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The Nominal Share Price Puzzle

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Evolution generally results in organisms that seem well-adapted to their environment. However, many animals have vestigial structures that once served a crucial purpose but no longer do, such as the human appendix. Many societal customs appear to be vestigial remnants from earlier generations as well. For example, the tradition of wearing neckties began in the sixteenth century when men donned linen cravats and the necktie served the sensible purpose of a bib or napkin. Although silk neckties still collect stains, they no longer serve any practical function.

The question we investigate in this paper is whether vestigial norms and customs affect corporate decision making. Consider the following fact: The average nominal price for a share of stock on the New York Stock exchange has remained roughly constant (about $35) since the Great Depression. The mechanism that has allowed share prices to remain remarkably constant for over 70 years is stock splits. However, the existence of stock splits is merely a necessary, not a sufficient, condition for nominal prices to remain stable. In fact, stock splits could have been used to create almost any

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time series of nominal prices. Research on stock splits has proposed some theoretical explanations of why managers may choose to split their stock, but these proposed models fail to predict that nominal share prices would remain constant.[1]

To illustrate the phenomenon consider the case of General Electric (GE). On December 31, 1935, GE was trading at $38.25 a share, and exactly 72 years later, it was trading at $37.07 a share. Had GE never split its shares from 1933 to 2007, its share price on December 31, 2007, would have been $10,676.16. In fact, it has split its stock seven times over this time period, resulting in a cumulative split of 288:1, and each targeted price was about the same. GE, like most firms, is proactive at keeping its nominal share price constant by splitting its shares. We argue that in so doing, GE and most other U.S. firms follow a norm that keeps their nominal share prices in a narrow and roughly constant range through time. Furthermore, while it may have made sense to maintain share prices in this range for some time period, it is difficult to think of a rationale that could support a constant share price as being optimal over the past 72 years.

Adhering to the norm and actively maintaining nominal stock prices in a narrow band through stock splits is costly. Based on discussions with lawyers and bankers who have been involved in these transactions, we estimate the direct administrative costs of splits to be in the range of $250,000 to $800,000 for a large firm, which is similar to the estimate offered by Ryser (1996). However, this direct cost is dwarfed by the costs imposed on shareholders. First, the relative bid–ask spread increases after splits (Copeland, 1979; Conroy, Harris, and Benet, 1990; Kadapakkam, Krishnamurthy, and Tse, 2005), which increases trading costs for all investors. (The relative bid–ask spread is defined as the posted bid price, less the posted ask price, scaled by the bid–ask midpoint, and is a measure of cost of trading a stock for investors.) Second, institutional investors (at least since the mid-1970s) tend to pay a fixed brokerage commission per share, regardless of share price. (We use the term institutional investor to describe professional money managers, as opposed to retail investors.) Thus, trading 288 shares of GE at $37.07 would be significantly more expensive than trading a single share at $10,676.16. Had GE never split its stock (and everything else had remained the same), investors could have saved more than 99 percent of their brokerage commissions—which would save those trading GE stock about $100 million a year in commissions.[2] Third, the

[1] We focus on the role of stock splits in setting prices, rather than cash dividends or other corporate actions, because a stock split is, at least on a first-order approximation, strictly cosmetic—nothing fundamental about the firm changes. The firm does not reduce its cash balance or retained earnings as it would in a cash dividend, and in a stock split no money is transferred from the firm to investors. Investors merely trade one share of old stock in exchange for, say, two new shares, each of which represents an economic right in the firm that is exactly one-half of the right of their old share.

[2] The number in the text is based on a cost estimate of 2 cents/share, which we believe to be conservative. In discussions with several large and active money managers, we have been told that commissions are typically between 3 and 5 cents per share. The total cost estimate is also conservative by a factor of two, as each trade involves a buyer and seller. In essence, we are assuming that each trade is a trade with the market maker and none of the trades are driven by institutions on both the buy and sell side, each of which would have to pay the commission.

New York Stock Exchange charges a per-share fee to companies listed on its exchange, so this fee increases after a split.

Given the economic consequences for investors, why do firms proactively keep their share prices in a nominally constant narrow band? We suggest norms as a potential explanation. The role of norms in economics has been established as a mechanism to coordinate actions in settings where there are multiple equilibria (Wärneryd, 1994). "Social norms are customary rules of behavior that coordinate our interactions with others . . . (a norm) continues in force because we prefer to conform to the rule given the expectation that others are going to conform" (Young, 2008). Our investigation points to a specific norm about nominal share prices and how it has continued in force long after any possible benefit of coordination on this specific equilibrium has dissipated.

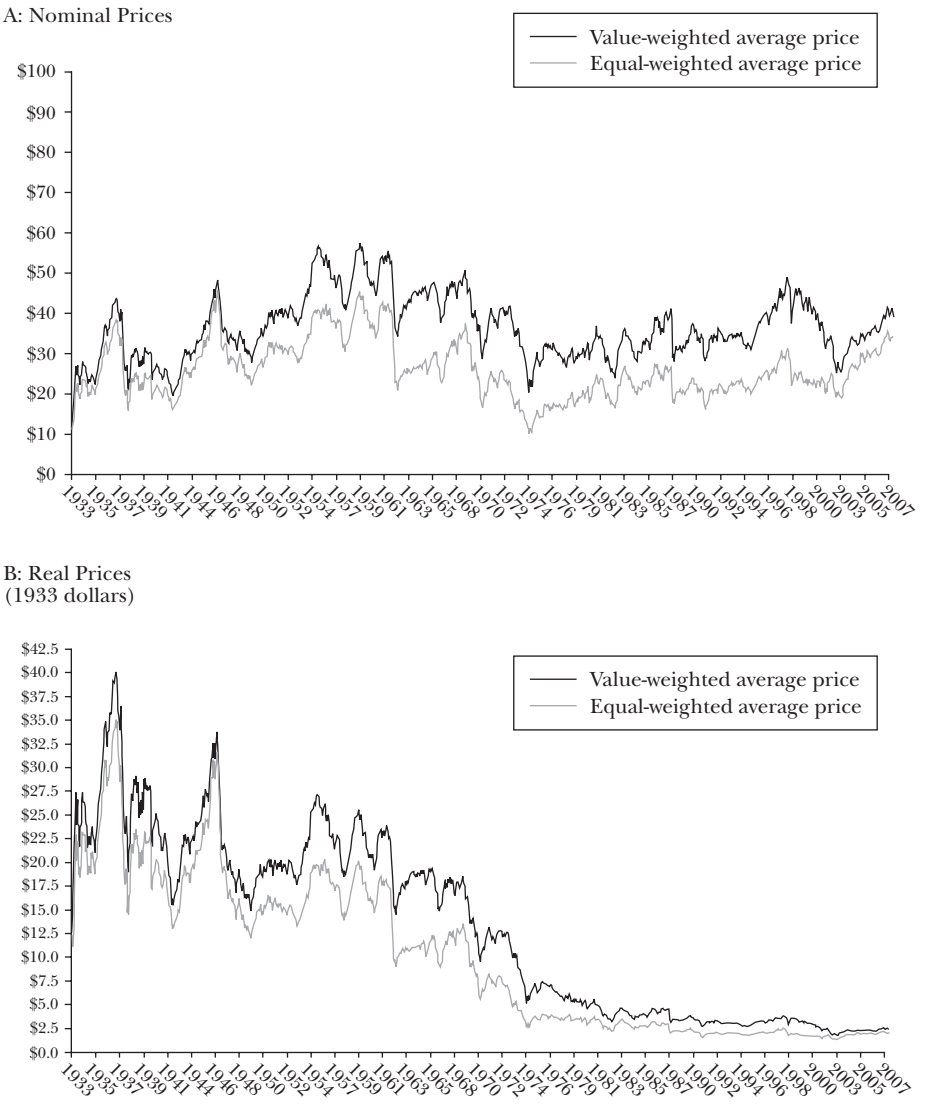
In the next section, we describe facts and patterns relevant to constant share prices, because any satisfactory explanation for the nominal share price puzzle should be consistent with all these facts. Next, we discuss whether economic hypotheses about optimal trading-ranges or about signaling can explain why share prices are nominally constant. We then explain some of the implications of norms on optimal price ranges and describe some possible reasons why the average price norm was set to $35 a share.

