Liquidity, Transaction Costs, and Reintermediation in Electronic Markets[*]

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 Department of Finance, Smeal College of Business Administration, Pennsylvania State University. The author may be contacted by email at domowitz@psu.edu. This paper was prepared for the Financial E-Commerce Conference of the Federal Reserve Bank of New York, 2001. Several of the ideas presented here were motivated by stimulating discussions with Ray Killian, of ITG, Inc. I have also benefitted from conversations with Mark Coppejans, Jack Glen, Ananth Madhavan, and Benn Steil, and from their coauthorship with respect to pieces of the puzzle, cited herein. Responsibility for how these pieces are put together, as well as for errors and omissions, is mine alone, of course.

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Abstract

The central theme of this paper is the relationship between trading cost, technology, and the nature of intermediation in the trading services industry. Electronic markets embodying automated trade execution are linked to reductions in trading transaction costs. Lower explicit costs are related to development and operating costs in an electronic environment. Information available from electronic limit order books is identified as a means of realizing implicit cost savings. The concept of liquidity management in electronic environments is introduced, and its potential and use in practice are illustrated using limit order book data. The empirical results suggest new roles for brokerage and exchange operations, and competition between the two. Reintermediation is defined as the reestablishment of a disintermediated institution, and its nature is investigated for brokers and trading markets in an electronic environment. Competitive advantage with respect to the provision of liquidity management services is compared across types of reintermediaries.

1. Introduction

The industrial organization of the trading services industry is changing rapidly. New exchanges for the trading of financial instruments and novel forms of financial intermediation appear on almost a continuous basis.[1] Trading market structure is marked by historically unprecedented market merger activity, as well as by consortia and alliance formation in the provision of exchange services. Introduction of products is joined by new methods of delivery and information transmission mechanisms. Developments occur on a global basis, ignoring the demarcations of national borders.

Electronic financial markets lead the way in this evolution. The choice of computerized trade execution systems, and many of the changes mentioned above, can be explained through two simple observations:[2]

- Markets are firms, with the possibility of revenue sources distinct from those obtained through market making services on the part of members.
- Markets are communications systems, and telecommunications is a better model for exchange services than, say, the banking industry.

Network effects peculiar to communications systems are closely related to liquidity and liquidity provision through changes in financial market structure. Although the link between liquidity and trading costs is well known, the connection between automated market structure and trading costs is not.[3]

The focus of this paper is on the potential of electronic markets to lower costs to the trader, and implications of that potential with respect to the development of trading markets. This perspective leads not only to a discussion of the future of exchanges, but also of their new competition, novel forms of financial intermediaries.

Three questions motivate the analysis, contributing to a view of evolution in the market for markets. Does trading in a venue characterized by automated trade execution result in lower costs to the trader? What are the means, peculiar to electronic

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[1] The word, exchange, is loaded with regulatory implications; see, for example, Domowitz (1996). For the purpose of this paper, exchange, market, and trading system are used interchangeably, without reference to regulatory definitions.

[2] This thesis is elaborated upon in Domowitz and Steil (1999), who link the choice of automated market structure to cross-border trading, competition, market merger activity, and changes in exchange governance.

[3] See Amihud and Mendelson (2000) for literature connecting liquidity and cost, and Domowitz and Steil (1999) for studies of market quality across traditional and automated market structure.

market design, that permit the realization of cost savings? What do answers to these questions imply about the nature of intermediation in an electronic environment?

Adoption of automated trading technology contributes to trading cost reductions. A group of European automated exchanges, examined in section 2, exhibits costs in the form of commissions and fees that are 41 percent below the global average. These exchanges have implicit trading costs that are 66 percent below others, on average. Trading costs across automated and traditional market structures also are investigated by comparing executions via alternative trading systems and those accomplished through Nasdaq OTC broker/dealers. Automated trade execution reduces total trading costs by an estimated 32 percent over the sample period.

The way in which cost reductions might be obtained via automated trading systems is the topic of section 3. Reduced explicit costs of trading can result from savings due to lower development and operating costs of automated markets. Recent estimates of exchange setup costs suggest that trading floor development is from two to forty times as expensive as that for electronic marketplaces. Electronic order books reduce the costs of market monitoring. They allow real-time assessment of liquidity, which suggests active liquidity management to control implicit transactions costs. Data from a computerized market suggest that observation of order depth through the book permits larger trades in an environment characterized by more trading activity. Larger sizes may be transacted with smaller spreads, conditional on order book information.

Liquidity management is illustrated by examining realized price impacts. Naïve order submission strategies result in execution costs that are from 59 to 240 percent higher than those observed in practice. Most notably, realized execution costs vary little as the size of trade increases. Trading costs for trades done through the limit order book also are less, on average, than costs incurred for "upstairs" negotiated trades done off the system. The results are consistent with active liquidity management on the part of market participants, and have interpretations with respect to order fragmentation strategies and the economic benefits of off-exchange dealing.

Some implications of these results with respect to intermediation in the trading services industry are addressed in section 4. Lower costs suggest disintermediation of trading services, especially at the level of the brokerage function. The concept of reintermediation is introduced, as the reestablishment of a disintermediated institution in

the new electronic environment. The issues revolve around product and services provision, and the focus is on trade execution and investor decision support services. Examples are provided, showing how brokerage reintermediaries may resemble exchanges, and how electronic exchange reintermediaries may rebundle services to coopt brokerage functions. Competitive advantages of each set of players are outlined, in an attempt to gauge the future industrial organization of the industry. The paper closes with a brief mention of the interaction between exchanges, brokers, the internet, and the matching and search functions that are integral to trading activity.

2. Trading Costs and Electronic Markets

Interest in electronic markets is fueled by explosive growth in the use of automated trade execution in practice. Outside the U.S. and a few emerging markets, there are few equity or exchange-traded derivatives trading systems that are not fully, or at least partially, automated.[4] Foreign exchange trading is increasingly done through automated systems, such as EBS and Reuters 2002. The number of initiatives in the fixed income arena has been estimated to be as large as 60 on a global basis, represented by eSpeed, Euro MTS, BondLink, BondConnect, and BondNet.

It also is not difficult to motivate the potential importance of trading transaction costs. Consider, for example, an equally weighted global portfolio of stocks.[5] Over 1996:3 through 1998:3, one-way total trading costs for this portfolio average 71 basis points (bps). If the portfolio turns over twice a year, 285 bps in total costs are incurred. Average annual portfolio return over the period is 1228 bps. On this basis, trading costs alone account for 23 percent of returns.

The issue addressed in this section is the historical relationship between these items of interest. The empirical link between automated markets and trading costs is first examined on an international level, then with respect to finer information on trading in the U.S.

2.1 International evidence

[4] Some partial automation simply represents gradual changeover to fully electronic operations. The London Financial Futures and Options Exchange, for example, began such a transition in November, 1998, closing the floor completely on November 27, 2000.

[5] See Domowitz, Glen, and Madhavan (2000) for discussion, analysis, and precise definitions of cost. Data are based on institutional trades representing the activity of 135 institutional investors in 42 countries. These institutions accounted for 28 billion shares in 632,547 trades, using 700 global managers and 1,000 brokers. Transactions costs used here include both explicit costs in the form of fees and commissions, as well as implicit costs, such as the bid-ask spread.

Trading transactions costs are falling world-wide, illustrated by the regional declines in Figure 1. Over the 1996:3 through 1998:3 period, costs declined by 10 to 53 percent by region, averaging about 16 percent. Explanations include competition for order flow, shifts of trading strategies to accommodate liquidity differences, more institutional trading, and pressure from new trading systems and regulatory authorities.[6]

Adoption of automated trading technology contributes to trading cost reductions. This is illustrated in Figure 2, which contains explicit and implicit cost figures for several computerized equity markets, in comparison to an overall average of transactions costs over 42 countries.[7] Implicit costs for the countries shown range from 5 to 15 bps, one way. The global average is 25 bps, and the U.S. number is approximately 30 bps. Sweden, for example, exhibits implicit costs which are 62 percent below the global figure, accompanied by explicit costs which are 43 percent below other countries, on average.

