Trading In Pennies: A Survey of the Issues

Lawrence Harris
Marshall School of Business
University of Southern California

Lawrence E. Harris
Fred V. Keenan Chair in Finance
Marshall School of Business
University of Southern California
Los Angeles, CA 90089-1421

Voice: (213) 740-6496
FAX: (213) 740-6650
E-Mail: LHarris@USC.edu

Version: November 15, 1999

1. Introduction

In the second half of year 2,000, the U.S. equity and options markets will switch to decimal pricing. Following the switch, and barring regulatory intervention, competition will likely drive the minimum price increment (tick size) down to a penny. This paper surveys the effects that trading on pennies will have on investors, dealers, brokers, exchanges, and data vendors.

Investors must consider how the switch to trading on pennies will affect their transaction costs, their order submission strategies, and ultimately the profitability of their trading. Dealers must consider how to remain profitable as their clients and competitors respond to the new environment. Brokers must understand how trading on pennies affects the markets so that they can better serve their clients. Exchanges must consider how the switch will affect their system utilization, how they regulate their markets, and their competitiveness. Data vendors must consider how trading on pennies will increase demands on their ability to move and present data. Finally, regulators must consider what minimum price increments markets should use.

This survey starts with short briefs about minimum price increments and about why the US markets are switching to decimal pricing. It then considers the theoretical effects of trading on pennies on trader strategies. A very brief survey of the empirical evidence concerning these effects is then presented. The implications of trading on pennies for system capacity are then enumerated. The paper concludes with a discussion of the regulatory problems associated with trading on pennies.

Minimum Price Increments

All markets have a minimum price increment (tick size) that determines the set of prices traders may use. In some markets, the increment is a decimal fraction, for example, 0.01, 0.05, or 0.1. In other markets, it is a fraction based on powers of two such as 1/2, 1/4, 1/8, or 1/16. In markets organized by exchanges or dealers, the organizer usually sets the tick. In other markets, traders set it themselves by common practice.

The tick varies substantially by market and location. Stock, bond and options markets in the US and Canada traditionally have used prices denominated in eighths. European and Asian markets typically use decimal prices. The practice in futures markets varies. Grains and some

interest rate contracts use fractional pricing. Industrial commodities, stock indices, foreign exchange contracts and some interest rate contracts use decimals.

Some decimal-denominated markets are de facto fractional markets. For example, the tick used to trade gas oil futures at the International Petroleum Exchange is 0.25 dollars. The tick used in most Italian stocks is 25 lira.

The size of the tick, expressed as a fraction of price, varies substantially across markets and within markets. The increment does not depend on whether the market uses fractions or decimals. For example, a US government bond priced at 100 trades on 1/32 increments, which is 0.03 percent of price. In contrast, a Japanese stock priced at 1200 yen trades on 10-yen increments (0.83 percent). A Japanese stock priced at 800 yen, however, trades on one-yen increments (0.13 percent). A typical 50 dollar stock at the New York Stock Exchange now trades on a 1/16 increment (0.125 percent) as does a 10 dollar stock (0.625 percent).

About ten years ago, some U.S. equity markets started experimenting with their minimum price increments. The American Stock Exchange decreased their tick from 1/8 to 1/16 dollar for stocks priced under 5 dollars in August 1992 and under 10 dollars in February 1995. All U.S. markets switched to sixteenths in June 1997. Canadian stocks switched to decimal pricing in April 1996.

In early 1997, US Representatives Oxley and Markey introduced a bill, "The Common Cents Stock Pricing Act of 1997," that would have required decimal pricing in the U.S. stock markets. Following congressional hearings on the bill in April 1997, the various U.S. equity markets announced that they would decimalize their markets after the securities industry had addressed its Y2K software problems. The bill subsequently died. The Securities Industry Association now expects that the switch to decimals will begin over the July 4th weekend.

Motivation

The U.S. stock and options markets are switching to decimal pricing for three reasons: to facilitate price calculations, to modernize market image, and, possibly, to decrease their minimum price increments.

For most purposes, decimal fractions are easier to use than fractions based on powers of two. The switch to decimal prices should simplify computations involving prices and thereby make it easier for all traders to use the markets. Since experienced traders presumably have

mastered the current fractional pricing system, the main beneficiaries will be less experienced traders.