Facts and Patterns

U.S. Share Prices Have Remained Constant since the Great Depression

Figure 1A displays the annual average share price of every stock from the New York Stock Exchange (NYSE) and the American Stock Exchange (AMEX) from 1933 through 2007. The equally weighted average of share prices remained close to $25 throughout the entire period. While the value-weighted price is higher with a mean of $36.56, the overall pattern is similar, suggesting that the results are not driven by just a few large stocks. Table 1 presents the average price, return, number of splits, and average split factor for all NYSE- and AMEX-listed securities by decade. Again, the same pattern emerges, the average price of securities remains close to $35/share, and many firms undertake splits in order to maintain this nominally constant price. As a reference, the Consumer Price Index experienced a geometric average annual inflation of 3.5 percent over this time, for a cumulative increase of 1,528 percent. Therefore, maintaining constant nominal prices resulted in a dramatic decrease in real prices. Figure 1B illustrates that real share prices have declined by more than 90 percent over this period. In today's dollars, the equivalent of average stock prices from the 1930s and 1940s is a price per share of around $450! Not only do the mean and median nominal prices remain constant, but there is also no trend in the cross-sectional variability of share prices, which has remained roughly constant over the last 72 years.

Figure 1
Average Prices of Securities on the NYSE and AMEX, 1933 to 2007



Source: Data is from the Center for Research in Security Prices (CRSP).
Note: These figures show the time series of value-weighted averages and equal-weighted averages of security prices. Data includes all ordinary common shares that are listed on the New York Stock Exchange and American Stock Exchange, but excludes Berkshire Hathaway. If Berkshire Hathaway is retained in the sample, the results are quantitatively similar for the value-weighted average price but significantly higher for the equal-weighted average price post-1996. Nominal averages are calculated without adjustment. Real averages are presented in 1933 dollars, using monthly inflation data from the Bureau of Labor Statistics Consumer Price Index for "All Urban Consumers, U.S."

Table 1
Summary of Prices, Returns, and Splits on the NYSE and AMEX

Sample years	*Value-weighted price*	*Equal-weighted price*	*# of splits*	*Split size*	*Value-weighted return*	*Equal-weighted return*
1933–1935	$24.80	$21.40	33	1.04 : 1	33.5%	66.2%
1936–1945	$30.62	$25.75	150	1.93 : 1	9.0%	17.2%
1946–1955	$40.53	$31.48	822	1.65 : 1	14.9%	13.1%
1956–1965	$46.61	$32.32	2,099	1.42 : 1	11.4%	12.8%
1966–1975	$36.71	$23.05	2,928	1.43 : 1	3.0%	4.8%
1976–1985	$30.94	$20.27	3,029	1.53 : 1	15.4%	24.3%
1986–1995	$34.13	$22.15	2,208	1.56 : 1	13.8%	11.4%
1996–2005	$36.36	$25.17	1,935	1.64 : 1	10.1%	13.5%
Average	**$36.56**	**$25.74**	**188/year**	**1.59 : 1**	**11.9%**	**15.5%**

Source: The data is from the Center for Research in Security Prices (CRSP).
Notes: The data includes all ordinary common shares listed on the New York Stock Exchange and American Stock Exchange, but excludes Berkshire Hathaway. For each time period, we calculate the value-weighted price and the equal-weighted price as the time series average of the monthly value-weighted and equal-weighted prices, respectively. The number of splits represents the sum of all stock splits and stock dividends. The split size represents the number of shares one would own after the distribution for each pre-split share held at the beginning of the period. If Berkshire Hathaway is retained in the sample, the results are quantitatively similar for the value-weighted price but significantly higher for the equal-weighted price post-1996. Returns are reported as the geometric annual average return over the sample period from the CRSP value- and equal-weighted return indices. The "Average" row shows averages across the whole time series. The average split size is the implied average annual split ratio.

