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6 The Effect of Integration between Broker-Dealers and Specialists

Robert Neal and David Reiffen

6.1 Introduction

In recent years, the New York Stock Exchange (NYSE) and the American Stock Exchange (AMEX) have relaxed their rules concerning the relationship between "upstairs" brokerage firms and "downstairs" specialists. Since 1986, large broker-dealers have acquired specialist units on the floor of the NYSE, and some smaller broker-dealers have acquired specialists on the floor of the AMEX. This paper exploits this structural change to evaluate whether the previous restrictions against integration of brokerage and specialist functions served investors' best interests.

The traditional objections to this integration suggest two mechanisms by which integration can lead to higher trading costs.[1] First, integration between broker-dealers and specialist units might lead to agency problems. For example, suppose that a customer can readily observe the quoted spread, but has difficulty determining if she received best execution. An integrated broker might provide a worse execution because of its incentive to route its trades through its affiliated dealer, rather than searching for the best price. Second, integration could lead to higher trading costs for unintegrated brokers, what Salinger (1988) has referred to as "foreclosure." As applied to this industry, integration may allow the specialist to increase trading costs for trades from other broker-dealers. In general, the degree of vertical integration within a firm is endogenous, and changes in the degree of vertical integration are rare and

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1. We use the term trading cost to refer to the costs of making a trade, taking into account effective bid-ask spreads, commissions, and so forth. While this term is often used interchangeably with "transactions" cost by financial economists, "transactions" cost may mean something completely different to industrial organization economists.

result from (typically) unobserved events. For this reason, it is difficult to test theories of vertical integration. In this industry, however, the recent integration resulted from a policy change, mitigating the usual identification problem.

Using data on combinations of broker-dealers and specialist units between 1987 and 1993, we test for evidence supporting these two hypotheses. The tests consist of comparisons of bid-ask spreads, execution quality, depth, volume, and order flow patterns for a one-month period before the integration to the corresponding post-acquisition period. In each case, we test the null hypothesis that integration does not increase trading costs against the one-sided alternative that integration is associated with higher trading costs.

The two hypotheses suggest different sources of higher trading costs. The pure agency hypothesis predicts that there will be no change in spreads (which are relatively easy to monitor), but execution quality (which is difficult to monitor) will decrease for the integrated exchange, as the integrated firm shifts its order flow pattern. Execution quality on the nonintegrated exchanges would be unaffected. The pure foreclosure hypothesis predicts that, across all exchanges, spreads will widen, execution quality will diminish, and aggregate volume will be reduced.

Our results provide little support for these hypotheses. We do not find evidence that execution quality has suffered. There is no virtually no change in NYSE execution quality for the NYSE integrated stocks, and a slight increase in execution quality for the integrated stocks on the regional exchanges. We do, however, find a diversion of order flow and a reduction in average trade size on the regional exchanges. These findings are consistent with the rerouting of retail orders and suggest some alternative motivation for these acquisitions.

We offer two conjectures. First, vertical integration may facilitate profitable trading against uninformed retail orders. Second, it is possible that the specialist units that were acquired had been managed in a way that did not maximize their value. While we present some evidence consistent with these alternatives, such analysis is not the focus of this paper. However, since on average investors have not been hurt by integrations, we believe a policy of restricting these acquisitions is ill-advised.

6.2 Overview of Industry Structure

6.2.1 Overview of the Markets

Two distinct market transactions are involved in turning a retail customer's wish to trade into an executed trade. First, the customer places the order with a retail broker, who charges a price (commission) for this service. The broker then arranges for the order to be executed, usually on an organized market.[2] If the trade is executed on an organized market, there is typically a bid-ask

2. Some trades are executed internally (or "crossed") at the firm.

spread, which provides revenue to the firm executing the transaction, be it a specialist or a market maker. The two transactions—order taking and execution—are complementary in the usual economic sense that a decrease in the cost of execution will increase the demand for retail brokerage services. Alternatively, one can view executions as an input into the "retail trades" product sold by broker dealers. From this perspective, one can view the two markets as vertically related to one another.[3]

The right to trade any individual security on the NYSE is a proprietary right assigned to a single specialist. While the NYSE specialist is the only agent on the floor of that exchange making a market in any particular stock, that specialist faces competition from other sources, such as the specialists on the regional exchanges, private crossing networks, and the National Association of Securities Dealers (NASD) for stocks listed after 1979. The right to trade a stock on each regional exchange is similarly proprietorially assigned to one firm. Hence, one specialist on each regional exchange competes, or potentially competes (since not all NYSE stocks are actively traded on every regional exchange), with the NYSE specialist in that stock.

The competition between specialists is restricted by Securities and Exchange Commission (SEC) regulations. Specifically, barring unusual circumstances, no trade can be executed outside the best intermarket bid or ask. For example, suppose the specialist on the Chicago exchange offers a bid of 59½, and the best bid among other exchanges if 59⅝. The Chicago regional specialist must pay at least 59⅝ if he is to execute that trade. It is important to recognize that this does not mean that all exchanges offer the same price. This holds for two reasons. First, the Chicago specialist is not obligated to trade at 59⅝, while the specialist offering 59⅝ is obligated to purchase some shares at that price. Second, and more interesting from our perspective, specialists may offer better prices than the best intermarket bid or ask. This phenomenon, known as price improvement, is fairly common. In their study of realized retail trading prices, Petersen and Fialkowski (1994) find that price improvement occurred for 35 percent of trades, while Blume and Goldstein (1992) estimate the figure to be between 12 and 31 percent. Evidence also suggests that the extent of price improvement varies across exchanges. Lee (1993) finds significant differences in realized spreads across exchanges, with the NYSE generally offering better prices than the regional exchanges, NASD, or Instinet.[4]

The relevance of specialist competition to the retail customer is that a broker can obtain different prices from different specialists. Hence, ignoring the broker's cost of searching, retail customers will be best served by brokers shopping across different exchanges. In this sense, specialists compete by offering more price improvement to the broker (and ultimately to the customer).

3. As Tirole notes (1988), the same analysis applies whether one thinks of the two markets as vertically related or complements.

4. For Lee's sample stocks in 1988 and 1989, only the Cincinnati Stock Exchange offered lower effective spreads in most size categories.

Offering price improvement is not the only means by which specialists compete. At least two other means of competing have been observed. First, exchanges may choose different rules governing transactions, which in turn affect the broker's choice of exchange. For example, during the time period we examined, the NYSE rules mandated that a "crossed" trade (where a broker-dealer represents private parties on both sides of the trade) must "clear" the order book.[5] The regional exchanges are not limited by such restrictions, so that certain types of trades are attracted to the regional exchanges.

Second, exchanges might offer other inducements to attract trades. In particular, some specialists (and third-market firms) offer direct payments to brokers in exchange for the opportunity to trade against retail transactions. This practice, known as payment for order flow, has been criticized by both academics and practitioners. For example, Lee (1993) questions the "propriety of order flow inducements which may impair broker's independence in pursuing best execution" (1009). Similarly, Blume and Goldstein (1992) raise the concern that payment for order flow results in worse prices for retail consumers. This same issue has been raised by NYSE chairman William Donaldson, who has argued for regulatory action to ban such payments.[6]

Clearly, a similar incentive might be created by the broker owning a specialist. In fact, it seems reasonable that the potential for consumers to receive inferior execution would be amplified by integration. As compared to contractual arrangements such as payment for order flow, vertical integration harmonizes the incentives of the broker and the market maker. For example, suppose that it is more profitable to trade against retail transactions than professional traders, so that specialists are only willing to pay for retail order flow. An integrated broker will have more incentive to screen out professional trades than a broker receiving payment for order flow.[7] Given the obvious similarity between integration and payment for order flow, however, our analysis of the effect of integration on trading cost offers insight on the effect of both practices.

6.2.2 Exchange Rules Governing Broker-Specialist Relations

Prior to 1986, both the NYSE and AMEX had rules governing broker-specialist relations, which had the effect of preventing such ownership.[8] Individuals affiliated with member firms of the exchange ("approved persons") could not simultaneously own a specialist unit and carry out normal brokerage

5. Clearing the order book means that all limit orders at prices more favorable than the crossing price must be executed before the crossed trade is executed. For example, suppose the specialist's bid is 59, his ask is 60, and there is a limit order to buy at 59¾. If two other agents agree to trade at 59½, NYSE rules require that the specialist or the broker take the opposite side of the limit order.

6. See David A. Vise, "NYSE Chief Urges Ban on Cash Payments," *Washington Post,* April 15, 1993, D11.

7. This is discussed more fully in section 6.5.

8. NYSE rules 104, 104–13, 105, 113–20; AMEX rules 190, 193.

operations.[9] Changes in the rules were proposed in 1985 and enacted in 1986. These rules allowed brokers affiliated with specialists to continue their brokerage operations in all securities as long as appropriate steps were taken to prevent certain abuses. In particular, a "Chinese Wall" was to be established to prevent the exchange of certain information between the specialist and brokerage units. For example, individuals associated with the brokerage unit are not allowed access to the specialist's "order book." Similarly, individuals at the brokerage entity who are privy to nonpublic information about the specialist's securities cannot relate that information to the affiliated specialist.

