	MCIC	T	NYSE
Panel A: Sample Period 11/21/94–11/13/97				
MCI	1			
MCIC	0.5592 (0.0302)	1		
T	0.0291 (0.0364)	0.1566 (0.0360)	1	
NYSE	0.1162 (0.0362)	0.2817 (0.0350)	0.3397 (0.0343)	1
Panel B: Sample Period 11/1/96–11/13/97				
MCI	1			
MCIC	0.6586 (0.0465)	1		
T	0.0366 (0.0617)	0.0568 (0.0617)	1	
NYSE	-0.0035 (0.0618)	0.1273 (0.0613)	0.2950 (0.0590)	1

was estimated using daily return data. All returns were normalized by their own standard deviations. A broad equity market index (the Standard & Poor's 500) and bond market index (the Lehman Brothers Long-Bond Index) are included in the regressions as proxies for the underlying assets in MCI. The Standard & Poor's Smallcap Index return is also included to proxy both for the smaller companies in MCI's portfolio and the premium/discount between the fund's price and net asset value.² To eliminate multicollinearity, the Standard & Poor's Smallcap Index return was regressed on the S&P 500 Index return and a constant, and the residual from this regression was used in place of the small-cap return to estimate equation (1).

Regression results for the various specifications and sample periods are presented in Table IV. Over the entire sample, both MCIC and the bond index are statistically significant determinants of MCI returns. Over approximately the last third of the sample, during which time the MCIC merger negotiations were taking place, only MCIC returns explain the returns on MCI. When the return on AT&T is added as an explanatory variable, its regression coefficient is not significant and the coefficients and significance levels of the other independent variables are little affected. Thus, it seems

² See Lee, Shleifer, and Thaler (1991) about the relationship between closed-end fund discounts and the performance of small stocks.

Table IV
Daily Return Regressions

This table presents OLS results for models of daily returns on Massmutual Corporate Investors fund (MCI), the dependent variable. The first row of each panel presents the sample period for each regression within that panel. The independent variables are, from left to right, a constant, the daily return on MCI Communications (MCIC), the daily return on MCIC interacted with a dummy variable that takes the value one if the return on MCIC is negative and zero otherwise, the daily return on AT&T (T), the daily return on the Standard & Poor's 500 Index, the residual from the regression of daily returns of the Standard & Poor's Smallcap Index on a constant and the S&P 500 Index daily return, and the daily return on the Lehman Brothers Long Treasury Bond Index. The return for security j is defined as $\text{Log}[(P_{j,t+1} + D_{j,t+1})/P_{j,t}]$, where $P_{j,t}$ and $D_{j,t}$ are the price and dividend, respectively, for security j on day t , and is normalized by its standard deviation. T -statistics are in parentheses. R^2 is the coefficient of determination of the regression, with the adjusted R -square shown directly below each R^2 value.

Constant	MCIC Return	(MCIC Return) * dummy (MCIC return < 0)	T Return	S&P 500 Return	S&P Smallcap Return Residual	Lehman Long Bond Index Return	R^2
Panel A: Sample Period 11/22/94–11/13/97							
0.0956 (2.6223)				0.0372 (0.9370)	0.1011 (1.9233)	0.0932 (2.3438)	0.0286 0.0247
0.0954 (2.6243)	0.0862 (2.2779)			0.0128 (0.3128)	0.1068 (2.0356)	0.0905 (2.2818)	0.0353 0.0301
0.0957 (2.6306)	0.0851 (2.2430)		0.0171 (0.4190)	0.0052 (0.1166)	0.1077 (2.0501)	0.0907 (2.2862)	0.0355 0.0290
0.0721 (1.5202)	0.1205 (2.0557)	-0.0722 (-0.7664)		0.0149 (0.3630)	0.1070 (2.0375)	0.0913 (2.3015)	0.0360 0.0296
Panel B: Sample Period 11/1/96–11/13/97							
0.1374 (2.3224)				0.0578 (1.2524)	0.0488 (0.5970)	0.1125 (1.7818)	0.0499 0.0389
0.1308 (2.2374)	0.1352 (2.8128)			0.0227 (0.4797)	0.0588 (0.7291)	0.1111 (1.7838)	0.0782 0.0639
0.1289 (2.2017)	0.1348 (2.8010)		0.0435 (0.7711)	0.0029 (0.0545)	0.0595 (0.7371)	0.1141 (1.8264)	0.0803 0.0624
0.0782 (1.1219)	0.2049 (2.9399)	-0.1522 (-1.3787)		0.0307 (0.6459)	0.0600 (0.7451)	0.1092 (1.7560)	0.0849 0.0671

that there is a statistically significant amount of comovement between MCI and MCIC, but not between MCI and other telephone companies.³ A dummy variable for days when the return on MCIC was negative was added to two of the regressions to test whether the relation between MCIC returns and

