

GAO

Testimony

Before the Subcommittee on Finance and Hazardous
Materials, Committee on Commerce
House of Representatives

For Release on Delivery
Expected at
10:00 a.m., EDT
on Friday
May 8, 1998

SECURITIES PRICING

Actions Needed for
Conversion to Decimals

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Securities Pricing: Actions Needed for Conversion to Decimals

In 1997, this Subcommittee held hearings on proposed legislation that would have directed the Securities and Exchange Commission (SEC) to require that securities be traded using dollars and cents instead of the traditional fractions within 1 year of enactment of the legislation. After industry representatives indicated that they were committed to converting to decimals, Congress took no further action on the legislation. Industry progress since the hearings has generally been limited. Four of the eight securities exchanges that GAO contacted had begun converting their systems. Two of four organizations GAO contacted that operated market support systems, such as those that transfer payments and securities after a trade, were in the process of converting their systems. One other was finished, and another had not yet begun the conversion process. The 16 securities firms, market information vendors, and others that GAO contacted had generally not yet begun their conversion efforts. Officials of most of these organizations estimated that the cost to convert their systems for decimal trading would be much less than the cost for information technology efforts, such as the Year 2000 conversion. They also estimated that it would take less than 6 months to convert to decimals, but they did not expect to complete the conversion until after Year 2000 changes have been tested and implemented.

An industry study showed that the securities industry was dedicating most of its available information technology resources and time to readying its systems for the impending date change in 2000, the introduction of a single currency in Europe in January 1999, and other information technology initiatives. In particular, industry officials said the time required to test and resolve any Year 2000 problems leaves little time for conducting the industrywide testing necessary for a conversion to decimal trading. Industry information technology officials warned that testing Year 2000 changes and a decimal conversion at the same time would make it too difficult to identify the source of any problems that might occur and would increase the risks of failure for both. GAO's work reviewing the Year 2000 efforts of numerous federal agencies and other entities has generally found that organizations are avoiding the simultaneous implementation and testing of multiple major systems changes to mitigate the risk of inadvertent malfunctions.

Ensuring that securities industry systems are ready for the Year 2000 is too important to the continued functioning of the industry to risk failure by attempting to implement decimal trading before the Year 2000 effort is completed. However, GAO is recommending several actions that are needed to ensure that decimal trading is implemented as soon as possible after

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January 1, 2000. These actions include developing a comprehensive plan for implementing decimal trading that would establish interim milestones, including those associated with industrywide testing; setting an implementation target date; and delineating technical standards and specifications that receive broad industry support. The Securities Industry Association has agreed to oversee and manage the project as it has done for Year 2000, but SEC should monitor the plan's implementation. Further, decimal trading may also have various effects on market operations, including placing additional demands on the industry's information processing and communications capacity and altering the functioning of various market and exchange rules. To maintain fair and orderly market operations, SEC needs to ensure that the industry also assesses and prepares for these effects.

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Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to provide the results of our assessment of the securities industry's readiness to trade stocks using decimal prices. In 1997, your Subcommittee held a series of hearings on a proposed amendment to the Securities Exchange Act of 1934 that would have directed the Securities and Exchange Commission (SEC) to require, within 1 year of enactment, that securities trading be in dollars and cents instead of the fractional increments of a dollar, such as eighths and sixteenths, used today. Shortly after those hearings, various exchanges and markets indicated that they were committed to converting to decimal trading, and Congress took no further action on the legislation. Subsequently, after market participants indicated that the conversion to decimal trading should be postponed until after 2000, you asked us to determine whether anything could be done to accelerate that time frame.

With a few exceptions, the majority of the exchanges; market support organizations, such as those that transfer payments and securities after a trade; and securities firms of various sizes that we contacted had made limited progress toward converting to decimal trading. Most organizations were extensively involved in modifying their systems to be ready for the date change in 2000 and the impending implementation of the new European Monetary Union (EMU), both of which have dates that cannot be changed. Market participants expressed strong concerns that attempting to convert to decimal trading while these and other information technology initiatives were under way represented a great risk to the success of any of them and to the industry as a whole. After consulting with SEC in January 1998, the securities markets established a working group to expand on previous industry discussions of decimal trading and to begin developing decimal conversion standards and establishing time frames for completing the conversion to decimals. The time frames this group has proposed envision that decimal trading would begin during the third quarter of 2000.

Our work shows that making Year 2000 changes continues to require significant securities industry resources and will demand much of the limited time remaining for testing the changes. Ensuring that these changes are successful is too important to the industry's continued functioning to risk failure by attempting to implement decimal trading before the 2000 changes are made. However, we identified several key elements that could help ensure that the change to decimal trading is made as soon as possible after January 1, 2000. One of these elements was

completed April 16, 1998, when the Securities Industry Association (SIA) agreed to act as the industry focal point for the implementation of decimal trading. The industry has also been working on the other elements, but additional work remains for SEC and the industry to reach consensus on the approach for the implementation, as well as on an implementation date, milestones, and technical standards and specifications. Further, because decimal trading may have significant effects on U.S. markets and market participants, assessing and addressing any such effects would be an important part of preparing for and planning its implementation. Potential issues include ensuring that adequate processing and communications capability exists in the industry to support decimal trading and evaluating any changes needed in market regulations to ensure that market operations remain fair and orderly.