The setup and operating cost advantages of an electronic trading venue suggest that commissions and fees might be lower in automated markets. Domowitz and Steil (1999) document such savings from the perspective of the exchange. Automated and floor system development plans indicate that the latter are far more costly, for example. Recent estimates of automated system development are from $10 million to roughly $100 million. Floor development costs can range from approximately $200 million to $400 million.[8] Annual operating cost savings are a bit more anecdotal, but some estimates put them at 40 to 60 percent of human resource and ancillary service cost.[9]

Although lower explicit costs are observed in automated venues, the proposition that automated market structure systematically reduces such costs is not universal. Australia's explicit costs are 10 percent above the global average. More strikingly, they

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[6] Competition between markets for international order flow is increasing (Foerster and Karolyi (1999)), which can reduce domestic market spreads (Domowitz, Glen, and Madhavan (1998)). Domowitz and Steil (1999) discuss the competitive landscape of exchange services competition. An example of regulatory pressure, and its effects, is given by Barclay, Christie, Harris, Kandel, and Schultz (1999).

[7] See also Pagano and Röell (1990), Pirrong (1996), and Schack (1999) for evidence on reduction of spreads in automated limit order books, relative to dealer and floor trading venues.

[8] The London Stock Exchange and Deutsche Börse expended over $100 million implementing Sets and Xetra, while Tradepoint was developed for under $10 million. LIFFE's floor development plan, abandoned in the spring of 1998, was priced at over $400 million. A bond futures trading floor project in Chicago was completed in 1997 at a cost of approximately $200 million.

[9] Sydney Futures Exchange and Toronto Stock Exchange, respectively.

are 83 percent above the average of the other three countries employing electronic markets in figure 2.

Higher explicit costs may be incurred for industry and regulatory reasons having little to do with the automation of trading market microstructure, however. Such effects are particularly prominent in emerging equity markets.[10] In derivatives markets, higher explicit costs are sometimes associated with the nature of the contracts traded. On the London International Financial Futures Exchange's CONNECT system, transaction fees on commodities such as sugar, coffee, and cocoa are 62 pence per lot per side, compared to 25 pence for financial futures contracts. The argument given by the exchange is that more costs are incurred for commodities, given infrastucture that includes expenses for grading and delivery systems.[11]

2.2 Evidence from the U.S.

In the the U.S., trading costs may be compared by examining executions via electronic communications networks (ECNs) and those accomplished through traditional brokerage and markets. Domowitz and Steil (1999,2001) carry out such studies using single-institution trade data between 1992 and 1996. The institutional investor was the largest single user of ECNs among active money managers during the period. The investor had no soft commission arrangements with brokers as a matter of company policy, thus making its trade data well suited for cross-market comparisons.[12] The data used in what follows are the same as employed by Domowitz and Steil (2001) with respect to the OTC market. Total trading costs include price impact, determined as a geometric average of realized and effective spreads, and measured relative to short-run industry performance.[13]

Figure 3 contains figures on trading cost savings on OTC trades by year, from 1992 through 1996. The numbers are calculated by volume-averaging total trading costs incurred through executions by 4 automated trade execution facilities and 34 traditional

[10] The correlation between explicit costs and whether equity trades take place in an emerging market is 0.47, given in Domowitz, Glen, and Madhavan (2000).
[11] See "Fee Outcry as Connect Goes Live," *Financial Times* (November 24, 2000), p. 17.
[12] Soft commission trades are those allocated not because a broker offers the lowest cost of execution on a given transaction, but because the institutional investor is obliged to pay a minimum level of annual commissions to the broker in return for services unrelated to trade execution.
[13] Details are available in Domowitz and Steil (1999); the cost measures were constructed by SEI, Inc.

broker/dealer operations. The savings reported then are computed as the difference between automated execution costs and those of the traditional dealers, relative to the traditional dealer average cost.

Average savings from using automated trade execution over the full sample are 32.5 percent, relative to traditional broker/dealer operations. Savings using automated systems are evident for every year except 1995, and range from 0.001 percent to 67 percent. The 1995 exception stems from a single outlier in the data. During the first half of 1995, a 37 percent cost was recorded on a trade done through Instinet, a system that averaged a total cost, as percent of value traded, of 0.55 percent over the 5-year sample period.

Trading costs depend on the difficulty of the trade, of course. Trade difficulty is obvious when viewed from the trading desk, but hard to quantify. Figure 4 contains cost savings disaggregated by various market indicators, all of which have been used previously in the measurement of economic characteristics of trading costs.[14] These characteristics include shares per trade, market capitalization of the stock, market beta of the stock, annualized daily standard deviation of returns for the traded issue, and the inverse of the share price. Execution costs may diminish with firm size, owing to relatively better liquidity and reduced informational asymmetries. Larger trades are more difficult, hence more costly, possibly due to larger inventory costs in intermediated settings or because of information content. Costs rise with volatility, especially in intermediated venues, given some degree of risk aversion. Trading costs are related to price levels, another measure of company size.

Savings from automated execution are evident even for "difficult" trades, measured as having above median values of trade size, beta, and volatility, as well as below average market capitalization. Such savings are observed regardless of price level. Although conventional wisdom that "easier" trades are more often sent to automated systems is born out by the data, it is still the case that automated systems afford savings even in more difficult trading situations.

Some examples from figure 4 illustrate the magnitudes involved. Automated systems are almost 60 percent less expensive than their traditional counterparts in relatively high volatility environments. A similar estimate is obtained for high volatility trades as

[14] See, for example, Bessembinder and Kaufman (1997) and Harris (1994).

measured by market beta. For small trades, the cost savings are over 28 percent, and for large trades, automated systems still deliver a 10 percent cost savings. For large capitalization stocks, there is little difference between automated systems and traditional dealer operations. Cost savings on the order of 85 percent, relative to dealers, are available through automated execution for small stocks, however. Such indicators cannot capture all aspects of trade difficulty, and trading costs certainly embody other factors.[15] Nevertheless, the results remain strongly suggestive of savings due to automation of trade execution technology.

3. Electronic Order Books and Strategic Liquidity Management

Smaller explicit costs can result from development and operating cost advantages of automated markets, passed on to the market's customers. It is not so obvious that automated market structure should translate directly into lower implicit trading costs. A claim to that effect is reminiscent of assertions that some market structures offer more liquidity than others, all other things equal. Market structure does not create liquidity; traders do. Similarly, automation by itself cannot induce lower implicit costs of trading.

On the other hand, a contribution of the theoretical and experimental literature on auctions is the observation that the form of the trading institution matters. Auction design affects trader behavior, the properties of transactions prices, and market efficiency. This set of findings also is found in the related literature on financial market microstructure.

The practical issue then is to identify the *means* by which electronic market design allows traders to reduce price impact costs. Abstracting from market structure considerations, how might traders accomplish such a reduction?

Suppose liquidity were to vary over the course of a trading day. Monitoring of liquidity characteristics permits what might be called strategic liquidity management, the goal of which is to reduce transactions costs.[16] In the theoretical literature, monitoring possibilities introduce discretionary timing of trades.[17] The competitive behavior of discretionary traders leads to trading in the lowest cost period presented by the market.

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[15] So-called "opportunity cost" is an example, a concept which has to date eluded effective empirical measurement, regardless of study.

[16] One might also add the management of risk associated with liquidity risk in the context of more general portfolio problems.

[17] See Spiegel and Subrahmanyam (1995), Admati and Pfleiderer (1988). and Scharfstein and Stein (1990).

This, in turn, induces clustering in liquidity supply and demand, reinforcing the time-varying nature of liquidity provision.

One mechanism through which such management may be accomplished is the electronic limit order book, a feature of most automated market structures.[18] The existence and dissemination of order book information sharply reduces the costs of monitoring the market, and permits real-time assessment of liquidity.