³ Alternatively the Standard & Poor's Telecommunications Index could have been used as an explanatory variable in this factor model for MCI returns. This was not done since this value-weighted index contains only two stocks other than MCIC and AT&T and because AT&T composes more than half of the index.

MCI returns depends upon the sign of MCIC returns. Although it cannot be rejected that MCIC returns explain MCI returns on all days, the correlation appears to be much stronger on days when MCIC returns are positive. As will be discussed in the third section of this paper, the more robust relationship on MCIC "good news" days is probably due to the fact that it is easier to erroneously purchase a stock than to erroneously sell a stock that you do not own, due to short-sale rules.

Aggregated daily return data show that there is a reversal of the short-term comovement between MCI and MCIC over longer periods of time. The p -value on the MCIC return in equation (1) is 0.023 for daily data, but increases to 0.058 and 0.179 when we aggregate returns over two and three days, respectively. Conversely, the p -value on the bond index return in equation (1) decreases from 0.023 for daily data to 0.006 and 0.009 for the regressions of two- and three-day returns, respectively, indicating that the bond index return becomes a more significant explanatory variable as the MCI-MCIC correlation decreases.

Interestingly, MCIC returns enter the regression significantly at horizons of around one month. This may indicate that investor irrationality does permanently increase the comovement of MCI and MCIC, but is more likely due to random variation or increased multicollinearity.⁴ When using monthly data, where a month is defined as 20 consecutive trading days, weaker but still significant correlation between MCI and MCIC is observed when one looks at return and volume data. The volatility of MCI, however, tends to be related to that of the market as a whole and not with MCIC in particular.

This reversal of the comovement is also reflected in the autocorrelation observed in daily returns and premiums over net asset value.⁵ Defining the premium over NAV in the standard way as $PREM_t \equiv (P_t - NAV_t)/NAV_t$,⁶ the first autocorrelation coefficients for MCI returns and PREM for the entire sample are -7.0 and -9.1, respectively, and -5.4 and -12.0, respectively, for the MCIC merger battle subsample. Box-Pierce Q -statistics for these variables are also highly significant. These results are consistent with the aggregated return evidence that abnormal returns due to investor confusion tend to be reversed within a short period of time through the actions of arbitrageurs or newly cognizant irrational investors.

⁴ Splitting the sample by the criterion of whether MCI trading volume was above or below its median level shows that there is no comovement between MCI and MCIC returns on low volume days. Thus, it is unlikely that there is a persistent effect of noise trader confusion between MCI and MCIC. The correlation is more likely due to mistakes repeatedly made by investors that each have an effect over shorter intervals.

⁵ MCI publishes its net asset value only on a quarterly basis. A fitted series of daily net asset values was imputed from this data by estimating a model including the returns on the S&P 500 Index, the S&P Smallcap Index, and the Lehman Brothers Long Treasury Bond Index over the period September 30, 1994, through September 30, 1997. Using a longer time series to impute daily NAVs does not have a significant impact on the autocorrelation results.

⁶ The standard deviation of PREM is approximately 75 basis points. Both the frequency of large changes in PREM and the magnitude of these changes are greater for the days on which more shares of MCI were traded.

Pairwise correlation coefficients for returns are consistent with the regression results in Table IV: There is a high degree of correlation between MCI and MCIC returns and little correlation between the price movements of MCI and AT&T. Analogous results are found for daily volatilities (defined as the log ratio of high and low trading prices) and daily volume. Controlling for the potential correlation between extreme volume and volatility trading days, the volume and volatility of MCI are highly correlated with those of MCIC. These results are not dependent upon the sign of MCIC returns, indicating that the correlation between MCI and MCIC is found both on "good news" and "bad news" days.