In doing this work, we contacted officials from SEC and eight major exchanges and markets that trade stocks and options in the United States as well as four support organizations for these markets, such as those that transfer payments and securities after a trade. We also contacted representatives from 12 securities firms of various sizes as well as 2 organizations that provide information technology support services for hundreds of additional firms. In addition, we discussed the readiness for decimal trading with officials of two major market information vendors. To obtain information from an exchange that had recently undergone a transition to decimal trading, we contacted the Toronto Stock Exchange (TSE). We also discussed decimal trading with various securities market experts, including academics who had conducted relevant studies. We did our work between February and April 1998, in accordance with generally accepted government auditing standards.

Securities Industry Progress Towards Trading in Decimals Has Been Limited

Converting to decimal trading requires industry participants to (1) identify those information technology systems and components involved in securities trading that need changes, (2) make the necessary software coding adjustments, and (3) test and validate those systems. The testing is done in three phases—internally, externally with individual counterparties (referred to as “point-to-point” testing), and “streetwide” in which simulated trades are processed by all major segments of the securities industry. As of April 30, 1998, only 2 of the 28 organizations in the securities industry that we contacted had converted and internally tested their systems for decimal trading. (See app. I.) Although most of these organizations had not started converting to decimals, they estimated that making the necessary modifications and readying their systems for testing

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with others would require less time and fewer resources than many of the other initiatives already under way in the industry, such as the work being done for the Year 2000 date change.

Of the eight stock and options exchanges we contacted, four had begun system modifications. The farthest ahead was the New York Stock Exchange (NYSE), which began its conversion 2 years ago to prepare for listing and trading the ordinary shares of foreign companies using decimal prices denominated in foreign currencies instead of the American Depositary Receipts currently traded.¹ NYSE officials told us they plan to complete system modifications by September 1998, when internal testing is to begin. They said their conversion efforts do not involve the accounting and processing systems used by NYSE specialists.² One official said that NYSE has not formally attempted to determine the readiness of specialists' systems for decimal trading, but he indicated that some firms have begun converting. The Nasdaq Stock Market, Inc. (Nasdaq), the American Stock Exchange, and the Chicago Stock Exchange have begun replacing older systems with newer technology that will be capable of decimal trading, and the new systems are scheduled for completion and internal testing by the third quarter in 1999. NASD Regulation, Inc. would not be ready until March 2000. The other four exchanges generally had done only internal assessments to determine which systems would require modifications.

Of the 12 securities firms we contacted, only 1 had modified and internally tested its systems for trading in decimals. Officials of this firm said they had replaced their older systems with newer ones that were capable of processing decimal prices. Many smaller securities firms rely on third-party firms to perform their data processing, but the two data processing firms we contacted—which process information for hundreds of medium and small securities firms—had not begun to modify their systems. Although most organizations we contacted had not begun converting their systems for decimal trading, many reported having at least conducted an informal inventory or assessment of their systems to determine which ones would be affected by such a conversion.

¹American Depositary Receipts (ADR) are traded on U.S. exchanges and markets in lieu of the actual shares of a foreign company. ADRs are secured by a foreign company's shares held on deposit with a U.S. bank and entitle their holders to all dividends and capital gains.

²Specialists are members of a stock exchange who are responsible for maintaining fair and orderly markets in one or more securities.

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The readiness of the four market support organizations we contacted varied. Officials of the largest U.S. securities depository organization, the Depository Trust Company, which maintains records of securities holdings for securities firms, custodian banks, and their customers, said they had only one affected system and it was already decimal ready. The Securities Industry Automation Corporation, which operates the NYSE and American Stock Exchange trading systems, also operates the systems that make up the National Market System. These systems allow quotes and orders to be routed among the exchanges in New York and other exchanges or dealers across the country. According to Corporation officials, those systems that route quotes are ready; those that route orders will be ready in the third quarter of 1999. Officials of the National Securities Clearing Corporation, which is the largest clearing organization for U.S. stocks,³ indicated that decimal trading modifications to the systems used for exchange-listed stocks were completed in March 1998, but the modifications for systems used for the stocks traded on Nasdaq are not expected to be complete until May 1998. Officials at the Options Clearing Corporation, which performs clearing functions for options trading, told us that they had not yet begun systems modifications.

The time and cost estimates for converting to decimal trading offered by exchanges, support organizations, and securities firms varied. The estimates generally ranged from 2 to 6 months and no higher than \$10 million but usually closer to \$5 million or less. Developing cost estimates was difficult for many organizations, because they (1) did not know the specifications, (2) had not yet started converting, and (3) had to consider the impacts of other information technology initiatives already under way at their organizations. An industrywide study done for SIA found that the level of effort required for securities market participants to ready themselves for decimal trading was less than that required for other ongoing information technology efforts.⁴ For example, the study estimated that decimal trading conversion industrywide would require slightly over 300 person years, the equivalent of about \$170 million, which is less than 5 percent of the estimated 8,800 person years and about \$5 billion for Year 2000 work.

³A clearing organization processes trade information for the purposes of ensuring accuracy and facilitating the transfer of payments and securities ownership.

⁴The Information Technology Capacity Study, Securities Industry, (1998-2000), The Tower Group (Apr. 1998). The study received responses from 10 of 22 large securities firms whose officials are represented on the Technology Management Committee of SIA. The results from these 10 firms were then used to estimate industrywide resource requirements.

Barriers to Implementing Decimal Trading Before 2000 Exist

Despite the less involved effort needed to convert individual firm systems to decimals, securities market participants told us the industry is unlikely to be able to implement decimal trading before 2000. The primary reasons cited were inadequate time and resources, given the demands of the Year 2000 effort and other information technology initiatives already under way.