The potential for liquidity management is investigated in Coppejans, Domowitz, and Madhavan (2000). The authors examine liquidity dynamics and cost control strategies using data from the OM market for Swedish stock index futures contracts.[19] Liquidity in that paper is characterized by depth of market at different numbers of ticks away from the quote midpoint. Another possible measure is the *size-adjusted spread*, defined as the round-trip spread cost of doing a trade as a function of trade size. These liquidity characteristics are observable to traders through the electronic book.[20]

Figures 5 and 6 illustrate the possibilities. As depth increases or the size-adjusted spread decreases, the number of trades in a five-minute period goes up and the average size of a trade increases. Trading frequency rises by 53 percent as depth goes from below median to the 95th percentile, for example. The average size of trade rises by 13 percent.

Larger trades in an environment characterized by more trading activity are possible, as a function of observable depth in the order book. Further, larger sizes may be transacted with smaller spreads, by monitoring the book. Traders consume liquidity when it is plentiful. They supply liquidity when needed.[21]

Traders appear to be using the electronic system to monitor liquidity and strategically trade against the book, with respect to cost control. This is evident from figure 7, which contains price impact calculations. The columns that increase in size with trade size are price impacts for each size, under a naïve trading strategy that

[18] See, for example, Domowitz (1993).
[19] The database comprises the complete limit order book for Swedish stock index futures contracts from the period 7/31/95 through 2/23/96. Information is time-stamped to the second. Transactions files and order information are matched. The order book is reconstructed from the raw data and completely consistent with transactions reported. "Off-exchange" cross trades are isolated and matched to the order book files.
[20] See also Irvine, Benston, and Kandel (2000) for alternatives.

ignores the monitoring of the book. The columns labelled "actual" show the price impact of realized trades in practice.

Price impact is not only smaller than the hypothetical costs, but is virtually the same across trade sizes. Naïve order submission results in execution costs ranging from 7 to 15 bps. In contrast, actual price impacts average 4.4 bps. Realized execution costs range only from 4 to 6 basis points as the size of trade increases, with 70 percent of trade sizes transacted at an average cost of 4 bps.

Coppejans, Domowitz, and Madhavan (2000) note that constancy of price impacts has a practical implication in the context of current trading practice. Institutional managers often use the value-weighted average price (VWAP) as a benchmark in evaluating performance. Traders may, therefore, attempt to achieve VWAP by breaking up their trades over the day. The findings suggest that this strategy is not optimal. Better executions may be expected by taking advantage of time-varying liquidity. The ability to do so is afforded by electronic market microstructure.

The results also suggest that off-exchange dealing in an electronic environment may not be required to reduce transactions costs. The price impact of cross trades done outside the limit order book also appears in figure 6.[22] These impacts are basically flat across trade size, as might be expected, but also are no less than those observed through trading on the limit order book. On average, a cross costs 4.8 bps, compared with an average cost through the book of 4.4 bps. Interestingly, the realized cost through the book is about half a basis point greater than the average quoted half-spread in the market.

Thus, crossing away from the midquote does not save much money relative to dealing through the book, which in turn is done at a small premium relative to the spread. Crosses often are done early in the morning in this market, with a thin book. An even greater number of crosses occurs towards the close, however, with a very thick book. This raises the possibility of internalizing some trading activity to the exchange, that currently leaks to outside trading desks. Both liquidity and exchange revenue increase in the process.

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[21] At least under normal trading conditions, for which the dynamics of liquidity provision are explored in Coppejans, Domowitz, and Madhavan (2000). See also Biais, Hillion, and Spatt (1995) and Handa, Schwartz, and Tiwari (1999).

4. Intermediation, Reintermediation, and Exchange Services

The rise of computerized market structure raises a variety of issues with respect to the industrial organization of the trading services industry. The changing nature of intermediation is one such issue, motivated by the previous empirical results. Low costs of direct trading through electronic markets may be an argument for the elimination of brokerage services, for example. The potential for liquidity and cost management through facilities provided by market design suggests a changing role for the exchange as intermediary. The combination of these perspectives blurs the line between traditional brokerage and exchange services.

4.1 Reintermediation

The potential of electronic markets to disintermediate trading activity is often suggested, is hotly debated, and is beginning, even at the retail level.[23] The discussion revolves around access restrictions and reductions in trading cost, balanced by concerns over liquidity provision and the usefulness of the broker/dealer search function. The arguments are not simple, in part due to a tendency to ignore the changing nature of intermediation. There also is confusion stemming from the diverse nature of intermediation in the form of capital commitment.

Electronic market structure does not eliminate the market making function, for example, although it may change its character. It is a popular misconception that market makers operate only in floor or telephone environments. Few automated continuous markets function without some form of market making activity. To the extent that a demand for immediacy exists, it is served at a price, regardless of the trading platform. In some cases, it is encouraged by exchange management, through agreements that impose obligations with respect to the posting of two-sided quotes in return for some consideration. In others, market making activity arises endogenously, for profit, in the face of perceived demand for immediacy.[24] The endogenous arrival of

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[22] Few crosses are done at the midpoint. The crosses are often at the bid or offer, yielding the nonzero price impacts reported.

[23] The Chicago Mercantile Exchange, for example, received regulatory approval on November 27, 2000, to permit nonmember and nonclearing individuals unlimited direct access to its $Globex_2$ trading system, subject only to financial backing arrangements.

[24] Examples of the first include market making activity on electronic options markets, such as those run by OM and the ISE. The Deutsche Börse is introducing a requirement for market making in less active stocks. Examples of the second are harder to document, but the author personally knows firms that engage in the practice on automated markets.

market makers is quite a bit different, however, from the traditional practice of making the dealer a central element of market design.

There is little room, however, for the role of traditional brokerage in an electronic environment, especially at the institutional level. Does that mean the disappearance of brokerage intermediaries? The short answer is, no. Exchange competition leading to some degree of fragmentation, search considerations, and liquidity demand create the need for reintermediation of electronic trading markets. If *disintermediation* occurs when an established intermediary is forced out due to structural change, *reintermediation* is the process by which a disintermediated institution is reestablished in the new environment.

An example may help illustrate reintermediation in the presence of electronic execution venues. Tradescape's technology consists of two primary pieces. SORT™ produces an analysis of alternative markets based on speed, cost, last sale, dealer activity, liquidity, and posted quotes. The investor may allow the algorithm to automatically determine the point of order execution, or may select relevant variables for the analysis of any particular order. The second piece is called ECP, short for electronic communications portal. The ECP offers a single point of access to multiple liquidity sources.

Such new firms provide direct connectivity for execution of trades, electronic and otherwise. They are a form of network adapter, providing aggregate market information from diverse sources on a single screen.[25] Since they have the capability of linking the trader to multiple order books, there is the potential of providing enhanced liquidity management services.

Reintermediation can induce competition between brokerage and exchange services. It is a small step to add automated execution services to electronic dealing and search functions, for example. In today's environment, one need not build such functionality independently. Examples of progress using alliances and acquisitions are already available. ConSors, Europe's second largest online broker, is negotiating with the Berlin Stock Exchange to jointly build an electronic retail trading market. Reminiscent of the discussion of market making activity, the company has already purchased Berliner

[25] CyberCorp, now a part of Charles Schwab, is a similar venture. Domowitz and Steil (1999) provide other examples of adapters, and discuss their role with respect to automated trade execution and the evolution of exchange services.

Effektengesellschaft, a group that controls the largest broker on the Berlin Exchange. Europe's leading discount broker, Comdirect, has announced plans to launch a retail-oriented exchange in partnership with its parent, Commerzbank, in 2001. Tradescape acquired MarketXT in February, 2000, with the intention of leveraging the ECN model of execution services with its technology.

