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DEVELOPMENTS IN THE THEORY OF SECURITY PRICING AND MARKET STRUCTURE[1]

by

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ABSTRACT

The purpose of this paper is to review the developments in the literature on the pricing of assets and the structure of financial markets. It begins with the development of early stock valuation models and the subsequent formation of the "random walk" or efficient market hypothesis. It then discusses newer empirical data that seems at variance with this hypothesis and the concurrent reexamination of theoretical underpinnings of an efficient market. The paper ends with a summary of the recent literature on market-making.

Introduction

There are two primary functions of a market in financial assets. The first is market making: bringing together potential buyers and sellers of securities. Competition, dealer involvement, the nature of the auction mechanism, and trading rules themselves all contribute to the effectiveness of the market making function.

The second function of financial markets is price determination: signaling to investors as to where the most profitable investments are to be made and at what price. An increase in a security price signals investors that the market values a particular productive activity more favorably. Thus, the prices of financial assets provide the same signals as prices do in the standard economic models of supply and demand: A rising price elicits an increased flow of resources to an industry, while a falling price elicits a decreased flow.

Until recently, price determination and market making were analyzed separately. Fundamental variables, such as earnings, dividends, interest rates, and risk determined security prices, independently of the specific market in which securities were traded. Increasingly there is a recognition that price determination and market making must be analyzed together.

It is the purpose of this chapter to review the developments in the literature on the pricing of assets and the structure of the financial markets. First we review the early literature on the pricing of risky assets, which relied heavily on what is now

called "fundamental analysis." We then discuss a parallel examination of the statistical properties of security prices, which revealed far more randomness in security pricing than was apparent from casual observations of the charts of stocks and bonds.

The recognition of the random character of stock prices led to the development of the efficient market hypothesis. This hypothesis claimed that if all known pricing factors, such as earnings or past price patterns, are included in the price of a security, then the market price of each security, and even of the level of the market itself, must follow a process that was to become known as a "random walk."

The random character of stock prices and the efficient market hypothesis were borne out by early tests, which showed that few investors, even those who managed large investment pools and mutual funds, realized returns superior to those from an investment in a random collection of securities. Coupled with the theory of efficient markets, this finding argued for investing in large diversified baskets of stocks which matched some broad based index, since it was futile to try to "beat the market."

However, a growing body of empirical results was **not** consistent with the efficient markets hypothesis. Studies showed that the returns to small firms significantly exceeded those of larger firms, even after adjustments for risk were taken into account. Moreover, these excess returns were perplexingly

related to the calendar - almost all occurring early in the month of January. More calendar anomalies were discovered by finding price irregularities related to the day of the week and even the time of the day.

Furthermore, the fact that some investment advisers did significantly outperform the market provided further evidence contradictory to the efficient markets hypothesis. Following inside trading by those closely associated with a firm also provided significantly higher returns. Finally, further statistical evidence covering long time periods suggested that the stock market was excessively volatile relative to the fluctuations that the efficient market theory would predict.

The empirical evidence against the efficient market caused a re-examination of the basic theoretical basis of the hypothesis, and a logical contradiction appeared. If the markets were populated only by informed and rational traders, as the efficient market hypothesis claimed, there would never be any trading among individuals motivated by new information, since there would never be any mispriced securities. Yet, if no trading took place, there would be no incentive to collect information on any security, since there would be no opportunity to profit in the absence of trading. If no information is produced, prices could not reflect all information, and the very concept of an efficient financial market collapses.

To resolve this apparent contradiction, new models of market pricing developed that included not only informed traders, but a

second group of traders who traded for reasons other than new information. The uninformed traders became known as "liquidity" traders. Trading by uninformed investors provided a solution to the logical inconsistencies of the efficient markets hypothesis.

But the introduction of liquidity traders also led to a re-examination of the nature of market making itself. The market maker was exposed to both informed and uninformed traders and the nature of his bids and offers critically depended on the mix of traders. Therefore, the efficiency of the market depends not only upon the costs and competition in the market but also upon the types of information possessed by different traders. Finally, security prices are themselves a function of the type of market in which they are traded. No longer could the pricing function of the capital markets, which is so critical for the allocation of investment, be separated from the market making process.

A. THE EARLY LITERATURE

Fundamental Analysis

Early writers on the subject of security analysis recognized that the essence of investing concerned the determination of the "true" or "intrinsic" value of a security and that this value may differ from the price of the security traded in the market. In 1934, Benjamin Graham and David L. Dodd[2] first published their classic work Security Analysis, in which they asserted that a security analyst is

> concerned with the intrinsic value of the security and more particularly with the discovery of discrepancies between the intrinsic value and the market price. We must recognize, however, that intrinsic value is an elusive concept. In general terms it is understood to be that value which is justified by the facts, e.g., the assets earnings, dividends, definite prospects, as distinct, let us say, from market quotations established by artificial manipulation or distorted by psychological excesses.[3]

According to their view, the intrinsic value of a security is a function of the future earnings, or "earning power" of a company, rather than the earlier concept of "book value." This earlier view held that the net assets of a business measured the value of the stock. While the market price of a security can deviate on occasion from its intrinsic value, over time it will move back to this value.

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[2]Benjamin Graham and David L. Dodd, Security Analysis: Principles and Technique, New York: McGraw-Hill Book Company, Inc., 1934.

[3]Graham and Dodd, op. cit., p. 17.

Implicit in their approach to the evaluation of securities are the assumptions that some investors have better information than others and those investors with better information can accumulate underpriced securities without a significant impact on the market price of the stock. Only as other investors learn the true value of the stock will the price adjust to its intrinsic value.

In the jargon of the academic literature, Graham and Dodd assumed that investors have "heterogeneous expectations." Stated simply, all investors do not have the same opinions about the future prospects of the company. We shall later show that this assumption is critical in understanding both the development of the efficient market hypothesis and the recent literature on market making mechanisms.

In the 1960s, there was substantial discussion in the academic world of what determined intrinsic value. Myron Gordon[4] published the model that is best known today. For the purposes of valuing a company, Gordon assumed that a company will pay a stream of dividends that grows at a constant compound rate of growth, g. He then discounted this stream of future dividends at an appropriate discount rate, r, which is related to market interest rates and risk. Assuming that dividends are paid annually and the dividend to be received a year from now is

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[4]Myron J. Gordon, The Investment, Financing and the Valuation of the Corporation, Homewood, Illinois: Irwin, 1962.

designated D, the price of a security P is given by the simple formula

$$P = \frac{D}{r - g} .$$

The value of a security increases if either the level of dividends or the growth rate of dividends increases. The value of a security decreases if the discount rate increases. These results accord with the common intuition about how dividends, growth, and discount rates influence security prices. Wall Street often calls the Gordon model and its many variations the "dividend discount model".

A major difficulty in using this model is that the appropriate discount rate was not precisely defined. Conceptually, the appropriate discount rate is the sum of an interest rate on some safe investment plus a risk premium that is positively related to the risk of the stock. However, in the 1950s and early 1960s, the concept of risk and the associated risk premium was not well developed. A more rigorous definition of risk had to await the theoretical development of the Capital Asset Pricing Model (CAPM) in the sixties, a model that relies heavily on the efficient market hypothesis.

The type of analysis espoused by Graham and Dodd as well as Gordon is generally classified as "fundamental analysis". These models made explicit those variables, such as earnings and dividends, that need to be forecast. Therefore, determining the

intrinsic value of a stock was an analytical exercise involving forecasts of specific company variables.

Chartists

A second approach to choosing securities is termed technical analysis or "charting".[5] Chartists plot the history of past prices (and often volume) and try to discern some predictive pattern for future price movements.

Chartists give various reasons why there might be predictive patterns in past prices. Patterns might arise as investors with superior information about the future level of earnings of a company begin to accumulate its shares. This buying generates increased volume and an increase in price. Some chartists may be able to detect this pattern before others and start accumulating a position. Other investors will observe these changes in volume and price and, in accumulating their position, ultimately drive the price to higher levels.[6]

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[5]A recent summary is contained in Sumner N. Levine, ed., Financial Analyst's Handbook, Homewood, Illinois: Dow Jones Irwin, Inc., 1988.

[6]Chartists themselves never worry about whether the price of a security is correct in terms of the fundamentals of the company. However, if chartists react to the trading of informed investors, chartists may facilitate the adjustment of a stock price to its new equilibrium.

B. THE EFFICIENT MARKET HYPOTHESIS

Early Studies

Paralleling the development of the theory of valuation were some empirical studies that examined the statistical properties of stock market prices. In 1953, Maurice Kendall published a detailed study of the weekly price behavior of British stock prices and American commodity prices.[7]

His conclusion was that changes in stock and commodity prices conform to a chance process, as if determined by the turn of a roulette wheel. The level of stock and commodity prices are, in turn, the summation of these changes in price.

The distinction between changes and levels is important. An investor makes money by predicting whether the change in the price of a stock will be positive or negative. Stock prices themselves are just sums of these positive and negative changes. Assume for the moment that the past sequence of price changes of a stock has no predictive value as to future price changes and hence conveys no insights to security analysts. However, almost as a statistical mirage, the sums of these price changes, namely the prices themselves, sometimes give the appearance of patterns

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[7]Maurice G. Kendall, "The Analysis of Economic Time Series. I", Journal of the British Statistical Society (Ser. A), CXVI (1953), 11-25. What was particularly impressive about this work was the number of calculations that were undertaken without the benefit of modern computers. Parenthetically, it should be noted that Kendall was not the first to observe the random behavior of price changes. For instance, in 1934, Holbrook Working in "A Random-Difference Series for Use in the Analysis of Time Series," Journal of the American Statistical Association, 29 (1934), examined the statistical properties of changes in wheat prices.

that at first glance may appear to be useful in forecasting the future.

As an illustration, Harry Roberts[8] simulated random market price changes for 52 weeks and then summed these price changes to obtain the price levels.[9] Although the price changes themselves in Roberts' simulation are perfectly random (Figure 1), the sum of these price changes, or the prices themselves, appear to follow a pattern. In the particular simulation shown in Figure 1, the prices conform to the classic "head-and-shoulder" pattern that many chartists believe predicts a substantial drop in price. Other simulations would produce other types of patterns frequently described by chartists.

The term "random walk" refers to the process by which the sum of random changes generates price levels.[10] Paul Samuelson[11] and Eugene Fama[12] provided a theoretical framework for security

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[8]Harry V. Roberts, "Stock-Market 'Patterns' and Financial Analysis: Methodological Suggestions," Journal of Finance, 14,1 (March 1959), 1-10.

[9]The easiest type of random process can be simulated by flipping a coin. For example, with heads, move a stock up by 1/8 and with tails, down 1/8. More complicated random behaviors allow for different size changes and the existence of a trend. These more complex, but still random processes are called "martingales."

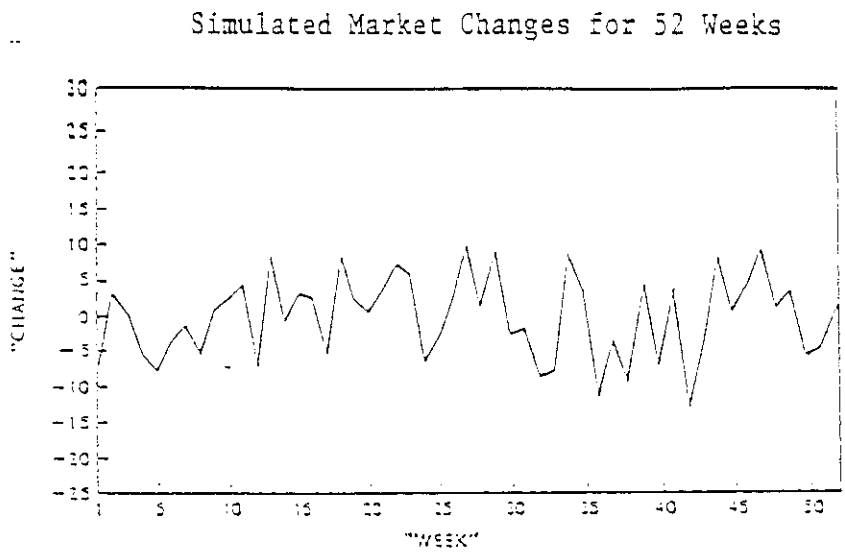
[10]See Paul H. Cootner, ed., The Random Character of Stock Market Prices, Cambridge, Mass.: The M.I.T. Press, 1964, for an early summary of price movements in speculative markets.