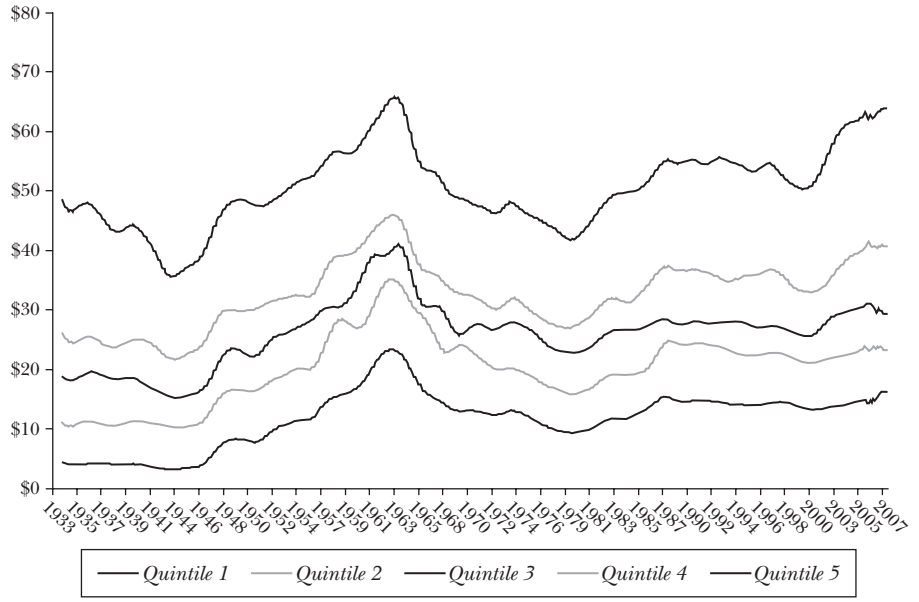
Larger Firms Tend to Have Higher Share Prices

Figure 2 shows that large firms have had consistently higher share prices than small firms. For example, NYSE and AMEX firms in the top quintile of market capitalization tend to trade around $50 a share. In contrast, firms in the bottom quintile tend to trade below $10 a share. These findings imply that as firms "graduate" from one size group to the other—primarily through a combination of firm growth and accompanying share price appreciation—they adapt to the norms of their new peers and choose a new, higher trading range for their shares. The correlation of firm size and share price is neither mechanical nor a result of listing requirements: all of the large firms could have selected different split ratios and achieved a lower price per share.

Initial Public Offering Share Prices Have Remained Constant

We find a pattern in the setting of new issue prices that is remarkably consistent with what we found for equity pricing in general. Initial public offerings have been issued at approximately the same share price since the Great Depression. Data on initial public offerings going back to 1976 show that the offering price per share has remained in the $15–20 range for the past 30 years. We also use the first appearance in the data collected by the Center for Research in Security Prices (CRSP) at the University of Chicago as a proxy for initial public offering to extend

Figure 2
Average Prices by Size Quintile of Securities Listed on the NYSE and AMEX, 1933 to 2007
(nominal equal-weighted average prices)



Note: The figure presents the twelve-month average of equal-weighted security prices by quintile. Quintile 1 are small firms and have the lowest average prices, quintile 5 are the largest firms and have the highest average stock prices, and the relationship of average price and size is monotonic. The results are robust to size deciles.

the time series back to 1933. Again, the same picture emerges: if anything, prices of shares in initial public offerings were marginally higher in the 1950s, but have remained in a tight band since 1933.[3] While share prices for initial public offerings are significantly lower than the average equal-weighted price of $25, this is consistent with the size and price regularity described above. Firms undertaking initial public offerings are smaller than the average listed firm, and their prices are consistent with the average share price of similar-size firms.

Share Prices of Open-End Mutual Funds Have Remained Roughly Constant since the 1960s

An investor who wants to invest in the shares of a mutual fund can send the money to the fund company and the fund will sell fractional shares in the mutual fund (calculated to three decimal places) as necessary. The price of a share in a

[3] We also investigated the time series of prices for initial public offerings using data from Gompers and Lerner (2003). The results are quantitatively similar to those of the CRSP first appearance proxy. We thank Paul Gompers for his generosity in providing us with the data.

mutual fund is a purely arbitrary number, a true *numeraire*. Nevertheless, mutual fund companies also have splits to keep share prices relatively constant.

Using the Mutual Fund Database from the Center for Research in Security Prices (CRSP), we find that from 1961 to 2007 the average open-end mutual fund net asset value per share drifted slightly upward. The average price is around $9 per share in the first 20 years of the sample and around $13 in the second part of the sample—about a 50 percent increase. However, this increase is very small when compared to cumulative increases in consumer prices of 605 percent and in stock returns of 11,250 percent over the same time period.

The Pattern of Share Prices Varies Dramatically across Countries

Consider the experience of the Tokyo Stock Exchange. The average nominal prices for individual shares in Tokyo has fluctuated considerably; it rose from about ¥300/share in 1975 to ¥1500/share in 1990, then dropped to about ¥800 to ¥1000 per share for most of the time from 1991 to 2005—although with a brief jump back to ¥1400/share in 2001. The main index for the Tokyo stock market, the Nikkei 225, has followed a similar pattern, generating a correlation of 0.85. For example, from 1975 to 1990 the Nikkei 225 index increased by 436 percent, and the average share price increased by a very similar 409 percent. Looking just at the 1980s, the Nikkei 225 increased ten-fold in market value and the average price of individual shares increased at the same pace—which suggests that large stock splits were rather rare in Japan.[4] As the Nikkei 225 index declined after 1990, share prices declined as well.

Share prices in the United Kingdom are also not close to constant in nominal terms. Since 1981 (the first year of data), nominal share prices increased approximately from £1.33 per share to over £4 per share in 2000, before falling back to £2.99 per share by 2005. As in Japan, the average price of a share and the main index of stock market returns are highly correlated at 0.79. For example, from 1981 to 1998, average share prices rose from £1.33 to £4.00, a rise of 200 percent, while the FTSE index rose from 313 to 2,674, a rise of 750 percent.

Unlike Japan or the United Kingdom, U.S. share prices remained roughly constant over this time period while the index increases dramatically. For example from 1975 to 2005, the Dow Jones Industrial index increased by 1,157 percent, but the average nominal share price changed only from $27.00 to $34.98, an increase of 30 percent (while consumer prices increased by 275 percent). In the United States, nominal share prices are only modestly correlated with the stock market index at 0.41; that is, in some cases share prices and the overall stock market index rise together, but then a number of corporations split their shares and the pattern is broken. The difference between the evolution of share prices in the United States

[4] We thank Mr. Yamaguchi from Ibbotson Associates for sharing data and information on the Tokyo stock exchange. Greenwood (2008) provides comprehensive coverage of split activity in Japan and documents that, prior to 1999, over 95 percent of splits in Japan were in the form of what would be called small stock dividends in the United States.

as compared with the United Kingdom or Japan does not appear to be driven by different levels of inflation as Tokyo nominal average share prices increased at approximately 2.4 times the rate of inflation, UK share prices increased at approximately 70 percent of the inflation rate, and U.S. average nominal share prices increased at only 10 percent of the rate of inflation.[5]

Firms in the United States, Japan, and the United Kingdom all face a roughly similar business climate. Firms in all three countries have the ability through stock splits to maintain constant nominal prices—yet only U.S. firms do so. The United States is the only country where average share prices have remained essentially constant in nominal terms. The international evidence we present suggests that the underlying preference for a specific price point in the United States is probably not determined by some underlying fundamental economic reason.