Representatives of almost all of the exchanges, support organizations, and securities firms we contacted indicated that they would not have sufficient time and resources available to both modify and test systems necessary for decimal trading until Year 2000 efforts were completed. Because decimal trading will affect all market participants' systems, they said that systems changes would have to undergo comprehensive streetwide testing similar to that required for the industry's Year 2000 effort. Nasdaq officials noted that the Year 2000 tests will be complex and that developing the testing plan has required months of effort by large numbers of staff across various organizations. NYSE officials indicated that most organizations can conduct systems testing on only 2 weekends a month, because processing associated with options expiration and the month's end is done during the other weekends. Industry officials noted that this is especially true for medium or smaller securities firms, which lack dedicated testing systems and can test only at those times when necessary business processing is not being done. TSE officials told us that extensive testing was done as part of the exchange's conversion to decimals and was a major factor in its smooth transition.

Industry officials also expressed concerns about the risks of converting to decimal trading while Year 2000 and other information technology initiatives were under way. Most market participants told us they have staff engaged in various other projects, including the introduction of a new currency as part of EMU and a new order tracking system required for trading on the Nasdaq market. Overall, officials at 17 of the 24 organizations we contacted told us that attempting to implement decimal trading before they were allowed to complete Year 2000 efforts and other initiatives would increase the risk of failure of one or more of the projects. For example, officials at one exchange called the prospect of converting their systems for decimal trading while Year 2000 efforts were under way "frightening," and they questioned whether the benefits were worth the potential damage that could result if systems do not work correctly and markets were unable to trade. Representatives of at least five organizations also warned that making simultaneous changes to multiple system variables, such as to both prices and dates, was not a prudent

practice and would make identifying and correcting any resulting processing errors very difficult. Officials at one exchange also indicated that making modifications for both 2000 and decimals would make it difficult for them to certify that their systems were Year 2000 compliant. Further, our work reviewing the Year 2000 efforts of numerous federal agencies and other entities has generally found that organizations are avoiding the simultaneous implementation and testing of multiple major systems changes to mitigate the risk of malfunctions.

Officials from most of the organizations advised us that obtaining the necessary internal and external resources for conducting information technology projects is extremely difficult, largely because such resources are already working on either Year 2000 efforts or the other industrywide initiatives. For example, representatives at four organizations said that they intended to use the same staff to convert to decimals that they are using for Year 2000 work now. Officials from one large securities firm said that the work entailed in converting systems for decimal trading requires an understanding of internal systems and the information flows among them and cannot be done by less experienced staff or external resources. Staff capable of performing this work are already engaged at their firm doing Year 2000 and EMU modifications. Officials at a smaller securities firm noted that unlike decimal conversion, many of these other initiatives stem from regulatory mandates or have externally fixed implementation dates, such as 2000 and the EMU target in 1999.

Key Elements Required for Successful Implementation of Decimal Trading

The readiness of the securities industry to convert to decimal trading has been hampered by the lack of certain key elements necessary for successful implementation. One of these elements was completed on April 16, 1998, when NYSE informed SEC that SIA had agreed to act as the industry focal point for the implementation of decimal trading. The industry had also begun work on the other elements, however, no SEC and industry consensus has been reached on the technical standards and specifications to be used by individual organizations in converting their systems or on implementation plans and time frames.

For other industrywide information technology projects, such as the Year 2000 efforts, a central organization or planning group was responsible for overseeing and coordinating the various participants' efforts. SIA has served as the coordinating body for the industrywide efforts under way for the Year 2000 project. An NYSE official said that for a conversion to decimal trading to go smoothly, leadership from an organization like SIA would help

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to focus the industry's efforts. SIA officials told us that they would be willing to perform this role for the industry using the same committee structure and organization that they have used for the industry's Year 2000 preparations; and on April 16, 1998, agreed to do so.

Developing an industrywide consensus on standards and specifications needed for decimal trading involves determining how many decimal places each organization's systems should be prepared to recognize and how rounding of prices would be done. Officials at six securities firms and one information processing firm told us that they would not begin converting their systems until standards and specifications for decimal trading had been established. Obtaining consensus from a broad range of organizations affected by these standards will also be important. For example, officials from one securities firm told us that after a set of standards is proposed, a working group of systems experts should provide input before such standards are finalized. They said that although the specifications for decimal trading will not be that complex, ensuring that they are workable for all organizations will require review by technology officials throughout the industry.

Developing an overall plan for decimal trading involves reaching consensus on how the transition will occur and what the implementation date will be. Officials of at least six organizations emphasized that determining the approach for implementing decimal trading was an important step. Some suggested that the approach might entail a phasing in of selected stocks; others suggested that all stocks and markets could convert at once. In addition, officials at many of the exchanges and securities firms we contacted emphasized the importance of establishing a target date for implementation. Six organizations indicated that they had delayed the start of any efforts to convert their systems for decimal trading, because such a date had not been set. Developing individual organization plans includes designating a project manager and identifying technical and management points of contact in core business areas, as suggested in our Year 2000 assessment guide.⁵

The industry has begun taking some of the steps necessary for successful implementation of decimal trading. An SEC official told us that SEC met with the exchanges, Nasdaq, and clearing organizations in June, and again in September 1997, to discuss the process needed to begin decimal trading. Also, NYSE's Operations Advisory Committee, an industrywide group comprising a broad range of securities firms, met in September 1997 to

⁵Year 2000 Assessment Guide, (GAO/AIMD-10.1.14, Sept. 1997).

discuss these issues. In January 1998, SEC requested that NYSE convene a small working group to propose a plan for the industry's conversion to decimal trading.