When the rule changes were proposed, the SEC issued a release describing the proposed changes and soliciting comments on the issues raised.[10] The commission received thirteen comment letters, including seven by firms or organizations opposed to the rule change.[11]

These seven commentators pointed to two general concerns regarding broker-specialist integration. First, several expressed concern that the integrated brokers would route orders toward their affiliated specialists, to the detriment of other specialists and retail customers. In the following sections, we describe several reasons that changes in order flow can both be profitable and reduce welfare. The second general concern was that the Chinese Wall procedure would be inadequate to prevent information from passing between specialists and brokers.

Those commentators supporting the change, as well as the SEC staff, noted the potential for increased capitalization of specialists that would result from integration. These comments suggested that this would result in increased liquidity and deeper markets. While these claims may describe the effect of integration, they do not explain the broker's incentive to integrate. That is, why is it profitable to increase the capitalization of a specialist? Moreover, if increased capitalization increases profits, why are brokers particularly well positioned to supply that capital?

Since 1988, several large brokers have taken advantage of the rule changes and acquired specialist units. Table 6.1 lists the acquisitions. From the standpoint of our analysis, the most relevant aspect of these acquisitions is that the broker acquires the right to act as a specialist in the NYSE stocks previously served by the independent specialist. This is the relevant aspect because, to

9. An approved person affiliated with a specialist could not (1) trade in securities in which the specialist made the market, (2) trade options on those securities, (3) accept orders in those securities, (4) undertake research in those securities, or (5) "popularize" those securities.

10. Securities Exchange Act Release no. 22396 (September 11, 1985), 50 *Federal Register* 37925.

11. These comments include those of the Boston exchange and Chicago Board of Exchange; Morgan Stanley; AT&T; Wertheim and Co. (NYSE brokers); Faganson, Frankel, and Steicher (NYSE specialists); and Wedbush, Noble, and Cook (brokers and specialists on other exchanges). Favorable comments were filed by most major NYSE brokers and several small NYSE brokers and specialists. These letters are public, and copies can be obtained from us.

Table 6.1 **Sample of Integrated Stocks and Control Stocks**

Acquiring Firm	Specialist Unit	Acquisition Date	Stocks
Boston Exchange			
BHR Securities	Corey MacTavish	7/22/91	BCC, CCK, ENS, EP, ETN, GCI, GPC, GRA, GRN, GSX, KMB, KR, KRI, MEA, MU, NLB, PPG, SNT, TMC, TRB, VFC
Canatella Specialist Corp.	Burlington Securities	10/16/91	AMW, BIC, BZR, CET, EXC, FGF, FGI, GHM, GOT, GRM, HPX, JHI, KVN, NAB, NNY, NPK, NWN, OBS, OXM, PNY, PWN, RBC, SCX, SIE, SNO, STW, SYM, TDS, TPL, TR, TXI
Natl. Financial Services Corp. (Fidelity)	Agoston	11/1/90	AA, ABX, AFL, AIR, ALD, ALX, AMR, APA, AR, BGE, BRC, CC, CCB, CLE, CPB, CS, DBD, DDS, DRM, EGG, EY, FOE, FRP, FTX, GTY, HSY, ICE, IF, KAB, MAS, MCK, MMC, MST, MXM, MXS, NCC, NSI, NWL, PHI, PLL, RYC, SB, SC, SPW, TNV, UCC, WIT
Natl. Financial Services Corp. (Fidelity)	Ocean Hill Securities	11/1/91	AFP, BRO, CMB, CQB, CW, CYR, DWW, ELJ, ESY, FMR, FSS, HI, ICL, KBH, LTD, LUV, LZB, MGF, SCT, SCZ, TDM, TEK, TJX, TYC, UCO, UCU, UJB, URS, USH, USR, UTR, UVX, WBN, WFC
Natl. Financial Services Corp. (Fidelity)	Chicago Corp.	1/4/93	AGL. AIZ, AME, APH, BAC, BBT, BDG, BDK, BGT, BKT, BNE, BTV, CAG, CCL, CHH, CMO, CMZ, CNG, CSC, CTS, ED, FQA, FWC, GII, GIM, GMT, GNC, GPS, GWW, I, IMC, ISS, JF, KEM, KUT, KIM, KMM, KTF, KTM, MDA, MHP, NBL, NEF, NMG, NPI, NT, OII, PCH, PCP, PGT, PIR, PMM, PNC, PPT, RBD, REL, ROK, RYL, SME, TMX, TRH, VFM, VIT, VKM, VLT, VMT, VNM, VOD, VSH, WGO, WIN, WNC, WR, XRX, ZE
Gowell Securities	Meldon	11/9/92	ACK, AMI, AMP, BNL, CCN, CMY, DH, DOV, FDO, FSI, LM, LOW, OHM, SEE, SK, V, WHT, WMT
Jefferies & Co.	Kemper Securities	5/6/91	ACY, ADI, ALG, AMD, APC, APD, AVE, BCP, BEV, BFI, BS, BYS, CH, CIR, CKE, CSM, DJ, FAX, FTU, GT, HE, HMS, HPC, HPH, KKS, LDS, LIT, LLX, MAH, MCN, NCM, NIC, NMI, PGR, PIF, PKD, PKN, PWJ, PZL, RCP, REC, RGS, RPC, SI, SVT, TMD, TRW, TSO, UAL, UK, UNM, UNP, WWW

Table 6.1 (continued)

Acquiring Firm	Specialist Unit	Acquisition Date	Stocks
NYSE			
Bear Stearns	Asiel & Co.	1/1/88	AA, AET, BK, DNB, HF, HMC, JC, MUO, PRE, PST, TX
Drexel Specialist Co.	Pforzheimer & Co.	3/1/88	AFL, AN, ANC, BCF, DEX, GAB, GMI, HNH, HYP, IAD, JCI, KU, KUH, NUV, OPC, PNS, TII, USR, WDG
Merrill Lynch	A. B. Tompane	10/26/87	ALN, CHL, CRN, DLT, ENE, FQA, FTK, GFC, HB, HFF, MST, RD, STY, TEP, WMB, X
Paine Webber	deCordova Cooper	9/1/89	ABY, ACP, BP, BTU, CBT, CHG, DRV, E, EXP, FW, GEC, GPO, GWW, HTN, HUG, IBM, LAW, MEI, SDP, SWX, TAC, TAN, WAG, WIC, Z, ZE
Philadelphia Exchange			
Shearson Lehman	Bloom Stalof	6/26/91	AA, AIG, AMB, AMR, AN, AR, ARC, ASA, AU, BAC, BCC, BCS, BEL, BZF, CBS, CCI, CDE, CHV, CLD, CLX, CWE, F, GP, GPU, GRN, HL, ITT, LNC, MDR, MMM, MOT, MRO, MTC, NVO, ORX, P, PBI, PD, PDG, PG, PH, RTZ, S, SBO, SO, SUN, SYN, TX, USR, WBB, WMT, WY, X, XON, ZE
Control stocks			ACB, AEG, AIP, AL, AP, ASO, ATN, AVY, BAX, BEN, BK, BKR, BN, BRK, C, CAS, CBR, CFI, CHX, CLT, CMA, CNL, CPH, CRS, CTC, CTK, CVT, DEC, DJI, DNB, DSP, EDE, EEI, EMR, ETZ, FCA, FLM, FPC, GAL, GER, GM, GOU, GRO, HCA, HEI, HMC, HRE, HWL, IEI, IR, JBM, JH, KEY, KML, KNO, KZ, LGN, LPI, LPX, MA, MAM, MD, MGC, MM, MRT, MXF, NER, NL, NSP, OIL, OSL, PAT, PEG, PIN, POR, PSC, RAY, RJF, ROG, RUS, SCE, SDY, SGI, SJT, SNA, SRR, SVM, TAC, TBP, TEF, TIN, TOY, TXF, UFF, UPT, VAT, VRC, WID, WOL, WRE, Y

the extent that the acquisitions adversely affect trading costs, those adverse consequences can be observed on the stocks in the integration.

In section 6.5, we describe how trading costs have been affected by integration. We find that trading costs do not appear to have changed much following the NYSE integrations. The evidence on the regional integrations is more

ambiguous, although it is difficult to ascribe the observed effects to any one cause.

To generalize from past experience to future acquisition, however, would require that future acquisitions resemble past acquisitions. Based on our conversations with practitioners, we think that the specialists acquired on the NYSE since 1988 have generally been less well capitalized and had received lower rankings from the exchange than the average NYSE specialist.[12] Hence, in generalizing these results to future acquisitions, one must consider how these selectivity issues influence the effects of integration. For example, it may be that, while the effect of an acquisition on undercapitalized specialists is to reduce trading costs, the effect of integration between a broker and a well-capitalized specialist might increase trading costs.