In addition to London and Tokyo, we investigated share prices on 16 international stock exchanges and found substantial cross-sectional variation in terms of average stock price, variation of stock price, and covariation of average price for individual stocks and the overall value of the stock exchange index. The data are suggestive of the fact that the nominal price fixation is primarily a U.S. or North American phenomenon. When we examine the correlation between prices and the primary stock index for the various exchanges, we find the New York Stock Exchange has the lowest correlation at 0.41, followed by the Toronto Stock Exchange with $\rho=0.64$. On the other extreme are the Johannesburg Stock Exchange and the Mexican and Italian stock exchanges with $\rho > 0.90$. The New York Stock Exchange also has the smallest coefficient of variation over the time series at 0.14, which is less than half of the variation on every other exchange (except for Toronto at 0.24).

Maintaining Constant Prices Increases Trading Costs

Maintaining constant share prices through stock splits is costly for investors. First, as mentioned earlier, institutional investors and many individual investors pay a fixed commission per share or per trade. Even if commissions are as low as 2 cents a share, the cumulative costs are nontrivial. Second, we find, more generally, that trading costs are related to price level. We use Hasbrouck's (2005) data on prices and bid–ask spreads for several hundred stocks starting in the 1920s until 2005. This data is generated by sampling daily stock data to estimate bid–ask spreads for over 190,000 firm-year observations, and it allows us to test the relation between prices and the cost of trading, defined as the relative bid–ask spread.

We regress the relative bid–ask spread on price, trading volume, turnover, and market capitalization on an annual basis, and report in Table 2 the time series averages of the annual coefficients (using what is called the "Fama-Macbeth procedure" from Fama and MacBeth, 1973). We find that higher-priced firms have

[5] Japan inflation data is from the Japanese Ministry of Internal Affairs and Communications' Statistics Bureau, available at ⟨http://www.stat.go.jp/english/data/cpi/index.htm⟩. UK inflation data is from the CDKO index, available at ⟨http://www.statistics.gov.uk/default.asp⟩.

Table 2
Prices and Trading Costs over 80 Years

Variable	*Parameter estimate*	*Standard deviation*	*t-value*	*P*
Intercept	0.0109293	0.0047560	20.55	< 0.0001
Price	−0.000102840	0.000070595	−13.03	< 0.0001
Volume	−9.997666E-8	1.5440817E-7	−5.79	< 0.0001
Turnover	−1.852681E-6	0.000117234	−0.15	0.8820
Size	1.927482E-10	1.8602275E-9	0.93	0.3569

Source: Data is from Joel Hasbrouck's website and CRSP.
Note: There are 197,755 firm year observations and 80 years of data. We estimate the cost per dollar of trade for each security ("Cost"). Volume is the annual sum of the monthly volume ("Volume"). We estimate turnover as the total annual volume/monthly average of shares outstanding ("Turnover"). We estimate size as the monthly average price times monthly average number of shares outstanding ("Size"). We create dummy variables D1, D2, D3, D4 and D5 based on annual quintile ranking of the monthly average price of the security. We use the Fama–MacBeth (1973) procedure for the two models shown below. We exclude Berkshire Hathaway and all stocks traded below $5/share from the analysis, but the results are robust to their inclusion. Our linear specification, with results shown in the table, is:

$$\text{Cost} = \alpha + \beta_1[\text{Price}] + \beta_2[\text{Volume}] + \beta_3[\text{Turnover}] + \beta_4[\text{Size}] + \varepsilon.$$

Our nonparametric specification mentioned in the text was:

$$\text{Cost} = \alpha_1[D_1] + \alpha_2[D_2] + \alpha_3[D_3] + \alpha_4[D_4] + \alpha_5[D_5] + \beta_1[\text{Price}] + \beta_2[\text{Volume}] + \beta_3[\text{Turnover}] + \beta_4[\text{Size}] + \varepsilon.$$

significantly lower relative bid–ask spreads. For example, holding all else constant, a $5 increase in stock price from $30 to $35 per share, decreases the relative bid–ask spread by approximately 9 percent. We also performed a robustness test using a nonparametric specification for price and find quantitatively similar results. Consistent with tests that show that the relative bid–ask spread increases after splits, we find more generally that the specific price targeted by firms matters, and lower prices impose higher trading costs.

Economic Explanations

Can this collection of facts about constant nominal stock price over time be explained by some standard economic explanation? Since the regularity is a result of firms splitting their stocks, we look to the stock split literature for possible explanations. A long literature about stock splits stresses three possible explanations for the act of splitting a stock: marketability, "pay to play," and signaling. We discuss them in turn.

The Marketability Hypothesis

One explanation for stock splits is that they are undertaken to increase the appeal of the stock to individual investors. A lower share price could increase the

pool of potential investors in the company, and so the demand for the stock will increase. It is sometimes also argued that this will also increase the stock's liquidity. This argument has a long tradition and some empirical support, but it does not explain many of the key facts presented in the previous section.

Dolley's (1933) early study of stock splits reported that 33 of 36 corporations that split their shares in the 1920s indicated that the primary objective was to increase the marketability of their common stocks. Half a century later, Baker and Gallagher (1980) surveyed chief financial officers of two groups of firms, one that had split and another that had not. For both groups, they report that the most popular reason for splitting is to "make it easier for small stockholders to purchase round lots (more shares, lower price)." Within the stock split group, 98.4 percent agreed with the trading-range hypothesis, and even within the non-split group, 93.8 percent supported the trading-range hypothesis. In a follow-up study, Baker and Powell (1993) report similar results. Even some managers of open-end mutual funds support the trading-range hypothesis, with 40.4 percent agreeing that "a lower NAV [net asset value] per share attracts more investors" (Fernando, Krishnamurthy, and Spindt, 1999).

Not only do managers appear to have this belief, but also several empirical studies have provided evidence that can be interpreted as supportive of the marketability hypothesis. Dyl and Elliott (2006) document a positive correlation between share price and institutional ownership, suggesting that individuals might prefer lower-priced stocks. Fernando, Kirsnamurthy, and Spindt (2004) document a positive correlation between institutional ownership and share prices of initial public offerings. One could conclude that institutional investors prefer high share prices due to lower brokerage commissions, whereas individual investors can only afford buying round lots of low-priced shares. However, direct tests of the increased marketability for common stocks subsequent to a stock split suggest that there is no long-term increase in marketability (for example, Lakonishok and Lev, 1987), and if there are any short-term effects, they are very small (for example, Byun and Rozeff, 2003).