Market makers in electronic environments are one form of reintermediary; electronic brokers are another. Developments with respect to the latter, in particular, raise the question of whether such reintermediaries can dominate the exchange services industry, at the expense of established exchanges. In order to examine the issue, a view from the exchange perspective is required.

4.2 Exchanges as reintermediaries

Many markets have revenue-generating functions that, given current information technology, market structure, and business practice, might be performed at less cost, hence competitively, by another entity. The functions of listing, for example, including the signaling to investors that the issuing company's stock is of good quality, need not be trading market services.[26]

Each "traditional" exchange function can be unbundled from its core business and, at least in principle, performed by some reintermediary. What is the core business? At the most abstract level, it is to provide a venue conducive to liquidity provision on the part of investors. At a more practical level, exchanges in an unbundled electronic world become a simple back office service. This service consists of (i) automated trade execution; (ii) a quote and price server; and (iii) a hosting, or "site" function.

In short, exchanges become utilities. Utilities can be low margin operations, which also are subject to extreme consolidation. Such a picture generates mixed feelings on the part of management of an exchange operating as a for-profit enterprise.[27]

On the other hand, the results in section 3 suggest that the exchange may have a competitive advantage with respect to products used by traders in making decisions. Electronic microstructure, network characteristics, and even resources offered by the internet, suggest that exchanges enter into the reintermediation business. The strategy

[26] This point is elaborated upon by Macey and O'Hara (1999) with respect to products that an exchange offers to a company, and by Domowitz and Steil (1999) in the context of cross-subsidization of exchange services offered to traders.

behind exchange reintermediation is *rebundling*. Rebundling is a creative recombination of financial service elements, leveraging the technology and information capabilities of electronic market structure.

Through an automated market, a potentially infinite product line may be offered. Pricing and liquidity information can be combined into value-added information products that are simultaneously diverse and customer-specific. Interactive tools to suggest products and trades can be introduced, together with specialization to narrow customer bases at low cost. As better trading tools are provided by the exchange, scaleability of operations increases as a function of lower interaction costs achievable through the technology.

Rebundling possibilities surrounding the hosting and trade execution functions are illustrated in figure 8. Information provision, for example, need not be limited to the simple dissemination of quote and price data. Useful packaging and analysis of such data, as well as data that aid in liquidity management, can be offered as well.[28] The exchange may provide products that assist liquidity management, in addition to financial products such as index shares, a development already underway.[29] Exchanges may specialize in certain market niches, such as young growth companies or the retail side, becoming category owners in their class.[30] More speculatively, the exchange may provide financial services to the investor, taking over some of the functions currently performed by others, including brokerage sales forces.[31]

As in the case of broker reintermediation, an exchange may not want to rebundle completely on its own. Mover advantages and the same forces that are shaping exchange mergers motivate rebundling through alliance formation. This development

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[27] The transformation of exchanges from mutual nonprofits to for-profit corporations is proceeding rapidly. See Domowitz and Steil (1999) and Macey and O'Hara (1999).

[28] The Deutsche Börse is moving in this direction for retail customers, putting the order book from its Xetra system online, as Xetra Live. Other efforts involve alliances, an issue treated below. An example is the choice of EasyScreen by the Australian Derivatives Exchange as its preferred workstation and trading software solution.

[29] The development of exchange traded funds is indeed progressing rapidly, with Deutsche Börse now offering even a share in an actively traded mutual fund, as opposed to simply an index.

[30] Jiway, for example, formed by OM Gruppen and Morgan Stanley Dean Witter, is to focus solely on orders from individual investors on a cross border basis.

[31] An amalgam of services is under consideration by the NYSE. NYSE MarkeTrac is to offer virtual navigation of trading facilities and real time trade and quote information, while OpenBook will offer public access to the specialist's book. Direct + will offer automated trade execution for

has already begun. The following types of alliances have been undertaken recently, and illustrate the possibilities:

- A financial services portal and electronic brokers, with investment in an electronic market
- An institutional investor and an automated market
- An electronic broker, together with an investment bank and retail-level adapter into multiple markets
- Investment banks with electronic brokers and multiple automated markets

As this section began with the observation that existing exchange services could be unbundled effectively, one must ask when rebundling makes economic sense. This question dates from the work of Cournot in the mid 19th century, and is most recently treated by Nalebuff (2000). Nalebuff shows that selling products as a bundle can be profitable in competition against established, but uncoordinated (unbundled product), firms. Further, profits of potential entrants are lowered, including profits of those wanting to compete on the basis of alternative but similar bundles of products.

For what kinds of goods do such results supporting the idea of (re)bundling hold? They are important for complementary goods and services, and when marginal costs are essentially zero, as with information goods. The listing function and trade execution, for example, are weakly complementary at best, suggesting unbundling. On the other hand, trade execution and liquidity management tools are strongly complementary goods, both with a large information component. The results of Nalebuff (2000) then suggest a competitive advantage to the rebundling process.

4.3 Servicing the institutions

Most reintermediation and rebundling possibilities mentioned thusfar are relevant for both the retail and institutional sides. There are some special considerations with respect to the growing institutional trading community.

Web-based platforms and internet delivery options for institutions are of growing importance in the provision of exchange services. This includes, in particular, web access to content, with that content provided by the exchange itself as a revenue-

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small orders, and NYSEnet is a web-based service for information on listed companies and their trading activity.

generator. Delivery options that permit integration with institutional trade order management systems follow naturally.

Insitutional trading motivates web-driven design objectives on the part of entities performing the exchange services function. With respect to information technology, this would include open and modular architecture. For the traders, the addition of new order types and linked order destinations for contingencies are desirable, and increasingly possible. Repackaging of price data suggests interfaces for value-added data items, as well as interfaces for third-party vendors and support.

Many reintermediation initiatives thusfar seem to be in the area of pure agency brokerage, representing a relatively neutral business model with respect to the buy side. Examples with respect to "smart" execution include ITG's, POSIT 4 electronic matching agents, trade management facilities, and institutional support for trading and order submission strategies. Tradescape Institutional has modified Tradescape's retail algorithms to accommodate institutional requirements, concentrating on support for its portal into alternative execution venues. Open architecture complements initiatives to permit the embedding of such systems into a variety of trade order management systems, using multiple communications protocols. Openness also permits expansion of services into other financial instruments. Tradescape's deal to link with Cantor Fitzgerald's eSpeed is one example, using an equity system to provide a portal for fixed income trading.

On the exchange side, progress in these directions is exemplified by the Sydney Futures Exchange. Plans exist to expoit modular architecture to permit trading from Asia, Europe, and the U.S. The electronic system interface is to be broadened, permitting software vendors to connect through the internet. Traders will have the ability to connect their own front end software to the system directly. A wider variety of order types may be enabled through proprietary connections, previously only available through specialized workstations. Finally, traders will be able to access features such as the custom market and market depth.[32]

The exchange itself can provide trading decision support capabilities, an important point given the earlier emphasis on cost and liquidity management. The possibilities are limited only by the imagination, but an example is available through the activities of one

[32] See *Futures*, December 2000, p. 18.

reintermediary, ITG-Australia. Clients begin the day by cutting and pasting in trade lists on an ITG facility. Stocks are sorted, and may be viewed by liquidity characteristics and execution difficulty measures, calculated on a historical basis. A market impact model calculates expected trading costs, over different times of day. Trading strategies are suggested based on client input with respect to the degree of urgency for any particular trade package. Direct automated execution access is offered to the Australian exchange's SEATS system and to ITG's own Australian POSIT crossing network.

The example is one of an electronic reintermediary on the institutional brokerage side, not one of exchange rebundling. The competitive advantage of the Australian exchange in providing the service is the ability to provide decision support based on real-time data through the repackaging of information from its own limit order book.

5. Concluding Remarks

Broker reintermediation and exchange rebundling, and the competition between them, can be cast in a framework often reserved for the internet. Electronic presence creates brand and scale players. Accessibility and the elimination of distance costs promote competition on a global scale. Enhanced information through technology induces the demand for tools. The ease of interaction with the reintermediary, be it brokerage or exchange, creates the possibility of customization of services previously offered only in an aggregate form. While the value of sites creates liquidity advantages, enhanced search capabilities reduce profit margins.

