seeking a quotation is itself a signal about the state of the market. In these circumstances a principal may use a broker to achieve anonymity, even though he does not expect to achieve best execution, and has lower search costs and better information about market conditions than his broker. I am told that this is not uncommon on commodity futures markets.

Still another reason for using an agent is to reduce the credit risks for the other side. On most organized exchanges, only members may trade. Credit-worthiness is a condition of membership. When members act as agent, they must guarantee the credit of their principals.

On the most important issue in this section of the paper, I agree with the authors. Agents, as a group, do not have to offer best execution to attract business. It is sufficient for them to offer "better execution" than the principals would provide for themselves. In positive economic terms, the fact that principals use agents to conduct transactions is no evidence for the proposition that agents are providing best execution in the legal, or even in the economic sense. Although the paper typically compares executions by principals and agents, the relevant alternative for the principal is usually which agent to use.

In part 4, the authors consider conflicts of interest, particularly as they are affected by compensation schemes. This reflects the tradition in agency theory that compensation schemes should be evaluated by how effectively they induce agents to behave the way a principal would have them behave. Part 5 examines some techniques principals can use to control the behavior of their agents. A problem is that these analyses attempt to encompass all securities markets. Since the specific characteristics of the agent, the principal and the competitive environment are not explicit, the validity of conclusions, which might be correct if they were properly qualified, is sometimes left in doubt.

Garbade and Silber's main conclusion "is that best execution in securities markets is accomplished through a variety of contracting, signalling and collective action arrangements." Although I disagree with few of the details of their analysis, my main conclusion would be that the advantages of agency relationships are so overwhelming in most security transactions, that the agency system is used even though there is no effective guarantee of best execution. A second conclusion is that focusing on how to get agents to behave as if they were principals (the best execution issue) is not an effective research strategy. Best execution may be a fundamental issue for lawyers, but not for principals and agents in securities markets. A better question might be how to maximize profits for a firm whose comparative advantage is executing securities transactions. Presumably the answers, whether to be an agent, a dealer, or both, and the relative weights to assign to favorable transaction prices, fast execution, personal service, guarantee of financial reliability, etc., will vary with the characteristics of the securities, the customers, the technology, and the competition.

DISCUSSION

A. KALAY*: This paper constitutes an interesting attempt to shed light on the operation of financial markets where the focus is on the institutional arrange-

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ments and their potential impact on asset returns. However, I have a major objection to the tests performed. The principle hypothesis purported to be tested is this: Does rule 144 have disruptive effects on the over the counter markets such that it adversely effects asset returns? A test of this hypothesis should involve an examination of asset returns around the announcement of this rule. If the rule has adverse effects on stock returns it could only be detected by observing negative excess returns around the announcement date. However, in this paper Osborne examines the behavior of restricted stock prices around their *actual selling dates.* He finds them to be insignificantly different from any other randomly chosen day—a result which is consistent with the existence (or absence) of costs stemming from rule 144.

Now, I would like to shift our attention to an important and often neglected institutional phenomenon that effects empirical studies, such as this one, which addresses the microstructure of markets—that is, observed prices and stock price changes on the organized exchanges are restricted to multiples of ⅛ of a dollar.

To date, stock price behavior is estimated under the assumption that the observed trading price is the 'true' equilibrium price. At the same time, the 'true' distribution of rates of return is usually assumed to be continuous (for example, the normal or the log normal). Clearly, if the underlying 'true' distribution is continuous an observed trading price can be different from the 'true' price.

A logical relationship between the observed price, $\hat{P}$, and the equilibrium price, P, seems to be the following,

$$\hat{P}(t) = \{nd \quad \text{if} \quad nd - d/2 < P(t) \leq nd + d/2\}$$

where; d is the discontinuity in stock price movements. That is, the observed price at time t, $\hat{P}(t)$, is the closest one to the true price, $P(t)$. Though this relationship seems logical, one cannot justify it empirically as $P(t)$ is not observable.

The difference between $P(t)$ and $\hat{P}(t)$ seems to be small since it is bounded by $d/2$ or $1/16$ in our case. However, this discontinuity can cause huge departures between the 'observed' rate of return, $(\hat{P}(t) - \hat{P}(t-1))/\hat{P}(t-1)$, and the 'true' rate of return, $(P(t) - P(t-1))/P(t-1)$. For stocks whose prices are greater than or equal to one dollar, the smallest possible price change is ±⅛ of a dollar. This change implies, for a \$30 stock, a minimum nonzero rate of return of ±0.00416. Notice that the expected daily rate of return for a typical stock is 0.0003. Therefore, for a \$30 stock the smallest nonzero observed rate of return is ±14 times the expected daily rate of return. For a one dollar stock this ratio is ±416. On the other hand, the observed rate of return can be zero while the true rate of return is nonzero. If the equilibrium price is nearly divisible by ⅛; namely, it is in the neighborhood of $n \times$ ⅛ any small equilibrium price change would leave the observed price unchanged.

The question which, therefore, naturally arises is: does the use of observed prices in estimating the parameters of the 'true' distribution of rates of returns or in estimating the well known 'market model' bias them in any way? This question has been addressed in a recent paper by Gottlieb and Kalay (1981). They demonstrate that due to the discrete nature of observed stock prices the natural estimators for the variance and the higher order moments of the rate of returns

are biased upward. This bias is shown to be larger for stocks with lower prices and smaller 'true' standard deviation. For instance, assuming that the true standard deviation is .001, the stock is one dollar, the 'true' probability distribution of rates of returns is normal and the observed prices are as close as possible to the 'true' prices, the natural estimator of the standard deviation has expectation .00998, hence, it is biased upward by 898%. For $\sigma = .005$ and a price of \$20, the observed standard deviation has expectation .00561—i.e., it is biased upward by 12.2%. Interestingly, the natural estimators of the mean rate of return, the portfolio measure of risk, 73, and the variance of a well diversified portfolio are found to be unbiased and 'nearly unbiased' respectively. For example, if the number of securities is large the upper bound on the difference between the true β and the observed β is less than 1% for stocks whose prices are more than 10 dollars. For a 100 dollar stock the upper bound is .06%.

These results reveal that the smaller σ the bigger the bias in estimating it (as well as other moments). Clearly σ is smaller, the smaller the interval of time studied. Thus the biases which result from the discontinuity in observed stock prices are huge for studies which examine the behavior of security prices within a day; and therefore, need be corrected for if a correct inference is to be made from observed empirical regularities.

REFERENCES

Gottlieb, G., and Kalay, A., 1981, "The Implications of the Discreteness of Observed Stock Prices," Unpublished paper, New York University.