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Mispricing of dual-class shares: Profit opportunities, arbitrage, and trading ☆

Paul Schultz, Sophie Shive *

Department of Finance, Mendoza College of Business, University of Notre Dame, Notre Dame, IN 46556, USA

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ABSTRACT

This is the first paper to examine the microstructure of how mispricing is created and resolved. We study dual-class shares with equal cash flow rights and show that a simple trading strategy exploiting gaps between their prices appears to create abnormal profits after transactions costs. Trade and quote data show that investors shift their trading patterns to take advantage of gaps. Contrary to common perception, long–short arbitrage plays a minor part in eliminating gaps, and one-sided trades correct most of them. We also show that the more liquid share class is usually responsible for the price discrepancies.

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1. Introduction

We examine price discrepancies between dual classes of shares offering the same cash flows and issued by the same company. We show that investors are frequently able to buy shares of one class of stock at its quoted ask price and simultaneously sell the other class at a higher bid price. These price discrepancies typically disappear over a few days as prices converge. A unique contribution of this paper is that we use intraday trade and quote data from NYSE Trade and Quote (TAQ) to see how these price gaps arise and how they are corrected.

Each pair of dual-class shares in our sample consists of shares with equal cash flow rights but different voting rights. Prices of the two classes of shares can differ for rational reasons. For example, the extra votes could have value or the market could value the extra liquidity provided by one class. Nevertheless, we find that significant abnormal returns are produced by the simple trading strategy of buying the cheaper class and shorting the more expensive class when the bid price of one exceeds the ask price of the other by a specified amount. The abnormal returns from exploiting these price gaps easily survive trading costs from bid–ask spreads, but we are unable to say if they survive all implementation costs. We frequently refer to these price discrepancies as mispricings, which we define as price gaps that would permit arbitrage profits in the absence of further market frictions.

We next examine intraday trade and quote data from TAQ to see how the price gaps arise and how they are

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* Corresponding author. Tel.: +574 631 8301; fax: 574 631 5544.
E-mail address: sshive1@nd.edu (S. Shive).

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eliminated. The most common cause of the gaps is price pressure moving the active nonvoting stock price out of line. This is somewhat counterintuitive. We would expect the least active, not the most active, stock to become mispriced. After gaps arise, we find that purchases of cheap shares and sales of expensive ones become more likely to execute at quoted prices, which is evidence that investors are trying to trade quickly before prices change. We also find that trading volume changes in the expected ways when a gap exists. That is, sell volume becomes a larger part of total volume for expensive shares and buy volume becomes a larger part of total volume for the cheaper class. The changes in volume are particularly clear for the less active voting shares.

Perhaps our most interesting finding is that, contrary to common perception, long–short arbitrage plays only a minor role in correcting gaps. To measure arbitrage activity, we examine volume from matched trades, defined as the purchase of shares of one class and the sale of the same number of shares of the other class within a minute. Volume from matched sales of expensive shares and purchases of cheap shares increases when a gap exists. The change in volume from matched trades is far less than the change from single-sided trades. We conclude that single-sided trades are more important than arbitrage trades for correcting price discrepancies. This could reflect limits to arbitrage for our sample.

We believe that our findings shed light on price discrepancies between other pairs of similar assets. Siamese twins are shares with equivalent voting rights that trade in different markets. Our work is also related to research on arbitrage opportunities involving portfolios of securities. Lee, Shleifer, and Thaler (1991), and Pontiff (1996) examine the mispricing of closed-end funds and Jarrow and O'Hara (1989) study the pricing of primes and scores. Several researchers, including Rosenthal and Young (1990), Froot and Dabora (1999) and Scruggs (2007), show that the ratio of prices of these shares diverge significantly and for long periods of time from the ratio of their cash flows. Our finding that price discrepancies in dual class shares appear to provide profit opportunities is also similar to findings on pairs trading (see Gatev, Goetzmann, and Rouwenhorst, 2006; Engelberg, Gao, and Jagannathan, 2009). Pairs trading is a statistical arbitrage trading strategy. Pairs are not stocks issued by the same company or stocks with proportional cash flow rights. Instead, pairs are formed from stocks that have historically had high correlations of returns. If cumulative returns (or normalized prices) diverge, the strategies call for buying the stock with the lower recent return and shorting the stock with the higher recent return. Gatev, Goetzmann, and Rouwenhorst (2006) report annual abnormal returns of 11% from pairs trading. In their view, these returns appear to exceed even conservative estimates of transactions costs.

The remainder of the paper proceeds as follows. In Section 2 we discuss dual-class shares. Section 3 describes our sample. In Section 4 we examine whether differences in the prices of dual-class shares represent mispricing. In Section 5 we analyze intraday trade data to see how prices of dual class shares diverge. We study how they converge again in Section 6. A summary of our results is given and conclusions are drawn in Section 7.

2. Dual-class shares

A company with dual-class shares has two classes of common stock with different voting rights or rights to elect different numbers of directors. Dual share classes are usually created to guarantee control for founding family members or other insiders who have a minority stake in the company's cash flows. In most cases, corporate charters require cash flows from dividends, liquidations, and other sources to be equal for both classes of shares. In other cases, cash flows for the two classes are required to be in specified proportions.

The trading rules we test later in the paper assume that, when share classes have equal cash flows, a share class with a lower price is underpriced relative to the other class. These are simple rules, not optimal ones. There are good reasons apart from mispricing for price discrepancies. All else equal, voting shares could be more valuable if private benefits accrue to those who control the company through ownership of voting stock (see Lease, McConnell, and Mikkelson, 1983; DeAngelo and DeAngelo, 1985; Bailey, 1988; Zingales, 1995; Nenova, 2003; Doidge, 2004). Christofferson, Geczy, Musto, and Reed (2007) examine the value of votes in the equity loan market and show that votes are usually worth zero. Their sample is not restricted to dual-class shares, however, and they note that the marginal price of a vote could be higher for these dual-class firms. Differences in liquidity may also cause prices of dual class shares to diverge (see Smith and Amoako-Adu, 1995; Zingales, 1995). Shares with superior voting rights are typically less liquid. There are often fewer of them outstanding, and they are usually held for long periods of time by investors who wish to retain control of the company. Lower liquidity can explain why shares with superior voting rights sometimes sell for lower prices than shares with inferior votes. If price discrepancies are the result of differences in votes or liquidity, our simple trading rules would not produce abnormal returns.

Casual observation suggests, though, that the value of votes and differences in liquidity are only part of the reason for the price discrepancies between voting and nonvoting stock. The value of liquidity and the value of extra votes should be fairly stable on a day-to-day basis, especially if we exclude dates around shareholder meetings and control events. However, if mispricing is behind the differences in dual-class share prices, we would expect the price differences to vary over time. Panel A of Fig. 1 shows the ratio of daily closing bid prices of Comcast voting stock to nonvoting stock from 1994 through 1997. Both classes of stock have the same cash flow rights, but only one class has voting rights. For most sample firms, both classes have votes but one has more than the other. For simplicity, in all cases we refer to the class of shares with more votes as voting shares and the class with fewer votes as nonvoting stock.

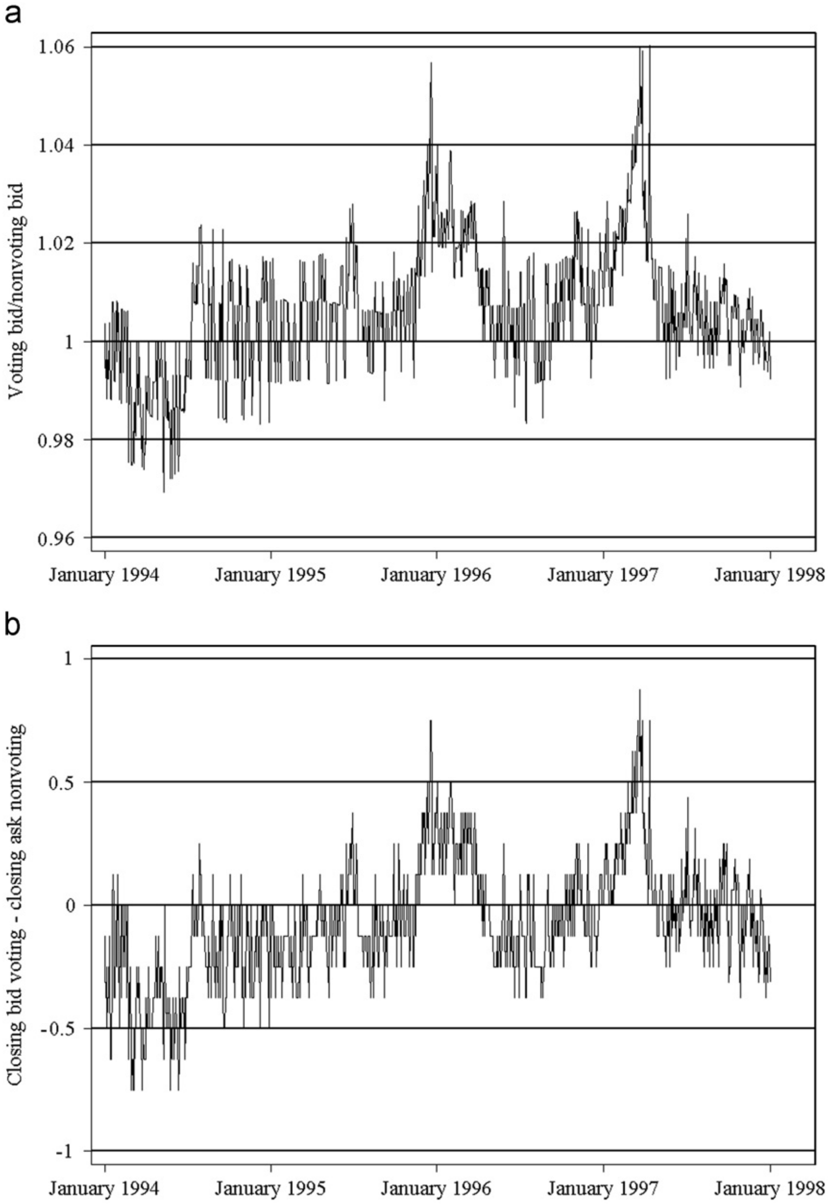

Fig. 1. Panel A shows the ratios of the closing bid price of Comcast voting stock to the bid price of Comcast nonvoting stock. Panel B depicts the differences between the closing bid price of Comcast voting stock and the closing ask price of Comcast nonvoting stock.

Panel A shows that the ratio of bid prices of the two share classes varies significantly between 1994 and 1997. In 1994 the bid price of the voting shares is often 1–2% below the bid price of the nonvoting shares. In 1996 and 1997, the closing bid price of Comcast voting stock often exceeds the closing bid price of the nonvoting stock by 3% or more. Panel B of Fig. 1 shows the dollar difference between the closing bid price of Comcast voting stock and the ask price of Comcast nonvoting shares. For a number of days in 1996 and 1997, the bid price of Comcast voting stock exceeds the ask price of the nonvoting shares by \$0.50 or more. That is, an unsophisticated investor trading at quoted prices could expect to sell voting shares for at least \$0.50 more than he would pay for nonvoting shares. This graph shows only price discrepancies at the close. When intraday data are used, far more trading opportunities present themselves.

Comcast is not a small company. The nonvoting shares by themselves would be in the ninth (second largest) size decile of NYSE stocks at the end of 1994 and 1995. They would be in the eighth decile at the end of 1996 and in the largest decile at the end of 1997. The voting shares by themselves would be in the fifth size decile of NYSE stocks at the end of 1994, 1995 and 1996. They would be in the sixth decile at the end of 1997. Shares in each class trade every single day over 1994 through 1997. The minimum number of trades on any day is 25 for the voting stock and 78 for the nonvoting shares.

Panel A, Fig. 2 depicts the ratio of bid prices of voting to nonvoting shares for Gray television from 2002 through 2006. Gray Television is a small company (usually first or second decile of NYSE stocks) and the price discrepancies are larger. In late 2002 and early 2003, voting stock sold for at least 10% and as much as 40% more than the nonvoting stock. From mid-2004 through 2005, Gray Television voting stock sold at a discount to nonvoting shares. The discount was more than 10% on many days. By the end of 2006, the voting stock was again selling at a premium.

Fig. 2, Panel B uses a solid line to show the daily difference between the closing bid price of the Gray Television voting stock and the closing ask price of the nonvoting stock. In 2002 and early 2003, the difference was usually more than $1, and reached over $3. This means that if an investor could borrow the voting shares, he could sell them at the bid, use the proceeds to buy nonvoting shares with identical cash payouts, and keep at least $1 per share. The dashed line shows the daily difference between the closing bid price of the nonvoting stock and the closing ask price of the voting stock. For most of 2004 and 2005, this value was positive, so an investor could expect to receive more by selling a share of the nonvoting stock than he would pay for a share of the voting stock. In many cases this difference was more than $1. It seems unlikely that greater liquidity is valued this highly.