[11]Paul Samuelson, "Proof that Properly Anticipated Prices Fluctuate Randomly," Industrial Management Review, (Spring 1965).

[12]Eugene F. Fama, "The Behavior of Stock-Market Prices," Journal of Business, 38,1 (January 1965), 34-105.

FIGURE 1

Relation of Changes in Price to Levels



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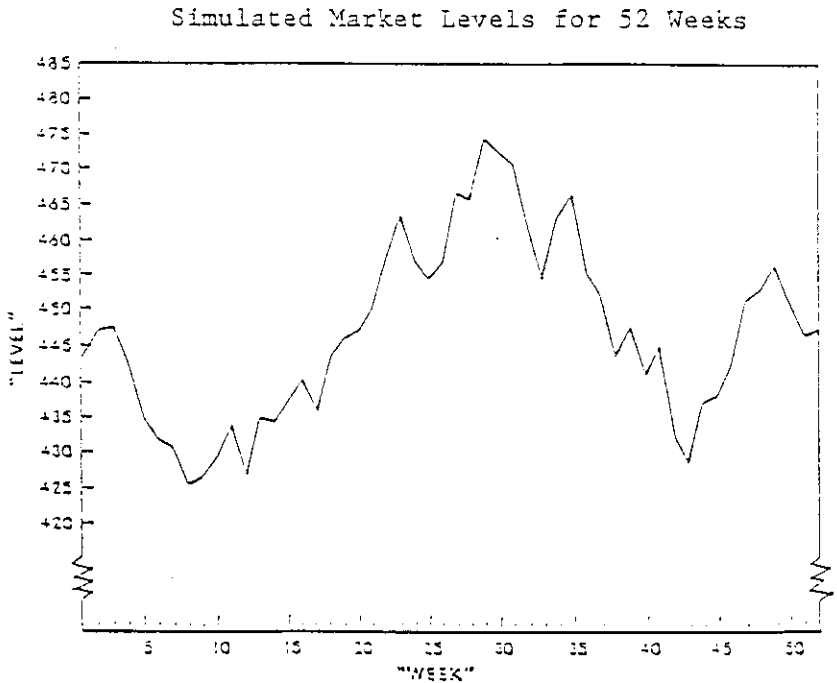

pricing that would lead to the random walk behavior of stock prices.[13] These theories were the key to the development of "the efficient market hypothesis."

Perfect Capital Market

The efficient market hypothesis makes a large number of assumptions about the market place, assumptions that are associated with the term "perfect capital market". None of these assumptions holds exactly, but collectively they do form the basis of a logical model of behavior. The more recent theoretical work on security prices and the market making process analyzes the effects of making more realistic assumptions about the capital markets.

For the moment, let us examine what is meant by a perfect capital market. The most critical assumptions underlying a perfect capital market are: (1) Nothing impedes the purchase and sale of securities. (2) All investors have free access to all information and are equally adept at evaluating the information. (3) All investors are indifferent to the source of income. (4) When confronted with several portfolios having the same expected return, all investors will select that portfolio with the least risk.

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[13]Burton Malkiel popularized this characteristic of stock prices with his book A Random Walk Down Wall Street, New York: W. W. Norton & Company, 1973.

The first assumption implies that there are no transaction costs, including brokerage fees, bid-ask spreads, transfer taxes, and so on. The early literature on market making, to be discussed below, relaxes this assumption and explicitly models bid-ask spreads.

The second assumption--that all investors have costless access to all information--is clearly violated in the capital market. More recent literature has analyzed how differential information influences the behavior of security prices and the market making function. The next section will show, surprisingly, that in some models in which investors have differential information, no trades take place. In order for trading to take place, one must make additional assumptions, the determination of which provides important insights into the market making function.

The third assumption is that investors are indifferent to the source of their income. While apparently innocuous, this assumption is in fact untrue for some investors. Investors that do not pay taxes should have an equal preference for dividends and capital gains, be they realized or unrealized. However, some non-taxable investors do prefer one source of income over another. For example, certain eleemosynary institutions can only spend dividends and interest payments and may prefer this type of income over capital gains. Moreover, this assumption may be incompatible with "social investing."

The fourth assumption states that an investor is indifferent between two portfolios with the same expected returns and risks. The "prudent man" rule as it applies to personal trusts can be inconsistent with this assumption. This rule states that each investment must be examined separately to determine its suitability for the trust, not how the investment interacts with other investments in the total portfolio. Thus, the "prudent man" rule may prevent investment in stock index futures, for example, although the integration of futures into an existing portfolio might increase its expected return, reduce its risk, or some combination of these two.

The Random Walk Theory

In a perfect capital market there are no dependencies in past price changes that a chartist could use to predict future changes. An indirect proof of this might be as follows. Assume there does exist a positive run in prices, so that the next price change is more likely to be positive than negative. If such runs exist, investors will try to buy as soon as they see any evidence of a positive run. As investors attempt to buy the stock, the buy orders of these investors will cause a very quick jump in price, and the run will stop.

According to the efficient market hypothesis, this adjustment process takes place so quickly that it would be impossible to exploit these price changes. The result is that the price of a security adjusts to a new level instantaneously,

thereby eliminating all price dependencies. As a result, forecasting future price changes from past price changes becomes impossible, and the level of the stock price follows a random walk.[14]

The statistical tests of the randomness of price changes provided strong and consistent support for this hypothesis. Statistically, the dependencies among past changes in stock prices and future changes were small and insignificant.[15] In the mid 1960's, Fama and Blume examined the profits from a trading strategy that relied on theory of relative strength and trading trends.[16] Their tests, and studies that followed, found that there were no abnormal returns from this type of trading.

Types of Efficiency

After having examined whether past prices could be used to predict the future, it was a natural step to study whether other types of information are discounted in security prices. In his

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[14]In practice, if the price change is not instantaneous, there may be some traders on the floor of the exchange (or at computer terminals) who might be able to take advantage of price dependencies. This may be particularly true if investors place limit orders which are executed between price jumps.

[15]There were two major types of tests used in estimating the degree of dependence among successive price changes. One was correlation tests, and the other was runs tests. The run tests counted the number of runs of positive changes, of zero price changes, and of negative price changes and compared these numbers to those expected under the random walk hypothesis.

[16]Eugene F. Fama and Marshall E. Blume, "Filter Rules and Stock-Market Trading," Journal of Business, 39,1 part II (January 1966), 226-241.

1970 article,[17] Fama proposed a classification scheme that has become widely accepted. A market is defined as "efficient in the weak sense" if the current and past prices, and perhaps volume of trading, do not provide meaningful forecasts of future changes in prices. This long phrase is usually shortened to: A market is weakly efficient if the current price reflects all past price and volume information.

A market is defined as "efficient in the semi-strong sense" if the current price of a stock reflects all **publicly** available information. If this is so, such information has no value in forecasting future price changes, since it is already discounted in the price. It is not necessary that everybody has the same information, but only that the price reflects all publicly available information, even if the trading is confined only to a few astute traders.

Interestingly, the majority of Justices on the Supreme Court has recently endorsed this definition of efficiency by accepting the argument that the price of a stock reflects all relevant publicly available information, including any misleading information released by a company or an insider.[18] Consequently, if there were such misleading information, an investor who purchased or sold such a stock could be damaged and hold the

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[17]Eugene F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," Journal of Finance, 25,2 (May 1970), 383-417.

[18]Basic Incorporated vs Levinson, 99 L. Ed. 2d 194 (1988).

provider of the misleading information liable, even though the investor did not rely upon or even know about the misleading information. This theory of damages is called "fraud on the market place."

A market is efficient in the strong sense if the current price of a stock reflects all information whether the information is publicly available or not. The additional feature of strong efficiency is the inclusion of "inside information" into the price of a stock, through either insider trading or the revelation of such information to other traders.

Efficiency considerations alone might suggest the desirability of having the current market price of a stock reflect inside information. If the information were positive, but not reflected in the price, a seller of the stock would be harmed. Similarly, if the information were negative, but not reflected in the price, the buyer would be harmed. However, social policy dictates that it is unfair for insiders to profit from their inside information and constrains insider trading through various restrictions and mechanisms.

One of the first tests of the semi-strong version of market efficiency was the 1962 Wharton study of mutual funds.[19] This study concluded that the performance of equity mutual funds was on average no better than randomly selected groups of stocks.

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[19]F. E. Brown, Irwin Friend, Edward S. Herman, Douglas Vickers, "A Study of Mutual Funds," Report of the Committee on Interstate and Foreign Commerce, Washington: U. S. Government Printing Office, 1962.

Following this study was a number of other studies of mutual funds, all reaching similar conclusions.[20] These studies persuaded many academics that the market for equities was efficient in the semi-strong sense. The managers of mutual funds with all their resources for analyzing individual companies were unable on average to outperform randomly selected indexes of stocks.

Although convincing to many scholars, these academic studies of price dependencies, trading rules, and mutual funds had only marginal impact on the practice of investing money. Combined with the many performance studies of institutional money managers,[21] however, these studies finally convinced many market practitioners that it is difficult to outperform the market. As a consequence of these types of studies, it is not surprising that institutional investors currently have 138 billion dollars invested in index funds,[22] over 10 percent of all domestic equities under institutional management.

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[20]Michael Jensen, "The Performance of Mutual Funds in the Period 1945-64," Journal of Finance, 23,2 (May 1968), 389-416; William F. Sharpe, "Mutual Fund Performance," Journal of Business, 39,1 part II (January 1966), 119-138; and Irwin Friend, Marshall Blume and Jean Crockett, Mutual Funds and Other Institutional Investors, New York: McGraw-Hill Book Company, 1970.

[21]A. G. Becker and Merrill Lynch were early providers of such studies. There are now many firms that undertake these studies, of which SEI is perhaps the dominant firm.

[22]Pension and Investment Age, July 24, 1989, p. 2. There may be additional equities that are managed in styles closely resembling index funds not included in the figure of $138 billion.

The implications of a semi-strong efficient market upon investor behavior are profound. Since prices reflect all relevant publicly available information, investors realize that all of the different views of the prospects of a firm are already incorporated into the price, thereby eliminating any potential abnormal profits from investing in any particular security. An efficient market also discourages investors from security analysis, which merely provides information that other investors already have. Since market prices already incorporate this information, gaining access to it will be of no value. Thus, even if an investor learned some additional information, the investor would not change his view as to the correct price of any security or make any change to his portfolio.

In a semi-strong efficient market, an investor requires access to non-public or inside information to determine that a market price is wrong. Security analysis, traditionally defined, does not reveal such inside information and hence would not benefit an investor.