On February 27, 1998, representatives from various exchanges began holding meetings to discuss the timing and standards for implementing decimal trading in U.S. markets. This group has developed preliminary standards for converting systems for decimal trading, including specifying prices with 2 decimal places. The group also suggested that system changes to accommodate decimals should be able to handle at least 4 places as a precautionary measure for future contingencies. In addition, the group has offered a potential timetable for implementing decimal trading that would call for initial testing among individual participants during January to May 2000, industrywide testing through July 2000, and implementation beginning September 2000. Further, the group has discussed a plan to revert to fractions from decimals if serious processing problems arise when decimal trading begins. The group presented the proposed plan to SEC for approval in April 1998. SEC officials told us that they have asked the group to adjust the time frames in an effort to have implementation of decimal trading begin by June 2000. However, officials at two firms we talked to said that even being ready by third quarter 2000 might not be possible. Although the members of this group are important to the implementation of decimal trading in the securities industry and have agreed on specifications and a testing timetable, additional work remains to achieve industrywide consensus on these elements.

Assessing and Planning for the Effects of Decimal Trading

Assessing and planning for the effects of decimal trading on investors, exchanges, securities firms, and the markets themselves could help ensure that implementation is successful. Converting to decimal trading is generally expected to result in lower spreads for stocks,⁶ although many market participants were skeptical that the savings for investors anticipated by some advocates would actually be achieved. Market participants also expressed concerns about the effect of decimal trading on certain aspects of market operations, such as processing capacity and market rules.

⁶The spread is the difference between the lowest price at which an investor is willing to sell stock and the highest price at which an investor is willing to buy stock. Narrowing the spread can provide both lower buying and higher selling prices for investors. When an investor buys or sells stock from a dealer, the spread represents revenue to the dealer.

**Decimal Trading Expected
to Reduce Spreads but
Magnitude of Savings
Uncertain**

Predicting the specific savings that may result by converting to decimal trading is difficult, because the conversion may also affect market variables, such as the number of shares offered to buy or sell, commissions, trading patterns, and individual investor behavior. However, to the extent that decimal trading reduces spreads, public investors potentially could save money on their trades.

Advocates of decimal trading have estimated that savings for investors could be considerable if the conversion results in lower minimum price change increments (tick size) and subsequently lower spreads. Estimates of the annual savings possible from a conversion to decimal trading in U.S. markets range from \$300 million to \$5 billion. One simply derived estimate used the 250 billion shares traded in 1996, adjusted for 100 billion shares traded that did not involve dealers, and estimated that U.S. investors would benefit by \$1.5 billion for every 2 pennies that spreads decline. Another estimate was derived from the experience of TSE in its decimal conversion. According to information provided by TSE, spreads on the largest stocks declined 37 percent after the conversion to decimals. One academic researcher estimated the savings for investors from this change were about \$216 million (Canadian dollars) each year. Projecting these results to U.S. markets, he estimated that decimals could save investors \$2.25 billion each year on the New York and American Stock Exchanges.

Many of the market participants we contacted agreed that some savings for investors may result from the lower spreads likely to accompany decimal trading. They doubted, however, that all of the projected savings would be achieved. Savings from decimal trading may be less than expected for the following reasons.

- Previous reductions in the minimum tick size have already captured some of the savings expected from decimal trading. On June 2, 1997, the Nasdaq market reduced its tick size from 1/8th to 1/16th; and NYSE made a similar reduction on June 24, 1997.⁷ This represented a decrease from \$0.125 to \$0.0625 in the minimum increment by which prices could change. One study of the effects of the decrease at NYSE indicated that the savings to investors, after adjusting for trades that do not involve a spread, may have been as much as \$1 billion a year.⁸ The further savings achievable by

⁷The American Stock Exchange reduced its tick size from 1/8th to 1/16th for all listed securities on May 7, 1997. It had reduced its tick size to 1/16th for securities priced under \$5 in September 1992, and expanded the securities eligible for trading in 1/16ths to those under \$10 in April 1995.

⁸"A Teeny Change at the NYSE: Is the Move to 16ths Paying Off as Expected?," *ITG Advance*, Investment Technology Group (New York, NY: Aug. 1997).

converting to decimals depend on the trading increments used. Some market officials indicated that if spreads only narrow to \$0.05 after the conversion to decimal prices, the bulk of the expected savings may already have occurred.

- Significant portion of trades on exchanges do not involve the payment of spreads. The projected savings from conversion to decimal trading could be less than projected by some estimates because not all trades currently involve the payment of a spread by an investor to a securities firm acting as a dealer. For example, the study of NYSE's tick size reduction to 1/16ths discussed above originally projected daily savings in NYSE-listed shares that would equate to as much as \$5 billion annually. However, the study's author later reduced his daily estimates to amounts that equate to as much as \$1 billion annually, because only about 20 percent of the volume on NYSE directly involve a specialist and could result in the payment of a spread.
- Some portion of trades on the Nasdaq market also do not involve the payment of spreads. Although trading on the Nasdaq market directly between customers and dealers acting as market makers potentially involves the payment of a spread, estimates of projected savings for decimal trading will also have to be reduced to account for the trades that take place within the spreads. For example, one academic researcher stated that about 20 percent of the Nasdaq volume is dealer-to-dealer trading and thus would not represent a potential source of savings for investors.⁹ In addition, another 20 percent of the total volume of trades are between public investors as block trades or on electronic communication networks such as Instinet and do not involve payment of a spread. In addition, this researcher estimated that another 30 percent of the volume represents the activities of institutional investors that commonly negotiate their trades at prices between the quoted spread. He concluded that only 30 percent of Nasdaq trading would potentially benefit from smaller spreads. Using these adjustments for the various types of Nasdaq trading, as well as similar adjustments for NYSE and other exchange-traded stocks, he calculated a maximum potential annual savings of about \$300 million for every penny the spread is reduced.
- Effect on spreads may not be the same for all stocks. Some studies have found that minimum tick sizes may artificially constrain the spreads on actively traded, high-volume stocks. Therefore, smaller tick sizes could reduce the spread on these stocks. However, officials at various organizations noted that decimal trading will not necessarily reduce spreads to the minimum for all stocks. Spreads for individual stocks are