6.3 Formalizing the Objections to Vertical Integration

As we discussed in the introduction, many of the comment letters expressed concern that trading costs would increase following integration. In this section, we develop descriptive and highly stylized models to provide economic content to these concerns. In constructing these models, our goal is to include enough relevant features of the market to generate testable predictions.

6.3.1 Agency Problems with Integration

SEC rules require stock brokers to provide "best execution" for retail customers. This does not mean that brokers are at all times required to maximize the price a retail seller receives (or minimize the price a retail buyer pays), since other factors, such as timeliness of the execution, are also relevant. Nevertheless, brokers do have a fiduciary responsibility to obtain the best price, other things equal.

It is possible that integration between brokers and specialists would undermine the broker's best execution responsibilities.[13] As noted above, brokers can frequently obtain "price improvement" on customer's trades: obtaining offers from competing specialists that are better than the best intermarket bid or ask. On the other hand, if an integrated broker routed its orders through its affiliated specialist, rather than comparing offers of competing specialists, it is possible that the integrated broker's customers would receive an execution inferior to that received by an unintegrated broker's customers. This possibility has also been raised by Hasbrouck, Sofianos, and Sosebee (1993).

To formalize this potential agency problem, we present a simple model in which integration can affect realized trading costs. First, we assume that there

12. The NYSE ranks specialists according to several criteria of efficacy. These rankings are not made public, but our understanding is that most of the acquired specialists were in the lower half of all specialists by this measure.

13. See Comments of Chicago Board of Exchange, 2.

exists a class of customers for whom specialists are willing to give discounts (price improvement).[14] We assume all of these customers can observe the commissions charged by brokers, but only α percent of them can determined whether they received best execution. Further, we assume that a dissatisfied customer can cancel the transaction, resulting in lost commission.[15] Finally, we assume that the broker has zero cost of obtaining quotes from specialists. Then a broker's gain from searching is αC (where C is the profit margin on commissions), and its cost is zero. Hence, absent integration, brokers will search for the best price.[16]

Consider the incentive of an integrated broker-specialist, under the assumption that the vertically integrated specialists can distinguish the orders of these customers from the rest of their orders.[17] Such an integrated firm gains αC from trying to obtain best execution for its customers, but loses the opportunity to trade its internal order flow at the posted bid or ask. The gains to trading these orders at the posted bid or ask is $(1 - m)(1 - \alpha)T + m(1 - \alpha)(T - t)$, where $T = |$(posted price) $-$ (the cost of making the trade)$|$ (i.e., the integrated specialist's trading profit); t is the trading profit on the trades the specialist would have made (i.e., absent "misrouting" due to agency problems); and m is the integrated specialist's market share, absent misrouting.[18] It will pay to route these orders internally as long as $\alpha C < (1 - \alpha)(T - mt)$. That is, for α, m, and t sufficiently small, and T high, it will pay to direct order flow internally. When this inequality holds, $(1 - \alpha)$ of this firm's customers are worse off.

If these conditions hold, testable predictions arise for changes in spread, execution quality, and order flow following integration. First, since the integrated broker-specialist wants to target retail customers, it will adjust the trading price for those customers only. This is most easily accomplished by the

14. Specifically, we are thinking of retail customers (who typically place small orders) as a class likely to obtain price improvement. Several sources provide evidence consistent with this assumption. First, Lee (1993) notes that orders sold for payment must be of small size and nonprofessional. Second, Petersen and Fialkowski (1994), whose data consist of retail orders only, report a greater degree of price improvement than Blume and Goldstein (1992), whose data include all trades. Finally, the assumption is consistent with Easley and O'Hara (1987) and Keim and Madhavan (1992), who argue that small orders are less likely to be information based.

15. This assumption simplifies the model by allowing us to incorporate "punishment" into a static game. Seppi (1990) employs a similar assumption to explain why informed investors do not behave opportunistically in a static model. More realistically, we could obtain similar results if α percent of customers choose their brokers on the basis of past price improvement, or if the SEC would (with some probability) impose a sanction on brokers who did not provide best execution.

16. More generally, brokers will search as long as their search cost is less than αC.

17. This assumption seems realistic. For example, among the information available to NYSE specialists on SuperDOT orders are the type of order (market, limit, or tick sensitive), buys, and the member firm originating the order. Hasbrouck and Sosebee (1992) also state that the identity of the member firm originating the order is a valuable signal of the underlying strategy of the trade. Virtually all NYSE retail orders go through SuperDOT.

18. One way of thinking about T and t is to suppose there are implicitly two spreads—one for retail customers and a larger one for professional customers—and both spreads are equal to the cost of trading with those customers. Then $t = 0$, and $T > 0$ is the difference in trading cost across the two classes.

integrated firm's reducing execution quality on orders for their own retail customers, without changing bid-ask spreads. Second, the incentive to provide execution quality on orders from other brokers is unaffected by integration, so that the integrated specialist continues to compete with other specialists to obtain these orders.[19] This means that execution quality on other exchanges will be unaffected by integration. Third, since the integrated broker shifts some orders to its integrated specialist, the market share of the integrated exchange will rise following integration. Finally, since m is smaller on the regional exchanges, the agency problem is most severe there.[20] The first column of table 6.2 summarizes these predictions, which are then tested against our data.

In addition to the predictions that are testable with our data, this model suggests other changes that are potentially measurable. For example, this model suggests that the market share of the integrated broker declines (since α percent of its would-be customers go elsewhere). Also, the model suggests that the retail customers of the integrated firm get less price improvement on the integrated exchange than other retail customers *on that exchange.* Similarly, these customers get worse execution on vertically integrated stocks than they do on other stocks, ceteris paribus. With a more refined data set, it may be possible to test these predictions.

6.3.2 Foreclosure Effects of Integration

Judicial interpretation of antitrust law has long viewed vertical mergers as having a potential for "foreclosing" rivals. The fear expressed has been that the acquisition of a customer or supplier would lead the integrated firm to reduce or eliminate its trade with nonintegrated suppliers or customers. As Chief Justice Warren put it in *Brown Shoe,* "the dimunition of the vigor of competition which may stem from a vertical arrangement results primarily from a foreclosure of a share of the market otherwise open to competitors."[21] A more rigorous conceptualization of foreclosure was developed by Salinger (1988). According to Salinger, a vertical merger leads to foreclosure if it increases the input cost faced by unintegrated firms.[22]

Whether a vertical merger can result in foreclosure has long been debated in the economics literature.[23] Recent work by Ordover, Saloner, and Salop

19. We assume away the possibility that other brokers, because of payment for order flow or reciprocal agreements, are not acting in consumer interest. The benefit of integration relative to other means of competing for order flow is discussed below.

20. This discussion abstracts from the constraints imposed on the specialist by competition from floor traders who wish to trade against the incoming orders. This suggests a second reason that agency problems may be more severe on regional exchanges, since the NYSE is a thicker market, and hence the NYSE specialist is more likely to face competition from floor traders on that exchange. This also suggests that the agency problem will be most severe for thinly traded stocks on any exchange.

21. *Brown Shoe Co. v. United States,* 370 U.S. 294 (1962), 328.

22. As discussed below, foreclosure in this sense is a necessary, but not sufficient, condition for welfare to fall with integration.

23. See, for example, Comanor (1967).

Table 6.2 **Summary of Agency and Foreclosure Model Predictions for Integrated and Nonintegrated Exchanges**

Variable	Agency Model	Foreclosure Model
Volume	Decrease in total	Decrease in total
Effective spread	Increase for integrated No change for nonintegrated	Increase for both types
Median spread	No change for either type	Increase for both types
Price improvement	Decrease for integrated No change for nonintegrated	Ambiguous for integrated Increase for nonintegrated
Percentage of volume	Increase for integrated Decrease for nonintegrated	Ambiguous for both types
Trade size	Decrease for integrated Increase for nonintegrated	Ambiguous for both types
Depth	No change for either type	Decrease for both types

(1990, 1992) provides a formal model under which vertical integration can result in foreclosure. In their model, firms that produce differentiated products compete in each of the two related markets.[24] The markets are related in that firms in one market sell a product that is an input used by firms in the second market. Because firms are differentiated, the Bertrand equilibrium prices for all firms exceed marginal cost.

In applying this model to financial markets, we view exchanges as supplying "execution services" to brokers. Brokers combine this input with retail brokerage services, and sell the combined package as a "retail execution" to customer. Exchanges are differentiated in that they offer different execution speed, depth, and the ability to execute prearranged crosses. The Ordover-Saloner-Salop model assumes that prior to integration, at the equilibrium prices (effective spreads), each broker routes some orders to each exchange. Following the integration, the foreclosure model predicts that the increased market power created by the integration allows the integrated firm to increase the effective price its specialist unit charges nonaffiliated brokers. This can be accomplished by increasing realized spreads, reducing depth, or similar means of making the integrated exchange less attractive to other brokers. The direct effect of this change shifts out the demand facing specialists on other exchanges, whose optimal response is to increase their effective prices.[25] Ultimately, by increasing its rival brokers' costs and prices, the integrated firm

24. In their 1990 paper, input producers manufacture undifferentiated products, which implies that foreclosure can occur only when there are *exactly* two input producers. As this assumption does not fit the market of interest here, the model we present incorporates the suggestion made in their 1992 reply, that differentiated firms exist in both markets. We assume the differentiation in the two markets to be "orthogonal"; that is, consumers' preferences across brokers are independent of their preferences across exchanges.