Implications of Efficient Markets

One of the implications of a semi-strong efficient market is that, under weak assumptions, the risky portion of the portfolio of every investor without access to insider information

should be as diversified as possible.[23] This results from the statistical property that total risk can be reduced by holding a large quantity of smaller risks. That diversification pays has often been summarized by the popular expression "Don't put all your eggs in one basket", which has strong theoretical and empirical support.[24]

Since in an efficient market every price is correct, there is no reason to tilt a portfolio towards any particular asset. Doing so would only increase the investor's risk without a compensating increase in return. The best portfolio of risky assets to hold is one that is totally diversified and where each security is held in proportion to its value in the market. In practice, this risky portfolio is approximated by broadly based "index funds." The non-risky portion of the portfolio is then usually invested in risk-free assets, such as short-term money market instruments. By changing the proportion of risky and

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[23]One set of assumptions needed to make this statement correct is that the distribution of returns is not too skewed and that the returns of any non-marketable asset, such as human capital, are uncorrelated with the returns on marketable assets. If returns of non-marketable assets are correlated with the returns of marketable assets, investors would hold not only the market portfolio but an additional portfolio to hedge the risk of the non-marketable assets. See David Mayers, "Nonmarketable Assets and Capital Market Equilibrium Under Uncertainty," in Michael C. Jensen, Studies in the Theory of Capital Markets, New York: Praeger Publishers, 1972.

[24]Harry M. Markowitz, Portfolio Selection, New York: John Wiley & Sons, Inc., 1959; Paul A. Samuelson, "General Proof that Diversification Pays," Journal of Financial and Quantitative Analysis, 2 (March 1967), 1-13; and J. Tobin, "Liquidity Preference as Behavior Towards Risk," Review of Economic Studies, 25,67 (February 1958), 65-86.

risk-free assets, the investor can adjust the overall risk level of his portfolio.

Since in an efficient market, prices adjust immediately to new information, the only issue in market making is the level of transaction costs. The market maker plays no role in the price discovery process, as prices could adjust without any trading. The raison d'etre of trading is to allow market participants to accumulate or dispose of assets and to adjust the risk and return characteristics of the portfolio. Thus, in an efficient market, the market maker's only role is to facilitate the transfer of correctly priced stocks and other assets from one investor to another. The best market making structure is the one that minimizes trading costs.

Because of the influence of the efficient market hypothesis, the major thrust of the earlier literature on the market making function concerned the level of transactions costs. Efficient markets had no meaningful role for security analysis or market markers in the price discovery process. As restrictive assumptions of the efficient market hypothesis were loosened, the theory of market making became an important subject of academic research, with much emphasis placed upon the price discovery process.

C. THE GROWING EVIDENCE AGAINST THE EFFICIENT MARKET

Despite the large body of evidence in support of the efficient market hypothesis, a growing body of evidence contradicts it. According to the efficient market hypothesis, it should be very difficult, if not impossible, to discover undervalued stocks and thereby make superior returns. Any widely circulated information about potentially mispriced stocks should already be incorporated into the price of the stock. Finding otherwise would contradict the hypothesis that the market is efficient, at least in the semi-strong sense.

Value Line

In 1973, Fischer Black published an article entitled "Yes, Virginia, There is Hope: Tests of the Value Line Ranking System".[25] This paper presented empirical evidence that the security recommendations of Value Line had some value in forecasting future prices. Since Value Line's recommendations circulate widely, this finding violates the semi-strong version of the efficient market. Subsequent studies of the Value Line

[25]Fischer Black, "Yes, Virginia, There is Hope: Tests of the Value Line Ranking System," Financial Analysts Journal, 29 (September/October 1973), 10-14

recommendations have reached similar conclusions.[26]

Value Line covers roughly 1500 stocks and assigns each to one of five groups. Group 1 contains those stocks that Value Line expects to show the greatest relative price appreciation over the next 12 months. Group 2 contains those stocks that Value Line expects to have the next best relative price appreciation, while Group 5 contains those stocks that Value Line expects to show the worst price performance over the next 12 months.

The prediction record of Value Line is impressive. From April 16, 1965 through December 30, 1988, the value of stocks in Group 1 increased 2388 percent (Figure 2)--a return of 14.5 percent per year. In contrast, the value of the stocks in Group 5 increased only 25 percent--a return of 0.9 percent per year. The increases for Groups 2 through 4 were respectively: 1345 percent, 603 percent, and 208 percent.[27]

There are several caveats in interpreting these returns. First, they ignore the transaction costs associated with the

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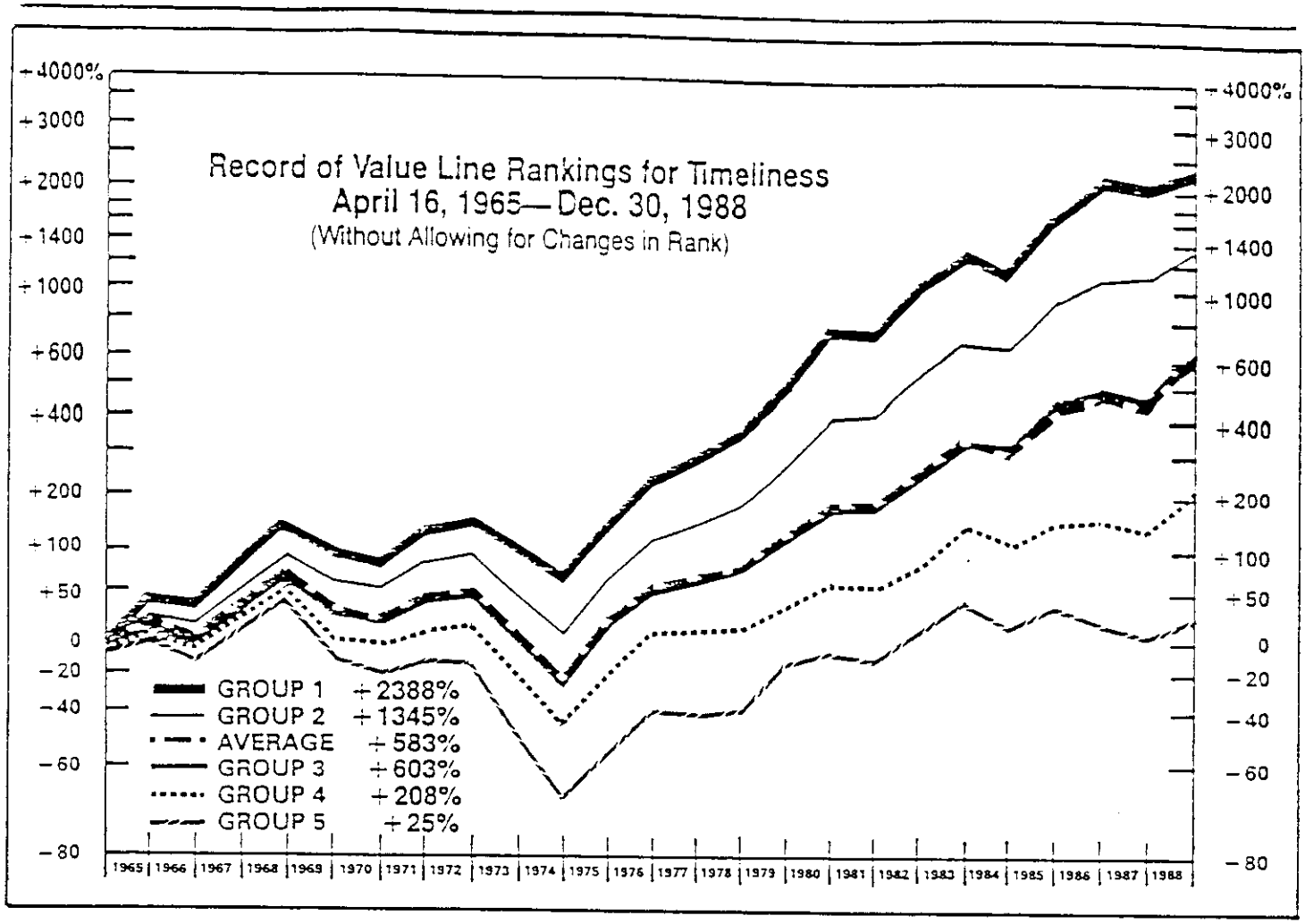
[26]Scott E. Stickel, "The Effect of Value Line Investment Survey Rank Changes on Common Stock Prices," Journal of Financial Economics, 14,1 (March, 1985), 121-43, is one of the most recent studies and contains a bibliography of previous articles on this subject.

[27]These returns assume that the investor constructs five portfolios at the beginning of each year based upon the last set of recommendations in the prior year and holds these portfolios for one year. In actual fact, Value Line publishes recommendations weekly. If one adjusts the five portfolios within a year for these intermediate changes in recommendations, the results are even more impressive.

FIGURE 2



Record of Value Rankings For Timeliness (Without Allowance for Changes in Rank)
April 16, 1965-Dec. 30, 1988

Group	1965*	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1	+33.6%	− 3.1%	+39.2%	+31.2%	−17.7%	− 8.9%	+25.5%	+10.1%	−17.1%	−23.1%	+51.6%	+35.3%	+15.8%
2	+18.9	− 6.0	+31.9	+26.3	−16.3	− 4.0	+17.4	− 7.5	−26.2	−27.8	+53.0	+36.3	−12.7
3	+ 8.9	− 9.7	+30.1	+21.4	−20.7	− 5.5	+12.2	− 6.2	−27.0	−28.5	+52.9	+33.8	− 5.2
4	+ 0.8	− 7.2	+25.1	+25.1	−26.8	−11.7	+14.2	+ 3.2	−29.1	−33.6	+48.4	+36.1	− 0.2
5	− 1.2	−12.4	+28.4	+25.9	−35.7	−13.1	+10.5	+ 2.9	−43.1	−36.8	+42.1	+38.2	− 2.8
Avg.	+10.1	− 7.9	+29.9	+24.6	−22.1	− 7.5	+14.9	+ 5.5	−27.7	−29.6	+51.2	+35.1	+ 5.8

Group	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1965 through 1988
1	+19.8%	+25.6%	+50.2%	− 1.9%	+33.7%	+25.2%	− 8.6%	+38.6%	+23.5%	− 1.2%	+16.0%	+2388%
2	+16.1	+30.8	+37.4	+ 0.7	+29.0	+22.2	− 0.1	+29.5	+18.7	+ 0.4	+19.7	+1345
3	− 9.2	+27.6	+20.8	− 2.7	+25.5	+26.7	− 1.6	+25.6	+11.5	− 4.1	+23.2	+ 603
4	− 2.4	+23.1	+13.2	− 0.9	+18.5	+35.2	−12.3	+24.6	− 1.5	− 9.1	−27.2	+ 208
5	+ 4.0	−39.9	− 8.4	− 4.2	+19.9	+30.0	−17.1	+18.7	−12.1	−17.9	+20.0	− 25
Avg.	− 9.6	+28.0	+23.4	+ 0.9	+25.0	+27.5	− 4.7	+27.0	+10.2	− 4.9	−22.6	+ 583
											Dow Jones Industrials	+ 138%
											N.Y. Stock Exchange Composite	+ 227%

*April through December

annual rebalancing. Second, they do not include dividends. Third, they do not adjust for differences in risk among the stocks in the five groups. One possibility is that Value Line assigns the most risky stocks to Group 1 and in the generally rising market from 1965 through 1988, one would expect these stocks to appreciate more than the less risky stocks.

In response to these criticisms, it can be shown that any reasonable estimate of transaction costs or differences in dividend yields cannot explain the differences between the returns of Groups 1 and 5. Furthermore, studies that have explicitly controlled for differences in risk find that the Value Line recommendations still have predictive value.

Proponents of the efficient market hypothesis found these results disturbing. Most of the evidence, at least through the seventies, had lent support to the efficient market hypothesis. After all, the typical mutual fund with all its resources did not outperform the market. Perhaps, the Value Line recommendations could not be used to invest significant amounts of money, or the tests of these recommendations were flawed in some unknown way. Nonetheless, the apparent success of the Value Line recommendations marked the first significant deviation from the predictions of the efficient market hypothesis.