⁹Testimony on H.R. 1053: The Common Cents Stock Pricing Act of 1997, Lawrence Harris, Marshall School of Business, University of Southern California (Los Angeles, CA: Apr. 16, 1997).

influenced by many factors, such as the liquidity of the stock or the investor demand for it. For some stocks, SEC officials anticipated that spreads may actually be wider than before, because the natural spread for the stock may be between two fixed minimum price increments. Furthermore, a securities firm official said that stock trades do not always occur at the minimum possible spread because of normal fluctuations in supply and demand.

Information Handling Capacities May Be Strained

The systems capacities of various market participants may be strained if decimal trading causes similar increases in processing and communication volumes, as the change to 1/16ths did. (See app. II.) Market participants told us that converting to decimal trading is likely to increase processing and communication volume, because such increases resulted when the tick size was reduced to 1/16ths in June 1997. Every exchange and large securities firm we contacted indicated that their systems experienced increased processing volumes following the reduction in the minimum trading increment from 1/8th to 1/16th. For instance, according to its officials, NYSE experienced as much as a 40-percent increase in message traffic following the conversion to 1/16ths. Officials attributed these increases to the doubling of the number of fractional increments of a dollar at which trades could be executed from 8 to 16, which produced more quotes and more trades of smaller size. They anticipate similar increases from a conversion to decimals, which could result in 100 such increments if trading is done in pennies.

Over the course of the last year, almost all of the various exchanges and market participants we contacted had experienced information processing problems, which most attributed to these increased processing and communication volumes. Although some organizations told us that they experienced problems right after the tick size reduction, the problems became most severe during October 1997, which saw record trading volumes on U.S. markets. That month, both NYSE and Nasdaq traded over 1 billion shares in 1 day.

Some of the problems encountered during this time included delays within the systems that make up the National Market System. For example, the communications network used to route price quotations in listed securities among markets and other data vendors experienced queuing problems on 29 occasions between June 1997 and the end of the year, including estimated delays of up to 1 minute at various times during the record trading days in October 1997. Officials responsible for the

operation of this system reported that a new, higher capacity network became fully operational on January 2, 1998, and, that, with two exceptions, they expected all data recipients to have migrated to the new network by the end of May 1998. The Nasdaq market also experienced problems in October, when one of the systems used to provide confirmation of trades went down for several hours. Nasdaq officials reported that they made changes to correct these problems the same day, and no operational effects on trading resulted. Many of the securities firms we contacted also experienced processing related problems in 1997. One representative said that his firm spent \$10 million making its clients whole as a result of processing problems it had with its internal systems and those of the various markets during those high-volume trading days.

As a result of these problems, market participants indicated that the industry will have to address capacity issues for trading both equities and options if the implementation of decimal trading is to be successful. Options exchange officials said that capacity concerns may be even more important for options trading because of the large quote traffic that options generate for exchanges, market participants, and vendors. Many of the organizations we contacted had plans to, or had already begun to take steps to, increase their systems capacities. Because of the problems experienced after the reduction in tick size to 1/16ths, one exchange official indicated that converting to decimal pricing before an industrywide capacity study was made would be unwise. Two of the organizations that are responsible for managing major national market systems have recently commissioned an outside consultant to develop a comprehensive capacity planning process for those systems. SIA officials advised us that a similar study is expected to be commissioned for assessing the impact of a conversion to decimal trading later in 1998.

Market Operations and Rules May Change to Accommodate Decimal Trading

Converting to decimal trading could also affect the functioning of various market rules.¹⁰ Some of the first rules affected would be those that establish the minimum allowable tick size in the various markets. Exchange and Nasdaq rules that denominate the minimum tick on their markets in fractions (usually 1/16) would at least have to be converted to decimals. Also, the appropriate tick size may be less than the fractional equivalent of the existing minimum tick (0.0625), or the rules could specify no minimum and allow tick size to be set by competition.

¹⁰Appendix III provides additional detail on some of these and other impacts that market participants have projected may result from the implementation of decimal trading in the United States.

Among the rules most affected by the smaller tick sizes that decimal trading could provide are those that stipulate order priority. Market participants expressed concerns that ticks approaching pennies could increase the prevalence of “order-jumping.” Order-jumping occurs when a trader submits an order that improves the price by a small amount and thus obtains priority over any limit orders waiting to be executed.¹¹ The investors whose limit orders then go unexecuted either do not trade or must resubmit their orders at less advantageous prices. As a result, the use of limit orders may be discouraged over time, and may reduce market liquidity and make markets less transparent. SEC and exchange officials told us that this issue will have to be assessed, and revised rules may be needed to mitigate its impact. For example, one way to protect investors that submit limit orders is for the exchanges and Nasdaq to establish rules that require professional traders wishing to trade ahead of their customers’ orders to submit such orders at a higher increment than the minimum increment used for trading.