More importantly for our investigation, the marketability hypothesis makes clear-cut predictions that are inconsistent with many of the patterns of constant nominal share prices. For example, why didn't share prices keep up with inflation? According to the marketability hypothesis, individuals have a budget constraint that restricts them to lower-priced shares. Suppose, for example, that an individual would like to diversify across ten stocks, and she has only $25,000 to invest. If she allocates $2,500 to each stock, and she is restricted to buying "round lots" (shares in multiples of 100), she can pay no more than $25 a share. This simple arithmetic ignores one important consideration: the investor who had $25,000 to invest in 1933 is likely to have much more money (in nominal terms) today. It seems natural to assume that the budget constraint of the average individual investor should remain approximately constant in real dollars. Assuming that the funds available for investing increase with inflation, then the marketability hypothesis clearly

predicts that nominal share prices should keep up with inflation. The data refute what is arguably the most basic prediction of the marketability hypothesis.

The idea that stock splits are undertaken by firms to maintain a preferred trading range for retail investors is problematic for other reasons as well. First, many firms offer direct investment programs that allow investors to buy small quantities of shares without any commissions (Scholes and Wolfson, 1989). Second, over the past 20 years the pricing of retail brokerage has changed in a way that makes the marketability hypothesis untenable. Many brokerage firms charge a flat fee for trades up to 20,000 shares. This commission structure means that retail investors should have no preference about the number of shares that they trade. Also, while trading odd lots was difficult and expensive historically, in a world of electronic trading this is no longer the case.[6] So unless individual investors have specific preferences for lower-priced stocks unrelated to their budget considerations, the marketability hypothesis is inconsistent with the facts. And if investors do have such preferences, why would their preferences for lower-priced stocks depend on the size of the company?

The marketability hypothesis also makes a clear prediction about diversified investment vehicles. In the mutual fund and exchange-traded fund settings, where a retail investor can obtain a well-diversified portfolio by purchasing one security, the marketability hypothesis predicts no splits at all. However, exchange-traded funds split their shares. For example, on April 24, 2006, the Rydex equal weight Standard & Poor's index fund executed a 4:1 split, and on June 13, 2005, a dozen different iShares funds managed by Barclays Global Investors split either 2:1 or 3:1. In the case of open-end mutual funds, the theoretical prediction is even more dramatic. The share price of such a fund is irrelevant, because you can purchase or sell whatever dollar value you want and the fund will calculate fractions of shares as necessary. And yet mutual funds do split. Moreover, we note that many mutual funds have a minimum initial investment requirement, which is consistent with our claims that very small shareholders are not the preferred investors for most firms, and mutual fund splits are hard to rationalize under the marketability hypothesis.

Finally, the marketability hypothesis suggests that share prices should respond to changes in the composition of stock owners—in particular, to the dramatic increase in institutional ownership that has occurred. According to the NYSE "Factbook," the percent of corporate stocks that were directly owned by individuals declined from 90.2 percent in 1950, to 41.1 percent in 1998. At the same time, indirect holdings of corporate stocks, such as via mutual funds, have increased

[6] In fact, there is some evidence that odd-lot trades get better execution on the New York Stock Exchange because of Rule 124 and the elimination of the odd-lot differential in 1991. Rule 124 effectively requires specialists to execute odd lots at the same price as the most recent or next trade. An example of the benefits of odd-lot trading was highlighted in 2004 when the NYSE announced that it was imposing a censure and $50,000 fine against Westminster Securities Corporation. The alleged abuse by Westminster was breaking up customer round-lot orders into odd-lot orders to sneak them ahead of other round-lot orders awaiting execution. The full text of Rule 124 is available at ⟨http://rules.nyse.com/NYSE/Help/Map/rules-sys186.html⟩.

many-fold from 3.3 to 27.5 percent, and the fraction of stock owned by nonhouseholds, such as defined benefit pensions, has increased from 6.5 to 31.4 percent, as seen in the Federal Reserve Flow of Funds Accounts data. Nonretail trading in at least some securities accounted for 96 percent of New York Stock Exchange trading volume in 2002 (Jones and Lipson, 2003). In short, institutional holdings and trading dominate the market.

The major reduction in direct household holdings, and the corresponding increase in institutional holdings and trading, indicates that there has been a significant change in the characteristics of investors. Therefore, the marketability hypothesis would predict higher prices as this investor composition shift occurs and firms cater to the new class of important investors. However, we already saw that share prices remained around $35 throughout the entire period, despite the major changes in stock ownership.

The nominal share price puzzle could also be related to characteristics of the retail investor.[7] For example, perhaps a few very wealthy individuals held stock in earlier periods, but now many more, though less-wealthy, individuals hold equity securities directly. The reduction in real price over time could then be a consequence of the fact that those less wealthy individuals are the marginal investors. However, the level of direct equity participation now and 80 years ago is quite similar. For example, the percentage of households with direct holdings of shares of stock in the 1920s was around 20 percent, roughly the same as in the late 1990s. As mutual funds have become increasingly popular since the mid-1960s, most individuals' stock-holdings are indirect, through these funds. Moreover, even nowadays stock ownership is highly concentrated: the wealthiest 10 percent of the population in the United States owns 85.1 percent of common stock, and approximately one-half of all households have zero stock holdings (Mishel, Bernstein, and Allegretto, 2005). It seems unlikely that the nominal price stationarity can be attributed to changing characteristics of retail investors.

The Pay-to-Play Hypothesis

A related hypothesis, which also posits an optimal trading range for stock prices, is based in the notion that firms set their share prices to induce brokers/dealers to provide liquidity through higher market-making profitability. Angel (1997) develops a theory of "relative tick size." In this approach, firms split their stock to lower the share price and increase the ratio of tick size (defined as the minimum possible difference between the bid and the ask price) to share price. A higher relative tick size economically motivates more dealers to make markets for the stock and to provide more liquidity.

This theory is consistent with the pattern observed in the United States over the period 1930–1996 where both tick sizes and prices remained constant. However, the theory predicts that if tick sizes fall, prices should fall as well. A natural test

[7] We thank George Akerlof for his suggestion to investigate this point.

is provided by the decimalization that occurred on the New York Stock Exchange. As Angel (1997, p. 678) boldly stated: "[A] reduction in the minimum price variation from $0.125 to $0.01 could eventually lead to a reduction in the average share price by the same factor, 12.5 resulting in an average share price around $3." Starting in 1997, the natural experiment Angel hypothesized actually took place. The tick size on the NYSE changed from 1/8 to 1/16 and then to 1/100. But Angel's prediction was not successful. Rather than falling by a factor of 12.5, share prices remained roughly constant during this period. Similarly, the reduction in minimum tick size on the Toronto stock exchange did not result in a like reduction in the average prices of shares traded on that exchange.