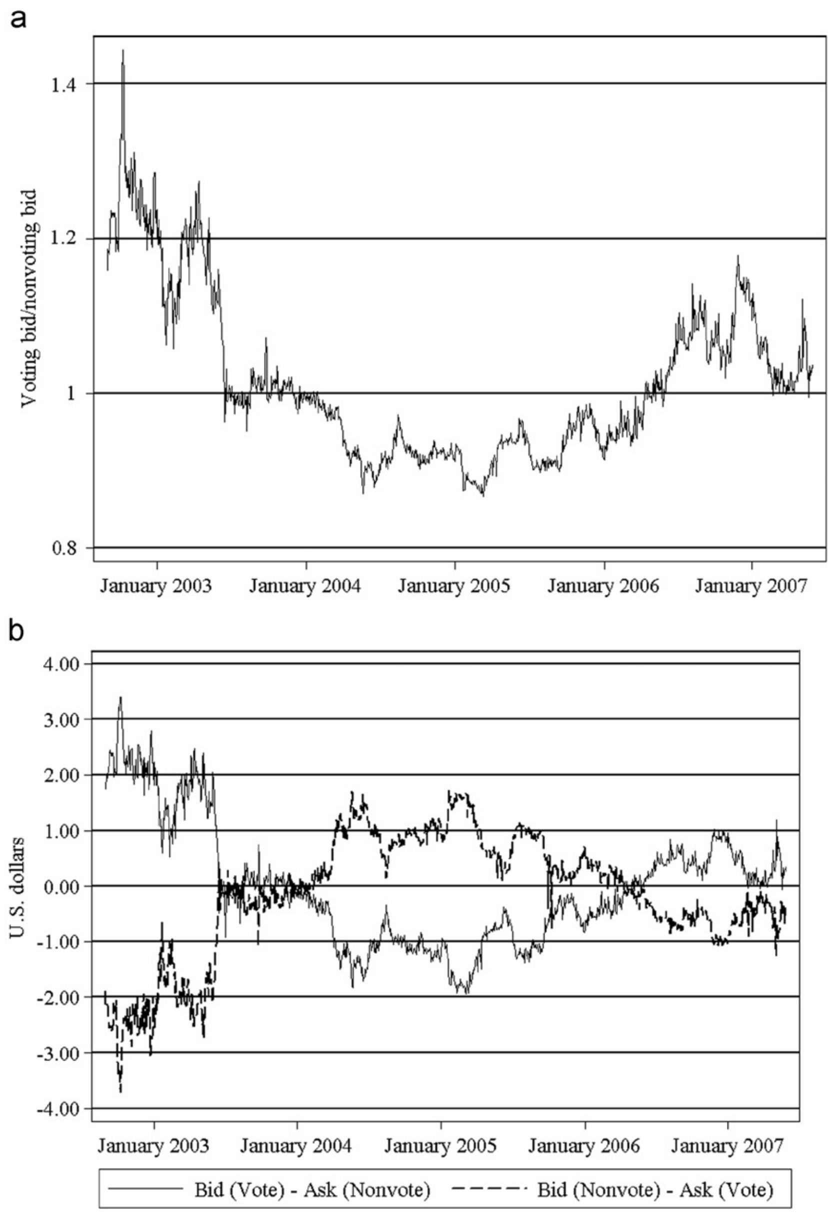

Fig. 2. Panel A shows the ratios of the closing bid price of Grey Television voting stock to the bid price of Grey Television nonvoting stock. Panel B shows the differences in prices of Grey Television voting and nonvoting shares.

More generally, if the price discrepancies are due to consistent differences in voting rights or liquidity, prices need not converge and trading rules that attempt to exploit price differences should not produce abnormal returns. We show that long–short positions that attempt to exploit these price discrepancies earn positive excess returns about 80% of the time. This suggests that, in the overwhelming majority of cases, price discrepancies indicate mispricings. So, while our trading rules are not optimal, they do produce abnormal returns and do allow us to study how investors trade in response to mispricings.

3. Sample

We identify all pairs of Center for Research in Securities Prices (CRSP) stocks that traded at the same time during 1993–2006, had the same first six characters in their Committee on Uniform Security Identification Procedures (CUSIP) numbers, but had different CRSP perm numbers. After discarding tracking stocks, we are left with an initial sample of 141 pairs of dual-class shares that traded on the New York Stock Exchange (NYSE), American Stock Exchange (Amex), or Nasdaq during 1993 through 2006. We discard pairs without TAQ data and pairs that do not have equal cash flow rights. If there are no times when the prices of both classes of shares exceed $5, we omit that pair of stocks as well. This leaves one hundred pairs of dual-class shares. In a handful of cases, there are more than two classes issued by one firm. If there are three classes of stock outstanding at the same time, there are three combinations of two classes and we count them as three pairs of dual-class shares.

The Appendix A lists each of the pairs of dual-class shares in our sample, along with the dates that both classes trade, the firm Standard Industrial Classification (SIC) code, the NYSE size decile of the voting stock, the NYSE size decile of the nonvoting stock, and the number of times the stock pair appears in one of our arbitrage positions. Many of the firms are small, but some are large and well known. They include Brown Forman Distillers, Reader's Digest, Comcast, and Continental Airlines. In total, our rules lead to arbitrage positions in 93 of the one hundred pairs of dual-class shares.

Table 1 provides a summary description of our sample. For each month over 1993 through 2006, we calculate the proportion of dual-class shares with data for that month that are listed on NYSE, Amex, and Nasdaq. We then average the proportions across the 168 months. Panel A reports that in an average month, 45.9% of the dual-class shares trade on the NYSE, 17.6% trade on the Amex, and 36.6% trade on Nasdaq. We calculate market capitalizations for all firms on the CRSP tapes each month over 1993 through 2006. For a firm with dual-class shares, firm size is the sum of the market capitalization of both classes of stock. In Table A1, the NYSE size decile is provided separately for each class of stock. We then divide all firms into deciles each month using NYSE size breakpoints and calculate the average proportion of dual-class shares in each decile across months. Dual-class shares are issued by firms of all sizes. Panel B shows that 22.8% of dual-class firms are in the smallest decile and 5.5% are in the largest decile. Even though most of our sample stocks trade on the Amex or on Nasdaq, over 30% of the firms are above the median size for NYSE stocks.

For brevity, we refer to the share class with fewer votes or that elects fewer members to the board of directors as nonvoting stock, but, as Panel C shows, only 39% have no votes. In most cases, the nonvoting stock has fewer votes, with 49% having one vote for every ten of the voting shares. In 20% of the cases, one class of shares elects more directors to the board than does the other class, even if, as in 7% of the pairs, both classes have the same number of votes per share for other matters.

One reason that prices of dual-class shares with equal cash flows could differ is differences in liquidity.

Table 1
A description of the dual-class shares sample. Each month, we first calculate the proportion of dual-class shares with data for that month that are listed on each exchange and the proportion in each NYSE size decile. Time series averages are then calculated across the 168 months from January 1993 through December 2006. A total of one hundred pairs of dual-class shares appear in the sample at least one month. New York Stock Exchange size decile breakpoints are calculated monthly. A * indicates that these are still dual-class shares but one class elects more directors.

New York Stock Exchange				American Stock Exchange					Nasdaq
Panel A: Time series mean proportion of dual class shares listed on each exchange									
45.9%				17.6%					36.6%
Small	2	3	4	5	6	7	8	9	Large
Panel B: Time-series mean proportion of dual-class firms in each NYSE size decile									
22.8%	14.0%	14.1%	10.3%	8.7%	6.5%	6.0%	7.1%	5.1%	5.5%
0		0–0.1		0.1			0.1–1		1
Panel C: Ratio of nonvoting to voting shares votes									
39%		6%		49%			8%		7%*
One class elects more directors									Same
Panel D: Directors elected by each class									
20%									80%

Table 2
The distributions of percentage spreads and turnover for voting and nonvoting shares. For each stock, the mean and median spreads are calculated across trading days. We then calculate the cross-sectional mean, 10th percentile, 25th percentile, median, 75th percentile, and 90th percentile of individual stock means and medians. For each stock, the distribution of daily stock turnover is calculated. Cross-sectional means of the percentiles are then calculated for voting and nonvoting shares. Cross-sectional distributions of individual stock daily mean and median price differences between the bid of one class and the ask of the other class are also computed, when the voting is convertible into nonvoting stock (Panel E) or not (Panel F).

Shares	Mean	10%	25%	Median	75%	90%
Panel A: Cross-sectional percentiles of stock mean spreads						
Voting shares	3.55%	0.29%	0.81%	2.05%	5.15%	8.46%
Nonvoting shares	2.40%	0.23%	0.48%	1.05%	3.42%	7.15%
Panel B: Cross-sectional percentiles of stock median spreads						
Voting shares	3.13%	0.22%	0.68%	1.81%	4.31%	7.71%
Nonvoting shares	2.04%	0.11%	0.33%	0.82%	3.05%	5.49%
Panel C: Cross-sectional percentiles of mean daily stock turnover						
Voting shares	0.25%	0.01%	0.04%	0.12%	0.36%	0.59%
Nonvoting shares	0.50%	0.06%	0.14%	0.32%	0.59%	0.98%
Panel D: Cross-sectional means of individual stock percentiles						
$\text{Bid}_{\text{Vote}}–\text{Ask}_{\text{Nonvote}}$	\$0.22	−\$1.11	−\$0.52	\$0.13	\$0.85	\$1.76
$\text{Bid}_{\text{Nonvote}}–\text{Ask}_{\text{Vote}}$	−\$0.96	−\$2.60	−\$1.59	−\$0.79	−\$0.13	\$0.42
Panel E: Cross-sectional means of individual stock percentiles, voting is convertible						
$\text{Bid}_{\text{Vote}}–\text{Ask}_{\text{Nonvote}}$	\$0.46	−\$0.79	−\$0.35	\$0.15	\$0.95	\$2.36
$\text{Bid}_{\text{Nonvote}}–\text{Ask}_{\text{Vote}}$	−\$1.40	−\$3.42	−\$1.94	−\$0.97	−\$0.43	−\$0.06
Panel F: Cross-sectional means of individual stock percentiles, voting is not convertible						
$\text{Bid}_{\text{Vote}}–\text{Ask}_{\text{Nonvote}}$	\$0.14	−\$1.23	−\$0.58	\$0.12	\$0.81	\$1.54
$\text{Bid}_{\text{Nonvote}}–\text{Ask}_{\text{Vote}}$	−\$0.80	−\$2.29	−\$1.47	−\$0.72	−\$0.02	\$0.59

Table 2 provides statistics on percentage bid-ask spreads and turnover, two measures of liquidity, for voting and nonvoting shares. For each firm, we calculate the mean and median closing bid-ask spread for voting and nonvoting stock across all days with quotes for both classes of shares. We then calculate cross-sectional percentiles of mean and median spreads for voting and nonvoting shares.

Panel A reports cross-sectional percentiles of mean spreads. Ten percent of the voting shares have mean percentage spreads of less than 0.29%, but 50% have mean spreads of 2.05% or more, and 10% have mean spreads of more than 8.46%. Nonvoting shares have narrower spreads. The median of the mean spread for nonvoting shares is only 1.05%, while the 90th percentile of mean spreads is just 7.15%. Panel B reports cross-sectional percentiles of individual stock median spreads. The mean of median spreads is 3.13% for voting shares but only 2.04% for nonvoting shares. The median of median spreads is 1.81% for voting stock but only 0.82% for nonvoting shares. Nonvoting shares are cheaper to trade.

Panel C provides the cross-sectional percentiles of mean daily turnover for voting and nonvoting stock. Some of the voting shares trade very little. Ten percent of voting shares have mean daily turnover of 0.01% or less. In these cases, some of the shares could turn over frequently, but a large proportion of the outstanding voting shares are held by controlling shareholders who hold positions for long periods. The 25th percentile of turnover for voting shares is 0.04% per day, or about 10% per year. The median turnover for voting stock is 0.12% per day, or about 30% per year. Nonvoting shares turn over more frequently. The 25th percentile of turnover for the nonvoting shares is 0.14% per day, or about 35% per year. The median turnover for nonvoting stock is 0.32% per day, or about 81% per year.

These differences in liquidity do not usually lead to higher prices for nonvoting shares in our sample. Instead, the voting shares typically have higher prices. For each stock and each day, we calculate the difference between the closing bid price of the voting stock and the ask price of the nonvoting stock as well as the difference between the closing bid price of the nonvoting stock and the ask price of the voting stock. We then compute the percentiles of these differences for each firm and calculate the means of the percentiles across firms.

Panel D reports cross-sectional means of the price differences. If the bid price of each class is always less than the ask price of the other, these differences would always be negative. Instead, we find that voting stock is often more expensive than nonvoting stock. On average, the median difference between the bid price of the voting stock and the ask price of the nonvoting stock is \$0.13. On average, the 75th percentile of the difference between the bid price of the voting stock and ask price of the nonvoting stock is \$0.85, and the 90th percentile of the difference is \$1.76. This indicates that for most firms, for a considerable portion of the time, an investor who owns voting stocks and does not reap any of the benefits of control would be better off selling those shares and buying nonvoting stock. The bid of the nonvoting stock does, on occasion, exceed the ask price of the voting shares. The mean of the 90th percentile of the differences is \$0.42. In these situations, investors are better off selling nonvoting shares and buying voting shares.

In some cases, voting shares can be converted into nonvoting shares at the holder's request. This minimizes transactions costs and makes it easier and cheaper to exploit underpricing of voting shares. Hence, we would expect to see fewer cases in which the price of the nonvoting shares exceeded the price of the voting shares when the latter was convertible. This is verified in Panel E, which shows the cross-sectional means of price differences for the 29 pairs of stocks with convertible voting shares. As expected, compared with Panel D, the voting stock is more likely to have a high price relative to the nonvoting stock. The bid of the nonvoting stock is now much less likely to exceed the ask of the voting stock. Though not reported in the table, the bid of the nonvoting stock exceeds the ask of the voting shares at least 10% of the time for only two of the 29 pairs that include convertible voting stock. In Panel F, we report the cross-sectional means of the stock percentiles of price differences when the voting stock is not convertible. Now, on average, 10% of the time the bid of the nonvoting stock exceeds the ask price of the voting stock by $0.59 or more.

The trading rules that we examine in this paper involve buying one class of shares and selling the other. Both positions are then closed out with trades when prices converge. If the voting class is convertible, and it is priced below the nonvoting shares, traders could exploit the mispricing with fewer trades. Panels E and F show that situations with cheaper voting stock become uncommon when the voting shares are convertible.

4. Do price differences indicate mispricing? Evidence from simple trading rules

Ultimately, we want to see how price gaps arise and how investors trade in response to them. First, we provide evidence that differences in prices of dual-class shares are mispricings. Discrepancies in prices of dual-class shares with identical cash flow rights are not necessarily indicative of mispricing, defined again as pricing differences that would lead to arbitrage opportunities in the absence of market frictions. If there are private benefits of control, voting shares could be overpriced relative to nonvoting shares, and the price gaps could last indefinitely. In this case, there should be two clienteles for the stock. Investors who are able to extract private benefits of control should hold the voting stock, and others should hold the cheaper nonvoting stock. Likewise, more liquid dual-class shares could sell for higher prices than the less liquid class indefinitely. In this case, we would expect the clientele that plans to hold shares for short periods to buy the more expensive and more liquid class, while the clientele that anticipates holding shares for long periods would buy the cheaper and less liquid shares.