Corporate Insiders

In addition to the Value Line studies, another body of literature demonstrated that corporate insiders have earned

superior rates of return on their trading activities. This evidence is inconsistent with the strong form of the efficient market hypothesis. It appears that insiders have information that is not incorporated into stock prices.

These studies showed that before transaction costs, insiders earn about six percent more per year than investors without special information.[28] Since insiders often trade for reasons not related to inside information, and since the data on insider trading does not distinguish between informationally motivated trading and other types of trading, the additional returns that insiders earn on informationally motivated trades are probably in excess of 6 percent per year.

Studies on insider trading disproved market efficiency in the strong sense. However, these studies did not disturb some proponents of the efficient market hypothesis. After all, the strong form of the efficient market is an extreme concept, much like a perfect vacuum. Just as a physicist cannot create a perfect vacuum, it is unreasonable to expect that the market would literally incorporate all relevant information into stock prices at every point in time. Insiders may be able to make money, but their actions would quickly drive stocks to the correct level.

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[28]Jeffrey Jaffe, "Special Information and Insider Trading," Journal of Business, 47,3 (July 1974), 410-28, is an early example of the study of insider trading. A more recent study is H. Nejat Seyhun, "The Information Content of Aggregate Insider Trading," Journal of Business, 61,1 (January 1988), 1-24.

However, these studies opened the question of whether outsiders could use the insider trading reports that the SEC collects to make superior returns. Insiders are required to report their trading to the SEC within ten days of the end of the month in which they trade, so significant delays exist between insider trading and the reporting of the trade. With such delays, it would be surprising if these reports had any predictive value under a semi-strong version of the efficient market.

Yet subsequent studies of insider trading found that, even with a lag, outsiders could mimic insider trading to make additional returns.[29] While not as great as those earned by insiders, the additional returns are still significant. The possibility that outsiders can utilize the publicly available record of insider trading to make additional returns is inconsistent with the semi-strong form of the efficient market hypothesis, just as is the Value Line evidence.

The "Anomaly" Literature

But perhaps some of the most persuasive evidence against the efficient market hypothesis is the "anomaly" literature, which

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[29]Michael S. Rozeff and Mia A. Zaman, "Market Efficiency and Insider Trading: New Evidence," Journal of Business, 61,1 (January 1988), 25-44, argues that this finding that outsiders can make additional returns by mimicking insider trading is due to an improper definition of the normal rate of return from which additional return is measured. By using another definition of normal return, they conclude that outsiders cannot make additional returns.

has discovered unusual patterns in the price behavior of securities. Some of the most puzzling price anomalies are related to seasonal and calendar patterns in the movements of stock prices. Other anomalies relate to the "size" of a firm and the "dividend yield". Most surprisingly, these anomalies seem to occur in January.

In the mid 1970s, Blume and Friend[30] showed that there were substantial differences in the returns between large and small firms that could not be explained by the accepted models of security pricing. From 1928 through 1968, the returns on stocks of small firms far exceeded the returns on those of large firms, although the reverse occurred during some subperiods. More recent articles have reached similar conclusions about the "size" effect,[31] and there is even evidence that this effect is present in foreign markets.[32]

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[30]Marshall E. Blume and Irwin Friend, "Risk, Investment Strategies and the Long-Run Rates of Return," The Review of Economics and Statistics, 56,3 (August 1974), 259-269.

[31]R. W. Banz, "The Relationship between Return and Market Value of Common Stock," Journal of Financial Economics, 9,1 (March 1981), 3-18; S. Basu, "Investment Performance of Common Stock in Relation to their Price/Earnings Ratios: A Test of the Efficient Market Hypothesis," Journal of Finance, 32,3 (June 1977), 663-682; and S. Basu, "The Relationship Between Earnings, Yields, Market Value and the Returns for NYSE Stocks: Further Evidence," Journal of Financial Economics, 12,1 (June 1983), 129-156.

[32]P. Brown, D. B. Keim, A. W. Kleidon and T. A. Marsh, "Stock Return Seasonalities and the Tax Loss Selling Hypothesis: Analysis of the Arguments and Australian Evidence," Journal of Financial Economics, 12,1 (June 1983), 105-127; A. Berges, J.J. McConnell and G.G. Schlarbaum, "The Turn-of-the-Year in Canada," Journal of Finance, 39,1 (March 1984), 185-192; T. Nakamura and N. Terada, "The Size Effect and Seasonality in Japanese Stock

The existence of a size effect in explaining stock market returns may not be that surprising. After all, it is possible that the accepted models of equilibrium had omitted some components of risk that were correlated with size. What is surprising, however, is that virtually all of the differences in the returns between large and small companies occurred in the month of January. Donald Keim has classified NYSE and AMEX stocks by deciles of market value into ten portfolios and then calculated "abnormal" returns.[33] Abnormal return was defined as the difference between the actual realized return on a stock over a period of time and a benchmark return over the same period. In Keim's work, the benchmark return is the return that an investor would have expected over that period on a stock of similar risk but without knowledge of the company's size.

As Keim discovered, abnormal returns and the market value of the firm's equity are strongly linked in January (Figure 3). Moreover, further work has revealed that most of the difference in the returns between small and large companies occurs in the

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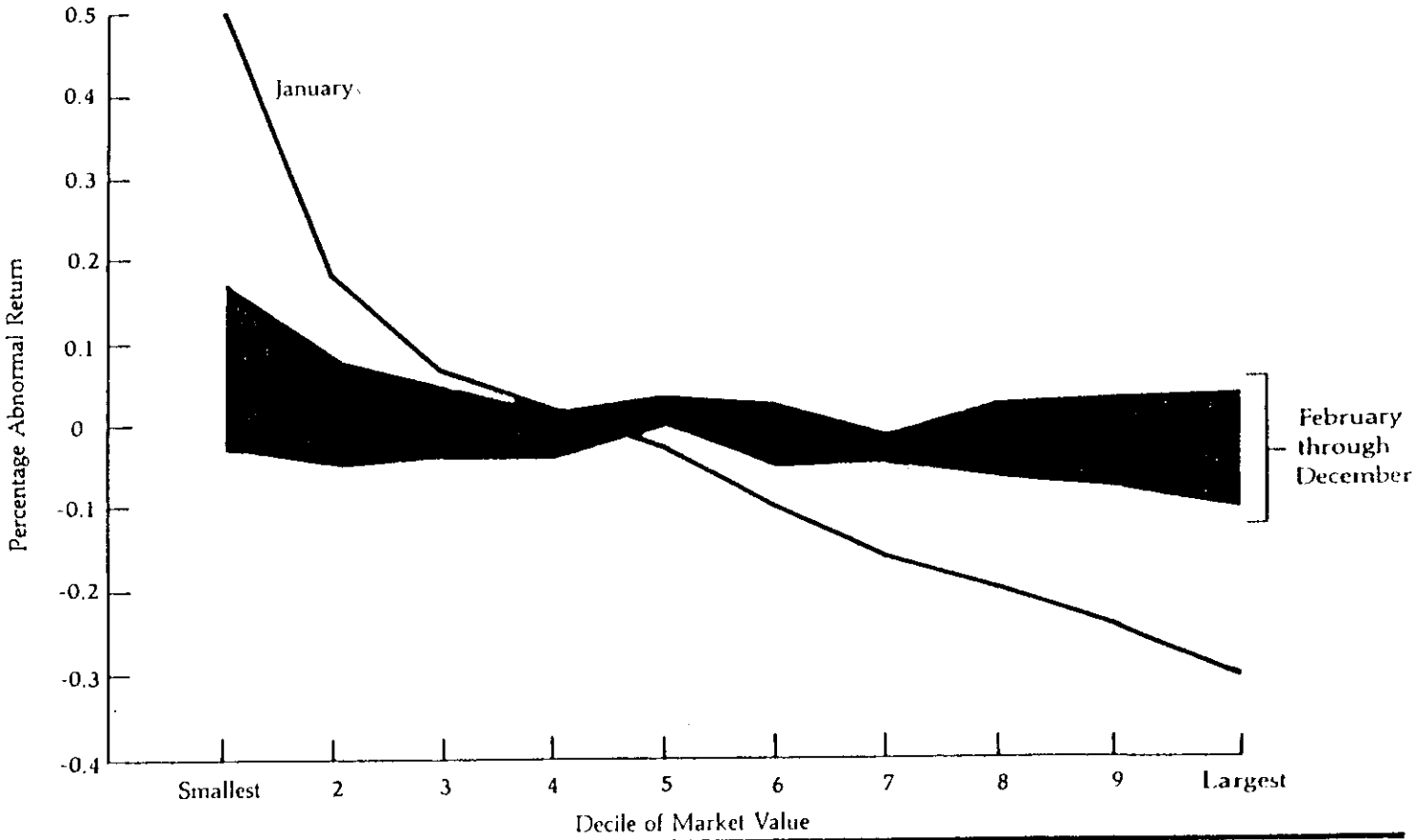
Returns" (Nomura Research Institute, 1984); and M.R. Reinganum and A. Shapiro, "Taxes and Stock Return Seasonality: Evidence from the London Stock Exchange" (University of Southern California, 1983).

[33]Donald B. Keim, "The CAPM and Equity Return Regularities," Financial Analyst Journal, 42,3 (May/June, 1986), 19-34.

FIGURE 3 The Relation Between Average Daily Abnormal Returns and Market Value for Each Month, 1963-1979*



*The 10 market value portfolios (deciles) are constructed from firms on the NYSE and AMEX. Abnormal returns are provided by CRSP.

Source: Donald B. Keim, "The CAPM and Equity Return Regularities," Financial Analysts Journal, 42,3 (May/June 1986), p. 25.

first few days of January.[34] As yet, no one has given a satisfactory rationale for these results.[35]

Another peculiar pattern is the "day-of-the-week effect." Monday returns, measured from Friday close to Monday close, are on average negative, and virtually all of this negative return occurs from Friday close to Monday open.[36] The greatest daily returns are on average Friday returns with the smallest companies realizing the greatest return (Figure 4).