B. Market Microstructure

Looking at individual trade and quotation data allows for a more thorough understanding of the ticker symbol confusion phenomenon. NYSE Trade and Quote (TAQ) data from the fourth quarter of 1996 through the end of 1997 was used to study the days during which there was unusually high trading volume in MCI.

The TAQ data allow us to attempt to match MCI purchases (sales) that are made on the basis of receiving news about MCIC with the corresponding sales (purchases) once the investor realizes his mistake. This matching provides information on both how long it takes for the misinformation to be corrected and how costly it is to make such mistakes. The matching of large trades is complicated by the fact that some of these trades receive partial fills, so that a single order for a large number of shares that is filled in several pieces may look like a number of different trades. Notwithstanding this difficulty, the TAQ quotation data were used to get a sense for the size of the bid-ask spread on which a trade was executed, under the assumption that a large purchase (sale) is more likely to be executed on the ask (bid) side of the market.

Table V lists the 22 MCI trades between October 1, 1996, and December 31, 1997, that were greater than 3,000 shares. The largest single MCI trade during the period under study was 9,800 shares with a dollar value of \$382,200, indicating that the noise traders who mistake MCI and MCIC are relatively small market participants. Of the largest trades, 6 were opening prints, 1 was a third-market give-up of a NYSE print, and 5 are sufficiently dissimilar that they cannot be matched with any of the other trades detailed in the table.⁷ The remaining 10 trades are paired by volume and designated a letter from A to E. In each case, it appears that the first transaction was a purchase rather than a sale. In two of these instances, the purchase and sale occurs on the same day, 9 minutes and 132 minutes apart, while on three occasions it took until the next day for the original trade to be reversed. Four of the original purchases occurred on significant MCIC news days.

⁷ Since the opening print is generally composed of a number of smaller trades and the size and number of constituent trades is indeterminable, it does not provide any information about the actions of a single trader.

Table V
Largest Individual MCI Trades

The largest individual trades for Massmutual Corporate Investors fund (MCI), for the sample period 11/1/96–11/13/97, are detailed in descending size order. A description of the trade is detailed in the rightmost column, if possible, and matched purchases and sales (in bold type) are denoted with the letters A through E. Trade data was obtained from the NYSE Trade and Quote database.

Trade Size	Date	Time	Price	Explanation
9,800	5/12/97	9:56:21	39	
9,500	4/30/97	11:02:47	$38\frac{7}{8}$	Sale A
9,000	4/29/97	12:42:02	$39\frac{1}{4}$	Purchase A
9,000	8/21/97	10:21:25	$42\frac{1}{4}$	Purchase B
7,600	8/21/97	12:33:32	$41\frac{5}{8}$	Sale B
6,900	11/10/97	9:39:12	$45\frac{3}{16}$	Opening print
4,500	6/18/97	11:46:22	$39\frac{1}{2}$	Sale C (offered all morning, finally hit a bid)
4,400	10/2/97	14:44:47	$42\frac{7}{8}$	Sale D (5000 share fill within 40 seconds)
4,200	1/17/97	9:35:02	$39\frac{1}{2}$	Opening print
4,000	11/11/97	10:11:35	45	
4,000	11/18/97	13:20:34	$45\frac{1}{8}$	
3,800	6/17/97	15:58:21	$39\frac{7}{8}$	Purchase C (size offer moments after trade)
3,700	12/27/97	9:38:28	$38\frac{7}{8}$	Opening print
3,500	11/1/96	13:23:32	37	Sale E
3,500	10/1/97	11:22:15	$43\frac{1}{2}$	Purchase D (5000 share fill within 10 minutes)
3,500	10/1/97	11:22:26	$43\frac{1}{2}$	Third market give-up of purchase D
3,400	10/16/97	9:32:07	$42\frac{1}{8}$	Opening print
3,300	11/1/96	13:14:18	$37\frac{3}{4}$	Purchase E (quotes start declining after trade)
3,300	9/25/97	13:00:47	$42\frac{1}{2}$	
3,200	12/31/96	13:28:03	$38\frac{7}{8}$	
3,100	11/4/96	9:31:51	$36\frac{5}{8}$	Opening print
3,100	3/17/97	9:37:19	39	Opening print

Purchase C occurred approximately two minutes before the close of trading. It appears that the buyer may have realized his mistake soon after as there was a sizable quantity of stock offered for sale moments later and during the next morning until Sale C occurred at 11:46 a.m. The buyer of Purchase E may have also realized the mistake fairly quickly since the bid-offer for MCI started dropping soon after the transaction and Sale E occurred at the bid side of the market only nine minutes later. A similar sense of urgency was not demonstrated in any of the three other trade pairs.