Decimal measurement systems are widely viewed as more progressive than fractional measurement systems. Most people view measurement systems based on non-decimal divisions – like the English system of weights and measures – as archaic. In contrast, they view metric systems as progressive. Decimalization will modernize our markets.

The switch to decimal prices will change the size of the minimum price increment used in our markets. For most stocks, the increment is presently one-sixteenth dollar, or 6.25 cents. For options priced above 3 dollars, the increment is one-eight dollar. Following decimalization, markets may reduce the increment to five cents or perhaps as small as one cent. Many decimalization advocates want our markets to use smaller price increments. Although smaller increments are possible in the present fractional pricing system, their use would make pricing more confusing. Decimalization will facilitate a smaller minimum price increment.

The best size for the minimum price increment is quite controversial. The minimum price increment significantly affects the profitability of various trading strategies. A smaller increment will make some strategies more profitable and other strategies less profitable. Traders therefore differ as to whether they would prefer larger or small increments.

2. Economic Effects of the Minimum Price Increment on Market Quality

The minimum price increment affects liquidity and volatility through its effects on the profitability of various trading strategies. Liquidity – the ability to trade at low cost when you want to trade – comes from traders who are willing to give trading options to other traders in the market. Dealers and public traders give these options to the market when offer firm quotes and when they submit limit orders. Traders offer liquidity because they find it profitable to do so. Since the profitability of these trading strategies depends on the price increment, the minimum price increment affects the liquidity that traders are willing to offer. This section explains how the minimum price increment affects the profitability of various trading strategies.

The binding constraint on bid/ask spreads

The minimum price increment limits the prices that traders can quote and therefore restricts price competition among traders. Traders cannot improve the best bid or offer when the bid/ask spread is just one tick. In such cases, a smaller increment would lead to smaller spreads.

Since market orders submitted by small traders typically trade at the best quoted price, tighter spreads will lower their transaction costs. Small market order traders therefore should favor trading on pennies. Since their transaction costs will be smaller, their trading volumes should increase.

When dealers can execute market orders at wide bid/ask spreads, their trading can be quite profitable, especially if they do not receive many orders from well-informed traders who are trading on information that will soon become public knowledge. Dealers must obtain these market orders, however, before they can profit from them. Since the market for dealer-supplied liquidity is quite competitive, many dealers provide various incentives to the brokers that collect and control the routing of these orders to influence their routing decisions. In exchange for explicit cash payments-for-order flow and/or other implicit or explicit considerations, brokers will route orders to specific dealers. Trading on pennies will make these market orders less profitable to dealers if bid/ask spreads narrow. In which case, trading on pennies will decrease payments-for-order-flow.

Dealers will not narrow their spreads to the point that they cannot profit from trading. Public limit order traders, however, may narrow spreads beyond this point. Many public limit order traders use limit orders in an attempt to lower the costs of completing trades that they otherwise would use market orders to complete. Since these traders want to execute their trades, they may place their orders very close to the market. If many of these traders are in the market, they may drive the dealers out. Tighter spreads will result as the public provides more liquidity to other public traders.

Protection for liquidity suppliers

US equity markets use various order precedence rules to determine which orders will be filled first. The economic significance of these rules depends on the minimum price increment. The minimum price increment therefore affects order submission strategy.

In all markets, the price priority rule comes first. Orders that bid the highest prices and orders that offer the lowest prices must be filled before orders with inferior prices can be filled.

The principles of best execution imply this rule: Buyers expect that their brokers will always seek to trade with the lowest priced sell orders and sellers expect that their brokers will always seek to trade with the highest priced buy orders.

The next order precedence rules are the secondary order precedence rules. The most important of these secondary rules are the public order precedence rule and the time precedence rule.

The public order precedence rule gives public orders precedence over dealer orders at the same price. In Nasdaq, the rule – known as the Manning rule after the legal case that established it – applies only to the dealer who holds the public order. Within each exchange market, all public orders have precedence over all dealers at the same price.

The exchanges also separately enforce time precedence rules. Among public orders, the first order to bid (or offer) at a given price must be filled before all other orders are filled. (Some markets use the rule to rank all orders at a given price under some circumstances.)