Still another anomaly is the dividend yield effect. On average, there is a U-shaped relation between dividend yield and returns, with the greatest returns accruing to those stocks with either a zero yield or a high yield.[37] Donald Keim showed that

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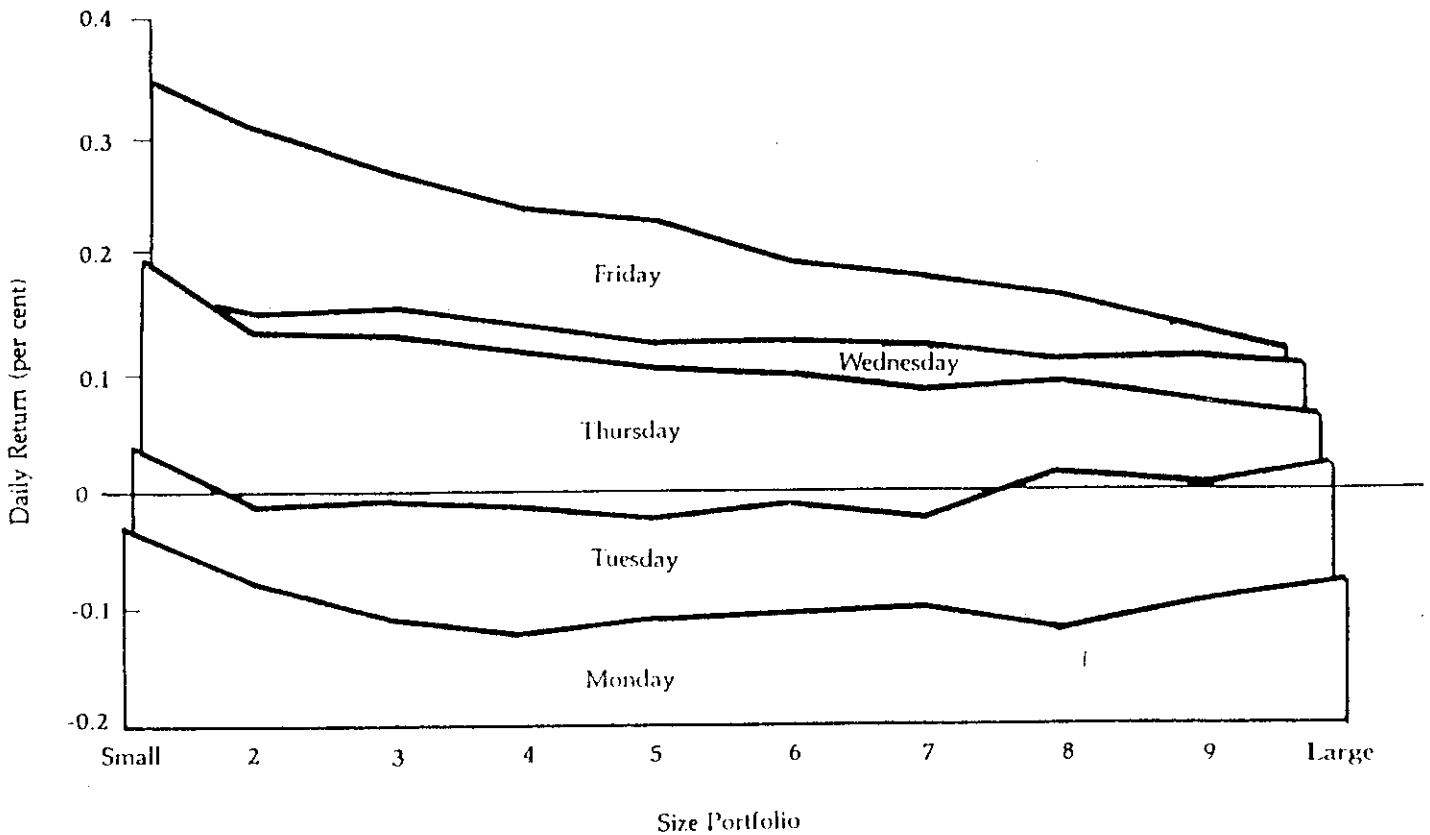
[34]Donald B. Keim, "Size-Related Anomalies and Stock Return Seasonality: Further Empirical Evidence," Journal of Financial Economics 12,1 (June 1983), 13-32.

[35]Keim's figure shows that there is also some size effect in the remaining 11 months of the year. However, this apparent evidence of a size effect in these months is due to a statistical problem in measuring returns. When this problem is corrected, the size effect is negligible in these 11 months. See Marshall E. Blume and Robert F. Stambaugh, "Biases in Computed Returns: An Application to the Size Effect," Journal of Financial Economics, 12,3 (November 1983), 387-404.

[36]F. Cross, "The Behavior of Stock Prices on Fridays and Mondays," Financial Analysts Journal, 29,6 (November/December 1973), 67-69; K. French, "Stock Returns and the Weekend Effect," Journal of Financial Economics, 8,1 (March 1980), 55-69; M. Gibbons and P. Hess, "Day of the Week Effects and Asset Returns," Journal of Business, 54,4 (October 1981), 579-596; and D. Keim and R. Stambaugh, "A Further Investigation of the Weekend Effect," op. cit.

[37]Marshall E. Blume, "Stock Returns and Dividend Yields: Some More Evidence," The Review of Economics and Statistics, 62,4 (November 1980), 567-577.

FIGURE 4 Size Effect by Day of the Week (NYSE and AMEX firms, 1963-1979)



Source: Donald B. Keim, "The CAPM and Equity Return Regularities," Financial Analysts Journal, 42,3 (May/June 1986), p. 24.

virtually all of this relation is due to the returns in January (Figure 5).[38]

Other reported anomalies include time patterns of returns during a trading day.[39] Also, during recent years returns in the first half of each month exceed those in the second half.[40] Again, there has not been a satisfactory explanation of these irregularities.

Volatility Tests

A further setback to the efficient market hypothesis consists of the growing body of research on the volatility of financial markets. While casual observation may suggest that markets are often too volatile, proponents of the efficient market hypothesis claim that rapid price movements are just a consequence of new information rapidly incorporated into the valuation of securities.

As noted at the onset of this chapter, one method for valuing securities consists of discounting future dividends at some appropriate discount rate. However, in an important article, Robert Shiller found statistical evidence that financial

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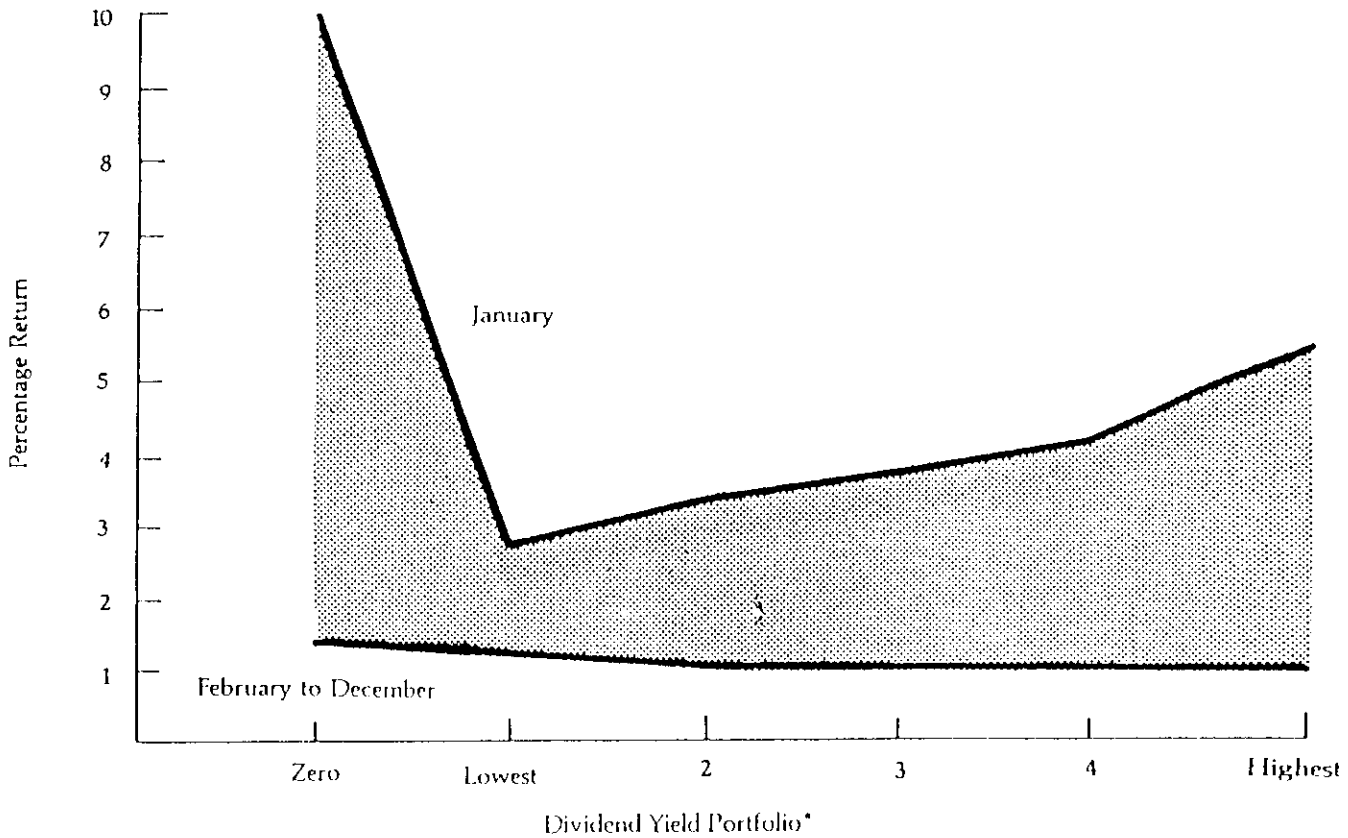
[38]Keim, "The CAPM and Equity Return Regularities," op. cit.

[39]Lawrence Harris, "A Transactions Data Study of Weekly and Intradaily Patterns in Stock Returns" (University of Southern California, 1985) and Michael Smirlock and Laura Starks, "Day-of-the-Week and Intraday Effects in Stock Returns, Journal of Financial Economics, 17,1 (September 1986), 197-210.

[40]Robert A. Ariel, "A Monthly Effect in Stock Returns," Journal of Financial Economics, 18, 1 (March 1987), 161-174.

FIGURE 5 The Relation Between Average Monthly Returns and Dividend Yield for January and All Other Months, 1931-1978



*Dividend yield in month t is defined as the sum of dividends paid in the previous 12 months divided by the stock price in month t-13. The six dividend yield portfolios are constructed from firms on the NYSE.

Source: Donald B. Keim, "The CAPM and Equity Return Regularities," Financial Analysts Journal, 42,3 (May/June 1986), p. 22.

markets, and particularly the stock market, are too volatile to be explained by subsequent dividends.[41] Shiller studied the aggregate dividends and earnings of the S&P 500 index from 1871 through 1979. He used this information to calculate what the "intrinsic" value of the S&P 500 stocks should be, for a wide range of discount rates, if investors, knew with certainty the future path of dividends and earnings. Shiller called these intrinsic values the "perfect foresight," or "ex post rational" value of the S&P 500 index.[42] He found that the actual value of the S&P index fluctuated far more than could be explained by subsequent cash flows to investors. The "excess volatility" of the stock market, as the phenomenon came to be known, could only be explained by such "irrational" behavior as investor over-reaction to short-run fluctuations in earnings or other variables.

It is true that investors do not and cannot know the future with certainty. Yet the research on volatility implies that investors become overly optimistic when earnings are rising and

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[41]Robert J. Shiller, "Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?", American Economic Review, 71 (June 1981), 421-36. Related work was published by Stephen LeRoy and Richard Porter, "Stock Price Volatility: Test Based on Implied Variance Bounds," Econometrica, 49 (1981), 97-113.

[42]The concept of the perfect foresight price (or yield) was introduced earlier in a similar study of the British "consol" (or long-term bond) market over a two hundred year span. This study also showed excess reaction to short-term trends. See Robert Shiller and Jeremy Siegel, "The Gibson Paradox and Historical Movements in Real Interest Rates," Journal of Political Economy, 85,5 (October 1977), 891-907.

far too gloomy when times are bad. In an efficient market where investors properly discount short-run events, overreactions would not occur.

The stock crash of October 1987 also perplexed the proponents of the efficient market. There is still no identifiable event to explain such a large drop. The subsequent recovery by the market to new highs in less than two years further strengthens the argument that the crash was unjustified by events and hence "irrational."

Excess volatility of the market, seasonal and other anomalies in stock prices and, to some extent, the predictive power of the Value Line recommendations and insider trading, have led to a rethinking of the efficient models of security pricing. Later work, which is described in the next section, concluded that the very concept of an efficient market may be internally inconsistent. This forced academicians to realize that the pricing function of the market was much more complicated than the equilibrium models implied by early versions of the efficient market hypothesis.