Other rules that market participants indicated could be affected by decimal trading are those requiring that trades by all exchanges or dealers be executed at the best prices prevailing across markets. For example, officials at one exchange told us that if spreads are as low as a penny, requirements that trigger automatic executions at the best prices will have to be changed to prevent manipulation. This could occur when a trader posts a quote for, or trades, a small volume of stock in one market to influence the prices in another where he intends to simultaneously trade a larger volume of stock. Other participants noted that with penny ticks, conducting trades that affect the functioning of the short sale rule would be easier.¹² Currently, trades conducted for the purpose of selling a stock short are allowed to be executed only if the last trade occurred at a higher price than the one prior (an uptick). With smaller ticks, manipulating the market to ensure that such a higher priced trade occurs before selling short would be less costly and easier to accomplish.

As a way of providing SEC and market participants an opportunity to address any negative effects of decimal trading, some industry officials suggested that the implementation be phased in, beginning with a limited number of stocks. They suggested that a minimum tick size of \$0.05 could

¹¹A limit order is one that is to be executed only if the trade price is equal to or better than the price designated in the order. Such orders establish a maximum price at which an investor is willing to buy a stock or a minimum price at which an investor is willing to sell.

¹²Short sales occur when investors borrow shares of a stock that they do not currently own from other investors and then sell those shares. Such investors profit when the stock’s price declines and they are able to repurchase the shares at a lower price to replace the ones they borrowed.

initially be mandated and assessed before additional stocks are included and further tick size reductions are permitted. SEC officials told us that assessing market effects is always difficult, even during a phase-in period. They said that they have not endorsed a phased implementation approach, although such an approach may help ensure that any systems-related or technical issues are corrected before decimal trading for all stocks occurs. They added that if the industry requests phased implementation, the phase-in period should be short and specifically set, and not used to unnecessarily extend the process.

Conclusions

The continued health and smooth functioning of U.S. securities markets is vital to the nation's economy and depends on the industry making Year 2000 changes successfully. Attempting a conversion to decimal trading before Year 2000 changes are tested and implemented increases the risks that securities industry systems would fail and adversely affect markets and investors. Achieving the potential benefits of decimal trading for investors before 2000 does not appear worth the risk.

SEC and the securities industry have been working on several elements that are necessary to help ensure the successful implementation of decimal trading as soon as possible after January 1, 2000. However, additional work remains to obtain industrywide consensus on the plan and targeted implementation date; the standards and specifications; and the schedule for internal, point-to-point, and industrywide testing. Obtaining final agreement on these elements requires detailed planning for all the entities in different industry segments, including the stock and options markets, supporting organizations, securities firms, and processing and market data dissemination firms.

Assessing and preparing for the potential effects of decimal trading on ongoing market operations would increase the likelihood that the conversion will be successful. Such effects might include increased strain on industry processing and communication capacity or reduced price ticks and spreads that may require modifications or additions to market rules. Preparing for these effects might involve phasing in certain numbers of stocks at specified minimum ticks, as some market participants suggest, or closely monitoring the effects of trading to be ready to quickly make necessary changes to maintain fair and orderly markets.

Recommendations

To help ensure a successful implementation of decimal trading in U.S. equities markets as soon as possible after January 1, 2000, we recommend that the Chairman, SEC, take the following actions:

- The Chairman should ensure that market participants develop a comprehensive plan for implementing decimal trading. Such a plan should establish interim milestones, including those associated with streetwide testing; set an implementation target date; and delineate technical standards and specifications that receive broad industry support. Although the Securities Industry Association has agreed to oversee and manage the project as it has done for Year 2000, SEC should monitor the plan's implementation.
- The Chairman should also ensure that an assessment is conducted of the potential impact of decimal trading on (1) the industry's processing and communication capacity and (2) the functioning of market regulations and exchange rules so that any necessary changes can be made and a smooth transition to decimal trading can occur.

Decimal Trading Readiness Status for Selected Securities Market Participants

Many organizations had not begun converting to decimals, because standards and specifications and an implementation date had not been established. Most considered Year 2000 and EMU changes their top information technology priorities.

Market Participant	Status of effort to convert?
Exchanges	
New York Stock Exchange	Started conversion 2 years ago, and plan to complete internal testing by the end of 1998.
Nasdaq	Replacing old systems with new that will be decimal ready.
American Stock Exchange	Inventory conducted, budgeted, and plan being developed. Some trading systems being replaced that will be decimal ready.
Boston Stock Exchange	Preliminary analysis of project but have not begun process. Waiting for specifications.
Chicago Stock Exchange	As part of system modernization, have begun converting.
Pacific Exchange	Conducting inventory and have budgeted.
Philadelphia Stock Exchange	Some scoping but have not begun formal process.
Chicago Board Options Exchange	Conducted inventory, budgeted, and have plan.
Market Support Organizations	
Depository Trust Corporation	Had only one affected system, which was already decimal ready.
National Market Systems (Securities Industry Automation Corporation)	Quoting (CQS) and trade reporting systems (CTS) decimal ready now. Intermarket trading system (ITS) modifications under way. Options-related systems have not begun to be converted.
National Securities Clearing Corporation	Systems for exchange-traded stocks completed in March 1998. Systems for Nasdaq-listed stocks to be completed by May 1998.
Options Clearing Corporation	Conducted preliminary inventory.
Broker-Dealers	
Bear Stearns	Have not begun process.
Goldman Sachs	Only performed quick issue assessment last year.
Merrill Lynch	Performed preliminary assessment, will not start until Year 2000 is complete, many systems decimal ready.
Morgan Stanley	High level assessment of scope.
Paine Webber	Previously performed a preliminary assessment, will not start until have specifications.
Salomon Brothers	Preliminary assessment of scope.
Advest	Have not begun process.