25. Recall that exchanges are viewed as differentiated, so that an exchange would not capture 100 percent of the market by keeping its effective price constant when the integrated exchange raised its price.

is able to increase its market share and/or increase the price it charges for retail executions.

Note that, while both the agency and the foreclosure theories imply higher trading costs, the means by which trading costs rise is likely to be different in the two cases. In the foreclosure model, the integrated firm wants to increase its rivals' costs of executing all trades in the integrated stock. Since most trades occur at the bid or the ask, this requires increasing spreads, or reducing depth. Hence, the foreclosure model implies higher spreads after integration, while the degree of price improvement received by other brokers on the integrated exchange need not change. Further, the model predicts that the other exchanges would increase their prices, but by less than the integrated exchange. This implies that the extent of price improvement (measured from the inside bid or the ask) would rise, although the realized trading cost (the absolute percentage difference between the trade price and the quote midpoint) would increase. These predictions are summarized in the second column of table 6.2.

6.4 Data and Summary Statistics

Our analysis is based on all integrations that occurred on the New York, Boston, or Philadelphia stock exchanges since 1987. There are four integrations at New York, seven at Boston, and one at Philadelphia. The corresponding numbers of stocks in these integrations are 72 in New York, 279 in Boston, and 55 in Philadelphia. For each integration, the date, brokerage firm, and ticker symbol of the associated stocks are presented in table 6.1. This table also contains the sample of 101 control stocks. Randomly selected from NYSE, these stocks were continuously listed from 1987 to 1993 and were not involved in any of the above integrations.

The data for our analysis are intraday bid, ask, and execution price data from the Securities Industry Automation Corporation (SIAC). To the extent possible, we examine four weeks of trade data from a period three months before the integration, and another four weeks from a period three months after the integration. Because the SEC only periodically saved the SIAC data, in some cases we can analyze only two weeks of data, in other cases the before/after window is reduced to two months.

It is an unfortunate fact of life that there are gremlins in the SIAC data. We have attempted to filter out obviously inconsistent values and used estimation procedures that minimize the impact of outliers. Nevertheless, the raw data set contains eighteen million observations, and undoubtedly some gremlins remain.

Summary statistics for the integrated and control stocks are presented in table 6.3. Each panel contains four groups of statistics, and each group contains before-integration and after-integration statistics. In panels B and C, the first group contains observations for the integrated stocks on the integrated exchange. The second group contains observations for the control stocks on the

Table 6.3 **Summary Statistics**

A. Integrations on the New York Stock Exchange[a]

	Integrated Stocks, NYSE		Control Stocks, NYSE		Integrated Stocks, non-NYSE		Control Stocks, non-NYSE	
	Before	After	Before	After	Before	After	Before	After
Median spread	1.469	1.359	1.568	1.788	2.812	2.073	2.322	2.648
	1.197	1.242	1.208	1.197	1.666	1.593	1.795	2.061
	0.143	0.138	0.07	0.098	0.118	0.085	0.055	0.062
Effective	0.730	0.612	0.898	0.794	0.740	0.608	0.830	0.806
spread	0.715	0.574	0.738	0.596	0.631	0.458	0.658	0.618
	0.048	0.043	0.032	0.031	0.030	0.028	0.018	0.017
Improvement	0.158	0.195	0.162	0.237	0.047	0.086	0.072	0.158
$\leq$ 3,000	0.110	0.159	0.132	0.166	0.018	0.039	0.016	0.061
shares	0.022	0.017	0.011	0.011	0.011	0.010	0.008	0.008
Improvement >	0.089	0.164	0.072	0.232	0.077	0.075	0.073	0.065
3,000 shares	0.076	0.083	0.044	0.146	0.000	0.000	0.000	0.000
	0.030	0.031	0.014	0.020	0.022	0.021	0.014	0.011
Price	35.71	34.68	30.56	26.56	40.88	39.69	35.66	30.00
	21.13	23.70	24.84	22.24	37.12	31.22	28.49	24.30
	3.663	3.888	1.439	1.234	1.905	1.952	0.846	0.670
% of volume	85.04	87.47	88.84	87.27	3.948	4.774	6.291	7.363
	87.06	89.43	86.22	90.13	1.748	1.823	1.464	1.869
	1.625	1.418	0.836	0.859	0.462	0.820	0.521	0.561
% of trades	78.97	81.08	83.44	80.45	5.672	6.322	7.789	9.127
	80.51	80.40	84.72	82.03	3.454	3.342	3.158	3.571
	1.658	1.352	0.918	0.896	0.464	0.707	0.501	0.534
Average trade	1634	1608	1694	1622	2261	1736	2085	2333
size	1449	1363	1212	1417	570.0	400.0	531.9	535.2
	129.4	105.8	209.7	65.85	372.5	338.6	310.0	498.0
Traded	1.674	1.518	1.474	1.280	0.276	0.246	0.222	0.252
volume	0.673	0.409	0.395	0.334	0.118	0.081	0.048	0.046
(millions)	0.425	0.463	0.150	0.140	0.067	0.026	0.026	0.051
Depth	31.00	44.22	28.76	34.78	5.027	4.651	4.560	5.417
	15.00	20.00	14.50	17.50	1.000	1.000	1.000	1.000
	6.499	10.33	2.522	3.534	0.743	0.763	0.346	0.860
Observations	71	67	302	291	65	61	279	283

B. Integrations on the Boston Stock Exchange[b]

	Integrated Stocks, Boston		Control Stocks, Boston		Integrated Stocks, NYSE		Control Stocks, NYSE	
	Before	After	Before	After	Before	After	Before	After
Median spread	2.628	2.629	2.694	2.547	1.421	1.127	1.424	1.263
	2.088	2.144	2.006	1.826	1.007	0.917	0.909	0.790
	0.126	0.119	0.098	0.096	0.095	0.074	0.073	0.064

(*continued*)

Table 6.3 (continued)

B. Integrations on the Boston Stock Exchange[b]

	Integrated Stocks, Boston		Control Stocks, Boston		Integrated Stocks, NYSE		Control Stocks, NYSE	
	Before	After	Before	After	Before	After	Before	After
Effective spread	0.759 0.582 0.036	0.739 0.583 0.034	0.805 0.598 0.032	0.721 0.516 0.029	0.770 0.670 0.033	0.702 0.586 0.030	0.797 0.631 0.028	0.715 0.555 0.024
Improvement ≤ 3,000 shares	0.144 0.078 0.015	0.165 0.104 0.017	0.179 0.088 0.017	0.191 0.090 0.016	0.147 0.122 0.009	0.141 0.115 0.007	0.166 0.118 0.008	0.157 0.119 0.006
Improvement > 3,000 shares	0.090 0.000 0.021	0.092 0.000 0.022	0.080 0.000 0.021	0.076 0.000 0.019	0.098 0.070 0.012	0.084 0.071 0.012	0.093 0.075 0.012	0.106 0.080 0.010
Price	32.28 25.67 2.655	32.39 25.88 2.411	26.74 25.18 0.766	29.24 28.09 0.839	30.80 23.31 2.522	32.46 25.72 2.503	27.15 24.15 0.846	30.21 27.95 0.955
% of volume	1.571 0.745 0.262	2.188 0.980 0.492	5.099 1.323 0.754	4.435 1.284 0.653	85.16 87.80 0.726	84.09 87.52 0.760	83.57 85.91 0.582	83.84 85.90 0.521
% of trades	2.300 1.333 0.231	3.817 2.384 0.524	6.573 3.019 0.704	5.742 2.952 0.548	73.76 75.21 0.976	72.12 73.74 0.918	70.91 69.96 0.727	70.42 69.43 0.728
Average trade size	1470 614.2 41.53	697.9 530.1 41.19	860.3 551.1 82.26	905.8 553.1 93.83	2078 1678 225.5	1960 1185 89.47	1733 1469 56.3	1780 1478 59.63
Traded volume (millions)	0.034 0.013 0.004	0.038 0.015 0.005	0.062 0.019 0.009	0.074 0.019 0.012	2.606 1.405 0.255	2.750 1.359 0.297	2.940 1.052 0.261	3.401 1.183 0.334
Depth	1.000 1.000 —	1.214 1.000 0.214	1.011 1.000 0.011	1.000 1.000 —	63.19 25.00 8.543	68.98 30.00 9.169	43.37 25.00 3.134	42.39 27.50 2.602
Observations	209	228	359	375	222	219	403	409