D. ACCOMMODATING HETEROGENEOUS EXPECTATIONS

The early development of the efficient market hypothesis recognized that investors had different views about the future values of dividends, earnings and other factors important to security valuation. As investors attempted to profit from these

different views, prices in the market would adjust to incorporate all relevant information. Out of this process would emerge a consensus view of the expected returns and risks of each security.

Early Work

In an important study of security pricing under heterogeneous expectations, John Lintner showed that the equilibrium value of securities is a weighted average of each investor's expectations, with greater weight given to those investors with greater wealth and to those investors with a greater tolerance to risk.[43] Risk tolerance matters because investors who are more tolerant of risk are willing to place more of their wealth in assets that they perceive to be mispriced.

Lintner showed that if the view of each investor is replaced by this weighted average, or consensus, the equilibrium level of stock prices is identical to the level reached when each investor has distinct expectations. Thus was born the idea of a "representative investor" with consensus expectations. Instead of incorporating the different views of each investor into the determination of security prices, one could instead use the

[43]John Lintner, "The Aggregation of Investor's Diverse Judgments and Preferences in Purely Competitive Security Markets," Journal of Financial and Quantitative Analysis, 4,4 (December 1969), 347-400.

representative or consensus view and obtain the same set of equilibrium prices.[44]

Rational Expectations

The incorporation of differential information into the pricing structure of risky securities thus seemed to present no real conceptual difficulties. However, Sanford Grossman, in a pathbreaking article in the late 1970s, showed that there was a major complication in the analysis of heterogeneous expectations that had been overlooked in the earlier studies.[45] This complication implied that stock prices could not reflect all information as required under the strong or semi-strong form of the efficient market hypothesis.

The contradiction inherent in an efficient market can be found by examining the two major functions of the price system in a securities market. First, prices provide individuals with a budget constraint and therefore place a constraint on how individuals can utilize their current wealth. Second, prices convey information about the valuation of individual securities. Since the aggregate supply and demand of investors determine

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[44]Mark Rubinstein showed in a very general context that there will always exist a consensus belief which, if held by all investors, would lead to the same set of equilibrium prices. See Mark Rubinstein, "Securities Market Efficiency in an Arrow-Debreu Economy," American Economic Review, 65,5 (December 1975), 812-824.

[45]Sanford Grossman, "On the Efficiency of Competitive Stock Markets Where Trade[r]s Have Diverse Information," Journal of Finance, 31,2 (May 1976), 573-585.

prices, and each investor's supply and demand reflect the specific information available to that investor, prices must contain information about the views of others.

In determining an optimal allocation of securities, an investor should utilize the potential information contained in the market prices of securities. To do otherwise would ignore valuable information and would not be optimal or, in the jargon of the economics profession, not "rational." Before investing, individuals should deduce as much information as possible from current prices, incorporate that information into the information that they may have obtained independently, and then recalculate their security demands accordingly. If all investors did this, the prices of all securities would reflect the information of every investor in market. The resultant set of prices is termed a "rational expectation" equilibrium.

One way to illustrate a "rational expectation" equilibrium is with the following example:

> Suppose that the current market price of ABC Corp. is $20 a share and that you obtain some private or special information that indicates to you that the price should really be $22 a share.
>
> Being "rational", you look at the market price of $20 and conclude that others may have other information that tells them that the stock is not worth as much as your information would suggest.
>
> Nonetheless, you determine that, although ABC Corp. may not be worth $22 a share, it is worth more than $20, perhaps as high as $20 1/2. Therefore, you place an order to buy ABC Corp. at a maximum price of $20 1/8.
>
> But in a rational expectation equilibrium, a potential seller will go through the same thought

process. He will ask, "Why is someone suddenly bidding up to $20 1/8 for ABC Corp.? Does he know something that I do not?" Thus, the potential seller is concerned that the potential buyer may have some private information that indicates a value for ABC Corp. of more than $20.

In the first round of bidding, the seller will utilize the current price of the stock, his own information, and the information that another is willing to buy at $20 to raise his offer price to somewhere above $20. Thus he will avoid being "picked off" by the knowledgeable investor.

Let's say the potential seller counters with a tentative offer to sell at $20 1/4. The potential buyer will use his own information and the information that another is willing to sell at $20 1/4 to determine whether he should accept this offer.

If the buyer still decides to accept the offer, the seller knows that the offering price is too low and will revise it upwards again. In our example, since the buyer originally believed that stock was worth 20 1/2, there may be a further upward adjustment in price.

Ultimately, the price will adjust to a new equilibrium level that reveals all of the special information that individual investors possess.

Note that no trade takes place in this sequence of bartering. Investors have the same endowment of assets as they had before the price adjusted. This results from the assumption, common in the rational expectation literature, that no trades take place until all the demands and supplies have been satisfied at a common price.[46]

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[46]If the bids and offers were binding, there might be trading at intermediate points in this process and it is possible that the final price would be different from the price reached in a world where no trades take place until all traders are satisfied. Indeed, some of the more recent literature on market making to be discussed below shows that the rules of the auction process can affect the clearing price.

As a result of this bargaining, the market price of a stock embeds all the relevant information about the security. In these circumstances, the market prices are said to be "fully revealing" in that the prices contain the special information and opinions of all investors. The market price of every security is said "to aggregate" all public and private information.

The concept of a fully revealing equilibrium is similar to the strong form of the efficient market hypothesis. As noted earlier, a strongly efficient market reflects all information whether it is public or private. If the market is strongly efficient, any individual's information concerning the price of a security is already incorporated into its price.

Logical Inconsistency

If there is any cost associated with obtaining private information, the fully revealing, or strongly efficient, market theory has a serious flaw. Since the final price of a security embeds any new information without any trade taking place, investors have no incentive to obtain private information. As a consequence, all investors will abandon searching for costly information and hence no new information will be produced. Under these circumstances, capital markets will no longer be efficient.[47]

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[47]Fama's original development of the efficient market hypothesis assumed that information was available to all and at no cost. If there is no cost to gathering information, there is no logical inconsistency in the efficient market hypothesis.

Thus, in the presence of costly information, a strongly efficient capital market is logically inconsistent. Since an investor derives no benefit from securing private information, there will be no resources devoted to security analysis. But investors do undertake security analysis. When a model misses reality by such a wide margin, the model needs to be changed.

A Resolution of the Inconsistency

A key result of the efficient market literature with informed traders is that the very process of making an offer to buy or sell revealed "too much" information to the other side of the potential trade. If a trade is to occur, an informed trader must be able to make an offer without fully revealing his private information.

A common device that the literature uses for this purpose is to introduce traders who trade for reasons other than the possession of special information. These traders are termed "liquidity" traders, or more descriptively "noise" traders. Among the reasons for "liquidity" trading are tax considerations, changes in wealth levels, changes in risk preferences, and the accumulation or decumulation of assets for consumption purposes. While the precise reason for "liquidity" trading is not really important, the existence of some non-informationally motivated traders is vital to resolving the logical inconsistency of a strongly efficient capital market.

Informationally Motivated Traders

A 1971 article written under the pseudonym of Walter Bagehot made the first reference to liquidity trading. This article attempted to separate informationally motivated traders from other types of traders.[48] Bagehot posits three types of investors: "one, transactors possessing special information; two, 'liquidity-motivated' transactors who have no special information but merely want to convert securities into cash or cash into securities; three, transactors acting on information that they believe has not yet been fully discounted in the market price but which has."[49]

The third type of investor is not consistent with a rational expectation equilibrium. These investors should eventually learn that their information is already discounted into the price and stop trading. Possibly, as a consequence, recent papers omit this third type of investor and use only the "liquidity" investors to induce noise into the trading process.[50]

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[48]Walter Bagehot, "The Only Game in Town," Financial Analyst Journal, 27 (March/April 1971), 12-14, 22. The real author of this paper is believed to be Jack Treynor. Walter Bagehot himself lived from 1826 to 1877 and was a noted English social scientist. This article is extremely prophetic but was forgotten until recently. Indeed, some recent work can be viewed as formalizing the essential insights of this article. Cf. Lawrence R. Glosten and Paul R. Milgrom, "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders," Journal of Financial Economics, 14,1 (March 1985), 71-100.

[49]Bagehot, ibid., p.13.

[50]There is empirical evidence, however, that it would be a mistake to ignore this third group of investors. A large number of institutional and individual investors trade a substantial number of shares each year, far too much to be explained by

Bagehot pointed out that the dealer always loses to informed traders. Continuing with the previous example, if he offers to sell at 20 1/8 and an informed trader buys, he has sold at too low a price. Likewise, if he offers to buy at 20 1/4 and an informed trader sells, he has paid too great a price. On the other hand, as long as there is a bid-ask spread, liquidity traders always lose to the dealer.

The existence of liquidity traders modifies the previous example of the pricing of ABC Corp. in the following way:

> As the investor with private information, you offer to buy the stock at up to $20 1/8 a share.
>
> A potential seller now says, "I don't know whether the offer to buy up to $20 1/8 a share comes from an informed trader or an uninformed trader. Yet, my knowledge of the number of liquidity traders and informed or informationally-motivated traders allows me to assess the probability that the offer is from a liquidity trader or an informationally motivated trader.
>
> "If I consider countering with a price of, say, $20 1/4, I will make a profit if the offer is from a liquidity trader but will lose if the offer is from an informed trader. Given the probability that the offer is from a liquidity trader and my judgment as to the type of information that an informed trader might have, I can determine whether I should offer to sell at $20 1/4."

In this example, the potential seller does not know whether the offer is from a liquidity or informed trader. If the seller knows that the buyer is a liquidity trader, he would certainly sell at 20 1/4, so liquidity traders have an incentive to

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liquidity needs. They do not, however, realize superior returns. Not to model this third group may be significant deficiency of the existing literature.

identify themselves as such. Moreover, informed traders have an interest in being mistaken for liquidity traders. Therefore, if the market believes that liquidity traders transact in smaller lots than informed traders, large and informed traders will split their orders into smaller orders in order to mimic liquidity traders. Informed traders may also try to hide their identity by using a number of brokers to execute a trade, and so on.

Thus, both liquidity and informed traders face many strategic decisions in executing trades. Traders recognize that their strategic decisions may affect the actions of other traders. In this game-theoretic world, the rules of the market place take on an important role in the disclosure of information, with the structure of the market itself influencing the market price of a security.

E. MARKET MAKING STRUCTURES

The previous section suggested that if all traders are informationally motivated, there would be no trading. However, if there are uninformed traders as well, trading may take place. This section will describe some of the ways in which a market can be organized and show that the rules and organizational structure of a market may make a substantial difference in how security prices are determined.

Types of Market Structures

There are two basic types of markets for common stocks: continuous and batch markets. In a continuous market, buyers and sellers continuously interact with each other and trades can take place at any point in time. In a batch market, orders are accumulated and executed together at specific points in time. Actual markets often involve combinations of these two types of markets.

Continuous Markets--Auctions and Dealers'

An auction market brings together all potential buyers and sellers at one physical location (or through a computer network). In practice, the potential buyers and sellers utilize agents, called brokers, to effect their transactions. In a physical location, there is a limitation on the number of individuals that can gather together in the "crowd". If the number of buyers and sellers is large enough, access to the crowd must be restricted and investors not in the crowd must use agents. Computer networking, however, enables the crowd to include all potential buyers and sellers. An example of an "auction" market is the market for commodity futures.

A dealers' market, however, consists of professionals who set prices themselves. Dealers, either one or many per stock, post their bid and ask prices along with the number of shares available at each price. A public investor, defined as an investor who is not a dealer, can only execute a trade by

notifying the dealer, who utilizes his own inventory to satisfy the order. In contrast to an "auction" market, there is no trading directly between two public investors, or their agents. As an example, NASDAQ, part of the over-the-counter market, is for the most part a dealers' market. Dealers utilize a computer system to display their quotes.[51] A public investor places a buy or sell order with an over-the-counter broker,[52] who either acts as a dealer himself or, as an agent, executes the order with a dealer.