Transactions A through E resulted in per share losses of $\frac{3}{8}$, $\frac{5}{8}$, $\frac{5}{8}$, $\frac{3}{8}$, and $\frac{3}{4}$, respectively. Each of these traders lost several thousand dollars as a result of their confusion. These per share losses are the same magnitude as the bid-ask spread on MCI, so if such losses are typical for all traders, the cost of ignorance for smaller investors who only traded a few hundred shares of MCI could easily total several hundred dollars, especially after accounting for commissions.

Rational economic theories do not preclude investor mistakes. These theories do posit, however, that the incidence of systematic mistakes must decrease over time as some investors learn not to make the same mistakes and others disappear because they lose their capital due to never learning the error of their ways. Profit-seeking arbitrageurs should become aware of the mispricing and enter the market so as to take advantage of the opportunities created by confused investors. If arbitrage is costly, however, arbitrageurs may choose to devote their resources elsewhere and anomalies may persist. Within a rational framework, one would expect the bid-ask spread, a measure of the difference between the price at which informed and uninformed investors transact, to decrease over time on those days during which there is a great deal of ticker symbol confusion as increased competition between sophisticated investors translates into smaller arbitrageur profits. There is no evidence that average bid-ask spreads decrease over time on "high-volume" MCI days, however, indicating that costly arbitrage precludes the entry of sophisticated investors into the MCI market. This finding supports the proposition that the MCI specialist gains the bulk of the rents from this case of ticker symbol confusion.

II. Other Examples of Ticker Symbol Confusion

The case of MCI and MCIC is not the only instance of investor confusion regarding a stock's ticker symbol. April 15, 1997, was a particularly volatile day in the market for the Castle Convertible Fund. This closed-end mutual fund, which trades on the American Stock Exchange with the ticker symbol CVF, had closed the previous day at 24. At 12:46 p.m. on April 15, the stock traded at its daily high price of $24\frac{5}{8}$. A mere 22 minutes later the fund's price had tumbled by 32 percent to a daily low of $16\frac{3}{4}$. The fund's management reacted to the severe decline in share price by issuing a press release stating that there was "no significant impairment" to the value of the fund and that there was no reason for its "precipitous" drop (Castle comments on trading activity (1997)). The shares recovered by the end of the trading session to close at 23, down one point from the previous day's close.

Rather than reacting to any broad market indicator, the move in the Castle Convertible Fund was a response to an article appearing the previous Friday in the *Financial Times* about the Czech Value Fund, abbreviated in the story as CVF (Czech market watchdog chief forced to quit (1997)). The Czech Value Fund had invested in fraudulent companies and was facing large losses.

The actions of a few confused Castle Convertible Fund investors were enough to start a wave of panic selling in the thinly traded stock. Officials at the American Stock Exchange, embarrassed that the Castle Fund market maker did not do more to support the stock in the absence of any negative news, offered investors the chance to reprice their sales at $21\frac{1}{2}$. Over 10,000 shares had been sold below this level during the day.

Similarly, a recommendation for the Morgan Stanley Asia Pacific Fund, a Hong Kong oriented closed-end fund, in the February 2, 1998, issue of *Barron's* listed the incorrect ticker symbol APB, rather than the fund's true symbol APF. APB is the ticker symbol of the Barings Asia Pacific Fund, a closed-end fund that was concentrated in Japanese securities. The average daily volume over the previous year for APB was approximately one-third of that for APF, 96,000 versus 289,000. When a market-on-open buy order for 184,200 shares of APB was placed that Monday, reportedly by an institutional investor, trading was delayed for almost one-half hour and the stock opened at 12, up 30 percent from the previous Friday's close. Ferocious short-selling by arbitrageurs and selling by the ignorant buyer, among others, drove the price down to 10 within 20 minutes of the opening print. Over 1.3 million shares of APB exchanged hands that day, more than 15 percent of the fund's outstanding shares.