The results and ideas presented here support some of these statements. A more narrow perspective has been adopted in this paper, however. The focus is on the relationship between trading cost, technology, and intermediation in the trading services industry.

Technology that is revolutionary in the sense of supplanting traditional exchange services provides lower cost services to the investor. Reduced transactions fees are possible, due to low development and operating costs in electronic venues. Cost savings also may be in the form of lower implicit costs of trading. One means by which the latter is achieved is through information available via the heart of most computerized execution systems, the electronic limit order book. Empirical evidence suggests active liquidity management by users of such systems, resulting in cost savings for every size trade in the sample.

Lower costs can result in disintermediation of trading services, especially at the level of the brokerage function. Disintermediation is simply part of a reintermediation cycle. Reintermediation, the reestablishment of a disintermediated institution in the new electronic environment, applies to brokerage and exchange functions alike. In both cases, the issues center around product and services provision, particularly with respect to the nexus between trade execution and investor decision support services.

Who will provide such services in the future, the exchanges or the reintermediaries? Exchanges have the competitive advantage in developing liquidity management services, in terms of real-time information and the technology behind automated execution. Brokers traditionally provide both information and search functions, however. The latter is problematic in considering the replacement of brokers by exchanges themselves.

At the institutional level, in particular, brokers put orders together, searching for counterparties. If two orders do not match exactly, brokers can attempt to bring the parties close enough to make a transaction possible. For automated markets, the existence of such a situation is sometimes called the "near match" problem. Solutions to this problem through an electronic negotiation process constitute a new frontier for trading system development.

Consideration of the internet is suggestive. Through the internet, exchanges have broadcast capabilities that previously were not available. The exchange can intermediate the process of resolving near matches through anonymous indications of trading interest via broadcast capabilities. Early examples of this idea exist in local area networks, such as the "block board" facility of the original Swiss SOFFEX design. Such broadcasts could, in principle, even be linked to share registries and clearance systems, given appropriate safeguards.

Ideas for computerized negotiation systems, new order types, and means of linking trades are forthcoming, especially as electronic execution makes inroads into fixed income and OTC derivatives markets. An example is given by ICor, which is developing mathematical methods of resolving the near match problem for OTC trades. Not all new ideas will work in all situations; the case of OptiMark's multidimensional order and execution technology is a caution. The influence of cost savings, and the means to realize them, nevertheless push development towards electronic market places. Dramatically lower interaction costs induce unbundling of services. Competitive

advantages in terms of information goods, complementarities in trading products, and economies of scale and scope, promote rebundling, hence consolidation. Finally, the network effects common to markets, which operate as communications systems, accelerate the transformations highlighted here.

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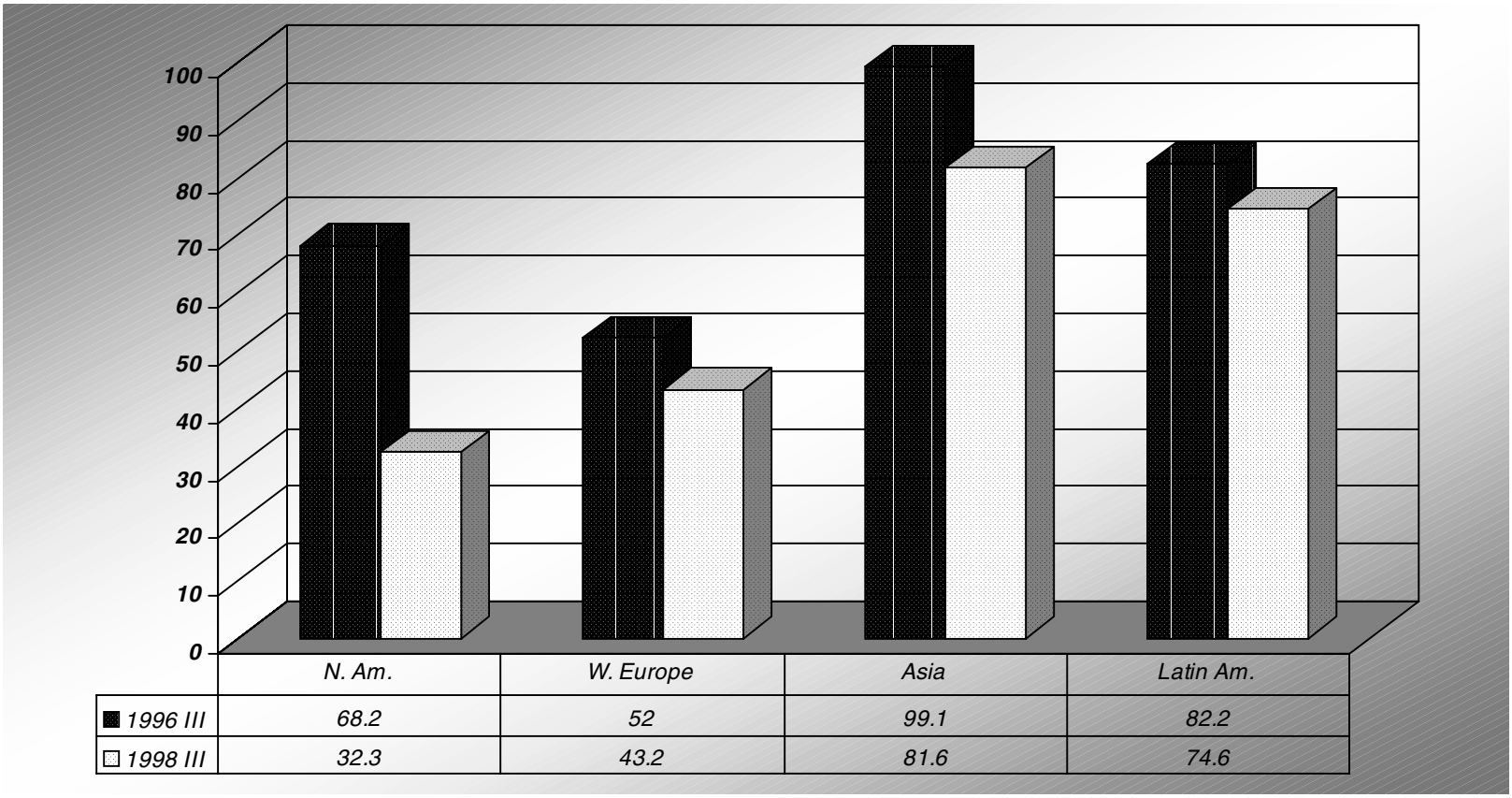
FIGURE 1