C. Integrations on the Philadelphia Stock Exchange[c]

	Integrated Stocks, Philadelphia		Control Stocks, Philadelphia		Integrated Stocks, NYSE		Control Stocks, NYSE	
	Before	After	Before	After	Before	After	Before	After
Median spread	1.831 1.263 0.220	2.383 1.536 0.327	2.684 1.951 0.259	2.802 2.150 0.276	0.709 0.488 0.082	0.709 0.459 0.085	1.516 0.904 0.197	1.355 0.793 0.179
Effective spread	0.657 0.459 0.080	0.583 0.435 0.060	0.795 0.630 0.071	0.830 0.686 0.073	0.495 0.336 0.059	0.478 0.319 0.055	0.743 0.522 0.065	0.733 0.531 0.067

Table 6.3 (continued)

C. Integrations on the Philadelphia Stock Exchange[c]

	Integrated Stocks, Philadelphia		Control Stocks, Philadelphia		Integrated Stocks, NYSE		Control Stocks, NYSE	
	Before	After	Before	After	Before	After	Before	After
Improvement	0.045	0.053	0.119	0.131	0.101	0.095	0.192	0.155
≤ 3,000	0.010	0.009	0.026	0.034	0.073	0.068	0.126	0.110
shares	0.012	0.018	0.037	0.034	0.012	0.0341	0.020	0.016
Improvement	0.026	0.020	0.140	0.010	0.066	0.067	0.144	0.095
> 3,000	0.000	0.000	0.000	0.000	0.057	0.053	0.102	0.075
shares	0.016	0.029	0.085	0.058	0.020	0.010	0.023	0.025
Price	46.06	44.47	28.75	29.52	31.37	28.80	26.80	29.24
	39.40	39.89	27.39	30.63	39.63	39.89	25.16	30.63
	4.235	3.815	2.279	2.180	4.309	3.884	2.017	2.306
% of volume	1.159	1.932	3.000	4.803	85.23	86.08	82.88	82.62
	0.813	1.539	0.865	1.109	85.87	87.16	83.71	86.04
	0.139	0.226	1.166	1.537	0.822	0.792	1.261	1.622
% of trades	2.615	5.537	3.826	5.865	68.60	66.35	70.14	71.65
	1.997	5.523	2.222	2.431	67.85	67.50	68.62	72.30
	0.334	0.504	0.683	1.461	1.627	1.600	1.803	1.977
Average trade	789.7	581.9	1497	1182	2008	2196	1687	1636
size	576.1	451.6	412.0	425.0	1973	2020	1534	1532
	94.24	57.29	932.6	481.2	111.0	132.1	102.1	111.2
Traded	0.082	0.120	0.037	0.053	5.887	4.728	2.509	2.009
volume	0.041	0.056	0.015	0.013	4.725	3.055	0.968	0.874
(millions)	0.015	0.021	0.018	0.018	0.748	0.636	0.489	0.390
Depth	1.842	1.455	1.000	1.065	52.81	66.94	36.78	39.85
	1.000	1.000	1.000	1.000	35.00	46.00	23.50	23.00
	0.612	0.389	—	0.065	6.841	10.20	5.362	6.959
Observations	54	56	54	61	53	55	67	69

Notes: For each group of statistics, the reported numbers are the mean, median, and standard error. These numbers refer to averages across firms.

[a]These statistics are based on four vertical integrations on the New York Stock Exchange (NYSE).

[b]These statistics are based on seven vertical integrations on the Boston Stock Exchange.

[c]These statistics are based on one vertical integration on the Philadelphia Stock Exchange.

integrated exchange. The third group contains NYSE observations for the integrated stocks. The fourth group contains NYSE observations for the control stocks. Panel A, which presents the NYSE integrations, differs in that the third and fourth groups contain observations from the other exchanges for the integrated and control stocks.

To analyze the effects of integration, we examine several measures of trading costs and trading volume. The median spread is computed from all bid and ask quotes. We focus on the medians to mitigate the effect of outliers. The

effective spread is defined as twice the absolute value of difference between the trade price and the midpoint of the spread. This value is then scaled by the price level. The midpoint is obtained from the highest bid price and lowest ask price, across all markets. The price improvement variables are defined as the minimum of the ask price minus the trade price, or the trade price minus the bid. This variable is scaled by the price level and computed for trades less than or equal to three thousand shares, and trades more than three thousand shares. The percentage of trades and percentage of volume correspond to the fraction executed on the specified exchange (Boston, Philadelphia, or New York). Trading volume represents the volume on the designated exchange. The depth is defined as the average of the quoted bid size and the quoted ask size. For each variable, the values reported in table 6.3 represent averages across firms. The numbers presented in the table are the mean, median, and standard error.

It is useful to compare these summary statistics on spreads and price improvement to those in other recent work. The data on NYSE price improvement is consistent with Angel's (1993) findings. He finds that on NYSE SuperDOT markets orders, average price improvement is 0.19 percent on buy orders, and 0.23 percent on sell orders. In our data, price improvement on small trades ranges from 0.16 percent to 0.24 percent. Lee (1993) finds that effective spreads are about 14 cents on the NYSE and about 15 cents on the Boston and Philadelphia exchanges, or about two-thirds the level suggested by our data.

The summary statistics suggest the impact of NYSE integrations on trading costs is minor. Relative to the control group, the NYSE integrated stocks show a similar decline in effective spreads. The spreads for the control stocks rise following the integration, but this is offset by greater price improvement among the control stocks. Following integration, the integrated stocks capture a larger fraction of trades and trading volume than the control stocks.

Panels B and C show a roughly similar pattern for the Boston and Philadelphia integrations. The effective spreads for the integrated stocks appear to decrease by slightly more than the control stocks. Relative to the control stocks, however, the median spreads rise slightly following integration. As with the NYSE integrations, the integrated stocks exhibit an increase in the fraction of trades and the fraction of trading volume following integration. Unlike the NYSE integrations, however, the average trade size shows a clear decrease following the regional integrations. Overall, these statistics are consistent with the interpretation that vertical integrations do not adversely affect trading costs.

6.5 Regression Tests of Agency and Foreclosure Models

In this section, we examine evidence from past acquisitions, with three purposes in mind. First, we look at measures of trading cost and volume to determine whether the net effect of integration has been to increase or to decrease the quality of executions. Second, we use information about trading costs and

market shares to test the models described in section 6.3. Finally, to the extent that the two proposed models do not explain the existing pattern, we present hypotheses that are consistent with the data, and offer some additional suggestive evidence.

6.5.1 Overall Cost of Trading

As noted in section 6.2, there are two components to retail trading cost: the bid-ask spread (the specialist's price) and the broker's commission. Since we have no data on the latter component, we use two approaches in order to draw some inferences from the changes resulting from broker-specialist integration. First, we assume that commissions are unaffected by integration and examine the effect of integration on measures of effective bid-ask spread. Second, we assume that, like other products, the demand for trading any stock is a decreasing function of the cost of doing so. This implies that changes in volume move inversely with changes in trading costs.

The regression results in table 6.4 offer additional evidence that broker-specialist integration on the NYSE has had little impact on trading costs. We measure this impact by regressing the difference between the median percentage spreads after the integration and the median prior to integration against the percentage change in price, percentage change in trade size, change in the standard deviation of quote midpoint returns, and the change in total volume across all exchanges. Parallel regressions are presented for the change in effective spreads and for two measures of the change in price improvement. The first price improvement measure is based on all trades, while the second is computed only for small trades of less than three thousand shares.

Panel A examines how the trading costs of NYSE integrated stocks change relative to nonintegrated NYSE stocks. Panel B examines how NYSE integrations affect the trading costs on the regional exchanges. The underlying stocks are the same in both panels, but panel A uses trades and quotes only from the NYSE, while panel B uses observations from the regional exchanges. In both panels, the dummy coefficients for the NYSE integrated firms are uniformly small, and the t-statistics are less than 1.25 in absolute value. The economic magnitude was similarly small. For example, in panel A, the median spreads increased by 0.027 percent following integration. This value is about 2 percent of the average percentage spread.

The effects of integration on trading costs at the regional exchanges is presented in table 6.5. Panel A examines how the trading costs of integrated stocks on the Boston (or Philadelphia) exchange change relative to other stocks on Boston (or Philadelphia). Panel B examines whether the regional integrations affect the trading costs on the NYSE. Panel A uses trades and quotes only from the regional exchanges, while panel B uses observations from the NYSE.