If price discrepancies between dual-class shares are indicative of mispricing, the discrepancies should disappear over time. Furthermore, the price discrepancies should provide trading rules that produce abnormal profits, at least before frictions and trading costs. In this section, we examine the performance of trading rules of the following type: When the bid price of one class of shares exceeds the ask price of the other class by a specified percentage, buy the shares of the cheaper stock at the ask price and sell short the shares of the more expensive stock at the bid price. When the ask price of the sold shares converges to the bid price of the purchased shares, the position is closed by repurchasing the sold shares at the ask price and selling the purchased shares at the bid price. Our trading rules do not necessarily assume that dual-class shares are mispriced when there are price discrepancies. The dual-class shares could be mispriced when there is a price discrepancy. However, if differences in voting rights or liquidity meant that the classes had different values, they would be mispriced when the prices converge. Our strategy assumes that the share classes are mispriced either when there are price discrepancies or when the prices have converged.

To simulate the execution of these trading rules, we compare bid and ask prices of the two classes of stocks at the end of each two minute period. If prices diverge enough for the trading rule to trigger the establishment of a position, the buys and sells are assumed to take place at the quoted prices in effect two minutes later. Likewise, when prices converge, the trades are assumed to take place at the quotes prevailing two minutes later. If a stock is delisted, or the end of the sample period arrives with the position still open, it is assumed to be closed at the last available prices. For a given pair of dual-class shares, we maintain at most one long–short position at a time.

In some ways, our simulations are conservative. It takes far less than two minutes to execute a trade, and prices could move against the arbitrageur over the two minutes. Bacidore, Ross, and Sofianos (2003) find average exposure-to-execution time of 22.5 second for NYSE orders in August 1999. NASDAQ trades through the Small Order Execution System (SOES) had even shorter execution times. It is also possible to execute some of these trades within the spread instead of at quoted prices. These quotes are firm: they represent prices at which transactions could take place, but trades often occur at better prices. In particular, NYSE trades were often given price improvement during this time. In addition, we observe prices only at the end of two minute intervals. It is likely that we don't even spot many mispricings.

Assuming a two minute delay between observing a trading opportunity and trading helps to ensure that our apparent mispricings are not due to data errors. In addition, we clean the data in a number of ways to ensure that bad data does not contaminate our results. Quotes are omitted if a stock's bid price is equal to or greater than its own ask price, or if the ask price is more than four times the bid price. Quotes are also discarded if either the bid or ask price increases or decreases 25% or more in a two minute period. Likewise, quotes are discarded if the bid-to-bid or ask-to-ask return of one class of shares exceeds the bid-to-bid or ask-to-ask return of the other by 25% or more over two minutes. Observations are also omitted if the bid price of one share class exceeds the bid price of the other by 50% or more. We do not establish or close positions during the first four minutes of the day. Some NYSE or Amex stocks have Nasdaq quotes during the first four minutes that are out of line with quotes that appear once the primary exchange for the stock opens. Finally, we do not open a position if either class of shares has a price under $5. These stocks are often more difficult

Table 3
Median turnover, dollar volume, and market capitalization for voting and nonvoting stock at the time when arbitrage positions are established. Daily turnover and daily dollar volume are estimated over the 20 trading days before the arbitrage position is established. Daily volume is in thousands of dollars. Size is the market capitalization of the class of stock, not the firm. It is estimated by multiplying the closing price of the shares by the number of shares outstanding the day before the arbitrage position is established and is expressed in millions of dollars. Volume, shares outstanding, and closing prices are from the Center for Research in Securities Prices.

	Number	Median daily turnover		Median daily volume		Median capitalization	
		Nonvoting	Voting	Nonvoting	Voting	Nonvoting	Voting
Vote/nonvote > 1.01	2,011	0.0022	0.0005	873	52	376	128
Nonvote/vote > 1.01	1,676	0.0024	0.0006	1,020	65	369	124
Vote/nonvote > 1.025	955	0.0018	0.0005	383	41	237	84
Nonvote/vote > 1.025	665	0.0021	0.0007	462	42	268	73
Vote/nonvote > 1.05	464	0.0016	0.0006	263	43	198	76
Nonvote/vote > 1.05	291	0.0018	0.0007	336	41	254	61
Vote/nonvote > 1.10	220	0.0016	0.0006	308	43	198	78
Nonvote/vote > 1.10	92	0.0018	0.0006	371	23	276	54

to short than other shares, and the short-seller usually is asked to put up additional margin.

These simulations are not intended to test whether abnormal returns can actually be earned by arbitrageurs. They are instead intended to test two things. First, whether the price discrepancies indicate that the shares are mispriced relative to each other. Second, whether an investor who was trading anyway, and for whom there was therefore no marginal cost of buying or selling a dual-class share, could profitably exploit information in the price discrepancies.

Table 3 provides median daily turnover, daily dollar volume, and firm size for stocks at the time positions are initiated to exploit price discrepancies. Turnover, defined as the proportion of shares traded, and dollar volume are calculated over the 20 days prior to the date the position is initiated. The sizes of the voting and nonvoting share classes are estimated on the day prior to the establishment of the position by multiplying the outstanding shares by the closing price of the stock. The first two rows describe turnover, volume, and size for dual-class shares when trading rules are triggered by price discrepancies of 1% or more. We report statistics separately for cases in which the voting stock has the higher price and instances in which the nonvoting stock has the higher price. Price gaps of this magnitude are common. Over the 14 year sample period, we find 3,687 opportunities to trade on price discrepancies of 1% or more. In 2,011, or 54.5%, of the 3,687 cases, the voting stock is overpriced relative to the nonvoting stock. Voting shares turn over about one fourth as frequently as nonvoting shares. The median capitalization of voting shares is a only about a third as large as the capitalization of the nonvoting stock. The combination of low turnover and small capitalizations implies that volume is low for voting shares. Median daily dollar volume is almost 20 times larger for nonvoting shares than for voting shares.

Results are similar when we look at the characteristics of stocks that would be traded with different price discrepancies as investment triggers. In all cases, voting shares tend to have lower turnover, lower volume, and smaller size than nonvoting shares. In all cases, the long–short position is more likely to consist of a short position in the voting stock than in the nonvoting shares.

Table 4 describes abnormal returns earned by the trading rules. The first three rows report results for the rule in which positions are established when the bid price of one share exceeds the ask price of the other by at least 1%. To calculate returns, we follow Mitchell, Pulvino, and Stafford (2002) and assume that arbitrageurs are required to put up 50% of the value of the long position and 50% of the value of the short position when the arbitrage position is established. Each day, we calculate returns to our open positions using TAQ quotes and dividends from CRSP.

For each day over 1993 to 2006, we calculate an equal-weighted average return on all positions established by each rule. We calculate an excess return for the portfolio each day by subtracting the return on one month treasury bills that day. We then regress the excess returns on the market excess returns, the differences between the returns of small and big firms (SMB), the differences between the returns of high and low book-to-market stocks (HML), and the momentum factor. All daily factor returns, along with the returns of one-month Treasury bills, are obtained from Ken French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/. In effect, we are estimating the abnormal returns earned by an arbitrageur who invests equal amounts in long–short positions in each arbitrage opportunity (and rebalances daily).

The first row of the table shows the coefficients and intercept from the regression when positions are initiated when the price discrepancy between one stock's bid price and the other's ask price is at least 1%. The intercept from this regression is 0.0014, with a robust t-statistic of 13.49. This indicates that the portfolio of long–short positions earns a return of 14 basis points per day (which compounds to 38.3% per year) after adjusting for risk using the three Fama and French (1992) factors and momentum. Coefficients on all of the factors are relatively small, as one would expect with long–short positions, and the R-square for the regression is only 1.6%. The coefficient on the market excess return is negative. These positions carry little or no systematic risk.

The positive and significant intercept from this regression has two important implications. First, the price differences between the share classes at least in part represent mispricing. If the difference in votes made one

Table 4

Regressions of daily excess returns of the long–short positions in dual-class shares on Fama and French factors and momentum. Long–short positions are initiated with a two-minute delay when the bid price of one class of shares exceeds the ask price of the other class by 1%, 2.5%, 5%, or 10%. Positions are closed with a two-minute delay when the bid price of the purchased stock is equal to or greater than the ask price of the sold stock. Equal-weighted portfolios of the long legs and of the short legs of all open long–short positions are formed each day, and the excess returns of these long portfolios and short portfolios are regressed on the Fama and French factors and momentum. SMB is the small minus big factor and HML is the high minus low book-to-market factor. Excess returns are calculated by subtracting the one-month Treasury bill return from the portfolio return. Heteroskedasticity-consistent t-statistics are shown in parentheses.

Position	Intercept	$R^{Mkt}-R^f$	SMB	HML	Momentum	R^2
(Bid/ask)−1 > 1%	0.0014	−0.0748	−0.0605	−0.0273	0.0373	0.0156
	(13.49)	(−4.08)	(−2.98)	(−0.95)	(2.23)	
Long leg only	0.0007	0.6974	0.4526	0.3707	−0.1442	0.5537
	(7.84)	(49.04)	(23.96)	(15.32)	(−9.51)	
Short leg only	0.0005	−0.6627	−0.4426	−0.3434	0.1584	0.5185
	(5.64)	(−34.85)	(−20.67)	(−11.23)	(8.91)	
(Bid/ask)−1 > 2.5%	0.0011	−0.0897	−0.0630	−0.0403	0.0420	0.0187
	(10.76)	(−4.55)	(−2.91)	(−1.28)	(2.40)	
Long leg only	0.0006	0.7139	0.4732	0.3751	−0.1568	0.5475
	(6.20)	(49.39)	(23.75)	(15.15)	(−9.82)	
Short leg only	0.0004	−0.7104	−0.4687	−0.3676	0.1808	0.5229
	(3.99)	(−35.71)	(−20.25)	(−11.13)	(9.55)	
(Bid/ask)−1 > 5%	0.0009	−0.1055	−0.0808	−0.0575	0.0528	0.0261
	(8.99)	(−6.15)	(−3.81)	(−2.20)	(3.30)	
Long leg only	0.0005	0.7297	0.4995	0.3867	−0.1719	0.5324
	(4.66)	(48.48)	(23.40)	(15.14)	(−10.36)	
Short leg only	0.0003	−0.7452	−0.5207	−0.3972	0.2063	0.5612
	(3.41)	(−41.72)	(−23.20)	(−14.11)	(12.02)	
(Bid/ask)−1 > 10%	0.0008	−0.1225	−0.1062	−0.0509	0.0519	0.0326
	(7.16)	(−6.91)	(−4.84)	(−1.86)	(3.21)	
Long leg only	0.0004	0.7574	0.5285	0.4460	−0.1654	0.4966
	(3.44)	(46.31)	(23.07)	(16.12)	(−9.64)	
Short leg only	0.0004	−0.7848	−0.5658	−0.4419	0.1949	0.5190
	(3.25)	(−39.67)	(−23.34)	(−14.64)	(11.05)	

class of shares more valuable than the other, we would expect the difference in prices to be permanent. We would not expect prices to predictably converge. Likewise, we would not expect a difference in prices that is due to differences in liquidity to disappear in a predictable way.

A second implication of the abnormal returns is that some investors could benefit from trading on these price discrepancies and their trading should, eventually, bring prices into line even without arbitrage. Investors who are going to buy a stock and bear trading costs anyway would do well to buy dual-class shares that are underpriced relative to the other class. An investor who is going to sell shares from his portfolio would benefit from selling shares that are overpriced relative to the other class of shares. Preferences for buying undervalued shares and selling overvalued shares should bring prices into line eventually even if trading costs and frictions preclude long–short arbitrage trading.

The next row of the table reports coefficients from a regression of the abnormal returns of the long leg of the positions on the Fama and French factors. If short sale restrictions are behind the abnormal returns earned by the long–short positions, we might expect higher priced shares to be overpriced, while shares of the lower priced class could be correctly priced. In this case, we would see abnormal returns to the short leg of the position, but not to the long leg. That is not what we find, however. The intercept from the regression is positive, is highly significant, and indicates that the long position earns abnormal returns of seven basis points per day (which compounds to 19.3% per year). This finding again raises the question of why the price discrepancies are not eliminated through normal trading. Investors who are considering buying shares for their portfolio earn larger risk-adjusted returns by adding shares of underpriced dual-class shares to their portfolios.

As expected for a long position, the coefficient on the market excess return is 0.70, and highly significant. The coefficients on SMB and HML are also positive and significant while the coefficient on the momentum factor is negative. The R-square of the regression is 0.55. In contrast, the R-square of the regression of long–short position returns on the four factors is only 0.016.

The next row of the table reports coefficients from the regression of the daily returns of the short positions on the four factors. The intercept coefficient is positive. The more expensive of the dual-class shares are overpriced and shorting them produces abnormal returns of five basis points per day. That the intercept is nearly equal for the regressions for long and short position returns suggests that the share classes are, on average, equally over and underpriced. As expected, the coefficient on the market

Table 5
Regressions of daily excess returns of the long–short positions in dual-class shares on Fama–French factors and momentum for pairs with convertible and non-convertible voting stock. Results are reported separately for the 71 with pairs with voting stock that is not convertible and for the 29 pairs with convertible voting stock when the position in the voting shares long and when it is short. SMB is the small minus big factor and HML is the high minus low book-to-market factor.