These secondary order precedence rules are meaningful only if the minimum price increment is not too small. The increment determines the cost of obtaining precedence through price priority when a trader does not have precedence at a given price. If the increment is insignificantly small, buyers can obtain precedence simply by bidding a slightly higher price and sellers can obtain precedence by offering a slightly lower price.

The size of the minimum price increment therefore determines the profitability of strategies that step in front of existing orders. If we trade on pennies, the costs of stepping in front of other orders will greatly diminish.

This issue is especially important to large public limit order traders. For example, suppose Public Limit Order Trader L places a limit buy order at 30. When the tick is one cent, Professional Trader P can front-run this order by bidding just 30.01. If a seller then arrives, P buys what L would have bought. If price then rises a dollar, P will profit instead of L. But if price falls a dollar, P will sell to L at 30. Trader P will lose only one cent and L will lose 99 cents. The public trader loses either way. The cost to the professional trader of playing this game is the penny tick he loses if prices fall.

Public traders defend themselves from front-runners by using floor brokers to hide their orders, by breaking up their orders, and by switching to market order strategies from limit order

strategies. These responses increase their transaction costs, lower displayed sizes, and reduce market transparency.

The long-term effects of these responses can hurt both sides of the market. In the example above, the seller received a higher price because Professional Trader P stepped in front of Public Trade L's order. But if L had not shown the order or if L had submitted a market order instead, there would have been no displayed buy order at 30 and P would not have bid at 30.01. The seller might not have received even 30.

Exchanges have secondary order precedence rules to encourage public traders to offer liquidity. The public order precedence rule ensures that members do not take inappropriate advantage of their proximity to the order flow. The time precedence rule ensures that public traders who can issue and cancel orders more quickly than slower traders cannot profit too much from their speed advantage. With the protection of these secondary order precedence rules made meaningful by an economically significant minimum price increment, large traders are more willing to expose than they are willing trade.

A smaller minimum price increment therefore will shift power from public traders to dealers and from slower traders to faster traders. These arguments suggest that trading in pennies should have the following effects on the market:

1. Spreads will narrow, especially for actively traded stocks. Small impatient market order traders will benefit and limit order traders will be harmed. The decrease in spreads will be most significant for stocks that now trade most of the time at a one-sixteenth spread. These are mostly stocks of large low-priced firms.

2. Quotation sizes will decrease significantly causing quotations to be less informative. Much of the decrease will be a consequence of the well-known positive relation between size and price. However, for a given spread, the total available size will decrease because large traders will be unwilling to display their orders.

3. Large market orders will be broken up more often as they fill at multiple prices.

4. The ratio of market orders to limit orders submitted by small retail traders will increase for stocks for which the spreads have narrowed.

5. Exchange specialists will trade more often and their trading will be more profitable because they are less bound by the public order precedence rule.

6. In markets of a given spread, exchange specialists will improve prices for market orders more often because price improvement is less costly.

7. Electronic proprietary traders will become more profitable. They will place and cancel orders at high speed in response to changing market conditions. Their orders will cause quotes to "flicker."

8. The interface between floor brokers and the limit order book will become more difficult to manage as quotes flicker. Specialists may need to freeze the book to allow floor brokers to interact with it. Alternatively, exchanges may have to create separate markets for electronic order flow and for floor-based wholesale orders. The electronic order market would be represented by the best inside quote, which probably would flicker substantially. The wholesale market would be represented by a quote representing aggregate size some distance behind the market. This wholesale quote probably would be much more stable.

9. Nasdaq dealers will make less money trading active stocks for which public traders cause spreads to tighten.

10. Payments for order flow will decrease, especially for actively traded stocks for which spreads decrease. Payments probably will cease entirely for stocks for which the decrease in average spreads is greater than the payments currently made for orders.

11. Dealers who obtain order flow primarily by paying for it may go out of business if they cannot provide other inducements such as fast execution. Regional exchanges whose dealers obtain order flow primarily by paying for it may go out of business.

12. Large traders will increase their use of floor brokers and of trading systems like POSIT and Instinet that allow them to control the exposure of their orders.

Empirical Evidence

Numerous studies have been made of the market effects associated with the decreases in minimum price increment made by various exchanges during the past decade. The results are generally consistent with the implications of the theories presented above.

The most obvious and immediate effect of a decrease in minimum price increment has been an immediate decrease in quoted spreads and in quoted sizes for actively traded stocks. Studies of limit order placement have shown that the total size available at a given spread has decreased as well.