Overall, the results are largely consistent with table 6.4. There is no significant change in the median or effective spreads following integration. While the spreads tend to rise following integration, the only statistical difference is in

Table 6.4 **The Effect of NYSE Integrations on Trading Costs**

	Dependent Variable			
	Change in % Median Spread	Change in % Effective Spread	Change in Price All Trades	Improvement Small Trades
A. Effect on NYSE trading costs[a]				
Intercept	.03331	−.00071	.00057	.00050
	(1.71)	(−4.85)	(4.18)	(3.64)
% change in price	−.68705	−.00480	−.00320	−.00315
	(−7.64)	(−7.04)	(−5.05)	(−4.96)
% change in trade size	−.04640	−.00119	.00044	−.00040
	(−1.53)	(−0.82)	(2.06)	(−1.88)
Change in standard deviation of returns	−.00710	−.00061	.00028	.00021
	(−0.11)	(−0.26)	(0.63)	(0.47)
Change in volume (millions)	.00099	−.00003	.00007	.00007
	(1.11)	(−0.52)	(1.16)	(1.15)
Integrated stock dummy	−.02765	.00018	−.00037	−.00030
	(−.065)	(0.55)	(−1.25)	(−1.00)
R^2	.181	.163	.127	.116
Observations	278	278	278	278
B. Effect on regional exchange trading costs[b]				
Intercept	.12932	−.00074	.00090	.00151
	(5.17)	(−.99)	(1.22)	(1.31)
% change in price	−.84628	−.00541	−.00135	−.00085
	(−7.22)	(−1.53)	(−0.39)	(−0.19)
% change in trade size	−.00711	.00011	−.00012	−.00025
	(−0.64)	(0.82)	(−0.37)	(−0.51)
Change in standard deviation of returns	−.05373	−.00063	.00035	.00056
	(−0.63)	(−0.24)	(0.14)	(0.14)
Change in volume (millions)	.00209	−.00003	.00000	.00004
	(2.15)	(−0.10)	(0)	(0.09)
Integrated stock dummy	−.01334	.00035	−.00062	−.00107
	(−0.25)	(0.22)	(−0.4)	(−0.44)
R^2	.232	.014	.003	.003
Observations	180	180	180	180

Notes: These cross-sectional regressions are based on four vertical integrations on the NYSE. Each observation for the dependent variable is the before/after change for the same firm. The dummy variable is one for the integrated stocks and zero otherwise.

[a]All variables, both integrated and control, are measured on the NYSE.

[b]All variables, both integrated and control, are the average for the two regional exchanges.

the price improvement regressions. Integration on the regional exchanges is associated with somewhat more price improvement for small trades ($t = 1.39$) and with less price improvement for small trades on the NYSE ($t = -2.36$).

Table 6.6 presents additional evidence on trading costs by examining the change in trading characteristics following integration. The change in share of trades executed, the percentage change in the trade size, the change in the

Table 6.5 The Effect of Regional Integrations on Trading Costs

	Dependent Variable			
	Change in % Median Spread	Change in % Effective Spread	Change in Price Improvement All Trades	Change in Price Improvement Small Trades
A. Effect on regional trading costs[a]				
Intercept	.01741	.00008	.00003	−.00002
	(1.42)	(0.52)	(0.14)	(−0.08)
% change in price	−.76576	−.00411	.00173	.00274
	(−15.70)	(−6.26)	(1.97)	(0.39)
% change in trade size	−.00506	−.00002	.00004	.00007
	(−1.14)	(−0.34)	(0.6)	(0.68)
Change in standard deviation of returns	.03875	.00086	−.00037	−.00021
	(0.56)	(0.94)	(−0.3)	(−0.13)
Change in volume (millions)	.00024	.00002	−.00000	−.00000
	(1.77)	(0.99)	(−0.09)	(−0.21)
Integrated stock dummy	.01694	.00031	−.00033	−.00059
	(0.92)	(1.26)	(−1.1)	(−1.39)
R^2	.513	.151	.025	.037
Observations	257	257	257	257
B. Effect on NYSE trading costs[b]				
Intercept	.04311	−.00010	.00032	.00030
	(3.79)	(−0.65)	(0.23)	(2.37)
% change in price	−.55254	−.00557	.00016	.00006
	(−12.74)	(−8.91)	(0.31)	(0.12)
% change in trade size	−.01336	−.00011	.00013	.00014
	(−0.59)	(−0.34)	(0.47)	(0.58)
Change in standard deviation of returns	.09306	.00286	−.00206	−.00206
	(1.54)	(0.33)	(−2.64)	(−3.03)
Change in volume (millions)	.00318	.00002	.00001	−.00001
	(1.16)	(0.51)	(0.43)	(−0.59)
Integrated stock dummy	−.00479	.00034	−.00054	−.00048
	(−0.26)	(1.32)	(−2.31)	(−2.36)
R^2	.178	.103	.016	.020
Observations	763	763	763	763

Notes: These cross-sectional regressions are based on eight vertical integrations on the two regional exchanges. Each observation for the dependent variable is the before/after change for the same firm. The dummy variable is one for the integrated stocks and zero otherwise.

[a]All variables, both integrated and control, are measured on the relevant regional exchange.

[b]All variables, both integrated and control, are the average for the two regional exchanges.

percentage of volume executed, and the change in total volume are all regressed against a dummy variable for the integrated stocks. Panel A presents these regressions for the NYSE integrations and is based on NYSE observations. Panel B contains the corresponding regressions for the regional integrations and is based on observations from the regional exchanges.

An alternative way to measure the change in trading costs following integra-

Table 6.6 The Effect of Integrations on the Characteristics of Trading

	Dependent Variable			
	Change in Trade Share	% Change in Trade Size	Change in Volume Share	Change in Total Volume (millions)
A. Integrations on the NYSE[a]				
Intercept	−2.7974	.16907	−1.8981	−.1779
	(−5.83)	(4.60)	(−2.44)	(−1.42)
Integrated stock dummy	2.8431	−.10485	2.7938	−.0476
	(2.53)	(−1.22)	(1.53)	(−0.16)
R^2	.022	.005	.008	0
Observations	278	278	278	278
B. Integrations of the regional exchanges[b]				
Intercept	.1339	.4440	.1286	1.2191
	(0.45)	(2.80)	(0.66)	(2.34)
Integrated stock dummy	1.7844	−.5493	.0660	−.18862
	(3.8)	(−2.18)	(0.21)	(−2.27)
R^2	.053	.018	0	.02
Observations	257	227	257	257

[a]These cross-sectional regressions are based on four vertical integrations on the NYSE. For all equations, the dependent variable is the before/afer change in that variable for the NYSE. The dummy variable is one for the integrated stocks and zero otherwise. All variables, both integrated and control, are measured on the NYSE.

[b]These cross-sectional regressions are based on eight vertical integrations on the two regional exchanges. For all equations, the dependent variable is the before/after change in that variable for that regional exchange. For the final equation, the dependent variable is the before/after total volume traded in the stock on all three exchanges. The dummy variable is one for the integrated stocks and zero otherwise. All variables, both integrated and control, are measured on the affected regional exchange.

tion is to examine the change in trading volume. For the NYSE integrations, trading volume fell by 0.047 million shares relative to the control stocks, but the t-statistic is only −0.16. A much stronger volume effect is observed for the regional exchanges. Relative to the control stocks, trading volume fell by 1.88 million shares, and the t-statistic changes to −2.27. This corresponds to a substantial decrease in total trading volume. Overall, these results are consistent with no change in trading costs for the NYSE integrations but provide some support for increased trading costs following the regional integrations.

The results in table 6.6 also suggest changes in the characteristics of the trading process for the regional exchanges. Relative to the control stocks, stocks involved in the regional integrations captured an additional 1.78 percent of the total number of trades executed and average trade size on the regional exchange decreased by 54 percent. The corresponding t-statistics are 3.80 and −2.18. The fraction of trading volume rose by 0.06 percent ($t = 0.21$), which reflects a trade-off between an increasing number of trades and a smaller trade

size. The NYSE integrations show a somewhat different pattern. The integrated stocks increased their fraction of trades by 2.83 percent ($t = 2.53$) and their fraction of volume by 2.79 percent ($t = 1.53$). Similar to the regional integrations, however, there is some evidence of a decrease in trade size.

6.5.2 Testing Implications of the Agency and Foreclosure Models

Our analysis of the effect of integration on trading costs suggests that the NYSE integrations had little effect on trading costs, while the regional integrations may have increased trading costs. While both the agency and the foreclosure explanations predict higher trading costs, their predictions for the effect of integration on effective spreads, trade size, and depth differ. The predictions of the two models are detailed in table 6.2.

Our results, detailed in tables 6.4–6.6, suggest that neither model explains the mechanism by which integration can lead to higher trading costs. For the NYSE integrations, the only significant changes are an increase in depth on the NYSE, and increased market share on the NYSE (particularly of trades). Neither of the changes are in the direction predicted by the foreclosure model, and only the increased market share is as predicted by the agency model. As predicted by the agency model, there is a small, although not statistically significant, reduction in price improvement on the integration stocks, but two other effects undermine this interpretation. First, the size of the reduction in price improvement is smaller on the NYSE than on the regionals for the NYSE-integrated stocks. Second, the decrease in NYSE price improvement is larger (and more significant) for all trades than for small trades. This is contrary to the notion that small, naive traders would be disadvantaged. Also note that while none of the changes in trading costs that occurred on the regional exchanges are consistent with the foreclosure model, none of the changes are significant.

