A STOCHASTIC DOMINANCE APPROACH TO MEASUREMENT OF MERGER SUCCESS

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ABSTRACT

A STOCHASTIC DOMINANCE APPROACH TO MEASUREMENT OF MERGER SUCCESS

By

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The purpose of this study is to determine whether or not large corporate mergers have been generally successful in increasing the wealth of the merging firms' stockholders. There have been several studies in recent years dealing with merger profitability, but for various reasons, an unambiguous resolution of the problem has not yet been achieved.

The general methodology consists of a comparison of the frequency distribution of aggregate market value for a population of weighted combinations of acquiring and acquired firms for a period of time prior to merger to the frequency distribution of aggregate market value for the same population of firms subsequent to merger for a time period of the same length. The test population of thirty-two large mining and manufacturing firm mergers represents the result of a rigid elimination process designed to yield only firms for which the "merger effect" can be relatively isolated from other individual firm effects.

Although it would be preferable to measure merger success directly in terms of increased stockholder utility, a link to a

tangible market-based measure of comparison is clearly necessary. The total market value of common stockholders' equity was selected as the measure because it takes into consideration the premerger to postmerger change in the level of stockholders' wealth as well as the premerger to postmerger change in the growth rate of this wealth position.

The stochastic dominance comparison criterion was selected rather than the more familiar mean-variance criterion because:

(1) Stochastic dominance compares complete distributions rather than estimated parameters of the distributions.

(2) Recent studies of common stock market price distributions have indicated the unreliability of variance computations for these distributions.

(3) Stochastic dominance can be used to measure stockholders' evaluation of merger performance without specifying either their utility functions beyond nonsatiety (and general risk aversion for second degree dominance) or the statistical distribution of the performance measure with which it is assumed to be directly related.

The market value data used for each merging firm in the test population are sixty weekly observations for each of the premerger and postmerger distributions--a total of one hundred and twenty observations per merger. A transition period of approximately one year is allowed between the end of the premerger period and the beginning of the postmerger period to avoid including the relatively erratic price

behavior that is often found to exist between a merger's announcement and its eventual completion.

The results of this study indicate both first and second degree dominance for the aggregate postmerger market value distribution. In other words, the aggregate wealth of the shareholders of merging firms was greater after the merger than it was before the merger. This is an ex post evaluation and is only directly applicable to the merger population and related time period that are specified in this study. However, with qualification, it can be stated that based on the results found, mergers contribute to the aggregate wealth position of the participating firms' stockholders. This is of particular interest because of the fact that most prior studies have indicated that mergers are not profitable, except to stockholders of acquired firms for which excessive premiums have been paid.

A comparison was also made of premerger and postmerger market value distributions for each individual test merger. If it is assumed that investors recognize the diluting effects of shares that are likely to soon become outstanding as a result of various contractual conversion arrangements, the individual merger results confirm those of the aggregate distribution comparison. On the other hand, if it is assumed that investors only consider officially outstanding shares when setting the share price at which they are willing to trade in the market, a majority of the individual mergers show premerger dominance.

The results of a comparison of stockholder return (as opposed to market value) distributions were indeterminate in terms of first

degree stochastic dominance, but showed second degree dominance for the premerger aggregate distribution. While return distributions are not sufficient as a total measure for merger success, these results do indicate that the aggregate postmerger dominance found in this study is a result of a market value level increase rather than an increase in the rate of return to stockholders.

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CHAPTER I

INTRODUCTION

In recent years, the profitability of corporate mergers has been a subject of an increasing volume of academic study. While most researchers have concluded that mergers have, in general, not been significantly profitable, their results have not satisfactorily laid the question to rest.

GOAL

The goal of this study is to measure the degree of success (or failure) of corporate mergers in terms of their contribution to the maximization of shareholder wealth. This measurement is accomplished by comparing the frequency distribution of aggregate market value for a population of weighted combinations of acquiring and acquired firms for a period of time prior to merger to the frequency distribution of aggregate market value for the same population of firms subsequent to merger for a time period of the same length. Generalizations concerning merger success are made primarily for the aggregated results of the individual mergers studied, rather than for the results of each individual merger. However, results of the latter type are used for purposes of comparison with the results of previous merger profitability studies.

PURPOSE

The purpose of this study is to fill a void in the field of merger research, viz., the direct measurement of merger success using the premerger and postmerger data of an aggregate of individual merger firms in such a way that both return and risk are taken into account. Until quite recently, prior research of merger results has been limited mostly to such approaches as measurement of the degree of diversification provided by mergers in general or to comparisons of postmerger returns of "merging firms" with the returns over the same period of "non-merging firms."

Use of the aggregated market value distributions in this study provides an indication of whether or not the combinations of securities available to common stock investors after the mergers are superior to combinations available before the mergers. This type of comparison is more important in terms of overall merger performance than measurement of the degree of diversification provided by the mergers because a similar degree of diversification could have been obtained by the investors themselves by rearranging the combination of securities in their portfolios. Thus, an attempt is made here to determine whether the merger movement has contributed to the overall economic welfare of investors.

The measurement technique used in this study (stochastic dominance) is also an important factor in achieving the stated purpose because, as used, it is a method of measuring stockholder evaluation of merger performance without specifying either the utility function of investors beyond general risk aversion or the statistical

distribution of the performance measure with which it is assumed to be directly related.