The ratio of retail market orders to retail limit orders has increased along with specialist participation rates and flickering quotes. Although other causes may explain these results (for example, the growth of retail Internet order submission trading and the growth of retail day trading), they respectively are most likely due to the tightening of spreads, to the relaxation of the public order precedence rule, and to the relaxation of the time precedence rules. The relaxation of the time precedence rule is probably also responsible for some of the growth in retail day trading.

Payments for order flow have decreased with the decreases in spreads. Nasdaq dealers are reportedly less profitable and some have withdrawn from making market in the more actively traded stocks. The decrease in spreads for Nasdaq stocks, however, may be more due to the near simultaneous introduction of the order handling rules (limit order exposure) than with the decrease in minimum price increment from one-eighth dollar to one-sixteenth dollar.

Volumes in POSIT and Instinet have increased. It is impossible to determine, however, whether the increases have more to do with the recent increases in market volumes than to concerns about order exposure. Recent increases in macroeconomic uncertainty and increases in investor confidence following a long bull market are probably more responsible for the recent increases in volumes than the changes in price increments.

3. Capacity and Information Display Issues

Trading on pennies will generate a greater volume of system message traffic. System message traffic includes order and cancellation messages, market quotation messages, and trade report messages.

Order and cancellation messages will increase substantially as dealers and electronic proprietary traders try to take advantage of changing market conditions and as other traders try to manage their orders as market conditions change. As an example of the second case, consider a trader who wants to peg his limit order to an underlying index. The number of cancel/change messages that a given continuous change in the index causes depends on the minimum price increment. If the increment is a penny, there will be many such messages. Many institutional traders commonly use this order submission/cancellation strategy. It is especially attractive to large traders who want to limit the option value of their exposed orders. Although most traders presently implement them manually, many now use software systems written by Lattice, ITG

(Quantex) and others to implement these strategies. Many more will likely do so in the future, especially if they are concerned about order exposure when trading in a penny tick market.

The increases in order submission and cancellation messages will generate an increase in market quotation messages. Since most of the submission/cancellation traffic involves orders near the market, many of the messages will cause the best quotes to change.

Trade messages will increase too, but the increase will be much smaller. The primary cause for the increase will come from messages that report trades that take place at multiple prices. For example, in a one-penny market, a 1000-share market buy order that executes 200 at 19.99 and 800 at 20.00 generates two messages. In our present 1/16 markets, that order might be filled with a single report of 1000 at 20.

The increased quotation traffic will be especially burdensome for the options markets. Options dealers use computers to produce and disseminate their quotes in the various options series in which they make market. These auto-quote systems typically use the midpoint of the bid/ask spread as an input into their models. Changes in the underlying quotation midpoint therefore often generate changes in their quotes, often for every series that they trade. The problem will be particularly severe if the options exchanges also reduce the size of their price increments. A given change in the underlying quote midpoint will more often generate changes in the options quote when the options price increment is small than when it is large. The effect will be particularly important for out-of-the-money options since they are less sensitive to changes in underlying prices.

These capacity problems all can be handled by increasing the size of the message pipes. Doing so will be expensive. The most difficult communications problems probably will be between data vendors and their clients that subscribe to broadcast services. If the data stream does not fit in the existing pipe, new pipes must either be installed or the data vendors will have to filter their feeds to send only what is most relevant. This triage, however, will expose brokers to potential legal liabilities if they fail to obtain information that their clients would reasonably assume that they should have.

As discussed above, trading on pennies will increase the numbers of flickering quotes and of small orders placed in front of large orders. These changes will make the best bid and offer quotations less meaningful. The problem will especially concern large traders who want to know the cost of trading large sizes, most of which will be behind the best quotes. If markets trade on

pennies, traders will demand more real-time information about the limit order book behind the best market. The dissemination of this information will place further burdens on information delivery systems and on the data vendors who will have to support systems to display the information. The burdens, however, are not unprecedented: Many electronic trading systems already exist that report and publish order book information.

The Securities Industry Association commissioned SRI Consulting to produce a study to forecast the capacity demands of decimalization on the markets. SRI obtained these forecasts by measuring how the June 1997 decrease in tick size from one-eighth dollar to one-sixteenth dollar affected the markets. Using various assumptions, SRI then projected these results forward for a five-cent tick and a penny tick.