There are some significant changes associated with the regional integration (most importantly the effect of total volume), but again, most of the changes are not along the lines predicted by either model. For example, these integrations seem to have reduced price improvement significantly on the NYSE, but neither model predicts such a change. We also note that effective spreads actually fell on the NYSE, albeit not significantly. Similarly, median posted and effective spreads rose (not significantly) on the regional exchange experiencing the integration, while price improvement actually increased. This is not the pattern associated with either model. Hence, even if trading costs did rise, as the volume data suggest, some other explanation needs to be found.

6.5.3 Other Potential Motivations for Integration

The evidence presented thus far supports the notion that the NYSE integrations have not resulted in higher trading costs, while the effect of the regional integrations is ambiguous. If the motivation for integration was not of the type described in section 6.3, an alternative motivation must exist.

One potential motive for an acquisition is to better distinguish among classes of traders. For example, as discussed in section 6.2, suppose it is more costly for the specialist to trade against orders from those who have better information than he has (informed traders), than to trade against those with the same or worse information as the specialist (uninformed traders). If the specialist can limit his transactions to trading against uninformed traders he can, ceteris paribus, earn higher profits.

This view provides an explanation for the practice of payment for order flow, and is consistent with specialists willing to pay for small, retail (i.e., nonprofessional) order flow only. It is reasonable to assume that brokers possess knowledge regarding which traders are professional, and that professional orders are more likely to be information based.[26] If one assumes that the broker has useful information regarding whether the trader is informed, this explanation implies that the payment the specialist makes to the broker is one way that specialists compete for the opportunity to trade against uninformed retail orders. In turn, competition among brokers may then result in lower commissions being charged to retail customers. That is, payment for order flow results in a kind of market segmentation; retail orders implicitly face lower trading cost reflecting the lower cost of dealing with such customers.

Broker-specialist integration may be an alternative, and more complete, means of accomplishing the same objective. Integration may dominate payment for order flow because an integrated broker has more incentive to separate informed from uninformed traders.[27] Integration would allow the specialist to outbid other floor traders for the orders from the integrated broker because only the specialist knows that the orders are retail (uninformed) orders. This is similar to the model in Seppi (1990). In his model, because the broker can identify the individual institutional trader, a separating equilibrium emerges where uninformed institutions trade with the broker, and informed institutions trade with an unaffiliated market maker. In both models, the information about the identity of the customer allows the broker to trade with uninformed (and hence less costly) customers.

This "separation" hypothesis implies that, following integration, the integrated specialist's trades will be characterized by a reduction in average trade size or, equivalently, by an increase in market share of trades and, to a lesser extent, market share of volume. One would also anticipate improved execution for small trades on the integrated exchange, and worse execution for trades on

26. Keim and Madhavan (1992) and Easley and O'Hara (1987) show that small orders are less likely to be information based as well. Since specialists know the size of an order, however, the valuable component of the broker's knowledge concerns the identity of the individual placing the order.

27. In a static (i.e., no repeat interaction) environment, the unintegrated broker has no incentive to screen out informed traders, since it realizes none of the costs of the specialist trading against informed traders. As the perceived length of its relationship with the specialist increases, the broker's incentive to screen increases, but can never exceed the incentive of the integrated broker.

the other exchanges. Finally, one would expect to observe larger effective spreads on small trades for those stocks when they are traded on other exchanges.

The results in tables 6.4–6.6 are broadly consistent with this conjecture. The integrations on the regional exchanges resulted in an increased market share of trades and a decreased trade size. Additionally, price improvement on small trades increased on the regional exchanges, but declined on the NYSE following the regional integrations. The NYSE integrations led to a similar effect on market share, although the statistical significance is lower. However, price improvement declined on all exchanges following the NYSE integration, not just on the regionals, contrary to the conjecture. Another implication of this explanation is that the integrated broker's ability to attract retail customers should increase as a result of integration. This implication is potentially testable if data on individual broker's market shares of order flow at the retail level were available.

A second potential motivation for a broker to acquire a specialist is one that is not unique to the broker-specialist relationship, but rather common to many acquisitions. If any firm is managed in a way that does not maximize the value of that firm, alternative management teams may attempt to acquire control of the firm. Thus, specialist firms may be acquired simply because they are not well managed. One reason brokers may be the acquirers is that, by virtue of their relationship with many specialists, brokers know which specialist units are poorly managed.

Data on profitability of specialists is not readily available. However, one measure of how well a specialist is managed is the ranking it gets from the NYSE. The NYSE ranking is based on characteristics such as average spread and depth in the traded stocks. As noted above, although the rankings are nonpublic, industry sources indicate that the acquired specialists had relatively low rankings. This is consistent with our data. On all three exchanges, the stocks of the acquired specialists had significantly lower market shares (of both volume and trades) than the average stock on that exchange. Moreover, for all three exchanges, the share of the affected stocks being traded on the integrated exchange rose. For the Boston and New York exchanges, this increase occurred despite a general reduction in the market share of that exchange over the period. While the Philadelphia exchange's share of trading in all stocks increased over the sample period, the increase in the affected stocks far exceeded the general increase in the exchange's market share. A second factor supporting the idea that ratings rose is that the depth increased in Boston and New York following integration. Average depth on the Boston exchange rose by nearly three standard errors, and the New York change was about two standard errors. The effect of the Philadelphia acquisition, however, was to reduce depth by about two-thirds of a standard error.

6.6 Conclusion

This paper examined the effect of brokers acquiring specialists on the NYSE and two regional exchanges. These acquisitions, particularly those on the NYSE, provide us an opportunity to examine the effect of an increase in the degree of vertical integration within a firm.

Two theories have been proposed that suggest that such an increase may work to the disadvantage of investors: an agency theory and a foreclosure model. We derived testable implications of these theories and, using transaction data, tested some of the implications. We find that, even for acquisitions where investors may have been harmed, neither theory accounts for the mechanism. Hence, neither provides much insight into the motivation for these acquisitions.

The changes we do observe are reductions in average trade size on the integrated exchanges, and a divergence of order flow. These findings are consistent with the rerouting of retail orders and suggest some alternative motivation for these acquisitions. We offer two conjectures in this regard. First, vertical integration may facilitate profitable trading against uninformed retail orders. Second, it is possible that the specialist units that were acquired had been managed in a way that did not maximize their value. We offer some suggestive evidence consistent with these alternatives. Further work, or alternative models, would expand our understanding of financial markets and, more generally, the determinants of the degree of vertical integration.

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Comment

Philip H. Dybvig

The effect of vertical integration by broker-dealers and specialists is a very good example of the theme of this conference. This question of whether such vertical integration is good or bad is not firmly within the domain of either industrial organization or finance, and benefits from simultaneous illumination from both disciplines. From industrial organization, we have traditional views of vertical integration producing possible synergy gains or reducing competition. From finance, we have views that such mergers may increase the conflict of interest between broker-dealers and their clients (which conflict is already significant absent the integration, especially given that broker-dealers can trade on their own account), and we have the notion that the more highly capitalized broker-dealers will tend to increase liquidity and stabilize the market. Constraining all of these effects is the impact of regulation, both by the SEC and by the exchanges. Neal and Reiffen have started the process of sorting out the relative importance of some of these effects.

The most interesting part of the paper is the empirical analysis, and the interesting result is that there is no smoking gun that suggests that performance of the specialists degrades significantly after acquisition by a broker-dealer. This result must be qualified by a number of limitations of the analysis (most of which are due to data problems). For example, we have no data on commissions, whose contribution is ironically the part of performance that is easiest for the customer to observe.

Price improvement is one of the important variables in the paper. Unfortunately, the measure of price improvement in the paper is not very satisfactory, due to data limitations. The measure in the paper takes the distance to the closest side of the spread, normalized to the spread midpoint. When the spread is one-eighth, according to this definition there is no price improvement (since

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the stocks are quoted in eighths), but that is not necessarily the case. As I understand the data, we do not even know which trades were made by the specialist (or which side the specialist took), and which trades were undertaken by floor traders or were negotiated upstairs and merely cleared on the floor of the exchange.

The nature of price improvement can make vertical integration profitable for subtle reasons, given that the specialists have the discretion to give special treatment to orders from their own firms. One form of price improvement is the stopping of a trade by the specialist, who later has the option of letting the trade stand with a counterparty from the limit order book or improving the price on own account. This is a free option that allows the specialist to profit with the submitter of the market order at the expense of the limit order book. For example, if the spread is 50–50¼, a market order to buy may be stopped by the specialist at 50¼, and tentatively matched with a limit order to sell at 50¼. If the stock price subsequently falls (say to 49¾–50), the specialist can improve the market order's price to 50⅛ and take the other side of the trade. Selling at 50⅛ is now profitable to the specialist, and the submitter of the market order also profits, both at the expense of the limit order. If the price rises, however, the submitter of the limit order is stuck with a losing sell.

