

# Chapter 16

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## DECIMAL TRADING IN THE U.S. STOCK MARKETS

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YAN HE, *Indiana University Southeast, USA*

### Abstract

*All NYSE-listed stocks were switched from a fractional to a decimal trading system on January 29, 2001 and all NASDAQ stocks followed suit on April 9, 2001. The conversion to decimal trading in the U.S. markets has significantly reduced bid-ask spreads. This decline is primarily due to the drop in market makers' costs for supplying liquidity. In addition, rounding becomes less salient after the decimalization. The decrease in bid-ask spreads can be ascribed to the decrease in price rounding, when controlling for the changes in trading variables.*

**Keywords:** decimal trading; decimalization; NYSE; NASDAQ; clustering; rounding; bid-ask spread; volatility; fractional trading; price improvement

The minimum increment of trading prices varies substantially with market and location. For instance, pricing of stock, bond, and options markets in the U.S. and Canada had traditionally been denominated in eighths, while in European and Asian markets decimal prices are more common. During the later half of 1990s, the U.S. and Canadian markets underwent substantial changes. Canadian stocks switched from fractions to decimals in April 1996. In the U.S. markets, the minimum tick size was reduced from one-eighth of a dollar to one-sixteenth of a dollar in June 1997. At the beginning of year 2000, the U.S. equity markets

were the only major financial markets in the world that traded in fractional increments. This fractional trading practice puts U.S. markets at a competitive disadvantage with foreign markets trading the same securities. In addition, individual investors may have a difficulty in determining the differences between increasingly smaller fractions.

To make the U.S. securities markets more competitive globally and their prices easier to decipher, the Securities Industry Association and the Securities and Exchange Commission decided to convert the U.S. equity and exchange-traded options markets from fractional to decimal trading. The NYSE selected seven pilot securities for a decimal pricing test on August 28, 2000, another 57 securities were added to the pilot program on September 25, 2000, and another 94 were added on December 4, 2000. The NASDAQ market began its decimal test with 14 securities on March 12, 2001, and another 197 securities were added on March 26, 2001. All NYSE-listed stocks were switched to a decimal trading system on January 29, 2001 and all NASDAQ stocks followed suit on April 9, 2001.

Recently, a number of studies have generated interesting findings about the effects of decimalization on return volatility and bid-ask spreads. They report that decimalization affects bid-ask spreads, volatility, quote size, and price improvement frequency (or the probability of trades within the quoted bid-ask spreads). First of all, it was shown that the recent conversion to decimal trading in the

U.S. markets has significantly reduced bid–ask spreads (see NYSE, 2001; NASDAQ, 2001; Chakravarty et al., 2001a,b; Chung et al., 2001; Gibson et al., 2002). These findings coincide with two earlier studies (Ahn et al., 1998; Bacidore, 1997) on the Toronto Stock Exchange (TSE). Bacidore et al., (2001b) examine a wide range of market quality issues on the NYSE post-decimalization, and find that an increase in the aggressiveness of limit order pricing results in narrower bid–ask spreads. Chung et al. (2004) examine the relationship between NASDAQ trading costs and the extent of order preferencing. They document lower order preferencing and a positive relationship between the bid–ask spread and the proportion of internalized volume on NASDAQ after decimalization. Second, Bessembinder (2003) and NASDAQ (2001) show that intraday return volatility has declined, and there is no evidence of systematic reversals in quotation changes. Thus, it appears that the NYSE and NASDAQ markets are able to supply sufficient liquidity in the wake of decimalization. Third, Bessembinder (2003) presents that quote size decreases after decimalization. Jones and Lipson (2001) and Goldstein and Kavajecz (2000) report decreases in limit-order book depth after an earlier NYSE tick size reduction, and Bacidore et al. (2001a) report decreases in limit-order book depth after the decimalization on the NYSE. Finally, Bacidore et al. (2001b) and Bessembinder (2003) find evidence that the percentage of orders experiencing price improvement (i.e. executed within the quotes) increases on the NYSE after decimalization, though the dollar amount of price improvement falls. According to Coughenour and Harris (2003), decimal trading effectively relaxes the public order precedence rule and gives specialists more price points within the bid–ask spread on which to quote aggressively. This allows specialist trading firms of all size to trade more often inside the current quote and so the probability that a trade occurs inside the quotes becomes higher.

Almost all the above studies document the changes in “total” return volatility and spreads of

transactions. He and Wu (2004) examine the composition of return volatility, serial correlation, and trading costs before and after the decimalization on the NYSE. Specifically, they decompose the variance of price changes into components associated with public news, rounding errors, and market-making frictions (asymmetric information and liquidity costs). First, the test results show that both variance components due to market-making frictions (or bid–ask spreads) and rounding errors decline considerably after decimalization, while the variance component due to public news shocks remains unchanged. Second, the serial correlation of price changes is significantly reduced after decimalization, indicating a weakened bid–ask bounce effect as a result of decimal trading. Finally, bid–ask spreads decline substantially after decimalization and this decline is primarily due to the drop in market makers’ costs for supplying liquidity.

In addition to volatility and transaction costs, the recent decimalization also provides an opportunity to revisit the issue of price rounding. Since traders often choose to use a larger price increment than the minimum tick, prices tend to cluster on certain fractions or decimals even when the tick is small. (See Ball et al. (1985) for gold trading; Brown et al. (1991) for silver; Goodhart and Curcio (1992) for foreign exchange; and Aitken, et al. (1995) for Australian stocks.) Harris (1999) predicts that the conversion to decimal trading would lead to lower execution costs. Bessembinder (2002) shows that bid–ask spreads have declined after the decimalization.

He and Wu (2003) investigate the pattern of price rounding before and after decimal trading and its effect on bid–ask spreads for NYSE stocks by using the second pilot sample which includes 57 NYSE securities. Prior to September 25, 2000, these stocks were traded on sixteenths. Since then, they have been traded on pennies. First, since decimal trading leads to a finer price grid or a set of less discrete prices, it is expected to observe a decline in frequencies of rounding on integers, halves, and quarters. Second, although frequencies of rounding on integers, halves, and quarters may

decline after decimalization, it is expected that cross-sectionally the relationship between rounding and trading variables and the relationship between execution costs and rounding will stay the same. That is, the sensitivity of trading variables to rounding and the sensitivity of execution costs to rounding should remain unchanged because the fundamentals of the market do not change as a result of decimalization. Finally, consistent with the arguments of Harris (1997, 1999), it is expected to find a significant relationship between the decrease in execution costs and the decrease in rounding after decimalization, when controlling for the changes in stock features. If fractional pricing indeed allows market makers to keep bid-ask spreads artificially high to earn a positive rent, a conversion to decimal trading should reduce price rounding, decrease market makers' rents, and cause a fall in bid-ask spreads.

The empirical results of He and Wu (2003) show that although rounding is pervasive in transaction prices, bids, and asks in both the pre- and post-decimalization periods, it has become less salient after the decimalization. The cross-sectional relationship between rounding and trading variables is similar before and after the decimalization, and so is the relationship between execution costs and rounding when trading variables are held constant for each stock. More importantly, the quoted and effective bid-ask spreads decrease after the decimalization, and this decrease can be ascribed to the decrease in price rounding when controlling for the changes in trading variables.

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