MCI and MCIC are not the only two stocks with similar ticker symbols that have displayed comovement due to the acquisition of one of the companies. Confirmation on June 24, 1998, that AT&T had agreed to purchase Tele-Communications Inc. for \$45.8 billion led to a 4.3 percent jump in the price of the stock with the ticker symbol TCI and trading volume in TCI of 50,100 shares, more than 37 times its three-month daily average. Unfortunately for TCI investors who bid up the price of the stock, shares of Tele-Communications Inc. trade on the Nasdaq under the ticker symbol TCOMA, while TCI is the symbol for Transcontinental Realty Investors Inc., a \$63 million real estate investment trust that trades on the New York Stock Exchange. These mistaken traders were most likely confused by the fact that Tele-Communications Inc. is commonly referred to as "TCI" among investors, in the media, and in the company's own press releases.

These misinformed investors were certainly not alone. The highest volume day for TCI was almost five years earlier on October 13, 1993, the day on which Bell Atlantic Corp. announced that it was buying Tele-Communications Inc. for \$21.4 billion. The news of the combination, a merger that never came to fruition, led to the trading of 178,050 TCI shares (adjusted for a subsequent three-for-two stock split). This volume was more than 72 times the three-month daily average. Trading in the stock was halted after the NYSE became aware of the confusion, but not before the stock price had leaped more than 15 percent from its close on the previous day. The stock price plummeted after trading was resumed and ended the day down almost two percent from its previous close.

The director of investor relations for TCI blamed mistaken retail buyers for both instances of ticker symbol confusion, adding that the company is accustomed to unusual activity in its stock on days when Tele-Communications Inc. is in the news. She added, "I just hope this doesn't mean some people will realize they've owned the wrong stock for all these years" (Tele-Communications news prompts trading in wrong TCI (1998)).

The proliferation of day-trading and the frenzy surrounding the shares of Internet stocks has resulted in a number of instances of ticker symbol confusion. In one such instance, shares of Temco Service Industries, a building

maintenance and security company, briefly doubled on December 3, 1998, when its shares were confused with those of Ticketmaster Online, a hot Internet stock that had an initial public offering that same day. Ticketmaster was assigned the ticker symbol TCMS, which had been Temco's ticker symbol until it was changed to TCMO on October 7, 1998. Temco shares, having traded on only 10 days for a total of 6,100 shares during the first 10 months of the year, traded 69,000 shares that day. The shares, which had closed at $28\frac{3}{4}$ the previous day, traded as high as 65 before collapsing to close at $25\frac{1}{2}$. Interestingly, Temco traded with a much higher frequency subsequent to the initial confusion between the stocks.

In another irrational moment, a firm that filed for an initial public offering under the ticker symbol APPN, AppNet Systems, was confused with the dormant shares of Appian Technology. Appian, a penny stock listed on the Nasdaq pink sheets, was to give up its ticker symbol APPN just before the AppNet IPO. Still, on March 30, 1999, irrational investors drove the stock price of Appian up by 657 percent. The next day the stock was up by another 277 percent, before settling to close up only 87 percent. Appian's ticker was changed to APPG the next day, but not before one noise trader bragged on a Yahoo web site, "Just bought 50,000 shares, took 3 transactions to get it done, there r [sic] NO shares out there, going to run big" (Trading places: Mistaken I.D. lifts tiny stock (1999)). He was half right on both counts: There were no shares of AppNet to be purchased until it completed its IPO, and Appian proceeded to "run" downward by 90 percent over the course of the next month.

III. Discussion

A. *Explaining the Phenomenon*

The strange relationship between MCI and MCIC engenders some fundamental questions. Is this comovement of great enough economic significance to further legitimize investor irrationality as an explanation for observed financial phenomena? Or is it due to an infrequent mistake that is an inevitable result of multitudinous transactions? To answer these questions, it is necessary to consider the underlying explanation for why investors trade MCI in response to news about MCIC. Three possibilities are incorrect order entry, failure to utilize all available information, and ticker symbol confusion.

One possible explanation for the observed comovement is that traders occasionally have "fat fingers"; they know the symbol for MCI Communications is MCIC and they intend to buy the stock with the symbol MCIC, but enter the wrong symbol MCI into their trading system. If this explanation were to account for the observed anomaly then the evidence against rationality presented here would be no more convincing than the fact that people dial incorrect telephone numbers from time to time.⁸ Making occasional

⁸ Obviously there is a greater cost associated with buying the wrong stock, as previously demonstrated, than with dialing an incorrect phone number, so one would be surprised if such mistakes occurred with the same frequency.

mistakes does not contradict rationality *per se*. Thus, to address this criticism, it can be demonstrated that the number of mistakes of this origin necessary to explain the observed facts is too high to be plausible.