How can specialists use this price improvement mechanism to favor trades from their own firm and its customers? When given a choice of what orders to stop for possible price improvement, specialists can stop orders stamped with their firm's name, which favors the firm's customers and the firm's own trade. Similarly, when tentatively matching a limit order to a stopped trade, the specialists can avoid doing so with orders from their own firms. This is a subtle way that vertical integration can profit a specialist, and this could not be detected without much finer information.

I liked the argument in the paper that a vertical integration of a specialist and a broker-dealer is a way for capturing the same rents one would obtain by selling order flow without such an obvious conflict of interest between the broker-dealer and its clients. Of course, this conflict of interest is no less strong, even if it is less obvious. A broker-dealer that profits either from selling order flow or from sending the order flow to its own subsidiary specialist would have less incentive than it should to seek out the best execution for its clients. This is a clear conflict of interest and is probably not in the public interest. Unfortunately, the paper has very little to say about this argument empirically. On a related note, it would be useful if we could measure the increased robustness of the specialists, given a larger capital base.

It is worth mentioning a few minor statistical issues. In general, I like the paper's attempt to find controls for some of the effects, but this could be carried further. For example, normalizing spread by price controls somewhat for the size of the stock price, but we do know that the proportional spread is related systematically to the size of the stock price. Similarly, there may be some selection bias in the population of specialists who are for sale. We know that some

merged because they were insolvent after the crash, and it came out in the discussion that the specialists who merged were generally on the exchanges' problem lists. It might be useful to compare these mergers to a sample of acquisitions by firms that are not broker-dealers. It might also be useful to categorize the results by large and small stocks. On a final statistical note, use of median statistics leaves out the outliers that may be the most interesting cases: median statistics suggest that there is no problem in the typical case, but in rare cases the mergers might be a real disaster. Of course, such analysis would require particular care to make sure that the outliers are not simply due to data problems.

To summarize, the integration of broker-dealers and specialists is a very interesting policy arena in with both finance and industrial organization are important. It is interesting that the paper does not find any strong evidence of big changes in the performance of specialists following these mergers. However, tests of many of the potential effects are beyond our reach, given the current data availability, and much work remains.

Comment

Michael D. Robbins

I believe the paper would have added value if it addressed the question, Who is advantaged when a broker directs order flow to his own captive specialist and who is disadvantaged? A distinction between regional specialists and NYSE specialists should be sharpened. The issue of "price improvement" when orders are exposed to the primary market should also be addressed. Are price improvement and fiduciary obligation quaint ideas?

A clear study of the history, both recent and not-so-recent, of broker-dealer specialist integration would be useful. How did Merrill Lynch back into the specialist business during the tumult of the 1987 crisis? How does it view the business today (1994)? Would it expand today? What caused the exit of Paine Webber from the specialist business? How much are regional specialists dependent upon the liquidity exit they have on the NYSE? What about the stealth specializing done by retail firms under rule 19c-3? Why do institutional (informed) investors get treated differently by integrated broker-dealer specialists than retail (uninformed) investors? My viewpoint, of course, is more pragmatic than theoretic because of my background—I am a businessman rather than an academic, and I earn my living as an agent in the marketplace day after day.

Experience has shown me that the major attribute of a specialist organization has to be an understanding of the nature of risk. This is not always avail-

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able abundantly in large, broad-based, integrated broker-dealers, but may be present in good measure in a small, tightly knit group of risk takers.

Authors' Reply

We would like to thank Philip Dybvig, Michael Robbins, and conference participants for their thoughtful commentary on our work. We would also like to thank Andrew Lo for organizing this conference.

Our goal in studying the effect of integration between specialists and broker-dealers was twofold: to see if we could understand the motivation for the integrations, and to draw policy implications concerning the desirability of future integration and payment for order flow. The comments of Dybvig and Robbins illustrate the significance of the issue discussed, as well as the potential pitfalls in our study.

A central issue addressed by both commentators is selectivity bias; that is, how does one explain which integrations took place, and how does the nonrandomness of integrations affect the inference one can draw from our study?

Dealing with the first issue, since these four NYSE specialists were presumably viewed by broker-dealers as the most desirable candidates for acquisition, it seems reasonable that the four differ from the fifty or so NYSE specialists that were not. We agree with the commentators that it would be valuable to gain some understanding of why these particular transactions occurred. To some extent, each event may be idiosyncratic, and hence it may be difficult to systematically explain the transactions. For example, it was suggested by both commentators that the first integration (Merrill Lynch acquiring Tompane) was motivated by the specialist's impending insolvency following the 1987 market decline.

While newspaper accounts of that transaction confirm the specialist's predicament, they also suggest that something else was going on. For example, while the timing of the acquisition was influenced by the market decline, the acquisition apparently was not; negotiations between Merrill Lynch and Tompane had been ongoing for eighteen months prior to the acquisition (i.e., since the rule change). Similarly, the notion that Merrill Lynch bailed out a failing company does not appear consistent with the fact that there were other bidders for Tompane after the market decline, and that Merrill Lynch paid $10 million for a company with $5 million in debts. Finally, the Brady commission report noted that thirteen specialists had run out of liquidity on October 19, 1987, and most of those did not sell out to a broker-dealer, so clearly there were other sources of capital available to these specialists.

In order to learn about whether there is a systematic relationship between the characteristics of the specialist and the likelihood of integration, however, would require extensive information about the specialists. Unfortunately, it is

difficult for someone outside the industry to learn much about the operating characteristics of the four specialists, as information such as profitability is not publicly available. Similarly, the NYSE ranks specialists in terms of the quality of their market making, but these ratings are not publicly available.[1]

One type of information that is available is the stocks in which each specialist makes a market, and some measure of the specialists' performance. These data are displayed in table 6.3 in our paper. Those data suggest that the stocks in acquired specialists' portfolios tended to be slightly larger volume stocks, selling at higher prices. In regard to performances of the specialists, the information is somewhat mixed; while the four NYSE specialists were worse than the control group in capturing trading volume (as measured in their market share), they did tend to have lower effective spreads than the control group. One final observation is that the four firms had on average a portfolio of eighteen stocks, which is about half the average for all NYSE specialists. This difference may reflect the lower NYSE ranking, as new listings are generally given to more highly rated specialists. Alternatively, it could be that smaller portfolios are not viable and must be combined with other business activities or other portfolios to achieve minimum viable scale.

To the extent that the four specialists were atypical of NYSE specialists, inference about future integrations from our work would be limited. If the agency motivation were a valid explanation of the reason for integration, then these four integrations would represent those with the greatest potential for harm. To the extent that no such harm was found, future integrations may be even less likely to produce these adverse consequences.

Dybvig notes that, while our theoretical analysis is based on specialists' taking the opposite side of all incoming orders, in reality the NYSE specialists' participation rate is considerably lower.[2] Many retail orders execute against NYSE floor traders and against existing limit orders, or are matched with other retail orders. This fact by itself mitigates, but does not eliminate, the kinds of problems we describe. For example, one can think of agency problems existing even if the probability is less than one that the integrated specialist has the opportunity to trade against the uninformed order flow.

One way of evaluating the consequences of our assumption is to examine how our results change as the percentage of trades that involved the specialist changes. Of course, we cannot observe the percentage. One proxy for participation rate of the specialist is the trading volume in a stock. Logic, as well as casual empiricism, suggests that floor traders tend to congregate around the posts of heavily traded stocks. Additionally, it seems likely that crosses occur less frequently and limit orders are less effective in thinly traded stocks. For

1. As Dybvig notes, the general impression among professionals is that these four specialists tended to be among the lower-rated specialists.

2. In the discussion during the conference, it was suggested that roughly 10 percent of NYSE trading involves the specialist's taking one side of the transaction.

both of these reasons, we would conjecture that, for any effective spread, the percentage of trades involving the specialist would be higher for thinly traded stocks.

Based on this, we examined whether the effect of integration was different for thinly traded stocks. If in fact we see diminution of execution quality on these integrated stocks, but not on integrated stocks in general, it would suggest that the agency theory may be relevant when the specialist faces reduced competition from floor traders (as generally occurs on the regional exchanges). To test this, we reran the regressions in panel A in tables 6.4 and 6.6, using only those test and control stocks in the lower 50th percentile of all stocks in the relevant group. We found no significant differences between these results and those reported in the paper; the coefficients changed little, although the standard errors rose due to smaller sample size. While it may be true that price improvement occurs less frequently for low-volume stocks, whatever advantages broker-dealers get from owning specialists do not appear to depend on the stock's trading volume.

Dybvig is correct when he notes that our measure of price improvement (and hence effective spread) is imperfect. Since we cannot observe whether an order is a buy or a sell, we cannot know the actual price improvement (or effective spread). In addition, our algorithm does not allow for price improvement when the bid-ask spread is one-eighth. These problems may contribute to the relatively low significance levels in our study.

In sum, we agree that the study does not fully explain the motives for integration, nor completely measure the effect. Nevertheless, we find it interesting that the data do not suggest that trading costs rose following integration. Our results therefore have significant implications for future integrations and for payment for order flow.