Batch Markets--Sealed and Open

As is the case with continuous markets, there are various types of batch markets. In one type of batch market, investors' bids and offers are kept secret, or "sealed" from the eyes of other investors. These bids can be either open market orders for a given number of shares or an entire schedule of quantities to be traded depending the actual price at which the market clears. An example of this type of market is the new issue market for U.S. government securities. If investors are able to view the orders of other investors before the auction takes place and to revise their orders before the actual auction, the market is termed open or "unsealed." Clearly, investors only know about

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[51]The quotes include the bid and ask prices and the number of shares available at these prices. In practice, the posted numbers of shares are nominal amounts and may understate the actual numbers of shares available at the quoted prices.

[52]An over-the-counter broker is registered with the NASD.

their own demands in the sealed process, whereas in the unsealed process, investors learn about the demands of others. This distinction between what investors know in a batch market may affect the clearing price.

A distinguishing characteristic of a continuous market, in contrast to a batch market with sealed orders, is that buyers and sellers agree on a price and quantity before a trade takes place. A distinguishing characteristic of a batch market with sealed orders is that a trader does not know both the price and quantity before the auction. With unsealed orders, a trader may know both price and quantity just before the auction.

New York Stock Exchange (NYSE)

At the opening, the NYSE operates as a batch market. After the opening, it normally operates as a continuous market with features of both an auction market and a dealer market. The NYSE assigns an individual or firm, called a "specialist", to each stock. According to the NYSE, the principal obligations of the specialist are to perform as dealers in the case of a temporary imbalance of public orders, to act as a catalyst to bring buyers and sellers together, to serve as auctioneers, and to manage the "book". Formerly, the book was a spiral ring notebook in which

the specialist recorded limit orders.[53] Nowadays, a computer system has replaced the physical book.[54]

The opening process proceeds as follows: Prior to opening a stock for trading, the specialist accumulates public market orders to buy or sell at the open. Until the stock is actually opened, investors can cancel or change their orders.[55] The specialist generally[56] provides information about the volume of orders as well as a likely opening price to NYSE members on the floor of the Exchange. The members in turn have the option of relaying this information to the public.

The specialist will then explore possible opening prices. At each possible opening price, the specialist will match the market orders to buy and sell with the limit orders in the book and calculate the corresponding order imbalance. If the

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[53]A limit order is an order that becomes a market order if the price of the security reaches a particular level. A market order is an order to buy or sell immediately at the prevailing market prices. Another type of limit order is a short sell order which can only be executed on an "uptick" or after there has been an advance in the price of the security.

[54]It is sometimes alleged that the book gives the specialist special and valuable information about the demand and supply conditions for a stock. However, the increased number of large trades and greater communications among institutional investors have undoubtedly reduced any special informational advantage the specialist may possess.

[55]The public is probably more likely to change or cancel orders than floor traders. If a floor trader continuously tries to take advantage of the opening process, the specialist will soon learn his identity. A public investor is better able to hide his identity.

[56]However, there is no obligation that the specialist provide this information.

specialist knows of possible orders in the crowd, he will solicit these orders in an attempt to minimize the order imbalance. If the specialist can find a price not too far from the previous close[57] at an acceptable level of order imbalance, he will open the stock at that price and cover the order imbalance from his own inventory. Otherwise, he will delay the opening to give time for other traders and investors to place orders. If the specialist plans to set the opening price substantially different from the previous close, the rules of the Exchange encourage the specialist to give an indication of the possible opening range on the tape and wait an appropriate interval of time before opening the stock. As a consequence, the opening on the NYSE has characteristics of both a sealed and an unsealed batch process.

After the opening, the market for stocks on the NYSE is a continuous market. The specialist for a stock quotes a bid and an ask price as well as the number of shares available at each price. The offers to buy and sell are a combination of the limit orders on the specialist's book and the offers from the specialist himself.

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[57]If the specialist wants to open a stock with too great a price change from the prior close, the specialist must seek permission from a Floor Official. Specifically, approval is required if the price change is more than one dollar from a last sale of under 20 dollars or two dollars from a last sale of 20 dollars or more.

Example

The Specialist's Book
Limit Orders

Buy		Sell	
Price	Shares	Price	Shares
		20 1/2	3000
		20 3/8	500
		20 1/4	10000
20	2500		
19 7/8	440		

The specialist might quote a bid price of 20 for 2500 shares and an ask price of 20 1/4 with 10000 shares. In this case, limit orders represent both sides of the quote.

Alternatively, the specialist might quote a bid price of 20 for 2500 shares and an ask price of 20 1/8 for 2000 shares. The bid represents a limit order. The ask represents an offering by the specialist. The specialist could also participate at the bid by, for instance, quoting a bid price of 20 for 5000 shares, adding 2500 shares to the limit order on the book.

With only an occasional exception,[58] the earliest entered orders are executed first. A specialist's offer to buy or sell is always executed after all other orders at the same price, even if the other orders come after the specialist's order. This time precedence of orders allows an exchange member in the crowd or even a public investor to act like a specialist.

Example Continued

Assume the same book as above and that the quote is a bid of 20 for 2500 shares and an ask of 20 1/8 for 2000 shares. If a member in the crowd offers to sell 2000 shares at 20 1/8 and the quote remains unchanged, that member has effectively supplanted the specialist. The member could also submit a limit order to sell 2000 shares at 20 1/8 and achieve the same effect. A public

[58]For example, in a turbulent market, there may be a delay in the execution of program related orders.

investor could also submit a limit order to sell 2000 shares at 20 1/8 and supplant the specialist.

The specialist is obligated to honor the quoted bid and ask prices and the number of shares available at each quote. Nonetheless, the quoted bid and ask prices and the available shares do not fully describe the market. For example, a specialist or anyone in the crowd may execute a market order within the bid and the ask price. Likewise, the specialist may decide to buy or sell more shares at the quoted bid or ask price than he has guaranteed in his quote. Furthermore, a specialist may hold or "stop" an incoming market order in order to obtain a price better than the posted bid or ask. In these circumstances, the specialist will guarantee that the buyer and seller will do no worse than the posted spread at the time the order is stopped.[59]

Under certain circumstances, the continuous trading process of the NYSE is halted. For example, if a company is about to release major news that may affect the company's value, or if there is a substantial order imbalance, the specialist, with the permission of a NYSE floor official, may halt trading. When trading is resumed, the stock is reopened in much the same manner as the stock is opened at the beginning of trading.

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[59]Under certain conditions, such as when the posted bid-ask spread is very large, the specialist is obligated to stop an incoming market order.

Other Markets

How much investors and dealers must reveal about their own supply and demand schedules constitutes a major issue in the design of a continuous market system. For example, institutional investors sometimes use means other than the organized exchanges and NASD to find the other side of a transaction. The amount of information that investors provide differs from one system to another. In one system, institutional investors only indicate whether they have an interest in buying or selling a particular issue and whether the trade is small, medium or large.[60] In another method of trading, an investor need only indicate a buying or selling interest, with no indication of size.

F. THE MARKET MAKING LITERATURE

The previous section described the structure of continuous and batch markets. In this section we will describe how the price of a security is determined in each of these markets.

In a continuous market, one or more dealers post prices and quantities at which they will buy and sell securities. The price at which the dealer is willing to buy the security is called the "bid" price, the price at which the dealer is willing to sell is called the "ask" price, and the difference is called the "bid-ask spread."

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[60]This particular system is the Autex System. Other systems available to institutional investors include the crossing network of Instinet and the Posit System.

Inventory Models

The early literature on market making viewed the dealer as a provider of transaction services to the public, with a "bid-ask spread" as compensation for these services. In a pioneering article, Harold Demsetz defined trading costs "as the costs of exchanging titles."[61] Demsetz then went on to explain that the bid-ask spread is "the markup that is paid for predictable immediacy of exchange in organized markets."[62] Immediacy is described as the service of providing an investor with an immediate execution of a buy or sell order. Thus, the bid-ask spread is very much like the inventory markup of a normal merchant, a markup charged to cover operating costs and the required return on working capital.

Since, in Demsetz's view, trading through the dealer is just like any other merchant trading activity, the principles of classical economics apply. The amount of competition that the dealer faces should influence the size of the bid-ask spread, just as it would in any market. Other markets on which a stock trades and floor traders who can provide similar services of immediacy provide competition to the specialist. In the spirit of a competitive model, Demsetz also argues that as the volume of "trading" increases, the bid-ask spread will decline. This

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[61]Harold Demsetz, "The Cost of Transacting," Quarterly Journal of Economics, 82 (February 1968), p. 35

[62]Ibid., pp 35-36.

conclusion is related to the usual merchant activity, where rapid turnover of inventory is associated with smaller margins.

However, the parallel of the trading of stocks to the usual trading of goods by a merchant is not perfect. In the case of trading goods, the merchant must finance inventory by borrowing money or selling assets and must receive compensation for the interest costs incurred or revenues foregone. In the case of securities, however, there is an offsetting revenue stream because stocks themselves are productive assets and provide a return to the holder.

Still in the spirit of a merchant trading model, Hans Stoll,[63] and later Thomas Ho and Stoll,[64] proposed a rationale for a bid-ask spread that explicitly recognized that an inventory of securities provides a revenue stream. Their model assumes that the dealer is risk averse and has invested his wealth in three types of assets: inventory for market making, cash or short-term safe assets, and other risky assets. By standing ready to buy or sell individual stocks, the dealer's inventory will change over time in a random way. Sometimes, the dealer will own too much or too little of one stock or stocks in terms of the best overall allocation of his wealth, or "optimal portfolio." In other words, the risk and return characteristics of his overall

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[63]Hans Stoll, "The Supply of Dealer Services in Securities Markets," Journal of Finance 33 (September 1978), 1133-51.

[64]Thomas Ho and Hans Stoll, "Optimal Dealer Pricing under Transactions and Return Uncertainty," Journal of Financial Economics, 9 (March 1981), 47-73.

portfolio will often be driven to suboptimal levels because of randomly changing inventory positions. The bid-ask spread emerges in this model as the compensation necessary to induce to the dealer to hold a non-optimal portfolio.

An implication of this model is that the bid-ask spread is a function of the dealer's risk aversion and the level of wealth. As a result, the bid-ask spreads of two equivalent stocks could differ if different dealers have different risk tolerances and wealth levels. A major contribution of these types of inventory models is that they provide insight into why there may exist a bid-ask spread even though a dealer in equities does not bear the usual carrying costs of inventory. The bid-ask spread arises as compensation to induce a dealer to hold a non-optimal portfolio of assets. However, it should be noted that these inventory models provide little insight into how new information or differences in investors' information affects the price of a stock.

Continuous Markets: Theory

Glosten and Milgrom took the insights about liquidity trading discussed above to develop several propositions about the behavior of quoted stock prices in continuous markets. They show that as the proportion of informed traders increases, the bid-ask spread will widen. At some point, the bid-ask spread may become

so large that trading ceases.[65] In this case, the market does not reveal in any meaningful sense the true price of the security. The market has failed.

Ananth Madhavan and Christopher Leach[66] have recently demonstrated that in some circumstances, a monopolistic dealer would keep a market open, while competitive dealers would let it close. The argument is the following: The specialist may decide to post a quotation having a reasonable bid-ask spread, knowing he will lose to an informed trader, but he can limit his losses by limiting the number of shares available at these prices. As a result of this experiment, however, the dealer will learn something about the true price of the security. Utilizing this information, the monopolistic specialist will set more accurate bid and ask prices, thereby generating increased trading and recouping the initial loss.