	Intercept	$R^{Mkt}–R^{f}$	SMB	HML	Mom.	R^2	Days
(Bid/ask) – 1 > 1%							
Not convertible	0.0011	−0.1518	−0.0986	−0.0702	0.0506	0.0417	3,527
	(9.78)	(−7.06)	(−4.31)	(−1.99)	(2.68)		
Long convertible	0.0029	−0.3757	−0.0376	−0.2099	0.2552	0.0189	2,838
	(5.36)	(−2.62)	(−0.35)	(−1.14)	(2.54)		
Short convertible	0.0011	0.2155	0.0874	0.1506	−0.0357	0.0174	3,527
	(5.00)	(5.40)	(1.92)	(2.35)	(−0.95)		
(Bid/ask) – 1 > 2.5%							
Not convertible	0.0009	−0.1694	−0.1019	−0.0774	0.0578	0.0502	3,527
	(7.97)	(−7.36)	(−4.25)	(−1.99)	(2.95)		
Long convertible	0.0025	−0.4495	−0.0295	−0.2632	0.2973	0.0187	2,259
	(3.16)	(−2.34)	(−0.17)	(−1.05)	(2.59)		
Short convertible	0.0009	0.2039	0.1013	0.1117	−0.0603	0.0134	3,521
	(3.32)	(3.75)	(1.86)	(1.35)	(−1.45)		
(Bid/ask) – 1 > 5%							
Not convertible	0.0007	−0.1826	−0.1180	−0.0863	0.0665	0.0664	3,527
	(6.89)	(−9.43)	(−5.34)	(−2.90)	(4.09)		
Long convertible	0.0014	−0.5153	−0.1791	−0.3552	0.2803	0.0178	1,528
	(1.19)	(−2.20)	(−0.81)	(−1.14)	(2.26)		
Short convertible	0.0007	0.1947	0.0865	0.1178	−0.0526	0.0116	3,474
	(2.62)	(3.28)	(1.48)	(1.32)	(−1.19)		
(Bid/ask) – 1 > 10%							
Not convertible	0.0006	−0.1995	−0.1617	−0.0916	0.0596	0.0667	3,527
	(5.37)	(−9.48)	(−7.07)	(−2.77)	(3.56)		
Long convertible	0.0008	−0.5442	−0.2876	−0.4163	0.3452	0.0208	1,072
	(0.49)	(−2.08)	(−1.08)	(−1.13)	(2.48)		
Short convertible	0.0006	0.1550	0.1008	0.1225	−0.0470	0.0066	3,465
	(2.10)	(2.72)	(1.67)	(1.45)	(−1.06)		

excess return is negative and highly significant. Coefficients on SMB and HML are also negative and significant, while the coefficient on momentum is positive.

The remainder of the table provides regression estimates for portfolio returns when the positions are initiated when price discrepancies reach 2.5%, 5%, or 10%. In all cases, intercepts are positive and highly significant. Moreover, they are positive and significant for both the long and short legs of the positions. In general intercepts and, hence, daily abnormal returns decrease as the price discrepancy required to initiate a position increases. Positions with larger initial price discrepancies take longer to converge, thus yielding smaller returns per day. We rerun the regressions for each half of the sample period (1993 through 1999 and 2000 through 2006) and obtain nearly identical results in each subperiod. We also use price discrepancies of \$0.50, \$0.75, \$1.00, and \$2.00 as trading triggers and obtain very similar results.

So far, we have not distinguished between returns from long–short positions in dual class pairs with convertible voting stock from returns to long–short positions when the voting stock is not convertible. In Table 5, we repeat the time series analysis of Table 4, but now we separately examine returns for mispricings when voting shares are convertible and overpriced, when voting shares are convertible and are the underpriced class, and when the mispricing involves one of the 71 pairs of dual class shares in which the voting share is not convertible.

The first three rows examine returns to long–short positions when the mispricing required to trigger a position is that the bid of one share class exceeds the ask of the other by at least 1%. The first row reports regression coefficients as in Table 4 when the voting shares are not convertible. The intercept of 0.0011 indicates that these positions earn risk-adjusted abnormal returns of 11 basis points per day. The last column of the table reports the number of days out of 3,527 with at least one long–short position of this type open. Every day, there was at least one open position involving a dual class pair with voting stock that was not convertible.

The next row reports regression results for daily returns to long–short positions when the voting stock is convertible and the convertible voting shares are underpriced relative to the nonvoting shares by at least 1%. We would expect this to be a somewhat unusual occurrence. These underpriced voting shares can be converted into higher priced nonvoting shares without paying commissions and without waiting for price convergence. In fact, these mispricings are relatively uncommon. There are only 2,838 days where there is at least one long–short position of this type. We would also expect prices to converge quickly in these circumstances and we find that the daily abnormal return is 29 basis points. This compounds to over 100% per year. The next row reports regression results for daily returns to long–short positions when the voting stock is convertible and the nonvoting shares are underpriced relative to the convertible voting shares by at least 1%. These price discrepancies are more common. There is at least one long–short position of this type open every day of the sample period. When the nonvoting shares are underpriced, abnormal returns average only 11 basis points per day, the same as long–short positions when the voting stock is not convertible.

The remainder of the table provides abnormal returns for long–short positions when different price discrepancies are used to trigger long–short positions. The results remain qualitatively the same. In each case, the abnormal returns when voting stock is convertible and overpriced are the same as the abnormal returns to long–short positions when the voting stock is not convertible. When the long–short strategy involves a long position in convertible shares, the abnormal returns per day are much higher. These cases are relatively rare, though, and there are many dates in our sample period without any positions that are long underpriced convertible voting shares. Hence, when price discrepancies of 5% or 10% are used as triggers, intercepts in the long convertible regression are not significant.

Our trading rules are simple, not optimal. We initiate positions when a price discrepancy between voting and nonvoting shares emerges, but the shares need not have equal value. The extra votes of voting shares could command a premium when control is at stake. To examine this more closely we look at returns to long–short positions that involve selling voting shares around annual meetings and at other times. If the value of voting shares is temporarily high because votes are valuable, we should find particularly large returns before the record dates on which shares must be owned to vote at annual meetings.

We collect 771 record dates from EDGAR proxy statements. In 15 instances, there is no proxy statement in a given year and no meeting announced for more than 20 months. This represents less than 2% of the total expected sample of record dates. To mitigate any errors caused by missing proxy statements for meetings that took place, we include only days in our non-meeting times that are between 10 and 240 days from a sample record date. This excludes from the non-meeting times dates that are approximately one year (252 trading days) from a record date. We define the annual meeting period as the ten trading days prior to a record date and the record date itself. To minimize the potential impact of investors unwinding voting share positions, days are included in our non-meeting times only if they are at least ten days after the record date. Thus, the number of strategies in this section is slightly lower than the number of strategies reported in Table 3. We then calculate time series abnormal returns for long–short positions that are initiated during the meeting period and at other times. We report the returns to positions that involve selling overpriced voting shares in Table 6. We also include time intervals containing two proxy fights in the meeting periods. The proxy fights were to elect members to the board of directors of Benihana (announced August 10, 2000) and to the board of directors of Blockbuster Inc. (announced April 7, 2005). For brevity, we refer to periods leading to record dates as meeting periods, but these references should be interpreted to include the two proxy fights as well.

Panel A provides descriptive statistics on the proportion of long–short positions that have a record date while they are open. Only a small portion of the long–short positions examined in Table 4 are open when a record date (or proxy fight announcement date) occurs. Only 8.03% of the positions opened with a 1% price discrepancy are open over a record date. The proportion rises as the initial price discrepancy increases because the holding period length increases with the initial price discrepancy. Even with a 10% initial price discrepancy though, only 38.52% of the open positions include a meeting date. In general, a somewhat higher proportion of long–short positions that are long the nonvoting stock (voting stock is overpriced) include a record date for an annual meeting. This would occur if the price of voting shares was bid up before meetings and proxy fights. As a whole, Panel A demonstrates that changes in the value of votes around meetings is unlikely to explain much of the abnormal returns to our long–short strategy—only a small proportion of our positions includes the record date for annual meeting voting.

Panel B examines the profitability of long–short positions initiated in the 11 days leading up to and including the record dates and at other times. By focusing our attention on positions that are initiated during 11 days ending in the record date, instead of all positions that include a record date as in Panel A, we ensure that we measure returns to implementable strategies. If price discrepancies were driven by high vote values prior to the annual meeting, we would expect voting shares to be overpriced relative to nonvoting shares. Hence we restrict our attention to positions in which the voting shares are the short leg and the nonvoting shares are the long leg. The first two rows of the table report results when a price discrepancy of 1% triggers the long–short position. The point estimate of the daily abnormal returns for positions initiated before record dates is 18 basis points, bigger than the 11 basis points for similar positions established at other times. When we restrict attention to positions initiated in the days before record dates, there are fewer positions and only 891 days when at least one position is open. As a result, the average abnormal return on the long–short positions established prior to meetings is not statistically significant. Daily abnormal returns for positions that are long nonvoting shares and short voting shares are somewhat smaller for positions established prior to meetings when a 2.5% price discrepancy or a 5% discrepancy are used to trigger trades. With the 2.5% trigger, the abnormal return is 17 basis points per day. A 5% trigger generates daily abnormal returns of 16 basis points. Both of these are larger than the returns of positions generated using the same rules but initiated at other times. Because of the small number of days with established positions, abnormal returns for positions established before meeting dates are less significant statistically.

Table 6

Regressions of daily excess returns of the long–short positions in dual-class shares on Fama and French factors and momentum before annual meetings and proxy fights and at other times. There are 771 annual meetings and two proxy fights in our sample. We obtain the announcement date and end date for proxy fights from Securities Data Corporation. The proxy fight period is assumed to extend from ten trading days before the announcement through the ending date. The before meeting period is assumed to last from ten trading days before the record date to vote at the annual meeting through the record date. In Panel A, the meeting or proxy fight is counted as included in the long–short position holding period if the record date occurs or a proxy fight is announced while the long–short position is in effect. In Panel B, positions are designated as before meetings if they are initiated within ten days before the record date to vote at the meeting. Other times include positions initiated at other times. Meeting periods also include, for two proxy fights, the days from the announcement of the proxy fight through its resolution.

240 day non-meeting period Record date	10-day record date period	10 days skipped	240 day non-meeting period

Panel A. Long-short positions that include meetings or proxy fights

	Number of positions			Proportion including record dates		
Initial price discrepancy	All	Voting long	Nonvoting long	All	Voting long	Nonvoting long
1%	3,140	1,444	1,696	0.0803	0.0568	0.1002
2.5%	1,400	582	818	0.1443	0.1031	0.1736
5%	654	254	400	0.2339	0.1732	0.2725
10%	270	76	194	0.3852	0.3290	0.4072

Panel B. Regressions of returns to long-short positions that are long the nonvoting stock on the Fama-French factors and momentum

	Intercept	$R^{Mkt}-R^{f}$	SMB	HML	Mom.	R^2	Days
(Bid/ask)−1 > 1%							
Before meetings and proxy fights	0.0018	0.0887	0.1279	0.1074	0.0436	0.0022	891
	(2.31)	(0.99)	(0.97)	(0.63)	(0.49)		
Other times	0.0011	0.0075	−0.0260	0.0028	0.0237	0.0008	3,451
	(7.31)	(0.29)	(−0.95)	(0.06)	(0.99)		
(Bid/ask)−1 > 2.5%							
Before meetings and proxy fights	0.0017	−0.0097	0.0648	−0.0759	0.0603	0.0028	823
	(2.17)	(−0.09)	(0.44)	(−0.43)	(0.65)		
Other times	0.0009	−0.0098	−0.0323	−0.0125	0.0261	0.0008	3,446
	(5.62)	(−0.33)	(−1.05)	(−0.25)	(1.08)		
(Bid/ask)−1 > 5%							
Before meetings and proxy fights	0.0016	0.0912	−0.0418	−0.0597	0.0221	0.0026	661
	(1.55)	(0.70)	(−0.22)	(−0.21)	(0.22)		
Other times	0.0008	−0.0411	−0.0439	−0.0377	0.0338	0.0025	3,455
	(5.13)	(−1.59)	(−1.56)	(−0.92)	(1.55)		
(Bid/ask)−1 > 10%							
Before meetings and proxy fights	0.0001	−0.2644	−0.1517	−0.1116	0.0765	0.0157	231
	(0.42)	(−6.30)	(−3.05)	(−1.62)	(2.14)		
Other times	0.0021	0.0309	−0.0282	−0.3618	0.1799	0.0043	3,456
	(2.02)	(0.10)	(−0.10)	(−1.01)	(0.56)		

There are two lessons to be drawn from the results of Table 6. First, returns to strategies that involve selling overpriced voting shares are higher before meeting record dates and during proxy fight than at other times. This suggests that the value of the votes is particularly high during these periods and long–short positions that involve selling voting shares are particularly profitable at these times. These differences, however, are not statistically significant. Second, the long–short strategies also work during periods when votes are less valuable.

In Table 7, we report coefficients and intercepts for regressions of portfolio returns on the Fama and French factors and momentum, but this time we report them separately in which cases where the voting shares are the position's long leg and cases in which the nonvoting shares are the position's long leg. The important result in Table 7 is that abnormal returns are positive and highly significant regardless of whether voting or nonvoting shares are held long. This implies two things. First, differences in liquidity do not explain the returns of the arbitrage portfolios. As we have shown, nonvoting shares are typically much more liquid than voting shares. If the long–short portfolios consisted of long positions in illiquid voting shares and short positions in liquid nonvoting shares, their abnormal returns could be construed as compensation for providing liquidity. This does not appear to be the case though, as abnormal returns are similar regardless of whether the liquid or illiquid shares are held long.

Second, Table 7 provides additional evidence that short-sale restrictions are not responsible for the price gaps. If shares are impossible to borrow, or can be borrowed only at a high cost, the overpriced class of shares may remain overpriced for long periods of time while the other class of shares trades at its true value. Voting shares are typically less liquid and more difficult to short than nonvoting shares. Table 7 indicates, though, that the long–short positions provide abnormal returns regardless of whether the short leg of the position is the difficult to short voting stock or the much easier to short nonvoting stock.

The remainder of the table presents regression results for the returns of the long and short portfolios when positions are initiated with price discrepancies of 2.5%, 5%, and 10%. Long positions earn positive abnormal returns regardless of which rule is used. This again suggests that price discrepancies in dual-class shares are not an artifact of short-selling restrictions. For each trading rule, daily abnormal returns of long and short positions are roughly equal. The magnitude of the daily abnormal returns declines from between 12 and 17 basis points to between seven and eight basis points as the initial price discrepancy increases from 1% to 10%. Prices tend to converge more slowly when the initial difference is large. It seems likely that large price differences are justified by valuable differences in control rights or liquidity.

We argue that even without arbitrage trading, the prices of dual-class shares should eventually converge as investors who are purchasing stocks should add underpriced dual-class shares to their portfolios, while investors who are selling stocks out of their portfolios benefit from selling overpriced dual-class shares. This suggests that it is worthwhile to examine the returns to individual dual-class share positions instead of returns to a strategy of buying all underpriced dual-class shares while selling all overpriced shares.

In Table 8, we report the distribution of returns across all the individual positions formed by purchasing shares of an underpriced dual-class and selling shares of the overpriced class. As before, we initiate a long–short position when the bid price of shares of one class exceeds the ask price of the other by 1%, 2.5%, 5% or 10%. Execution is delayed by two minutes. Each position is closed when the bid price of the class of shares that had been purchased equals the ask price of the shares that had been sold short. Trade executions are assumed to be delayed two minutes when positions are closed. All transactions are assumed to take place at the National Best Bid and Offer (NBBO) prices. As before, returns are calculated assuming that investors put up half of the money for the long position and half the money for the short position.