Another problem with this theory is that it is hard to see why large firms would feel any need to pay anyone to provide liquidity. Does the management at Microsoft or GE think that their shares would not trade if the price were $500 or $1,000 when Berkshire Hathaway, which has traded at over $100,000 per share, is among the most consistently profitable stocks traded by specialist firm LaBranche?[8] Even putting aside Berkshire Hathaway, Google's management seems to share our view that this argument is implausible since their share price has traded above $700 and the firm appears to have no intention of splitting. Clayton Moran, an analyst with Stanford Group, remarked, "All the indications I get from the company is that they are comfortable with a stock price that implies a superiority to competitors so I don't think they are motivated to split the stock" (La Monica, 2006). Finally, the tick size explanation can provide no explanation for mutual fund splits.

The Signaling Hypothesis

In a world of asymmetric information between those insiders who are managers and those outsiders who are investors, insiders may wish to convey their private information to the outsiders in the market, even if it is costly to do so. Several papers suggest that a stock split may serve as such a signaling device. As in all signaling models, two immediate questions arise: 1) what do the managers signal; and 2) what is the cost of the signal?

Brennan and Copeland (1988a) develop a model in which undervalued firms use stock splits to signal the quality and strength of their future prospects. In their model, splits are credible signals because they are costly. Since commissions are related to the number of shares traded, investors would save money by trading a smaller number of shares, each having a higher share price. Another component of the costs is the bid–ask spread. The relative bid–ask spread—defined as the bid–ask spread for $1 worth of trade—is greater post-split, as our own tests and previous

[8] "As a rule, the spread on Berkshire A shares fluctuates between $100 and $200 a share. (On most other shares on the Big Board, the spread is a matter of pennies.) Like other chief executives, Mr. Buffett doesn't want to see big spreads between buyers and sellers of his stock. However, large spreads can be lucrative for specialist firms. 'I want Berkshire to be a good stock for LaBranche, but not the best stock,' says Mr. Buffett, referring to Mr. Maguire's employer, the specialist company LaBranche & Co. Berkshire shares rank among LaBranche's most consistently profitable stocks, but not the most profitable, says owner Michael LaBranche" (Richardson, 2005).

studies show (for example, Conroy, Harris, and Benet, 1990). There are also administrative costs that add to the cost of the split, as mentioned earlier. In a signaling model, undervalued firms increase the number of shares and decrease share prices to signal their higher quality.[9] In equilibrium, one might expect undervalued firms to end up with lower share prices than overvalued firms. The greater the split factor and the lower the price, the more credible the signal and the more likely the firm is undervalued. A final implication of the signaling hypothesis is that the market reaction to the split should be positive.

If stock splits are a rational economic signal, then they presumably should be correlated with future profitability. Lakonishok and Lev (1987) report that profitability does increase significantly, but it does so *prior* to the split rather than *after* the split. Asquith, Healy, and Palepu (1989) also find large earning increases and returns prior to a split, but none thereafter. Do splitting firms try to signal that they have already reached their peak and their growth rate should revert back to a lower level? That interpretation seems unlikely. The price of shares after stock splits seems less consistent with signaling then with "rejoining the herd" at the near-constant nominal stock price.

The evidence on price performance after splits is not uniform. In the seminal paper on this subject, Fama, Fisher, Jensen, and Roll (1969) found that firms having a stock split have experienced abnormal returns of 34 percent in the 30 months leading up to the split, but experience no abnormal returns thereafter. Byun and Rozeff (2003) find that any abnormal returns subsequent to a split are specific to the sample period chosen. Some studies do find abnormal returns over long horizons after splits, but such studies are very sensitive to the methods used and there is no consensus on the results.[10]

The signaling model also predicts less information asymmetry after splits since management's private information has already been conveyed to the market via the split. This ought to lead to a reduction in "informed trades" following splits. Easley, O'Hara, and Saar (1998) examine this prediction and find no evidence that information asymmetry is reduced after splits.

Several of the facts we discussed earlier also seem at odds with the signaling hypothesis. Many exchange-traded funds are passive index funds, and it is very difficult to believe that they somehow have superior "inside information" that the underlying index they hold is going to outperform in subsequent periods—and yet

[9] Note that the signaling explanation is the opposite of the "pay to play" explanation: In the first, the split reduces liquidity and the costs are truly just burning money. In the second, the costs are effectively a payment for better liquidity and promotion. However both stories (and the entire literature related to splits) are premised upon the fact that costs of trade are increased by stock splits.

[10] For example, Grinblatt, Masulis, and Titman (1984) find median abnormal returns of 27 percent in the four months prior to the stock split, and 3 percent in the four months subsequent to the split. Desai and Jain (1997) find buy-and-hold abnormal returns of 7.05 percent in the year after the split, which suggests that the firm continues to have good performance post-split, and yet the signal is not fully incorporated into prices by the market. Ikenberry, Rankine, and Stice (1996) and Ikenberry and Ramnath (2002) find abnormal returns of between 8 and 9 percent, and abnormally low negative earnings realization in the year subsequent to the split.

they split. Mutual funds split too, yet it is difficult to construct a model in which the funds can (much less do) predict out-performance. ADRs, or American Depository Receipts, are a financial vehicle that represents a certain number of shares of a foreign stock, but they are denominated in dollars and sold on U.S. stock exchanges. Unsponsored ADRs split, while their home country security, where most of the trades are done, does not (Muscarella and Vetsuypens, 1996). The depository bank that created the unsponsored ADR is unlikely to have better "inside information" on the future prospects of the firm than do the managers of the firm itself. From these examples, it seems difficult to identify exactly what splits signal.

Signaling theories also imply that as the cost of the signal changes, the intensity of the signal should change as well. Thus when brokerage commissions dramatically decreased with the shift from fixed minimum to negotiated commission on "Mayday" in May 1975, and again with the penetration of discount brokers, we should have observed a like decline in share price. Similarly, the reduction in the minimum bid–ask spread over a very brief period in time should have an abrupt impact on share prices, which it has not. From 1933 to 1997, the minimum tick size remained constant at 1/8 of a nominal dollar. June 23, 1997, marked the first change in nominal tick size from 1/8 to 1/16, and January 29, 2001, marked the transition on the New York Stock Exchange to having all stocks quoted in decimals, and yet throughout these changes, prices have remained remarkably constant. In summary, the evidence casts doubt that signaling could explain share prices remaining at a nominal price of $35 since the Great Depression.