SRI Consulting projects that quotes in listed stocks, in Nasdaq stocks, and in options of all types will respectively increase 139, 231, and 276 percent if the markets trade on pennies. They expect that listed and Nasdaq equity trades will increase about 80 percent.

4. Regulatory Issues

The Securities and Exchange Commission does not presently appear willing to impose a minimum price increment on the US equity markets nor does it appear willing to allow the securities trading industry to jointly specify a common minimum price increment. The Commission apparently wants competitive forces to set the minimum price increment.

The presumed reasoning is that each exchange and trading system will choose an increment that will best serve its clientele. Those exchanges and trading systems that choose well will obtain more order flow. Those that choose poorly presumably will revise their decisions to preserve their order flow.

Although this competitive process is the source of great productive efficiency in many areas of our economy, it does not work well in this instance. Two well-recognized economic forces will cause the market to fail to obtain the best solution. The first involves an agency problem between brokers and their clients that presently is solved through the principles of best execution. The second involves an externality known as the order-flow externality.

Brokers are responsible for obtaining best execution for their clients. As currently defined, they must obtain the best price available in the marketplace for orders smaller than the size quoted for that price. In practice, the best execution principles will require all exchanges and trading systems to adopt the smallest minimum price increment that any of them adopt.

Otherwise, those that adopt larger increment will not be able to obtain order flow when another exchange has a slightly better price. This argument strongly suggests that all markets will trade on pennies following decimalization.

The only exchanges and trading systems that might have a chance of maintaining a larger minimum price increment would be those that explicitly cater to large traders who want to expose their orders in a protected environment. To prevent front-runners from abusing these traders, these markets would have to prevent small traders and electronic traders from accessing their liquidity. Although we can imagine such markets, they probably will not form and the Securities and Exchange Commission probably will not be comfortable with the market fragmentation that will result should they form.

The resulting competitive solution in which all markets trade on the smallest price increment chosen by any market probably is a poor solution because it does not address the externality problem associated with the exposure of orders. Traders who expose orders offer free trading options to the market as a whole. Since traders value options whether they exercise them or not (they provide liquidity), it is in the public interest to encourage traders to offer them. Otherwise, traders will only offer them to the extent that they personally benefit from doing so. In particular, their order submission decisions will not reflect the value that they give to the market by offering to trade. Secondary precedence rules make offering liquidity more valuable by giving liquidity traders privilege in exchange for their offers, and by protecting them from other traders who would exploit information about their orders. Since these rules are not economically significant when the minimum price increment is too small, unregulated competition will not produce an economically efficient outcome. For most stocks, a penny increment will be too small.

If the Securities and Exchange Commission refuses to sanction a specific minimum price increment, it will effectively have decided to sanction the smallest increment in the market. In the current environment, that would appear to be a penny.

5. Conclusion

Decimalization is coming to the US equity markets. By quoting prices on a decimal grid, we will make the markets easier to understand and more accessible to public traders.

The change to decimal prices will be accompanied by a change in the minimum price increment. That increment is presently one-sixteenth dollar (6.25 cents) for most stocks. It will definitely be reduced to five cents and most likely to just one penny.

A penny increment will affect the trading strategies and the profitability of various traders. Dealers, market makers, computer-driven high-frequency proprietary traders, small market order traders and floor brokers will be better off. Large traders and most limit order traders will be worse off. System traffic will increase substantially.

Inside market quotes will be less informative with a penny increment as traders show less size close to the market and as large traders refuse to display size for fear of attracting front-runners.

Security markets have a minimum price increment for the same reasons that all oral auctions do. The increment keeps the market moving and it requires traders to make an economically significant contribution to price if they are to obtain precedence over other traders and if they are to burden others with information about their orders.

In auctions for cars, art works, tobacco, farm machinery and real estate, the market organizer typically sets the minimum increment. Since these markets stand alone, they do not require regulatory assistance to set their increments.

The various securities markets, however, must coordinate their operations to ensure that all traders receive the best prices for their orders. The need to coordinate to avoid fragmentation implies a responsibility to set a common minimum price increment. That variation should be set to maximize the economic benefits that the public obtains from the markets. Unfortunately, the broker-client agency problem and the order-flow externality ensure that a minimum price increment set only by competitive forces will be too small.