The first row of Table 8 shows that, over the sample period, a total of 3,687 price discrepancies occur in which the bid price of the higher priced class of shares exceeds the ask price of the lower priced class of shares by at least 1%. Of these, 3,025, or 82.0%, provide profitable trading opportunities. Trades can lose money for two reasons. First, our simulations include a two-minute delay between submission and execution of orders. Prices can and do change over these short intervals. Second, if prices have not converged by the time one or both of the share classes is delisted, we assume positions are closed out at the last CRSP price. Likewise, we assume all positions open at the end of our sample period are closed out at closing prices at the end of 2006. The mean return of the 3,687 trades is 1.26%, and the median is 1.37%.

A bigger issue is whether the price discrepancies converge fast enough to allow abnormal returns to be earned on the money invested in long–short positions. The second row of the table shows the distribution of the returns net of one-month Treasury bill returns for the holding period. Daily Treasury bill returns are calculated assuming that one-month treasury bill returns are the same each day of the month. If a position is established or closed during a day, we subtract the interest for the entire day to calculate excess returns. Results reported earlier in this paper indicate that there is little or no systematic risk to these long–short positions, so returns net of Treasury bill returns can be considered abnormal returns. On average, returns exceed Treasury bills over the holding period by 0.71%. The difference is highly significant, with a t-statistic of 7.45. The median difference is 1.17%. Of the 3,687 positions, 77.2%, or 2,848 provide larger returns than Treasury bills. Investors who are adding stocks to their portfolio or diminishing their holdings almost always profit by exploiting price discrepancies for dual-class shares.

There is a wide range of holding periods for different positions. Hence, the next row of Table 8 reports the

Table 7
Regressions of daily excess returns on Fama–French factors and momentum for long–short positions in dual-class shares when voting or nonvoting shares are held long. Long–short positions are initiated with a two-minute delay when the bid price of the nonvoting (voting) class of shares exceeds the ask price of the voting (nonvoting) shares by 1%, 2.5%, 5% or 10%. Positions are closed with a two-minute delay when bid price of purchased stock is equal to or greater than the ask price of the sold stock. Equal-weighted portfolios of all open long–short positions are formed each day, and the excess returns of these portfolios are regressed on the Fama and French factors and momentum. SMB is the small minus big factor and HML is the high minus low book-to-market factor. Excess returns are calculated by subtracting the one month Treasury bill return from the portfolio return. Robust *t*-statistics are in parentheses.

	Intercept	$R^{Mkt}-R^{f}$	SMB	HML	Mom.	R^2
(Bid/ask)−1 > 1%						
Long nonvoting	0.0012	0.0056	−0.0165	−0.0037	0.0230	0.0007
	(9.11)	(0.23)	(−0.62)	(−0.09)	(1.01)	
Long voting	0.0017	−0.2310	−0.1145	−0.0587	0.0554	0.0774
	(13.54)	(−11.16)	(−4.19)	(−1.80)	(2.74)	
(Bid/ask)−1 > 2.5%						
Long nonvoting	0.0011	−0.0048	−0.0102	−0.0120	0.0273	0.0007
	(7.75)	(−0.17)	(−0.37)	(−0.26)	(1.19)	
Long voting	0.0013	−0.2643	−0.1233	−0.0829	0.0594	
	(9.25)	(−11.39)	(−3.82)	(−2.18)	(2.57)	
(Bid/ask)−1 > 5%						
Long nonvoting	0.0009	−0.1055	−0.0808	−0.0575	0.0528	0.0261
	(8.99)	(−6.15)	(−3.81)	(−2.20)	(3.30)	
Long voting	0.0010	−0.2755	−0.1525	−0.1119	0.0758	
	(6.00)	(−11.13)	(−4.56)	(−2.99)	(3.16)	
(Bid/ask)−1 > 10%						
Long nonvoting	0.0008	−0.0448	−0.0458	−0.0101	0.0339	0.0043
	(5.97)	(−2.10)	(−1.72)	(−0.30)	(1.70)	
Long voting	0.0007	−0.3022	−0.2042	−0.1252	0.0873	0.0487
	(3.25)	(−9.67)	(−5.30)	(−2.58)	(3.11)	

Table 8
The distribution of holding period excess returns across long–short positions. Long–short positions are initiated with a two-minute delay when the bid price of one class of shares exceeds the ask price by 1%, 2.5%, 5%, or 10%. This table describes the distribution of holding period returns, returns net of Treasury bills, and holding periods. Positions are closed with a two minute delay when the bid price of purchased stock is equal to or greater than the ask price of the sold stock.

Initial difference	Variable	Mean	*t*-statistic	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	Number of positions	Number > 0
1%	*Return*	1.26%	(14.97)	−0.78%	0.53%	1.37%	2.16%	3.36%	3,687	3025
	Return—T-bills	0.71%	(7.45)	−1.49%	0.17%	1.17%	1.92%	3.05%	3,687	2,848
	Ret—T-bills per day	0.37%	(15.99)	−0.13%	0.01%	0.17%	0.53%	1.16%	3,687	2,848
	Holding days	33		0	1	4	15	55	3,687	3,169
2.5%	*Return*	2.88%	(15.38)	0.31%	2.01%	3.03%	4.08%	5.81%	1,620	1,472
	Return—T-bills	1.80%	(8.54)	−1.62%	1.26%	2.64%	3.63%	5.19%	1,620	1,373
	Ret—T-bills per day	0.62%	(12.54)	−0.02%	0.03%	0.21%	0.69%	1.56%	1,620	1,373
	Holding days	60		1	3	10	38	136	1,620	1,512
5%	*Return*	5.22%	(14.45)	1.48%	4.37%	5.58%	6.81%	9.09%	755	702
	Return—T-bills	3.28%	(7.94)	−2.69%	2.52%	4.82%	6.19%	8.19%	755	641
	Ret—T-bills per day	0.80%	(7.95)	−0.01%	0.03%	0.16%	0.69%	1.64%	755	641
	Holding days	104		2	7	26	90	321	755	724
10%	*Return*	9.75%	(12.42)	4.92%	9.22%	10.37%	11.99%	15.05%	312	293
	Return—T-bills	6.13%	(6.77)	−3.92%	3.70%	8.82%	10.61%	14.41%	312	261
	Ret—T-bills per day	1.14%	(4.78)	−0.01%	0.02%	0.14%	0.44%	1.57%	312	261
	Holding days	213		5	22	71	222	629	312	302

distribution of returns net of Treasury bills per day. The mean is 37 basis points per day, while the median across all 3,687 positions is 17 basis points per day. This is different from the 12 basis points per day abnormal return in Table 4. Here we are weighting each position equally In Table 4, we weight each day equally.

The fourth row of Table 8 shows the distribution of holding periods. It would certainly seem that these abnormal returns would provide investors with strong incentives to shed higher priced dual-class shares and to load up on the lower priced shares. Nevertheless, 3,169 of 3,687, or 86.0%, of the price discrepancies fail to converge the same day. When the initial price discrepancy is 1%, the median time to convergence is four days and the mean is 33 days.

This analysis is replicated in the rest of Table 8 using price discrepancies of 2.5%, 5%, and 10% as triggers to establish positions. As the initial price discrepancies are increased, the mean and median returns, and returns in excess of Treasury bill returns increase. When a 10% price difference is required before initiating a position, the mean return on the position reaches 9.75%, while the mean return net of Treasury returns is 6.13%. The proportion of positive returns and positive returns net of Treasury returns also increases as larger price discrepancies are required.

The average holding period also increases, though. The 1.26% mean return for the price discrepancy of 1% is earned over an average holding period of 33 days. The 9.75% mean return for the price discrepancy of 10% is earned over an average holding period of 213 days. The median daily return in excess of Treasury bills falls from 17 basis points for the price discrepancy of 1% to 14 basis points when the initial price discrepancy is 10%.

As a whole, the examination of individual position returns indicates that the overwhelming majority of price discrepancies between dual-class shares provide an opportunity to earn a return that exceeds the riskless rate. Price discrepancies provide abnormal returns in more than 80% of the cases. We do not claim that our trading rules maximize profits. Use of limit orders, for example, might improve execution or allow positions to be closed more quickly. It might also be worthwhile to close out positions at a loss if prices do not converge within a few days. Engelberg, Gao, and Jagannathan (2009) find that this improves the profitability of pairs trading. Alternatively, it could be worthwhile to compare relative prices with their historical averages to see if dual-class shares are mispriced. Nevertheless, our evidence that price discrepancies between dual class shares are mispricing indicate that these price discrepancies can be used to study how mispricings arise and how they are eliminated.

5. How prices diverge

Our evidence indicates that either price discrepancies between dual class shares or their subsequent convergence represent mispricing. We next study how these price discrepancies arise by examining quotes and trades around the time that prices diverge. With the advent of decimalization in 2001, the Lee and Ready (1991) algorithm that we use to sign trades became far less accurate (see, for example, Barber, Odean, and Zhu, 2006). In addition, decimalization led to more order splitting, making it more difficult to determine the size of an order and see if it was part of a long–short strategy. Hence, in studying how prices diverge, and how they later converge, we use data only from 1993 to 2000. We do not use a minimum percentage price discrepancy here, as in testing the trading rules, but define a price discrepancy as the bid price of one class exceeding the ask price of the other. In a robustness test, we replicated the tests that follow with a minimum 2.5% price discrepancy; the results were weaker but still statistically significant.

Prices of dual class shares can diverge in two ways. We define asynchronous price adjustment as a price discrepancy that occurs when one share class changes in price and is eliminated when the price of the other class changes in the same way. This type of price gap arises if information is incorporated more quickly into the price of one share class than the other. We define price pressure as a price discrepancy that is created when the price of one class changes and is eliminated when the price change is reversed. In general, price gaps fall into one category, but it is possible for them to fall into two. This occurs if the price of one share class changes but the convergence occurs with prices of both classes moving back towards each other.

Table 9 describes the frequency with which price gaps arise from asynchronous price adjustment and from price pressure. Panel A presents the results for the full sample, and Panel B breaks down the sample by market value tercile, and Panel C presents the results by volume tercile. Size is the sum of the market values of both types of shares, using number of shares outstanding and end of day prices from CRSP. Volume is the total number of shares traded in both classes on a particular day, also from CRSP. Terciles are computed annually and assigned each day. The columns labeled "Asynchronous price adjustment" and "Price pressure" contain the proportion of price gaps that belong to that category only. The last column of the table shows the proportion of price gaps that belong to more than one category. We use a difference in means test to test, using firm-level means, the difference in proportions of the voting and nonvoting leading in the asynchronous price adjustment and price pressure categories. The results of these tests appear as superscript stars that show the 1%, 5%, and 10% significance levels.

We also test whether the difference between the proportion of asynchronous price adjustment and price pressure is significant for the voting categories and again for the nonvoting categories. The significance levels of these tests are indicated by superscript cross hatches. For example, the first number in Panel A shows that, in situations in which the voting became overpriced, 16.5% of price gaps occurred solely when the price of the voting class changed and the price of the nonvoting class followed with a lag. This number is significantly different at the 5% level from 0.219, the proportion of price gaps due solely to asynchronous price adjustment when the nonvoting stock leads, but not significantly different from 0.173, the proportion of price gaps that occurred solely from price pressure when the voting moved.

Panels B and C show that these results hold regardless of firm size or stock trading volume. In these panels, as in Panel A, the proportions in each category are usually above 15%, which shows that no one cause of price discrepancies dominates. In general, price discrepancies occur most often because the nonvoting stock changes price. When a price discrepancy arises it is usually from price pressure. The general lesson to be drawn from this is that more frequently traded shares, which most consider

Table 9
Types of mispricing. We define asynchronous price adjustment (APA) as a price gap that occurs when one share class moves and the other class moves later to eliminate the price gap. We define price pressure (PP) as a price gap that arises when one class moves and later moves back to eliminate the price gap. Price gaps can fall into more than one category. Size (Panel B) is daily market value of both classes of shares from the Center for Research in Securities Prices, and Volume (Panel C) is total daily volume in both types of shares from CRSP. Tercile cutoffs are computed each year using all the firm days in that year. Terciles are assigned each day. Means are firm level, and superscripts are from a difference in means test with unequal variances. ***,**, and * are 10%, 5% and 1% significance levels when comparing voting to nonvoting inside the same ASA or PP categories. ###, ## and ## are significance levels when comparing voting an APA to voting in PP and no-voting in APA to nonvoting in PP.

Mispricing	Asynchronous price adjustment		Price pressure		> 1 category
	Voting leads	Nonvoting leads	Voting moved	Nonvoting moved	
Panel A: Full sample					
Voting becomes overpriced	0.165**	0.219**,###	0.173***	0.315***,###	0.128
Nonvoting becomes overpriced	0.159**	0.234**	0.182***	0.281***	0.145
Panel B: by size					
Voting becomes overpriced					
Big	0.135***	0.208***,###	0.201**	0.324**,###	0.131
Medium	0.174***	0.215***	0.149***	0.343***,###	0.119
Small	0.148**	0.264**	0.156***	0.299***	0.133
Nonvoting becomes overpriced					
Big	0.153*	0.228*	0.146***	0.276***	0.197
Medium	0.137**	0.260**	0.188*	0.267*	0.148
Small	0.164	0.213	0.231	0.259	0.133
Panel C: by Volume					
Voting becomes overpriced					
High	0.167	0.213	0.176***	0.304***	0.140
Medium	0.165**	0.216**	0.140***	0.341***,##	0.138
Low	0.097**	0.218**,##	0.121***	0.402***,##	0.162
Nonvoting becomes overpriced					
High	0.179	0.247***	0.145	0.295***	0.133
Medium	0.154**	0.203**	0.248**	0.237**	0.158
Low	0.114	0.179**	0.187*	0.329*,##	0.191

to be more efficiently priced, can be more susceptible to price pressure than infrequently traded shares. At the same time, though, when one share class incorporates information more quickly than the other, it is usually the more active, nonvoting shares that move first.