Finally, certain questions always arise with signaling hypotheses. Firms that split their shares are primarily those whose shares have greatly increased in price. Why is this signal more likely to be available in bull markets or for firms that have been doing exceptionally well? Wouldn't firms in down markets (or firms that have done poorly in the recent past) also have private information they would like to signal? In fact, why don't low-price firms use splits to signal strong future prospects, since a split to an abnormally low price would seem to be an especially strong signal? Finally, why does every high-priced company undertake this specific signal? Does every high-priced firm have good future prospects, except for Berkshire Hathaway and Google?

Customs and Norms

As Sherlock Holmes liked to say, "When you have eliminated the impossible, whatever remains, however improbable, must be the truth" (Doyle, 1890). The standard economic explanations for stock splits cannot account for the facts surrounding the nominal share price puzzle, so we must consider alternatives. We consider the possibility that firms are simply following convention when they set the share price. They set the price to whatever is considered the norm. Unlike the norm of driving on either the left- or right-hand side of the road, in this case there is no strong penalty for violating the norm. Having an outlier price such as Berkshire

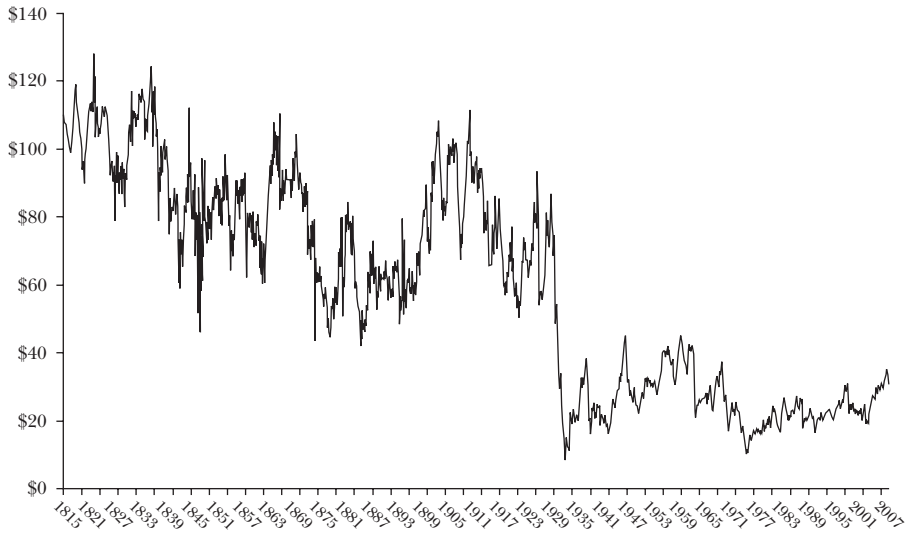
Hathaway or Google will not get you killed. However, the norm is sufficiently engrained that going against it invites scrutiny. Almost every in-depth article in the popular press on Berkshire Hathaway comments on its unusually high per share price and on Warren Buffet's unwillingness to split the stock. Interestingly, the norm of an average price of about $35 has been formed only since the 1929 crash. Figure 3 shows that, until the crash in 1929, stock prices were much higher. Prior to 1915, share prices were quoted as a percentage of their par value, not in dollars (Angel, 1997), and it was very common for par values to be to set at $100 a share. However, after the market crash of 1929, share prices dropped from roughly $70 to $35 and have never increased. This pattern suggests that the norm around share prices can be changed in response to a dramatic shock. Additional anecdotal evidence from Europe around the introduction of the euro currency suggests that price norms can be broken when the set of "peer" firms change. After the introduction of the euro, for example, many Italian-listed companies reportedly considered reverse stock splits to raise their trading prices to more "respectable" levels (Bologna, 1999).

Admittedly, because no formal model exists of how norms are created and maintained, it is difficult to test the norms hypothesis. At this stage, we can conjecture about the process of the formation of the "price-range norm." Perhaps $35/share was a binding constraint for investors in the 1930s. The average annual income in the 1930s in the United States was under $1,400, making a $35 purchase a meaningful amount of money. With this in mind, the findings of Dolley (1933) are plausible—a lower price allowed investors to purchase shares of the companies and therefore increased the breadth of share ownership. For example, a May 17, 1916, article in the *New York Times* reported that the Willys-Overland Company (an automotive company) split its shares 4:1, moving its price from approximately $225/share to $56. Anticipation of the increased participation by a broader set of investors precipitated by the split had led to almost a 15 percent increase in price. However, by 2004 the mean annual income in the United States exceeded $60,000. This dramatic increase in nominal income, by over 40 times, makes $35/share seem no longer relevant as a binding constraint. In other words, the $35 share price is a vestigial norm.

If investors used price information for classifying firms (perhaps because of information costs or bounded rationality), it made sense for firms to coordinate on price. Once established, the norm for firms to split their stocks when the per-share price has gotten high became self-reinforcing. When considered in the time series, each of the explanations for why a particular share price might have been optimal at one point in time also leads to the conclusion that $35/share could not have been optimal in 1930, 2007, and every date in between. However, the active targeting of a price of $35/share persisted throughout this time series. Regardless as to what mechanism was initially responsible, once the behavior became a norm, it became self-reinforcing.

As our discussion has suggested in a number of places, the norm is not quite as simple as "$35 a share." Instead, the norm for the stock price of U.S. firms

Figure 3
Nominal Average Price per Share of Securities Listed on the NYSE and AMEX, 1815 to 2007
(equal-weighted average price)



Source: Data for January 1815 to December 1925 is from the "NYSE Monthly Price File from 1815 to 1925," made available from the NYSE History Research Project by the International Center of Finance, Yale University. The data for January 1926 to the present is from the Center for Research in Security Prices (CRSP).

appears to depend on the firm's characteristics, such as size and industry. Managers appear to choose stock splits in an attempt to bring share price back in line with that of their size and industry peers. In Table 3, we report that over 62 percent of the variance in post-split prices can be explained by a model that predicts the split-targeted price using a firm's share price deviation from its size and industry peers. When we restrict the sample to "large" splits, defined as 1.25:1 or greater (thus eliminating from the sample firms that have a policy of small annual dividends paid in the form of stock that the data may count as "splits"), we have even stronger results, with an *R*-squared of over 78 percent. This result supports the idea that firms are reluctant to deviate from the norm, and when they find themselves violating the pricing norm, they split to a price that rectifies the violation. Our findings are consistent with other empirical work as well. Lakonishok and Lev (1987) report that post-split share prices converge to the industry norm. Similarly, McNichols and Dravid (1990) show that the further away the share prices are from the norm price, the higher the split factor (see also Dyl and Elliott, 2006).