MCIC trading volume is on average approximately 1,000 times that of MCI. This tended to be approximately true for the sample both within and outside the subset of abnormal trading days. Since a significant part of the trading volume of MCIC comes from large share blocks, and most MCI trades consist of smaller blocks, an average trading day witnesses around 100 times as many MCIC trades as MCI trades. This back-of-the-envelope calculation means that the order-entry error rate for MCIC is on the order of one percent! The optimal rate of mistakes is clearly greater than zero, given the cost of avoiding such errors, but this number seems to be several orders of magnitude higher than what could be explained with "fat fingers." In fact, conversations with several stock brokers have indicated that this type of mistake is exceedingly rare and that there are generally safeguards to prevent its occurrence.⁹

Another way to demonstrate that this mistake is not responsible for the comovement is to look at the other stocks whose ticker symbols are formed by removing a single letter from MCIC. These stocks are Carson Incorporated, a manufacturer and marketer of personal care products, the Muniyield California Insured Fund, a closed-end fund that invests in California municipal securities, and Mestek, a manufacturer of industrial products. These stocks trade on the New York Stock Exchange under the ticker symbols CIC, MIC, and MCC, respectively. One would expect that the incidence of incorrectly typing any of these ticker symbols instead of MCIC would be similar to that of typing MCI instead of MCIC. Nevertheless, there is no correlation of returns, volume, or volatility between MCIC and any of these three stocks, indicating that the mistaken MCI trades cannot be explained by "fat fingers."

An alternative explanation is that some investors fail to condition their portfolio decisions on the complete information set. This would be the case for an investor who sees a headline of a news story such as "MCI to Be Acquired by . . ." and places an order for MCI without checking the article to see whether it refers to MCI or MCIC. This explanation is unlikely to account for much of the comovement that is observed because it would be a factor only for a very short period of time after information becomes publicly available.

⁹ The specialist for MCI on the floor of the NYSE commented that he was aware of only two instances in 1997 when an order was incorrectly placed for MCI by an investor trying to trade MCIC. In both cases, the mistake was realized within 30 minutes and the investor traded out of the incorrect position. He noted that because of the likelihood of mistakes, MCI trades in excess of 1,000 shares are usually checked to make sure that the order has been placed correctly. The Exchange has been contacted in the past about changing the ticker symbol, but the NYSE does not believe potential confusion is great enough to justify the change. Moreover, the specialist stated that he is not aware of any unusual trading in MCI on significant MCIC news days.

The most plausible explanation for the relationship observed between MCI and MCIC is that some investors simply do not know the correct ticker symbol for MCI Communications, the stock that they intend to trade, and enter an order for the stock with the symbol MCI. Assuming that this mistake is made predominantly by small investors, it was shown earlier in this section that approximately one percent of the trades that small investors intend to make in MCIC are entered as trades for MCI. Moreover, the wide MCI volume discrepancy between days with and without significant MCIC news implies that a large proportion of total trading in MCI occurs on these significant news days. These errors are exacerbated on significant news days because it is less likely that a given investor on such a day has taken the time to familiarize himself with the stock. A large proportion of MCI transactions is, therefore, due to the actions of those having no intention of trading the stock and, most likely, do not even know of its existence. The extent of these trades is even greater if there is long-run comovement between MCI and MCIC due to investors making such mistakes on non-MCIC news days.

The fact that this confusion has implications for prices makes it of interest to behavioral and financial economists. If this trivial group of noise traders can persistently impact the price of MCI, one could only imagine what would occur if a group of correlated noise traders experienced a change in sentiment regarding a group of stocks, such as stocks just added to the S&P 500 or that recently reported higher than expected earnings.¹⁰

B. Comovement on MCIC "Bad News" Days

The comovement between MCI and MCIC on MCIC "bad news" days is particularly striking because of the increased intricacy of placing and executing a short sale relative to an outright purchase. One might expect that the additional steps in executing a short sale, such as locating a borrow on the stock, would make it more probable that someone would point out the investor's mistake. There are several possible explanations for the latter phenomenon, each of which is fairly difficult to reconcile with investor rationality.