We next examine trading just prior to prices diverging. We obtain trading data from TAQ for each of the classes of stock from 1993 to 2000. We categorize each trade as a buy (buyer-initiated) or sell (seller-initiated) using the Lee and Ready (1991) algorithm. We identify potential long–short arbitrage trades by matching buys in one class of stock with sells of the same number of shares of the other class of stock that occur within one minute. For example, a buy of one thousand shares from the voting class could be part of a long–short arbitrage strategy if there is a one thousand share sell of the nonvoting class within 60 seconds. Many of the trades matched in this way are independent trades made by different investors, not part of an arbitrage strategy. Hence, we calculate the proportion of buys of nonvoting shares that can be matched with sells of voting shares and the proportion of sells of nonvoting shares that can be matched with buys of voting shares when there is no price discrepancy. We do not expect matched trades to be particularly interesting around the time that prices diverge, but of course we are very interested in their role in bringing about convergence. We do not report tests that include dates when poison pills come into effect or are amended and all periods with proxy fights. The results do not substantially change if we include these dates or if we remove shareholder meeting dates.

As Asquith, Omana and Safaya (2008) point out, the Lee and Ready (1991) algorithm has its limitations. Uptick rules could make it unsuitable for signing short sales, and Asquith Omana and Safaya find that it classifies short sales as buys more than 50% of the time. To rule out the possibility that the algorithm misclassifies trades in a biased manner that affects our results, we replicate all of our tests using a broader definition of matched trades that are matched by size, time, and opposite share class only and not necessarily by the trade sign assigned by the Lee and Ready (1991) algorithm. This definition would catch arbitrage trades even if the trade direction of one or both trades is misclassified. Results are similar for all tables involving matched trades.

For each stock and class, we calculate the proportion of all volume from unmatched buys, matched buys, unmatched sells, and matched sells for the base case of no price discrepancy. We then calculate the proportion of volume from these trade types on days when prices diverge. We use all trades up to and including the trades that cause prices to diverge. We compute abnormal volume as the difference between the proportion of trades that fit into these categories when there are discrepancies in the prices of dual-class shares and the proportion in the base case. We do this separately for each stock and

Table 10
Abnormal volume on days when prices diverge. Deviations of trade category proportions on divergence days from proportions on no mispricing days. Divergence days are defined as days when (1) the ask price of each share class exceeded the bid price of the other share class at the previous day's close or (2) prices diverged during the day so that the bid price of shares of one class exceeded the ask price of shares of the other class at the close. We consider only trades leading up to the price divergence on that day. N is the number of firms.

Class	Mispricing	Buy or sell	Match	N	All	All, t-statistic	< 500 shares	< 500 shares, t-statistic	[500,2,000] shares	[500,2,000] shares, t-statistic	> 2,000 shares	> 2,000 shares, t-statistic
Voting	Voting becomes underpriced	Sell	No	64	**0.066**	(2.24)	0.050	(1.52)	**0.073**	(2.34)	**0.109**	(2.07)
			Yes	64	0.010	(0.77)	−0.006	(−1.24)	0.019	(1.17)	−0.007	(−0.74)
		Buy	No	64	−**0.068**	(−2.34)	−0.051	(−1.62)	−**0.088**	(−2.76)	−**0.088**	(−1.74)
			Yes	64	−**0.008**	(−2.60)	0.007	(0.45)	−0.004	(−1.03)	−**0.015**	(−6.69)
	Voting becomes overpriced	Sell	No	72	−**0.105**	(−4.34)	−**0.107**	(−3.78)	−**0.108**	(−4.12)	−**0.111**	(−2.78)
			Yes	72	−0.005	(−1.50)	−0.005	(−1.33)	0.000	(0.01)	−**0.015**	(−3.89)
		Buy	No	72	**0.102**	(4.14)	**0.104**	(3.73)	**0.091**	(3.44)	**0.133**	(3.22)
			Yes	72	0.009	(1.29)	0.007	(0.89)	**0.017**	(1.78)	−0.006	(−1.19)
Non voting	Nonvoting becomes overpriced	Sell	No	63	−**0.080**	(−3.08)	−**0.102**	(−3.35)	−**0.089**	(−3.58)	−0.064	(−1.59)
			Yes	63	−**0.003**	(−2.33)	0.001	(0.28)	0.000	(0.10)	−**0.007**	(−3.55)
		Buy	No	63	**0.086**	(3.37)	**0.101**	(3.31)	**0.087**	(3.59)	**0.073**	(1.81)
			Yes	63	−**0.002**	(−1.82)	0.000	(0.20)	0.001	(0.57)	−0.002	(−1.05)
	Nonvoting becomes underpriced	Sell	No	73	**0.096**	(4.56)	**0.054**	(2.65)	**0.081**	(4.56)	**0.080**	(2.87)
			Yes	73	0.000	(0.08)	0.001	(0.30)	0.005	(1.45)	−**0.006**	(−2.00)
		Buy	No	73	−**0.094**	(−4.52)	−**0.058**	(−2.90)	−**0.088**	(−5.28)	−**0.070**	(−2.46)
			Yes	73	−0.002	(−1.54)	0.002	(0.75)	0.002	(1.02)	−**0.005**	(−3.66)

Table 11
Percentage of trades occurring at quoted prices.
This table provides the proportion of all trades in each cell that occur at inside bid or ask quotes. The symbols +++,++ and + signify greater than the no-mispricing proportion at the 1%, 5% and 10% levels."Smart" trades, in italics, include purchases of underpriced shares and sales of overpriced shares.

		Unmatched trades			Matched trades		
Relative prices		< 500	500–2,000	> 2,000	< 500	500–2,000	> 2,000
Panel A: Voting shares							
Voting overpriced	Sell	*0.728++*	*0.746+++*	*0.687++*	*0.630*	*0.751+++*	*0.634++*
	Buy	0.701++	0.670+++	0.655++	0.637++	0.633++	0.675+++
No mispricing	Sell	0.682	0.622	0.608	0.607	0.534	0.463
	Buy	0.640	0.607	0.564	0.590	0.546	0.425
Voting underpriced	Sell	0.657	0.674+	0.636	0.578	0.619+	0.628+
	Buy	*0.758+++*	*0.804+++*	*0.653++*	*0.685++*	*0.748+++*	*0.811+++*
Panel B: Nonvoting shares							
Nonvoting overpriced	Sell	*0.769+*	*0.784+++*	*0.772+++*	*0.715*	*0.785+++*	*0.741*
	Buy	0.675	0.704++	0.728+++	0.650	0.650	0.651+
No mispricing	Sell	0.710	0.671	0.664	0.687	0.588	0.700
	Buy	0.689	0.656	0.598	0.631	0.628	0.492
Nonvoting underpriced	Sell	0.720	0.686	0.665	0.641	0.682++	0.635
	Buy	*0.739++*	*0.729+++*	*0.681+++*	*0.683*	*0.748+++*	*0.661++*

calculate means and t-statistics cross-sectionally. Results are shown in Table 10. In this table, N is the number of stocks in each category.

The first eight rows of the table report changes in volume of voting shares on days when prices diverge. The first row of the table provides the change in the proportion of voting stock volume from unmatched sell orders. The column marked "All" provides results when trades of all sizes are considered. Here we see that the proportion of voting stock volume from unmatched sell trades is, on average, 6.6% higher than normal prior to the voting stock becoming underpriced. So, if unmatched sells normally make up 50% of the volume in voting stock, they make up 56.6% before the voting becomes underpriced. Similarly, two rows below, the value of -0.068 indicates that unmatched buy orders of voting stock decrease by 6.8% before the voting stock becomes underpriced. Other rows report average abnormal trading volume in voting shares before the voting stock becomes overpriced and in nonvoting stock before it becomes over or underpriced. In each case, the abnormal volume is as expected. There is an increase in buy volume for the class that becomes overpriced and an increase in sell volume for the class that becomes underpriced. Abnormal volume from matched trades is small. Matched trades can be indicative of long–short arbitrage, and we would not expect arbitrage to move prices out of line.

Succeeding columns of the table show abnormal volume by trade size categories of less than five hundred shares, five hundred to two thousand shares, and more than two thousand shares. Abnormal volume from trades in all trade size categories and both share classes seem to move prices out of line. Point estimates suggest that large trades are a slightly more important cause of price discrepancies than small trades

6. How prices converge

We next examine how trading in dual-class shares is affected by price gaps. We hope to accomplish two things by looking at trades. First, we want to provide additional confirmation that price discrepancies represent real mispricing and not just differences in value caused by differences in liquidity or voting rights. Second, we want to know what causes the convergence of stock prices. Are prices driven back into line by textbook long–short arbitrage trades or by bargain hunters who buy cheap shares? We would like to know if trades in the less active and less liquid voting shares eliminate price gaps or whether trades in the nonvoting shares are more important.

We first see if investors recognize price discrepancies as fleeting profit opportunities and trade accordingly. Investors who can trade patiently often succeed at trading within the quoted spread. However, investors who want to ensure that their trades execute quickly usually submit market orders that execute at quoted prices. We test the urgency of traders by examining the proportion of trades that occur at the quotes.

Table 11 reports the proportion of trades that we type as buys and sells that occur at quoted prices. For each firm, we calculate the proportion of buys and sells of each class that occur at the quotes when there is a price gap and the voting (nonvoting) shares are more expensive, and when there is no price gap. We then average the percentages across stocks and calculate t-statistics using the cross-sectional standard deviations.

Panel A reports the mean percentage of voting share trades taking place at quoted prices with and without a price gap. In this table, the smart trades that go against the price gap are in italics. The first row of the table reveals

Table 12

Abnormal trading volume when shares are mispriced. For each firm, we calculate the proportion of all volume in each share class from matched buys, matched sells, unmatched buys and unmatched sells for the base case of no mispricing. We then compute abnormal volume as the difference between the proportion of trades in these categories when there is mispricing and the baseline proportion. *N* is the number of firms. Cross-sectional means are presented, and cross-sectional *t*-statistics are in parentheses.

Class	Mispricing	Buy or sell	Match	*N*	All	All *t*-stat	< 500 shares	< 500 shares *t*-stat	[500,2000] shares	[500,2000] shares *t*-stat	> 2000 shares	> 2000 shares *t*-stat	Trade
Panel A: Full sample													
Voting	Voting underpriced	Sell	No	73	−**0.139**	(−5.01)	−**0.162**	(−5.97)	−**0.144**	(−5.81)	−**0.097**	(−2.23)	Dumb
			Yes	73	−**0.008**	(−2.71)	−0.002	(−0.66)	−**0.010**	(−2.64)	−0.008	(−1.57)	Dumb
		Buy	No	73	**0.105**	(4.04)	**0.136**	(5.13)	**0.094**	(4.07)	**0.098**	(2.34)	Smart
			Yes	73	**0.042**	(4.40)	**0.028**	(3.44)	**0.060**	(4.62)	0.006	(1.21)	Smart
	Voting overpriced	Sell	No	77	0.017	(1.06)	0.014	(0.87)	**0.035**	(2.16)	0.031	(1.17)	Smart
			Yes	77	**0.016**	(2.76)	**0.017**	(2.93)	**0.015**	(2.52)	0.006	(0.76)	Smart
		Buy	No	77	−**0.029**	(−1.78)	−**0.033**	(−2.12)	−**0.044**	(−2.66)	−0.033	(−1.23)	Dumb
			Yes	77	−**0.004**	(−2.70)	0.001	(0.40)	−**0.006**	(−2.69)	−**0.004**	(−2.01)	Dumb
Non voting	Nonvoting overpriced	Sell	No	71	−**0.052**	(−2.43)	−0.009	(−0.42)	−0.029	(−1.28)	−0.031	(−1.15)	Smart
			Yes	71	**0.027**	(1.82)	**0.007**	(1.79)	**0.033**	(2.16)	−0.001	(−0.18)	Smart
		Buy	No	71	0.026	(1.27)	−0.002	(−0.09)	−0.004	(−0.17)	0.035	(1.32)	Dumb
			Yes	71	−0.001	(−0.32)	**0.004**	(1.87)	0.000	(0.02)	−0.003	(−1.27)	Dumb
	Nonvoting underpriced	Sell	No	77	−0.006	(−0.40)	−0.022	(−1.46)	−**0.018**	(−1.74)	0.008	(0.37)	Dumb
			Yes	77	−0.003	(−1.51)	0.004	(1.48)	−0.002	(−1.00)	−**0.006**	(−1.91)	Dumb
		Buy	No	77	0.007	(0.48)	0.012	(0.81)	0.015	(1.47)	−0.003	(−0.13)	Smart
			Yes	77	0.002	(1.44)	**0.007**	(2.65)	**0.005**	(3.30)	0.001	(0.53)	Smart
Class	Mispricing	Buy or sell	Match	*N*	All	All *t*-statistic	< 500 shares	< 500 shares *t*-statistic	[500,2000] shares	[500,2000] shares *t*-statistic	> 2,000 shares	> 2,000 shares t-statistic	Trade
Panel B: Pairs with convertible voting stock only													
Voting	Voting underpriced	Sell	No	23	−**0.261**	(−5.56)	−**0.265**	(−5.48)	−**0.288**	(5.94)	−**0.220**	(−2.35)	Dumb
			Yes	23	0.011	(−1.56)	−0.006	(−1.33)	−**0.007**	(−1.00)	−**0.026**	(−1.79)	Dumb
		Buy	No	23	**0.192**	(5.11)	**0.209**	(4.86)	**0.185**	(4.37)	**0.230**	(2.78)	Smart
			Yes	23	**0.079**	(3.64)	**0.064**	(3.04)	**0.109**	(3.57)	0.016	(0.92)	Smart
	Voting overpriced	Sell	No	24	−0.013	(−0.57)	−0.008	(−0.29)	0.012	(0.54)	0.027	(0.54)	Smart
			Yes	24	**0.030**	(1.98)	**0.045**	(2.75)	**0.037**	(2.50)	−0.019	(−1.31)	Smart
		Buy	No	24	−0.005	(−0.18)	−0.035	(−1.30)	−0.034	(−1.15)	−0.004	(−0.07)	Dumb
			Yes	24	−**0.012**	(−3.12)	−0.001	(−0.14)	−**0.016**	(−3.02)	−0.006	(−0.95)	Dumb