The norm applies to foreign firms listed on U.S. exchanges as well. For example, Muscarella and Vetsuypens (1996) note a consistency in the pricing of American Depository Receipts or ADRs—which, as described earlier, are securities

Table 3
The Price Targeted by Managers via Stock Splits

Panel A: All Forward Splits
(Adj. R^2 = 0.6284, N = 16,092)

Variable	*Parameter estimate*	*Standard error*	*t-value*	*P*
Intercept	2.65406	0.12688	20.92	< 0.0001
(Pre-Split Price) − (Size Median Price)	0.34356	0.1080	31.82	< 0.0001
(Pre-Split Price) − (FF48 Industry Median Price)	0.24427	0.00945	25.85	< 0.0001

Panel B: Average All Splits greater than or equal to 1.25:1
(Adj. R^2 = 0.7851, N = 8,370)

Variable	*Parameter estimate*	*Standard error*	*t-value*	*P*
Intercept	3.00831	0.18731	16.06	< 0.0001
(Pre-Split Price) − (Size Median Price)	0.45406	0.01328	34.19	< 0.0001
(Pre-Split Price) − (FF48 Industry Median Price)	0.27384	0.01198	22.85	< 0.0001

Source: Data is from CRSP as described in Table I.
Notes: We determine for each firm the month end price prior to the month in which it announces its split ("Pre-Split Price"), the price at month end of the split announcement ("Post-Split Price"), the median price of its size peers (as determined by size deciles) at the end of the year prior to the split announcement ("Size Median Price"), and the median price of its industry peers, as determined by the Fama–French 48 industry definitions, at the end of the year prior to the split announcement ("FF48 Industry Median Price"). Panel A shows the regression results from all firms from 1933 through 2005 that had a forward split, and Panel B shows the results for all firms from 1933 through 2005 that had a split of 1.25:1 or greater. The regression model is

$$[(\text{Pre-split Price}) - (\text{Post-split Price})] = \alpha + \beta_1[(\text{Pre-split Price}) - (\text{Size Median Price})] + \beta_2[(\text{Pre-split Price}) - (\text{FF48 Industry Median Price})] + \varepsilon.$$

We have also run this regression with different specifications, and all specifications show quantitatively the same result.

representing a certain number of shares of foreign stock that are denominated in dollars and sold on U.S. stock exchanges. The share price on the home exchange is in line with that exchange's pricing, and the number of shares packaged in an ADR brings its price in line with other securities on the foreign exchange. Share splits keep the prices at the appropriate norms. We also find evidence that Global Depository Receipts ("GDRs"), a similar type of security traded on the London exchange, are packaged at ratios which decrease the cross-sectional variability of prices of the GDRs relative to the prices of the underlying securities.

An interesting question is whether firms suffer economically by violating the norm. To investigate this question, we compare the returns of firms with high prices

to firms with norm prices. Specifically, we run the following cross-sectional regression each year (from 1962 through 2005):

$$p_i = \alpha + \sum_{j=1}^{5} d_j Size_j + \sum_{k=1}^{48} d_k Industry_k + e_i,$$

where p_i is the firm's average annual price, "Size" is a dummy variable for five size quintiles, and "Industry" is a dummy for 48 industry categories provided by Eugene Fama and Kenneth French.[11]

We use the error term from the regression to rank order firms in terms of their deviation from the norm. We then use these ranks to assign firms into deciles, and call the firms in the tenth decile (firms with the highest prices relative to their peers) "norm violators" and firms in the 5th and 6th deciles "norm adherents." Every year we match each "norm violator" firm to a set of firms from the "norm adherent group," which are in the same book-to-market and size quintile. We then calculate the average return of the norm violator portfolio, and subtract the average return of the norm adherent portfolio of matched firms for each year. We then use the time series average of the difference in portfolio returns, and their standard deviation, to calculate the difference in returns for firms that violate price norms relative to firms that adhere to the price norm. We find that the violators actually earn a tiny (and insignificant) 7.34 basis points per year more than the firms that adhere to the norm.

Based on this analysis, it appears that firms that violate the price norm do not generate any economically, or statistically significantly, different returns over the next year. This finding suggests that the failure to split is not punished in any way and that the aggregate effects of adhering to the norm compared to violating the norm are not material. (Warren Buffett can relax—he has been right all along.) This is further evidence that the mechanism that generates the price stationarity is norms and not some economic rationale. It also suggests that while firms may try to cater to investor preferences via price targeting actions as suggested by Greenwood, Baker, and Wurgler (2008), the gains from catering are short-lived and reversed over time.

Conclusion

U.S. share prices have remained constant at around $35 in nominal terms since the Great Depression, while the general price level in the U.S. economy has risen more than tenfold. These constant share prices are not a coincidence, but rather result from a pro-active effort of firms splitting their stock. This pattern

[11] The industry definition comes from Kenneth R. French's data library, available online at ⟨http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html⟩.

cannot be explained by the standard explanations for stock splits, such as marketability and investor budget constraints, nor by "pay to play" considerations such as bid–ask spread and brokerage commissions, nor by signaling. The average price choice of firms and mutual funds in the United States has remained stable in the face of changing tic size, investor composition, trading costs, inflation, real wealth, and market returns. We conclude that the constant nominal share prices are a puzzle when viewed through the conventional lenses.

In our view, firms are following norms when they determine their "optimal" trading range. Specifically, keeping share prices in the same range for 70 years is the result of firms following traditions and norms that have evolved over time. Why have nominal U.S. share prices remained at $35 for so long? We respond in the same manner as Tevya, the central character in *Fiddler on the Roof*. When asked why things were done as they had always been done, he replied that he had a simple explanation: "And what is that you may ask? I can tell you that in one word. 'Tradition!'"

Tradition may also explain other aspects of corporate behavior (Akerlof, 2007; Cronqvist, Low, and Nilsson, 2009; Ben-David, Graham, and Harvey, 2007). For example: Why do some firms have almost no debt? When and why do firms initiate dividend payments (which are also irrelevant in a Miller and Modigliani (1961) world)? Why are some firms sensitive to cash flows while others are not (Kaplan and Zingales, 1997, 2000)? Why do spin-offs behave like their parents (Cronqvist, Low, and Nilsson, 2009)? Norms provide a parsimonious explanation for all these phenomena: this is the way things have always been done.

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