(continued)

**Appendix I
 Decimal Trading Readiness Status for
 Selected Securities Market Participants**

Market Participant	Status of effort to convert?
Gruntal	Internal systems completed but its clearing firm provides systems that are not ready
Lynch Jones Ryan	Processing done by vendor that is not ready.
Bernard L. Madoff Securities	Taken ancillary look but no inventory, budget, or plan. Instead, project is part of ongoing systems development.
Processing/Clearing Organizations	
Automatic Data Processing	Have not begun process.
Pershing	Have not begun process.
Market Information Vendors	
Bloomberg	Have not begun process but minimal effort required.
Reuters	Have not begun process.

Decimal Trading's Impact on Industry Information Processing and Communications Capacity

The implementation of decimal pricing within the securities industry may lead to increased processing and communication volumes, because such increases resulted from the reduction in tick size to 1/16ths. All of the exchanges we contacted, along with representatives of organizations that provide information processing for the national market system, indicated that their systems experienced increased processing volumes and operated at greater capacity levels following the reduction in the minimum trading increment from 1/8th to 1/16th. They also indicated that they experienced information processing and communications-related problems during the record trading volumes that were reached in October 1997.

According to NYSE officials, that exchange experienced as much as a 40-percent increase in message traffic following the conversion to 1/16ths. They attributed these increases to the doubling of the number of potential price points from 8 to 16, which likely encouraged traders to submit larger numbers of smaller orders in an attempt to achieve the most favorable pricing. Additional message traffic was created by traders who increased the practice of cancelling and resubmitting orders as a way of attempting to ascertain the direction of price movements. Analysis of data provided to us by NYSE shows that the number of one type of message—price quotes—almost doubled, rising 92 percent from 1996 to 1997; 1997 trading volume on the exchange increased just 27 percent from the prior year. On Nasdaq, which also experienced increases because of new SEC rules that introduced more quotes to the Nasdaq system, quotation volumes rose 84 percent as they increased from about 6.6 million messages in January 1997 to over 12.1 million in July 1997. The message volume increased further from there, peaking at over 20 million quotes in October but remaining as high as 16 million in December 1997. In contrast, although Nasdaq's trading volumes increased 19 percent in total from 1996, Nasdaq began and ended the year trading 14 billion shares, with volume peaking in October at 18 billion.

During the record volumes in October 1997, Nasdaq also experienced problems with one of its trading systems. On October 28, 1997, the day when Nasdaq achieved a record trading volume of about 1.4 billion shares, the system used to provide confirmation of trades was operational, but unavailable for user inquiry for several hours. This problem did not stem from a lack of processing capacity but instead was due to a programming restriction that had limited the number of individual buys and sells to a number under 1 million a day. However, this number of transactions was exceeded at about 3 p.m. that afternoon, after which the system continued

Appendix II
Decimal Trading's Impact on Industry
Information Processing and
Communications Capacity

to process trades but was no longer available to traders for confirmation that their trades had been executed. Nasdaq has since made changes to its confirmation system to address these problems, including raising the programming restriction to 10 million a day. Nasdaq officials also said they have begun expending about \$600 million to upgrade their communications network because of the increased processing demands resulting from the conversion to 1/16ths and the increasing trading volumes being experienced in the market.

The system that provides quotations for the National Market System also experienced significant information processing and communications problems following the reduction in tick size from 1/8ths to 1/16ths. For example, the communications network used to route price quotations in listed securities among markets and other data vendors experienced queuing problems on 29 occasions between June 1997 and the end of the year, including estimated delays of up to 1 minute at various times during the record trading days in October 1997. Officials responsible for the operation of this system reported that a new, higher capacity network became fully operational on January 2, 1998, and, that, with two exceptions, they expected all data recipients to have migrated to the new network by the end of May 1998.

These queuing problems were primarily attributed to significantly increased quotation traffic resulting from a combination of normal growth and two external factors, the new SEC rules in January 1997 and the reduction in the minimum price change increment from 1/8ths to 1/16ths in June 1997. Following the reduction in the price increment, the average daily message traffic of the quotation system increased by about 300,000 messages. The introduction of 1/16ths caused an overall reduction in the processing capacity of the communication network supporting the quotation system, because the use of 1/16ths required a long message format (94 bytes); the use of 1/8ths allowed the use of a short message format (40 bytes).

Decimal Trading Projected to Have Various Impacts on Markets and Market Participants

Market participants and others indicated that the implementation of decimal trading in U.S. markets could have a wide range of effects on the markets themselves and on the participants in them. The following presents some of the projected effects that were described to us by regulators, exchange and securities firm officials, and market experts. We also discuss the effects contained in various analyses and studies of U.S. and foreign markets that addressed issues relevant to decimal trading.

One of the effects seen by market participants from the implementation of decimal trading in U.S. markets was an increased use of a trading strategy known as “order-jumping.” This occurs when a trader submits an order that improves the price by a small amount and thus obtains priority over any limit orders waiting to be executed. Officials at various exchanges and securities firms expressed concerns that if minimum ticks or spreads decline to pennies, the use of this strategy will become more commonplace, because the risk of loss associated with it would generally be limited to the level of the minimum tick. This is because order-jumping traders can usually reverse their positions quickly by submitting an order to be executed against the very same order they jumped in front of, thus incurring a loss of only the size of the tick or the increment by which they originally achieved priority.