Class	Mispricing	Buy or sell	Match	N	All	All t-statistic	< 500 shares	< 500 shares t-statistic	[500,2000] shares	[500,2000] shares t-statistic	> 2,000 shares	> 2,000 shares t-statistic	Trade
Nonvoting	Nonvoting overpriced	Sell	No	24	−0.023	(−0.61)	0.016	(0.34)	0.002	(0.05)	**−0.088**	(−2.31)	Smart
			Yes	24	0.018	(1.53)	0.007	(1.15)	**0.026**	(1.95)	−0.003	(−0.86)	Smart
		Buy	No	24	0.007	(0.20)	−0.023	(−0.52)	−0.025	(−0.63)	**0.094**	(2.41)	Dumb
			Yes	24	−0.002	(−1.13)	0.000	(0.10)	−0.003	(−1.25)	−0.003	(−1.00)	Dumb
	Nonvoting underpriced	Sell	No	24	0.006	(0.49)	−0.013	(−0.72)	0.003	(0.23)	0.001	(0.05)	Dumb
			Yes	24	**−0.003**	(−1.89)	0.006	(1.12)	−0.002	(−1.21)	−0.003	(−1.45)	Dumb
		Buy	No	24	−0.006	(−0.42)	−0.002	(−1.15)	−0.006	(−0.57)	0.003	(0.10)	Smart
			Yes	24	0.001	(0.74)	0.007	(1.45)	**0.004**	(2.77)	−0.002	(−0.68)	Smart
Class	Mispricing	Buy or sell	Match	N	All	All t-statistic	< 500 shares	< 500 shares t-statistic	[500,2000] shares	[500,2000] shares t-statistic	> 2,000 shares	> 2,000 shares t-statistic	Trade
Panel C: Pairs with non-convertible voting stock only													
Voting	Voting underpriced	Sell	No	50	**−0.083**	(−2.63)	−0.053	(−1.11)	**−0.079**	(−3.35)	−0.116	(−3.76)	Dumb
			Yes	50	**−0.007**	(−2.27)	−0.002	(−0.38)	**−0.011**	(−2.51)	0.000	(−0.09)	Dumb
		Buy	No	50	**0.066**	(2.03)	0.051	(1.09)	**0.053**	(2.10)	0.104	(3.19)	Smart
			Yes	50	**0.025**	(2.81)	0.003	(0.81)	**0.038**	(3.21)	0.012	(2.00)	Smart
	Voting overpriced	Sell	No	53	0.030	(1.51)	0.033	(1.04)	**0.046**	(2.15)	0.024	(1.23)	Smart
			Yes	53	**0.010**	(1.97)	**0.015**	(1.73)	0.005	(1.01)	**0.005**	(1.48)	Smart
		Buy	No	53	**−0.039**	(−2.03)	−0.044	(−1.39)	**−0.047**	(−2.36)	−0.031	(−1.64)	Dumb
			Yes	53	−0.001	(−0.74)	**−0.004**	(2.02)	−0.002	(−0.89)	**0.002**	(0.77)	Dumb
Non voting	Nonvoting overpriced	Sell	No	48	**−0.067**	(−2.55)	−0.006	(−0.16)	**−0.045**	(−1.76)	−0.022	(−1.02)	Smart
			Yes	48	0.031	(1.46)	0.000	(0.01)	**0.036**	(1.65)	0.007	(1.36)	Smart
		Buy	No	48	0.035	(1.43)	0.008	(0.25)	0.008	(0.30)	0.010	(0.40)	Dumb
			Yes	48	0.000	(0.05)	−0.003	(−0.93)	0.002	(0.45)	**0.006**	(1.91)	Dumb
	Nonvoting underpriced	Sell	No	53	−0.012	(−0.55)	0.012	(0.39)	**−0.028**	(−2.01)	−0.027	(−1.31)	Dumb
			Yes	53	−0.003	(−1.10)	−0.007	(−1.60)	−0.002	(−0.63)	0.003	(0.98)	Dumb
		Buy	No	53	0.013	(0.61)	0.006	(−0.20)	**0.025**	(1.80)	0.018	(0.90)	Smart
			Yes	53	0.003	(1.24)	0.002	(1.60)	**0.005**	(2.47)	**0.006**	(2.22)	Smart

Table 13
Abnormal volume on days when prices converge.

Days when prices converge are defined as those where 1) the bid price of one class of shares exceeded the ask price of the other class at the close on the previous day and 2) at the close the ask price of each share class was at least as great as the bid price of the other class. We consider only trades before the convergence. N denotes the number of firms. Cross-sectional means are presented, and cross-sectional t-statistics are in parentheses.

Class	Mispricing	Buy or sell	Match	N	All	All t-statistic	< 500 shares	< 500 shares t-statistic	[500,2000] shares	[500,2000] shares t-statistic	> 2,000 shares	> 2,000 shares t-statistic	Trade
Voting	Voting underpriced	Sell	No	63	−**0.239**	(−6.90)	−**0.207**	(−4.90)	−**0.241**	(−7.00)	−0.088	(−1.59)	Dumb
			Yes	63	−0.001	(−0.17)	0.003	(0.38)	0.006	(0.60)	−**0.017**	(−4.13)	Dumb
		Buy	No	63	**0.205**	(5.61)	**0.178**	(4.09)	**0.181**	(4.67)	**0.115**	(2.07)	Smart
			Yes	63	**0.035**	(2.33)	**0.026**	(2.40)	**0.053**	(2.40)	−**0.010**	(−2.82)	Smart
	Voting overpriced	Sell	No	71	**0.088**	(3.29)	**0.064**	(2.70)	**0.059**	(1.99)	**0.095**	(2.13)	Smart
			Yes	71	**0.016**	(2.14)	**0.030**	(2.16)	**0.017**	(2.22)	0.004	(0.36)	Smart
		Buy	No	71	−**0.097**	(−3.63)	−**0.090**	(−4.12)	−**0.070**	(−2.41)	−**0.088**	(−2.08)	Dumb
			Yes	71	−**0.007**	(−1.96)	−0.003	(−0.79)	−0.006	(−1.58)	−**0.011**	(−1.89)	Dumb
Non voting	Nonvoting overpriced	Sell	No	60	**0.037**	(1.66)	0.032	(1.11)	**0.053**	(1.92)	0.024	(0.84)	Smart
			Yes	60	0.009	(1.49)	0.012	(1.55)	**0.017**	(1.98)	−0.007	(−1.58)	Smart
		Buy	No	60	−**0.045**	(−2.04)	−**0.052**	(−1.84)	−**0.071**	(−2.87)	−0.011	(−0.37)	Dumb
			Yes	60	−0.001	(−0.51)	**0.008**	(1.68)	0.001	(0.58)	−**0.006**	(−2.86)	Dumb
	Nonvoting underpriced	Sell	No	69	−**0.109**	(−5.03)	−**0.071**	(−2.94)	−**0.147**	(−8.11)	−**0.088**	(−2.80)	Dumb
			Yes	69	−0.003	(−1.38)	−0.000	(−0.00)	0.001	(0.49)	−**0.005**	(−2.03)	Dumb
		Buy	No	69	**0.107**	(4.89)	**0.063**	(2.60)	**0.138**	(7.53)	**0.096**	(3.03)	Smart
			Yes	69	**0.005**	(1.73)	**0.008**	(2.47)	**0.008**	(2.42)	−0.002	(−1.06)	Smart

that the proportion of sales that take place at the quoted bid price is greater when voting stock is expensive than when there is no price gap. This holds true for all trade sizes and for both matched and unmatched trades. The difference is statistically significant in each case except for matched trades of fewer than five hundred shares.

The last row of Panel A reports the mean proportion of buys that take place at the quoted ask price when voting shares are cheap. For all trade sizes and for both matched and unmatched trades, the proportion of buys of voting shares that take place at the ask is significantly higher when the voting shares are cheap than when there is no price gap. In some cases the results are striking. When there is no price gap, 42.5% of matched buys of more than two thousand voting shares take place at the quoted ask price. When the voting shares are cheap, on average, 81.1% of matched buys of voting shares occur at the quoted ask price.

Panel B presents the results for the nonvoting shares broken down by trade size. The first row of the panel reveals that the proportion of nonvoting sell orders that execute at the quoted prices is higher when the nonvoting class is expensive than when there is no price gap. This holds for all trade sizes and for both matched and unmatched trades. For example, 67.1% of unmatched sells of five hundred to two thousand nonvoting shares execute at quoted prices when there is no price gap. When the nonvoting shares are expensive relative to the voting shares, 78.4% of five hundred to two thousand share sells take place at the quoted bid. The last row of Panel B provides the proportion of buy orders of nonvoting stock that take place at quoted prices when the nonvoting shares are cheap. For every trade size category, and for both matched and unmatched trades, the proportion of buy orders that execute at the quoted ask price is greater when the nonvoting shares are cheap than when there is no price gap. As a whole, Panel B shows that trades of nonvoting shares reveal a greater sense of urgency when the nonvoting shares are expensive or cheap, and the trades exploit that mispricing.

To summarize, Table 11 shows that when voting shares are cheap, a higher proportion of buy orders take place at the quoted ask price than when there is no price gap. When they are expensive, a higher proportion of sell orders execute at the bid price than when there is no price gap. The same pattern is revealed for trades of nonvoting shares. This is consistent with investors trading urgently to avoid missing an opportunity when there is mispricing.

It is important to note that foolish trades that buy expensive shares and sell cheap ones are also more likely to execute at the quotes during periods when there is a price gap. The differences are weaker, however, and less likely to be significant than the differences between the likelihoods that smart trades execute at quotes when there is and is not a price gap. Perhaps, spreads are narrower, or there are fewer counterparties besides the market maker willing to trade between the quotes in times of price gaps. We find that spreads are, in fact, narrower during price gaps. For the 72 firms that display both kinds of price gaps during our sample period, the cross-sectional average of median spreads for the voting and nonvoting stock are 3.58% and 1.96%, respectively, when there are no price gaps. When the voting stock is expensive, these averages are 3.00% and 1.88%, respectively. When the nonvoting stock is expensive, these averages are 2.37% and 1.43%, respectively. If the increased frequency of trades at the quotes were due only to smaller spreads, however, we would observe that all trades are equally more likely to execute at quoted prices during periods of price gaps. Instead, we find that trades that could profit from the mispricing have a larger increase in the tendency to execute at the quotes than trades on the opposite side.

We next examine how signed trading volume is affected by the presence of price discrepancies. In Table 12, as in Table 10, we calculate the proportion of trading volume from unmatched buys, unmatched sells, matched buys, and matched sells for each stock when there is no gap. We then compare those proportions with the proportions that occur when there is a gap for the same stock. We calculate the average difference in proportions for each stock and the t-statistics cross-sectionally over the N firms that have data for each category. For convenience, the last column of the table designates trade type as "Smart" or "Dumb." Smart trades buy cheap shares or sell expensive ones. Dumb trades buy expensive shares or sell cheap ones. If investors exploit the price gaps, changes in the proportion of volume should be positive for smart trades and negative for dumb ones. Panel A presents the full sample. Panels B and C examine the sample of dual-class firms in which the voting stock is convertible into nonvoting stock. Panel C examines the firms in which the voting stock is not convertible.

The first eight rows of Table 12, Panel A present results for trades of voting shares. In general, when voting shares are cheap, they are less likely to be sold and more likely to be bought. When expensive they are more likely to be sold and less likely to be purchased. The column labeled "All" presents results when trades of all sizes are included. When voting shares are cheap, unmatched volume from sales declines 13.9%. So, for example, if unmatched sales account for 50% of the voting class volume when there is no price gap, they would account for 36.1% of the volume of voting shares when the voting shares are cheap. Sales of voting shares that can be matched with buy trades in nonvoting stock, and, hence, could be part of a long–short arbitrage strategy, make up 0.8% less of total voting share volume when the voting shares are cheap.

The next two rows report changes in buy volume of voting shares when the voting shares are cheap. The proportion of total volume in voting shares from unmatched buy trades is 10.5% greater when the voting shares are cheap than for the base case. The t-statistic of 4.04 indicates that this increase in buy volume is highly significant. Matched buy orders make up 4.2% more of the total volume in voting shares when the voting shares are cheap. The t-statistic of 4.40 indicates that volume from matched buys of voting shares and sells of nonvoting shares increases significantly when the voting shares are underpriced. It is interesting that this significant increase in matched trades occurs when the relatively liquid nonvoting stock is shorted and the more difficult to short voting stock is purchased.

To summarize, these results suggest that, when voting stock is cheap, investors attempt to take advantage of price gaps through their trades of voting shares. Buy orders become a larger proportion of the volume while sell orders become a decreasing proportion. By far, the biggest change in the proportion of trades comes from unmatched trades. One-sided trades seem to be more important than arbitrage trades in moving prices toward equilibrium levels.

The next four rows report abnormal trading volume for voting shares when there is a price gap and the voting shares are relatively expensive. There is more sell volume from matched trades than when there is no price gap. Unmatched sell volume increases by 1.7% of the total volume, but the difference is not statistically significant. A potential explanation for why the results are weaker when voting shares are expensive is that it could be more difficult to sell shares of voting stock short than to short nonvoting shares. Both matched and unmatched buy volume decrease for the voting shares when that class is more expensive.

The next eight rows of the table present results for volume of nonvoting shares. Results are weak. For the most part, there is little change in buy or sell volume of nonvoting shares when there is a price gap. When all trades are considered together, there are two exceptions. When nonvoting shares are expensive, there is a decrease in unmatched sales that is marginally significant. This change is of the opposite sign to what is expected. Smart trades have decreased with the price gap. The next line shows that matched trades involving selling nonvoting stock increase when the nonvoting stock is expensive. The arbitrage trades go in the right direction.

We would not expect trades of all sizes to be equally likely to come from traders who are trying to exploit mispricings. Barclay and Warner (1993) show that most price changes are due to medium-size trades, which they define as between one thousand and 9,900 shares. Similarly, Chakravarty (2001) finds that medium-size trades, which he defines as five hundred to 9,900 shares, explain most of the cumulative price changes for NYSE stocks. These results suggest that it is the medium-size trades that are used by informed traders. They could use medium-size trades in an attempt to conceal their information through stealth trading. Alternatively, they could use medium-size trades because they need to trade quickly and quoted depths are of medium size. Informed traders, or smart traders, prefer to trade larger amounts (Easley and O'Hara, 1987) and could break up orders. It is limitations on the size of trades that can be executed immediately or the effort to disguise information that leads smart investors to use medium-size trades. For Nasdaq stocks, it could mean trading one thousand shares, the maximum number that could be executed automatically through the SOES (see Harris and Schultz, 1997). In the other columns of Table 12 Panel A, results are broken down by small, medium and large trades. Small trades are less than five hundred shares, medium-size trades are from five hundred to two thousand shares, and large trades are defined as more than two thousand shares. Looking first at voting shares, we see that results are strongest for the five hundred to two thousand share trades. Proportions of trades in every category are significantly different from their proportions when there is no price gap. Furthermore, each change is in the direction to be expected if investors were trading to eliminate mispricing. For example, when voting shares are cheap, the proportion of their volume of 500–2,000 share trades from unmatched sales declines 14.4%. When voting stock is expensive, the proportion of volume from unmatched sales of 500–2,000 voting shares increases 3.5%. Volume from trades of less than 500 shares also seems to change in the expected directions, but not as consistently. Unmatched volume of voting shares from large trades changes in the right direction when the voting shares are cheap, but for the most part large trades are not affected much by the presence of price gaps.