The MCI selling that comes on the heels of negative MCIC news is not likely due to short selling, since the short interest in MCI was well below 10,000 shares for most of the period under study and illiquidity and a small float make this stock difficult to borrow. Approximately 45 percent of the trading volume on each of the MCIC "bad news" days occurs on upticks, providing an upper bound on the amount of stock that may have been short sold on these days. This measure overstates the amount of short selling by noise traders because not all upticks are short sales and we cannot distinguish short sales by noise traders from those by sophisticated investors trying to take advantage of the anomaly.

¹⁰ See Bernard and Thomas (1989) and Chan, Jegadeesh, and Lakonishok (1996) about post-earnings announcement price effects.

Investors who own MCI and know that they own MCI might sell the stock when there is negative news about MCIC. These investors are not misinformed about the ticker symbols, yet their actions are rational if they know about the MCI-MCIC anomaly and front-run their irrational cohorts. The correlation on "bad news" days repeatedly observed through the sample implies that there are enough other investors acting irrationally to make the front-running profitable.

It is also possible, but even more implausible, that some investors mistakenly hold MCI for long periods of time, never realizing they are not holding MCI Communications in spite of having received trade confirmations and account statements from their broker with details of their trades and stock positions. These investors may feel perfectly rational selling MCI on poor MCI Communications news, since they were never aware of their mistake in the first place. Indeed, if they continue to ignore their account paperwork they may buy, own, and sell the wrong stock without ever realizing their error.

IV. Conclusion

This paper has presented evidence of an unusually high correlation in returns between two stocks with similar ticker symbols. It is possible that as many as one percent of the MCIC trades that investors intend to make incorrectly result in an MCI transaction. Each of the proposed explanations for the comovement of these stocks stands in stark contrast to the traditional assumptions of rationality.

The relationship between the share prices of MCI and MCIC documented in this paper is an interesting special case, much like closed-end funds, which provides an unbiased forum, free of innovations in information or preferences, in which we can measure the impact of noise traders. Within this framework it is possible to demonstrate that comovement of asset prices need not be due to common fundamental or economic factors. Compare this situation to the comovement observed among value stocks. Lakonishok et al. (1994) argue that this comovement is due to a common sentiment factor that causes the prices of value stocks to move in tandem. Fama and French (1995), on the other hand, take the view that common variation among the returns on value stocks reflects common exposure to an economic risk factor. Thus, they argue that the reason value stocks move together is that their earnings move together. In some sense, one cannot distinguish these two conflicting hypotheses because they have the same implications for asset price correlations. The comovement considered in this paper is immune from this debate because it cannot be argued that the earnings of MCI and MCIC move together. Thus, a story involving a common fundamental factor cannot reconcile the comovement puzzle and we are able to support the proposition that comovement in securities prices may be due to common sentiment or demand shifts.

A fair criticism of this work is that the ramifications of ticker symbol confusion are small relative to some of the other noise trading examples that have been examined previously in the literature, such as the relative performance of glamour and value stocks and additions to the S&P 500 Index. Ticker symbol confusion affects stocks for which there is no change in fundamental information and provides a forum to study noise trading in the absence of complicating informational variations. This phenomenon is notable not for its significance, but rather for its incontrovertibility.

The MCI-MCIC comovement is emblematic of situations in which one might expect arbitrage to be costly and ineffective. MCI is a stock for which bid-ask spreads are wide, small trades can have a large impact on prices, and it is difficult to establish large arbitrage positions. More important, the cost of continuously monitoring MCI for pricing anomalies may outweigh the potential gains from capitalizing on noise trader mistakes. Thus, even though the reason for MCI-MCIC comovement could not possibly be construed as fundamental information, so that transient mispricings should reverse themselves quickly, and despite the existence of both numerous MCIC news days and MCI arbitrage opportunities during the merger subsample, there is no evidence of increased competition between arbitrageurs during this period.

The comovement between MCI and MCIC demonstrates the problems arbitrageurs face in driving asset prices to fundamental values. Returns to arbitrage may be low if securities like MCI are difficult or costly to borrow or if pricing discrepancies persist for long periods of time. Thus, this relatively trivial anomaly foreshadows the much larger impact noise traders could have in the event of a genuine shift in sentiment, as well as arbitrageurs' limited ability to remedy the resulting price deviations.

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