The ultimate effect of increased instances of this strategy is not clear. Although the investor whose order interacts with orders that only slightly improve the prevailing price is better off, any investors whose limit orders then go unexecuted or have to be cancelled and resubmitted at prices less advantageous to those investors are worse off. As a result, some of the benefits of decimal trading may be offset by losses to those investors whose limit orders lost priority, and may discourage the use of limit orders over time.

Market participants also indicated that a conversion to decimal trading could affect the overall quality of U.S. markets. Numerous exchanges and securities firm officials indicated that decimal trading was likely to reduce the amount of liquidity in the markets, although the results of various analyses produced unclear results as to whether markets that reduced their tick sizes experienced overall declines in market liquidity. The studies we reviewed of U.S. and foreign markets that reduced their tick sizes generally confirmed that fewer shares were available at the best prices after such reductions than before. However, whether overall liquidity was reduced is unclear. According to statistics provided to us by TSE, after it reduced its minimum tick size from 1/8th to \$0.05, the number

Appendix III
Decimal Trading Projected to Have Various
Impacts on Markets and Market Participants

of shares quoted for purchase or sale at the best prices declined over 60 percent for the top 35 stocks and by at least 33 percent for the top 300 stocks. However, TSE officials reported that approximately the same volume of shares is offered as before, but the volume is just spread over more price levels.

Another effect that market participants discussed was that decimal trading could reduce the number of securities firms willing to make markets in stocks if it reduces profitability. An official from a medium-sized securities firm told us that his firm has already reduced the number of Nasdaq stocks that it makes markets in as a result of lower profitability. He indicated that investors could be negatively affected as further narrowing spreads will lower the rewards but not the risks to dealers. In his opinion, tick sizes of a penny would dramatically affect the economics of market making, and this could make it more difficult for smaller emerging companies to access the capital markets if the returns to securities firms for making markets in such stocks do not match the risks. At least five of the securities firms we contacted had recently reduced the number of listings in which they made markets, including one large securities firm whose officials told us that they had reduced the number of stocks for which they made markets from about 850 to 550. NASD officials, although not providing exact statistics on the number of market makers, indicated that some firms had reduced the number of stocks for which they made markets, but other firms had increased their market-making activities, and thus no large net impact had resulted. However, a securities firm official noted that when a smaller firm begins making markets in the stocks dropped by a large firm, the costs to investors are not likely to be as low.

The impacts of a conversion to decimal trading on overall securities firm profitability were not clear and may vary across the activities of the firms. As noted above, the profits of firms that make markets in Nasdaq stocks would likely be further reduced by any additional narrowing of spreads brought about by decimal trading. Officials at two medium-sized securities firms indicated that their firms' market-making activities are no longer operated for the purposes of producing profits from such trading. Instead, the activities are maintained as part of providing services to customers that also use these securities firms for corporate finance and other purposes.

Decimal trading's potential impact on profits, however, may not be negative for all dealers. For example, one study of TSE's conversion to decimals and reduction in tick size found no measurable change in gross

Appendix III
Decimal Trading Projected to Have Various
Impacts on Markets and Market Participants

trading revenues for member securities firms.¹³ According to officials in NASD's Economic Research Department, this suggests that decimal trading on TSE led to no net benefit to public investors because those investors that submit limit orders have lost at the expense of those that submit orders to buy at the prevailing market price.¹⁴ Furthermore, officials at three organizations told us that securities firms acting as specialists on the floors of NYSE, the American Stock Exchange, and other exchanges may actually experience increased profits if a move to decimal trading brings smaller tick sizes. This is because these firms would be able to participate in more trades without violating rules requiring that customer orders receive priority over the specialist's own trading. According to information reported by NYSE, specialist firm profits were a record \$268 million in 1997, which was an increase of 33 percent from the prior year.

Various market participants also projected that decimal trading would increase market volatility. However, the impact of any further tick size reductions arising from decimal trading on overall market volatility is not clear, because a smaller tick size is likely to lead to more frequent, but smaller, price changes. The Investment Technology Group's study of the U.S. market's move to 1/16ths found that volatility as measured by price changes from trade to trade had actually declined by almost 20 percent. We did not identify other studies that attempted to show whether the overall level of market volatility has changed over the last year or not.

Market participants also indicated that the implementation of decimal trading could affect the functioning of various market rules. Currently, trades conducted for the purpose of selling a stock short are allowed to be executed only if the last trade occurred at a higher price than the one prior (an uptick). With smaller ticks, manipulating the market to ensure that such a higher priced trade occurs before selling short would be less costly and easier to accomplish. Various rules also currently exist that require trades to be executed at the best prices prevailing across markets. For example, officials at one exchange told us that if spreads are as low as a penny, requirements that trigger automatic executions at the best prices will have to be changed to prevent manipulation. This could occur when traders post quotes for, or trade, a small volume of stock in one market to influence the prices in another where they intend to simultaneously trade a larger volume of stock.

¹³Decimalization and Market Quality, Daniel G. Weaver, Marquette University (Milwaukee, WI: Mar. 1997).

¹⁴Issues Relating to the Decimalization of the Nasdaq Stock Market, NASD Economic Research (Washington D.C.: Sept. 11, 1997).

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