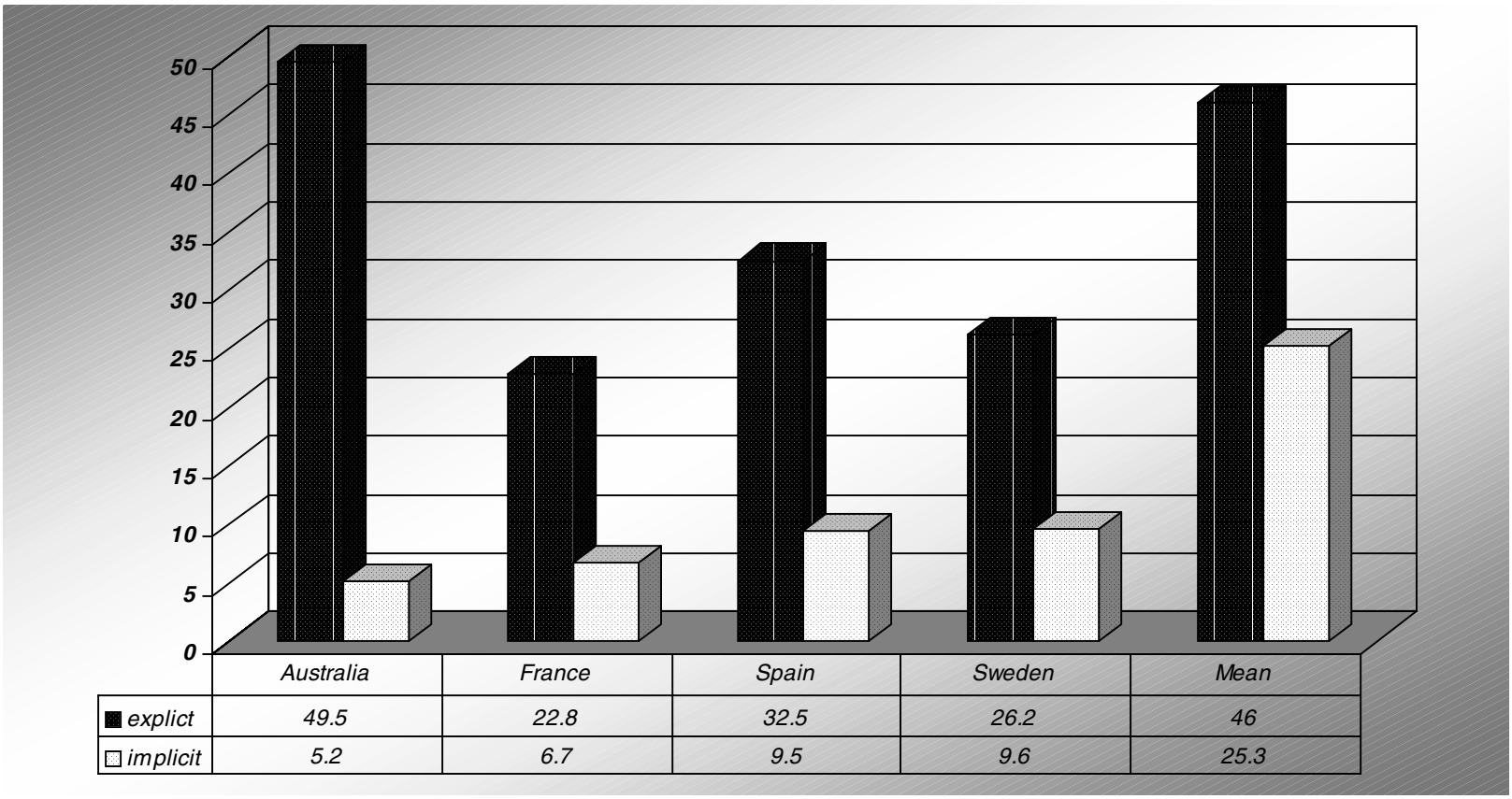
Regional Trading Costs



	N. Am.	W. Europe	Asia	Latin Am.
1996 III	68.2	52	99.1	82.2
1998 III	32.3	43.2	81.6	74.6

FIGURE 2

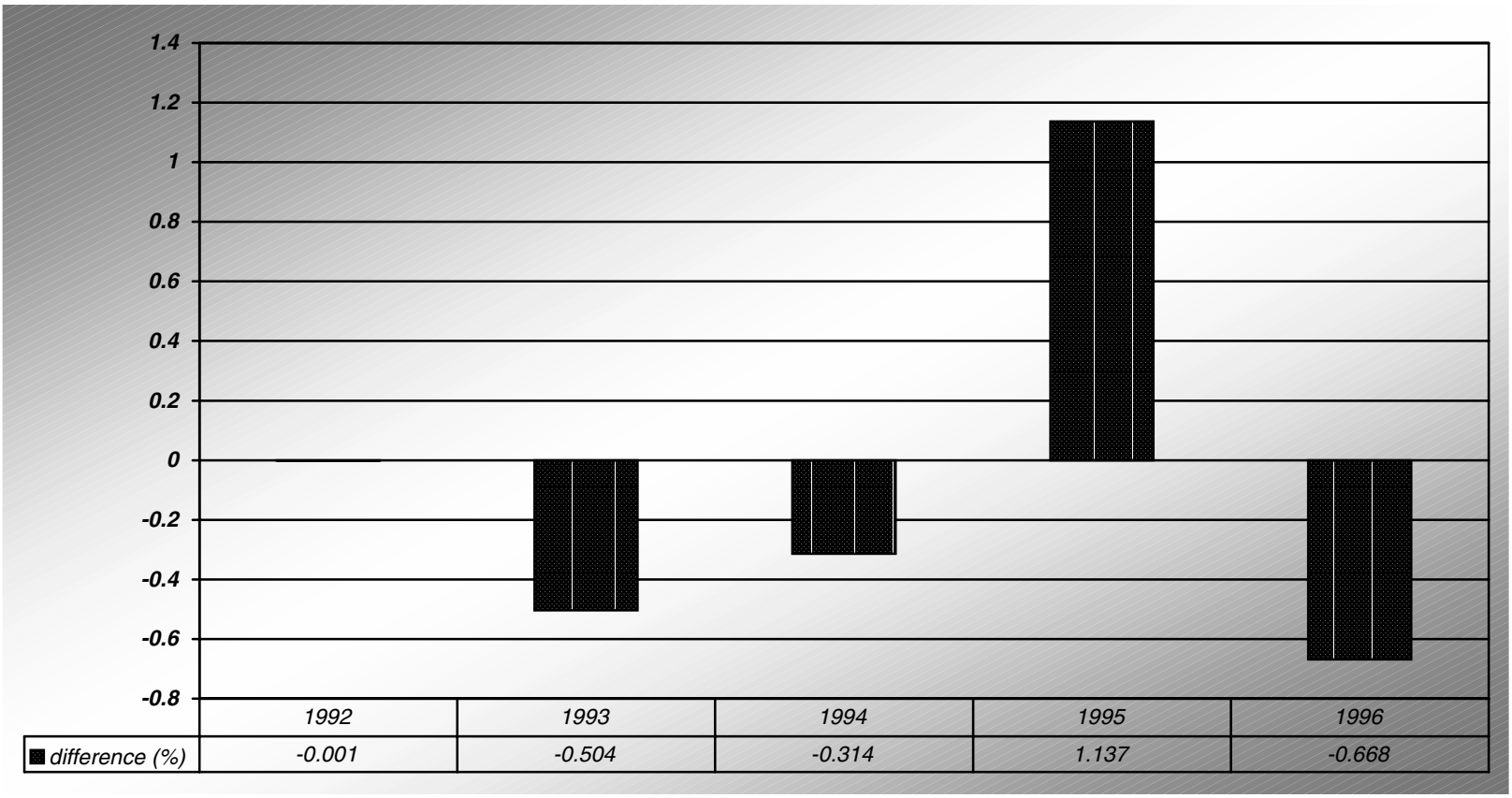
Trading Costs for Some Automated Markets versus Mean Costs



	Australia	France	Spain	Sweden	Mean
explict	49.5	22.8	32.5	26.2	46
implicit	5.2	6.7	9.5	9.6	25.3