In a competitive model, a dealer is unable to recoup earlier losses and hence he will not experiment by posting a quote to discover the correct price. Therefore, under some circumstances, the granting of a monopoly to a dealer may encourage the faster discovery of correct prices, which benefits society.

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[65]If in the limit, all traders become informed, there will be no trading under the rational expectation equilibrium, as discussed previously.

[66]Christopher Leach and Ananth Madhavan, "Price Experimentation and Market Structure" (University of Pennsylvania, 1989).

Batch Markets: Theory

In the United States, most stock trading takes place in continuous, rather than in batch markets. However, as mentioned earlier, batch trading is important at the opening of the New York Stock Exchange and when a stock reopens after trading is halted. Other markets, such as the new issue market for government securities and some foreign equity exchanges, only employ batch auctions.

Albert Kyle[67] has proposed a model of a sequential batch market in which there are three types of participants: liquidity traders, informed traders, and dealers. It is assumed that before each auction, informed traders possess special information--better information than is available to other participants in the market--about the true, or intrinsic price of the stock. Each informed trader is rational insofar as he adjusts his order to take into account the likely responses of other informed traders and the response of the dealer to the order flow.

Just before each auction, each liquidity trader determines how many shares he wishes to buy and sell and submits the appropriate market order. The dealer receives the orders from both liquidity and informed traders, but does not know which orders come from each group. The dealer calculates the net order

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[67]Albert Kyle, "Continuous Auctions and Insider Trading," Econometrica, 53,6 (November 1985), 1315-1335.

imbalance and accommodates this imbalance through adjustments to his own inventory.

In setting the price that clears the batch of orders, the dealer makes a judgment as to the proportion of liquidity traders and the strategies of the informed traders. As in the case of a continuous market, the dealer will lose on average to the informed traders and gain by trading with the liquidity traders. If virtually all of the traders were liquidity traders, the dealer would adjust his price very little from the last price, unless there was the release of some significant news since the last trade. But, in general, the dealer recognizes that some of the trades are from informed traders, and adjusts the price upwards or downwards to anticipate the information contained in their trades. If the order imbalance is positive, the dealer increases the price; if negative, he decreases the price.

The actual change in price is a function of three variables: the net order imbalance, the number of liquidity traders, and the volatility of the intrinsic value of the stock. If the magnitude of the net order imbalance increases, the change in price will increase. If the number of liquidity traders increases (holding order imbalance constant), the change in the stock price will decrease. And finally, as the volatility of the stock's intrinsic value increases, a given order imbalance will result in a larger change in the price of the stock since there is less

agreement on the true, underlying value of the security.[68] Another important result of the Kyle model is that as the number of liquidity traders increases, the informed traders will also increase their order sizes. This is because informed traders can obtain better prices by buying and selling from uninformed traders. In a sense, the liquidity traders provide a camouflage for the informed traders and reduce the latter's impact on the market price.

In an attempt to try to explain why volume and volatility on the NYSE is often greater at the beginning of the day than during the middle of day, a study by Admati and Pfleiderer[69] has added a fourth type of participant to Kyle's model. These participants are liquidity traders who anticipate their liquidity needs and have some flexibility in the time they participate in batch auctions. The term used for these traders is "discretionary liquidity traders".

The discretionary liquidity traders will find it in their interest to trade together by concentrating their orders in the same auction.[70] With an increased presence of liquidity

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[68] In the limit as a stock's intrinsic value becomes certain, informed trading will vanish and the dealer, responding only to liquidity traders will not change the stock price.

[69] Anat R. Admati and Paul Pfleiderer, "A Theory of Intraday Patterns: Volume and Price Variability," Review of Financial Studies, 1,1 (1988), 3-40.

[70] Another reason for liquidity traders to concentrate their market orders at the opening is that the trading costs may be less. Since all stocks trade at the same price at the open, a buyer of stock will sometimes be buying at essentially a bid price, an ask price, or within these two prices. Thus, on

traders, a price change will be less sensitive to the size of the net order imbalance. Liquidity traders have an incentive, as in the case of continuous markets, to reveal their presence to a dealer. Because of the increased presence of liquidity traders, there will also be more informationally motivated volume. Order flow attracts order flow.

The empirical implication of this theory is provocative. Price changes should be less sensitive to net order imbalances at the beginning of the day and more sensitive during the day. In the terminology of the Street, the market is "deeper" at the morning opening. Furthermore, those investors who have some discretion as to the timing of their purchases would find they receive better prices during this auction.[71]

A recent article by Ananth Madhavan[72] extends these studies by analyzing the price setting mechanism of two types of batch markets--sealed and unsealed auctions. In a sealed auction, buyers and sellers place orders that are not subject to revision.

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average, the trade price for a buy or sell will be between the bid and the ask price. Furthermore, there is no floor brokerage on orders executed at the open.

[71]Of course, another reason for greater trading on the opening is the action of investors with different interpretations of the news that has taken place since the previous close. Sometimes the morning price may be particularly volatile because of the greater uncertainty of the intrinsic value of the stock. As the demands are revealed throughout the day, volatility may decrease.

[72]Ananth Madhavan, "Price Formation in Speculative Markets under Rational Expectations and Imperfect Competition," (University of Pennsylvania, 1989).

In an unsealed auction, traders are able to revise their orders before the final price is determined. This second type of batch market is closer to the procedure on the New York Stock Exchange where floor traders and the specialist, after viewing the overnight accumulation of orders, are able to change their bids.

In an unsealed batch auction, an informed trader can observe the orders of others and may learn something about the number of liquidity traders as well as special information of the informed traders. The informed trader thus becomes better informed. As a result, the informed trader may revise his orders and hence influence the price set in the batch auction. In contrast, in a sealed batch auction the submitted orders reflect only the original information available to each investor. Since the order flow in these two types of batch auctions is based upon different sets of information, the prices set in sealed and unsealed auctions can differ. Hence, the rules and procedures of a stock exchange may have significant impacts on the types of information that stock prices reveal.

Other Issues

A batch market and a continuous market incorporate new information into prices in quite different ways. Liquidity traders may prefer one type of market over another. Grossman and Miller[73] suggest that in normal markets, liquidity traders should

[73]Sanford J. Grossman and Merton H. Miller, "Liquidity and Market Structure," Journal of Finance, 43,3 (July 1988), 617-637.

prefer a continuous market, since for small orders, a trader knows in advance the price and quantity that can be traded and receives immediate execution. However, in the presence of significant new information, they suggest that a batch market with its greater concentration of orders may be the more efficient market. It is interesting to note that the trading process on the NYSE parallels these observations. A continuous market accommodates small trades (now through the super DOT system), but in the presence of significant new news or a large order imbalance, trading may stop and the market reopens with a batch auction.

There is finally some limited literature on market fragmentation. Marco Pagano[74] has shown that, under certain conditions, there could emerge two or more separate markets--one for large orders and one for small orders. For instance, institutions may find it profitable to engage in a costly search for a trading partner rather than placing a large order on an exchange where it might have an adverse price impact. Small investors, however, avoid this high fixed cost of search by using an exchange. Thus, separate markets could arise as a natural outcome of the competitive process.

If social benefits differ from private benefits, the outcome of a competitive process may not always be the most socially desirable. As noted above, institutions may find it in their

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[74]Marco Pagano, "Trading Volume and Asset Liquidity," The Quarterly Journal of Economics, (May 1989), 255-274.

best interest for some transactions to bypass organized exchanges. However, this diversion of volume may reduce the liquidity of the Exchange, harming individual investors, and destroying the time priority of limit orders. The SEC has permitted some fragmentation of the order flow through Reg 19(3)c that allows members of the NYSE to transact some stocks without bringing them to the floor.

One possible result of the use of different markets for the same security is the fragmentation of the reporting systems for transactions and quotations. If the order flow conveys useful information, this fragmentation is not desirable. The current thrust of government regulation is to allow fragmented markets, but to consolidate the reporting systems of the order flow and make the information available to all investors immediately. Thus has evolved the Consolidated Tape and Quotation Systems for exchange transactions. The NASD has its own separate reporting system.

Today, there are some trades that these systems do not capture. Roughly twenty percent of program related trading is carried out on the London over-the-counter market after the close of the NYSE and is not reported. Some U.S. stocks are traded on foreign exchanges, and such trading information is not readily available. Finally, some trades between institutional investors that bypass the major markets are not reported. As the markets become more global, there is likely to be more fragmentation. To date, the literature has not provided a good understanding of the

costs to society of failing to capture information about the entire order flow.

G. SOME UNANSWERED ISSUES

The early literature on market making stressed transaction costs, while the more recent literature emphasizes the incorporation of new information into prices. Despite the increasing amount of research on price discovery, there is as yet no unified or accepted theory of how prices are determined in the market making process. Furthermore, no one has yet incorporated into a general model those traders who believe, incorrectly, that they have some special insights about a stock's future price which is not yet discounted in the market. Despite the important insights that the literature has thus far provided, there are important issues that remain unanswered. This last section presents some unresolved issues affecting the design of a market.

*The amount of anonymity given to traders

The distinction between informationally motivated traders and other traders is very important in the market making process. Non-informationally or liquidity motivated traders have an incentive to identify themselves. If all trading is anonymous, there is no possibility for this identification to take place. In a market with identified traders, a trader may use his reputation to identify a liquidity order and hence facilitate certain trades. How much or how little anonymity should be incorporated into a market is an important question.

*The disclosure of orders and transactions

A trader frequently has an incentive to hide the real size of his order. In some markets, the trader does not need to report volume on a timely basis. In some

markets, a quotation may omit the number of shares available or include just a nominal number. How much information a trader must disclose is a major issue in the functioning of a market.

*Human involvement versus computerized systems

Can one devise a computerized trading system with sufficient flexibility and reliability to replace a system with human involvement? How important is face-to-face or telephone contact in the trading process?

*Centralization of order flow

To what extent should regulatory authorities permit the fragmentation of markets? Permitting fragmented markets makes it difficult, if not impossible, to maintain the time priority of orders, makes limit orders less useful, and makes the regulatory task more onerous. It may, however, provide useful competition and lower costs for traders.

*Batch versus continuous markets

When is a batch market to be preferred to a continuous market? In many types of batch markets, the trader will not know the price or quantity of his trade before the auction. In a continuous market, the trader will know these variables. Which type of market is better at discovering the true price in the presence of new information?

*Monopolistic versus competitive dealers

The choice is not simple. In some circumstances, a monopolistic dealer may better facilitate the price discovery process. Regulation may force a monopolistic dealer to undertake trades that are desirable from the viewpoint of society but would not normally be undertaken.

*Consolidated tape and quotation reporting

Currently, the Consolidated Tape and Quotation Systems report most trades and quotes for companies listed on registered exchanges. The NASD maintains its own system. With the globalization of world markets and possible further fragmentation of domestic trading, an increasing number of trades of U.S. companies will not be reported under current rules. How important is the full reporting of order flow to the functioning of the

equity markets? If important, what needs to be done to integrate the world markets?

*Financial reporting requirements

Financial reporting requirements differ substantially from one country to another. How important is it to have universal standards? If important, how can universal standards be implemented?

*Order priority

Order priority is a desirable feature of a market. Individuals can be assured that their order will be executed fairly. Without order priority, there would be little incentive to submit limit orders since there is no guarantee of execution. Already, there has been some breakdown in the market's ability to provide order priority. If markets become more fragmented in a global setting, it may be necessary to scrap this feature of a market.

*Fairness and individual investors

Public policy encourages individuals to own common stocks. For this policy to work, individuals have to perceive that the markets are fair and that their orders are executed properly without fear of being "picked off" by professional investors.