When trades of nonvoting stock are broken down by trade size, results remain weak, with some of the marginally significant results being of the wrong sign. When the trades of the five hundred to two thousand share size that is preferred by informed investors are examined, volume changes usually have the expected signs. Results are of the right sign and statistically significant in three cases for medium-size trades.

Panel B of Table 12 reports results when voting shares are convertible, and Panel C reports results for pairs in which the voting shares are not convertible. When we contrast Panels B and C of Table 12, we find that in pairs where the voting is convertible and when the nonvoting stock is expensive, there is much less selling and much more buying of voting stock than in Panel C, where the voting is not convertible into nonvoting. Differences in the trading of nonvoting shares between Panel B and Panel C are much smaller. It appears that smart traders take advantage of the opportunity to convert underpriced shares when it is available.

There are several conclusions to be drawn from Table 12. First, investors' trading patterns change significantly and in the expected way when dual classes of shares have price gaps. This indicates that investors believe that the price discrepancies do represent mispricing and that they attempt to exploit these mispricings. Second, while both matched and unmatched trades change in the expected ways, the total change in volume from unmatched trades far exceeds the total change from matched trades. This suggests that arbitrage trades might not be very important for eliminating mispricings. One-sided trades that involve buying cheap shares or selling expensive shares could be more important. Third, price gaps have their biggest impact on trading in voting shares. Trading in nonvoting shares could be dominated by uninformed noise traders, and their trading could be less affected by percieved mispricing than the trading of the smarter, better informed investors who trade voting shares. Also, results could be clearer for voting stock because there is less noise trading in these shares. Finally, trades of five hundred to two thousand shares are particularly strongly affected by price gaps. These are the medium-size trades that other researchers have found to be most likely to be informed.

We next examine abnormal trading volume on days when price gaps converge. These results are shown in Table 13. Our methodology is similar to that of Table 12. For each firm and class, we calculate the proportion of total volume from trades of each type (matched or unmatched, buy or sell) on days with price gaps but

Table A1

Firm names and standard industrial classification codes are the most recent available from the Center for Research in Securities Prices. Each month, both voting and nonvoting shares are assigned to NYSE size deciles. The table presents the time-series mean of the deciles across the months when both classes traded. The number of arbitrage positions are the total initiated when price discrepancies are 1%, 2.5%, 5%, or 10%. If a firm has more than two classes of shares, more than one pair is listed.

Name	First date	Last date	SIC code	Voting size decile	Nonvoting size decile	Number of arbitrage positions
Crawford	1/1993	12/2006	6411	2.80	2.66	318
Baldwin and Lyons	1/1993	12/2006	6330	1.00	2.48	256
Brown Forman	1/1993	12/2006	2084	6.80	7.35	245
P H I Inc	1/1993	12/2006	4520	1.00	1.05	235
John Wiley & Sons	1/1993	12/2006	2731	2.10	4.94	211
Constellation Brands	1/1993	12/2006	2084	2.20	5.82	207
Gartner Inc	7/1999	7/2005	8741	2.76	4.43	207
Hubbell Inc	1/1993	12/2006	3644	3.24	6.93	205
Forest City Enterp.	1/1993	12/2006	6512	3.23	4.65	130
Penn Engineering	5/1996	5/2005	3452	1.00	2.08	189
Methode Electronics	1/1993	1/2004	3678	1.00	4.30	187
Rush Enterprises	7/2002	12/2006	5511	1.00	1.04	184
Nelson Thomas	1/1993	6/2006	2731	1.00	2.25	181
Crown Central	1/1993	3/2001	2911	1.28	1.30	160
Reading Intl	1/2000	12/2006	6513	1.00	1.00	137
Marsh Supermarkets	1/1993	9/2006	5410	1.00	1.00	132
Watsco	1/1993	12/2006	5075	1.00	2.88	132
Reader's Digest	1/1993	12/2002	2731	4.72	8.11	127
Jones Intercable	1/1993	3/2000	4840	1.62	4.37	123
Kelly Services	1/1993	12/2006	7361	1.03	2.91	123
Playboy	1/1993	12/2006	4841	1.05	2.37	122
E X X	11/1994	12/2006	3621	1.00	1.00	118
Aaron Rents	1/1993	12/2006	7359	1.05	2.77	111
Name	First date	Last date	SIC code	Voting size decile	Nonvoting size decile	Number of arbitrage positions
Tecumseh Products	1/1993	12/2006	3580	2.52	4.40	102
Moog Inc.	1/1993	12/2006	3494	1.00	2.65	94
Triarc Cos.	9/2003	12/2006	2086	1.85	2.80	94
Benihana	1/1993	12/2006	5810	1.00	1.00	90
Plymouth Rubber	1/1993	1/2005	3069	1.00	1.00	86
Gray Television	9/1996	12/2006	4833	1.27	1.83	85
Comcast	1/1993	11/2002	4840	9.37	5.59	82
Bio Rad Labs	1/1993	12/2006	8731	1.38	3.55	81
McData	8/2000	12/2006	3572	3.69	2.13	80
Radio One	6/2000	12/2006	4832	2.35	4.72	80
American Maize	1/1993	11/1995	2046	2.91	1.03	69
Continental Airlines	9/1993	1/2001	4512	3.24	6.34	65
Seneca Foods	9/1995	12/2006	2033	1.00	1.00	65
Sequa Corp	1/1993	12/2006	3724	1.93	2.92	64
Florida East Coast	10/2000	9/2003	4011	3.94	3.94	59
First Commerce Banc	10/1993	6/2000	6020	1.02	2.51	58
Waddell & Reed	11/1998	4/2001	6799	5.60	5.70	58
Telecommunications	8/1995	3/1999	4841	5.23	9.28	57
Sport Chalet	9/2005	12/2006	5941	1.00	1.00	53
Liberty Homes	1/1993	5/2004	2452	1.00	1.00	52
Heico Corp.	4/1998	12/2006	3724	1.62	1.50	48
Jo Ann Stores	8/1995	11/2003	5949	1.87	1.71	48
Oriole Homes	1/1993	2/2003	1531	1.00	1.00	47
T C I Satellite	12/1996	4/1999	4890	1.00	2.96	43
Tronox	3/2006	12/2006	2816	1.40	1.00	37
Neiman Marcus	10/1999	10/2005	5311	4.50	5.47	36
J.M. Smucker	1/1993	8/2000	2033	3.51	3.40	30
Name	First date	Last date	SIC code	Voting size decile	Nonvoting size decile	Number of arbitrage positions
Bandag	1/1993	12/2006	3011	3.62	3.60	27
Molson Coors	2/2005	12/2006	2082	1.04	8.00	27
Fedders	9/1994	3/2002	3585	1.46	1.37	26
Turner Broadcasting	1/1993	10/1996	4833	8.49	7.40	23
Gamestop	11/2004	12/2006	5734	3.69	4.19	21
Conoco	8/1999	10/2001	1311	9.81	8.69	18
Curtiss Wright	11/2000	5/2005	3728	2.14	3.17	18
Dairy Mart	1/1993	2/2000	5411	1.00	1.00	18
Infousa	10/1997	10/1999	7330	2.42	2.38	16
Fredericks Hollywood	11/1993	9/1997	5621	1.00	1.00	15
Spinnaker Inds	8/1996	11/2001	2672	1.17	1.13	14
Freescale Semicond	7/2004	12/2006	3674	8.25	7.00	13

Table A1. (*continued*)

Hechinger	1/1993	9/1997	5210	1.70	2.98	13
Pilgrim's Pride	8/1999	11/2003	2015	2.75	1.39	12
Federal Agricultural	1/1994	12/2006	6159	1.00	1.71	11
I D T Corp	6/2001	12/2006	4813	2.25	4.24	11
Associated Group	12/1994	1/2000	4810	4.25	4.23	10
Wackenhut	1/1993	5/2002	7381	1.09	1.83	10
Premier Radio	1/1996	6/1997	7920	1.00	1.12	9
Base Ten Systems	1/1993	5/1998	7372	1.00	1.03	8
Discovery Holding	7/2005	12/2006	4841	1.00	7.17	8
Molex	1/1993	12/2006	3670	7.48	7.05	8
Stevens Intl	1/1993	7/1999	3555	1.00	1.00	8
Name	First date	Last date	SIC code	Voting size decile	Nonvoting size decile	Number of arbitrage positions
Freeport McMoran	7/1995	5/2002	1021	6.11	7.15	6
CCH Inc	1/1993	1/1996	2730	4.08	4.03	5
Liberty Media	8/2001	5/2006	4813	6.04	10.00	5
M I P S Technologies	6/2000	11/2003	3674	2.54	2.10	5
All American Comm.	12/1995	11/1997	7810	1.13	1.04	4
Comcast Corp	11/2002	12/2006	4840	10.00	10.00	4
D E P Corp.	1/1993	11/1996	2840	1.00	1.00	4
Lennar Corp	4/2003	12/2006	1521	5.16	8.27	4
Liberty Media	5/2006	12/2006	4841	2.00	9.00	4
N P C International	1/1993	8/1995	5810	1.84	1.68	4
Roses Stores	1/1993	4/1995	5310	1.08	1.12	4
Sportmart	9/1994	1/1998	5990	1.35	1.10	4
Telephone & Data Sys	5/2005	12/2006	4813	6.00	6.00	4
American Fructose	1/1993	2/1993	2046	2.00	2.00	3
Blockbuster Inc.	10/2004	12/2006	7822	1.85	2.78	3
C B S Corp	1/1993	12/2006	4833	8.22	9.83	2
Viacom	1/2006	12/2006	4841	6.00	10.00	1
Agere Systems	6/2002	5/2005	3674	6.06	5.66	0
Everest & Jennings	1/1993	11/1993	3842	1.00	1.00	0
Liberty Media	5/2006	12/2006	4841	2.00	9.00	0
Reinsurance Group	6/1998	9/1999	6311	6.87	2.87	0
Telecommunications	9/1997	3/1999	4840	5.00	9.06	0
Liberty Media	5/2006	12/2006	4841	2.00	9.00	0
Wang Laboratories	1/1993	9/1993	3574	1.00	2.25	0

before the price gaps are eliminated. We then subtract the proportion of volume from trades of each type that occur during periods with no price gaps. We then average across all N firms and calculate t-statistics from the cross-sectional standard deviation of firm proportion changes.

When all trade sizes are considered together, purchases of underpriced stock increase and sales of overpriced share decrease regardless of which share class is cheap. Here, changes in volume are significant for both share classes. Of more interest is that the change in the volume from unmatched share trades greatly exceeds the change in the volume from matched share trades. Prices converge because investors separately buy cheap shares and sell expensive ones. Long–short arbitrage is much less important, perhaps because of limits to arbitrage in our sample. The popular idea that arbitrage is needed to eliminate mispricing is just not true.

It is also interesting that changes in volume for both classes are larger and more significant when the class is cheap than when it is expensive. This suggests mispricing has a larger impact on volume when the mispricing is exploited by taking a long position or avoiding selling instead of by taking short positions or avoiding buying. Costs and difficulties of selling short, along with the fact that few investors hold a particular stock, make it easier to take advantage of underpricing than overpricing. This agrees with work by Miller (1977) and subsequent empirical work suggesting that short sale restrictions exacerbate mispricing.

7. Summary and conclusions

We examine the prices of dual classes of shares issued by the same company that differ in votes but have identical cash flow rights. It is surprisingly common for the bid price of one class of shares to exceed the ask price of the other. Using our sample of one hundred pairs of dual-class shares with equal cash flow rights, we find 3,687 separate cases over 1993–2006 in which the bid price of one class of shares exceed the ask price of the other by at least 1%. We call these price discrepancies, or price gaps. More than 75% of these price discrepancies provide returns after bid–ask spreads that exceed the returns on Treasury bills. An arbitrage strategy that involves shorting the expensive shares and buying shares in the cheap class when there are price gaps earns abnormal returns of 14 basis points per day net of the bid–ask spread. This suggests that the price discrepancies we show are due to mispricing of the shares.

Our use of intraday TAQ data allows us to delve more deeply into how mispricings arise and how they are eliminated than does prior research. We classify the price discrepancies into those that are caused by price pressure and those caused by one share class leading the other class. We find that the nonvoting share class often responds more quickly to information than does the voting class. The most common cause of price discrepancies, though, is price pressure that moves the nonvoting shares. This finding goes against the commonly held belief that more liquid securities are less likely to be mispriced.

Once a price discrepancy arises, we find the trading volume in the relatively cheap shares shifts from sales to purchases and trading volume in the relatively expensive shares shifts away from buys and into sells. This is additional evidence that the price discrepancies we find are mispricing, not differences in the true values of the share classes, and that investors attempt to exploit the mispricing. In addition, we find that the urgency of trading, as measured by the number of trades that occur at the quotes, increases during periods of price gaps. Furthermore, the increase in urgent trades is concentrated in those trades that buy the cheaper shares or sell the more expensive class.

We usually think of long–short arbitrage as the means by which relative value mispricings are corrected. Arbitrage, however, does not seem to be an important factor in eliminating dual class share mispricing. Matched trades, our proxy for arbitrage trades, account for little of the change in trading when price discrepancies exist. One-sided purchases of relatively cheap shares and sales of relatively expensive shares seem far more important for moving prices back into line. Our findings suggest that the role of arbitrage in reducing mispricing has been overstated in the finance and economics literature. Mispricing can be and is corrected by intelligent investors through independent purchases of underpriced securities and sales of overpriced securities.

Appendix A

See Table A1 here.

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