FIGURE 3

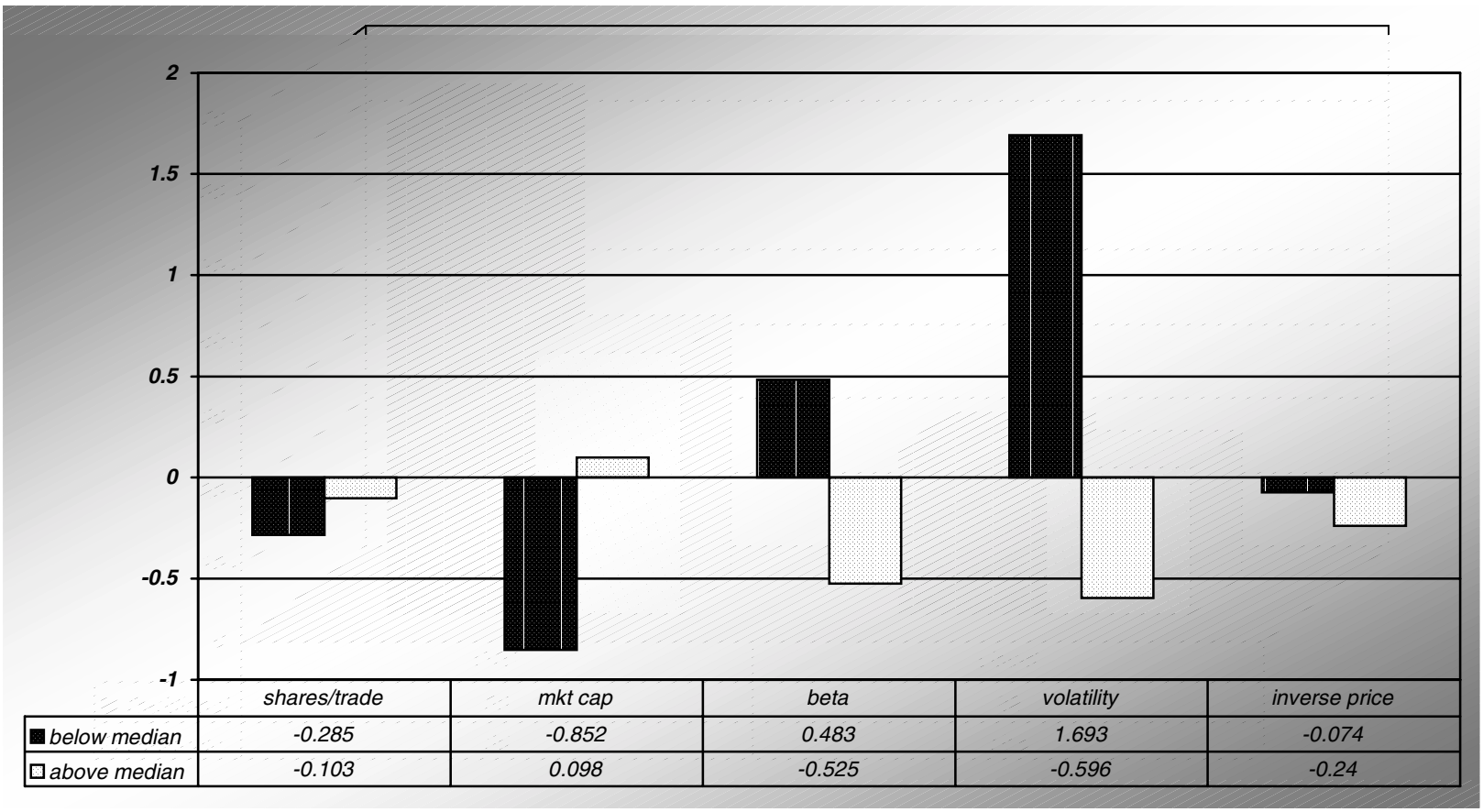
OTC Trading Costs: Savings Due to Automated Execution



	1992	1993	1994	1995	1996
difference (%)	-0.001	-0.504	-0.314	1.137	-0.668

FIGURE 4

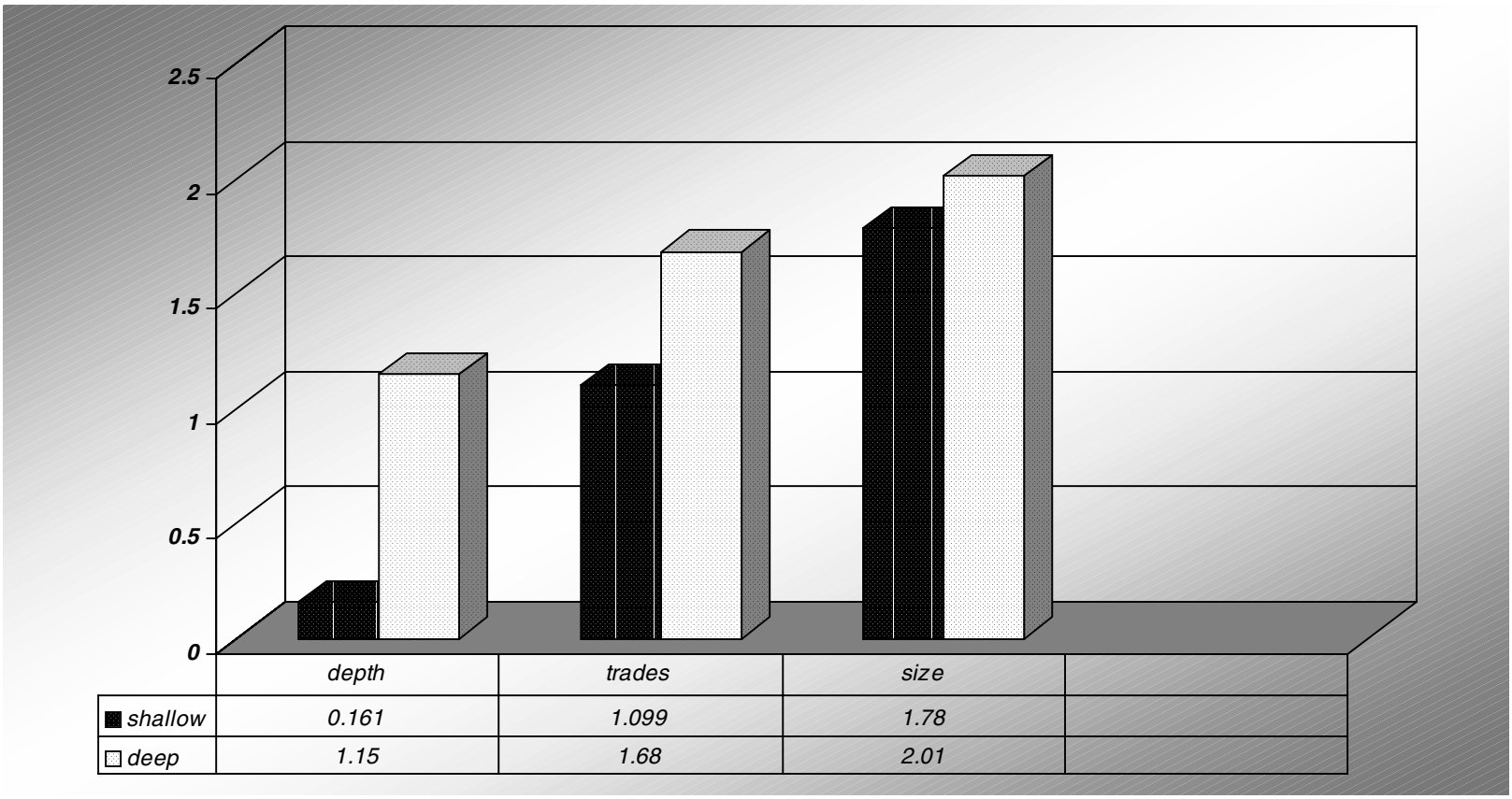
OTC Trade Characteristics
and Cost Savings Due to Automated
Execution



	shares/trade	mkt cap	beta	volatility	inverse price
below median	-0.285	-0.852	0.483	1.693	-0.074
above median	-0.103	0.098	-0.525	-0.596	-0.24

FIGURE 5

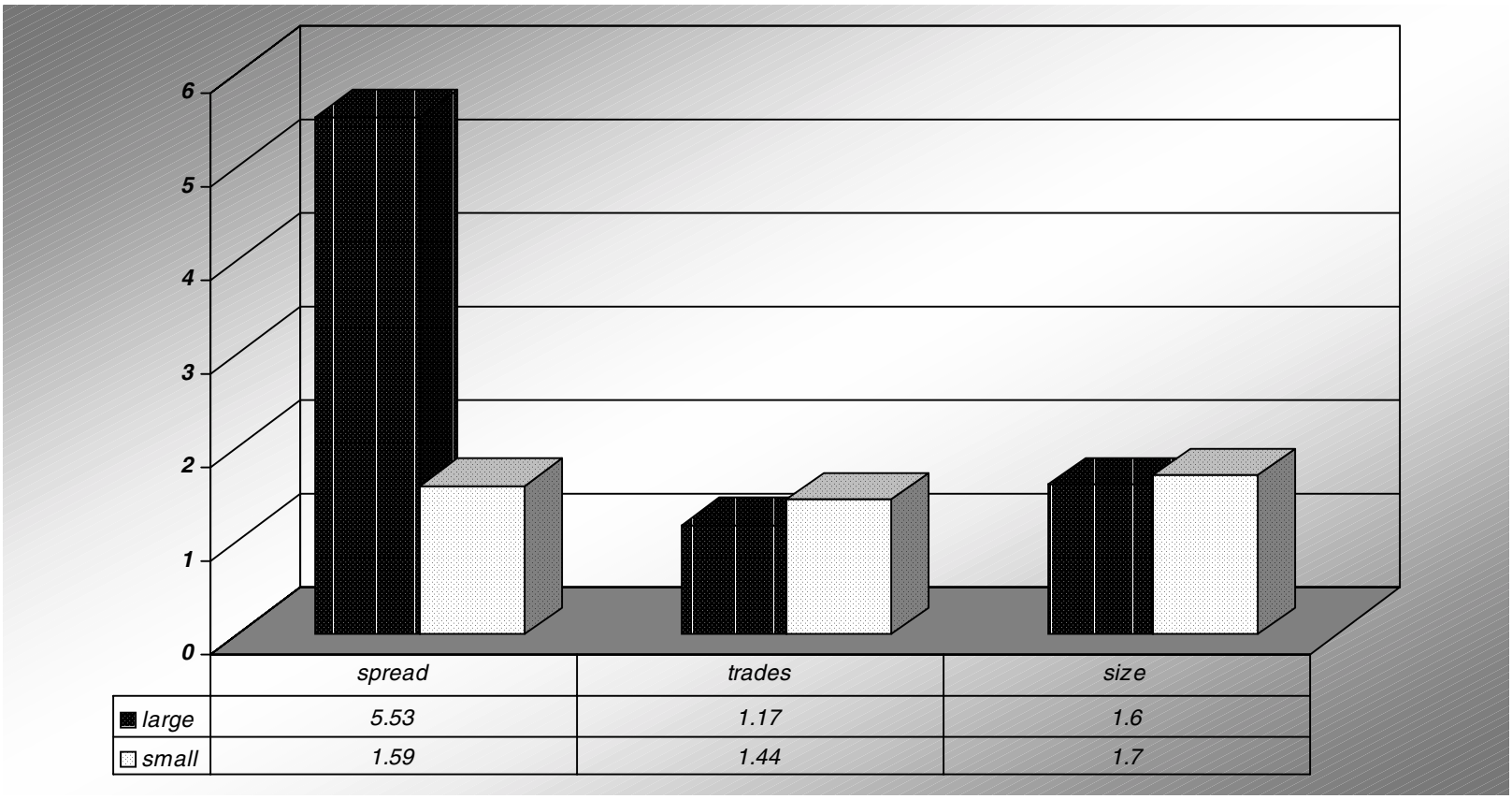
Market Depth at Six Ticks Away from Quote Midpoint



	depth	trades	size	
shallow	0.161	1.099	1.78	
deep	1.15	1.68	2.01	

FIGURE 6

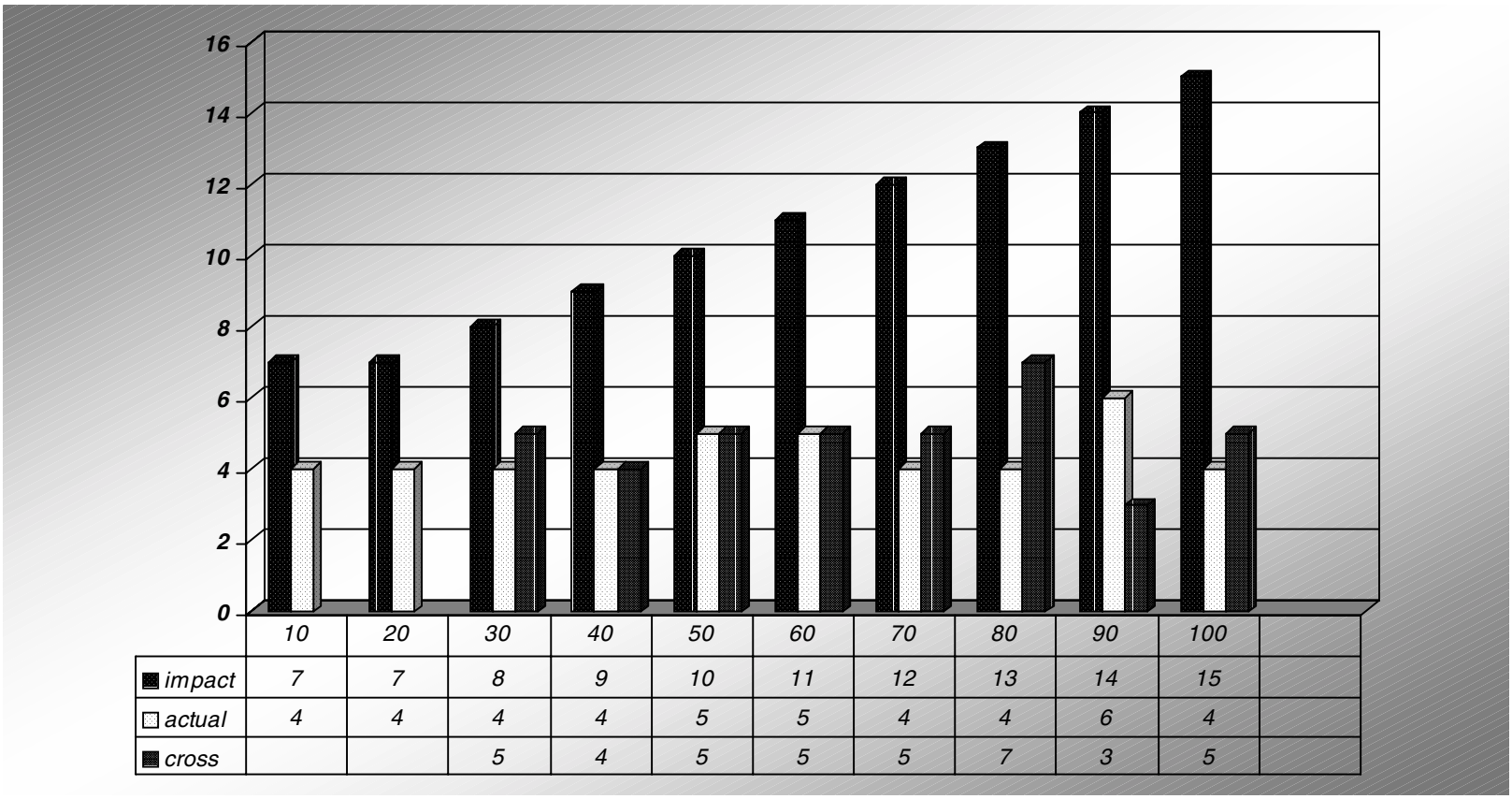
Effective Spread at 20 Contracts



	spread	trades	size
large	5.53	1.17	1.6
small	1.59	1.44	1.7

FIGURE 7

Price Impact by Size of Trade



	10	20	30	40	50	60	70	80	90	100	
impact	7	7	8	9	10	11	12	13	14	15	
actual	4	4	4	4	5	5	4	4	6	4	
cross			5	4	5	5	5	7	3	5	

Figure 8

Rebundling Possibilities