SCOPE OF STUDY

A merger is defined herein as any combination of acquisition involving the purchase or transfer of ownership of a company that was previously under separate control. Total market value of common equity is defined as market price per share multiplied by the total number of shares outstanding.[1]

Only mergers effecting a substantial increase in the total asset size of the acquiring firm are considered. As an arbitrary standard, a fifty percent increase in the size of the total assets of the acquiring firm[2] is used as a minimum "substantial" increase. Small-scale merger transactions would not be as likely to have a measurable effect on the market value distribution of the acquiring firm even if such an effect occurred. Partial mergers (acquisition of a part of another firm) and multifirm mergers (more than two firms combining) are not used.

Because of limitations of data availability, the test mergers involve only acquired manufacturing or mining companies which had assets of at least $10 million at the time of acquisition. The merger

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[1]For reasons that are discussed later, results are also obtained using shares outstanding plus shares being held in both specifield and unspecified treasury stock reserves.

[2]Mergers in which the total assets of the acquiring firms are less than 50 percent of the total assets of the acquired firm are also eliminated from consideration.

data, other than the market value data, was obtained from the Federal Trade Commission's Statistical Report No. 7, "Large Mergers in Manufacturing and Mining, 1948-1970." This data was obtained by the FTC from public sources, such as The Wall Street Journal, Moody's Industrial Manual, Standard and Poors Corporation Records, and prospectuses filed with the Securities and Exchange Commission.

All types of mergers--vertical, horizontal and conglomerate--are included together in the test population. No specific consideration is given (nor was it necessary, given the methodology used) to the method of accounting (purchase or pooling), the method financing, the exchange ratio, or the particular reasons for mergers. As to this last point, merger "success" in this study is defined as relating exclusively to the maximization of shareholder wealth, notwithstanding any other goals of the combining firms' managements.[3]

Use of market value distributions rather than shareholder return (market value change) distributions is suggested by the nature of the measurement attempted--i.e., a measurement of the valuation of firm performance before and after merger. There are two submeasures of "success" involved:

(1) the overall premerger to postmerger change in market value level and

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[3]For an interesting discussion of management goals vs. stockholder goals in a merger context, see Samuel R. Reid, Mergers, Managers, and the Economy, McGraw-Hill, Inc., 1968.

(2) the overall premerger to postmerger change in market value growth.[4]

Use of shareholder return distributions would adequately represent change in performance in terms of market value growth, but would ignore the change in market value level. While comparison of mean market value levels would ignore changes in growth, use of market value distributions in conjunction with the stochastic dominance technique allows consideration of both level and growth by comparing the market value distributions themselves rather than selected parameters.

The extent to which the market values of the aggregate premerger and postmerger populations have been affected over time by changes in the general economy are corrected by dividing each market value observation for each firm by the Standard and Poors 500 Composite Index value corresponding to the same date. An example of this adjustment technique is illustrated in Table 1.

Removal of the general time-related trend in stock market prices is necessary to make comparable the firm market values within and between premerger and postmerger time periods. This is accomplished by the above procedure because market index percentage changes

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[4]For a more detailed discussion, see U. E. Reinhardt, "Conglomerate Earnings for Share: Immediate and Post-Merger Effects," Accounting Review, XLVII (April, 1972), 360-370.

TABLE 1

EXAMPLE ILLUSTRATION OF MARKET ADJUSTMENT TECHNIQUE

Observation	Firm Market Value, $Millions	S & P Index Value	Adjusted Firm Market Value
1	1000	100	10.00
2	1100	105	10.48
3	1300	115	11.30
4	1200	110	10.90

include the general time-related trend. Removal of specific time-related trends would not be appropriate because market-adjusted growth over the test period is one of the performance components being measured. Removal of between-distribution time trends is accomplished by the conversion of all the market value observations to a common base.

This adjustment technique might be unsatisfactory if the adjusted values obtained for the individual firms were then used to measure the success of the individual mergers involved. It is well known that the individual firms may have a typical percentage change relationship with the percentage change of "the market" ranging anywhere between (-1)-to-(+1) and (+1)-to-(+1). This market relationship measure is usually referred to as the beta value. To measure this beta value for each firm would require regressing each firm's market values on the selected market index for a period of time prior to both the premerger and postmerger time periods. This would not be practicable because market value distributions do not meet the requirements for use of ordinary least squares techniques. (The properties

of market value distributions are discussed in more detail in Chapter III). Other problems with computing beta values are:

(1) The stability of beta values over time is questionable.

(2) The proper time interval for the computation of the beta values has not yet been resolved.

Fortunately, there is empirical evidence that the diversity of individual beta values within a security portfolio of the size represented by the aggregations used in this study (32 firms) is not important. The beta value for a randomly selected common stock portfolio of 32 different firms is very likely to approximate 1.0.[5]

The choice of the Standard and Poors 500 Stock Index was made because:

(1) This index is considered to be broad enough to serve as general standard for stock price movements.

(2) This index is based on market value aggregations similar to the ones used for the test firms.

Although removal of industry effects might also be beneficial, this is not a practicable procedure for merger analysis because, along with the ordinary difficulty of categorizing firms by industry in a meaningful way, there is also the problem represented by the fact that firms often move from one uncertain category to another by merging.

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[5]John L. Evans and Stephen H. Archer, "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance, XXIII (December, 1968), 761-769.

The market value data used for each firm are sixty weekly observations for each of the premerger and the postmerger distributions--a total of one hundred and twenty observations per merger. However, the premerger period begins twenty-four months prior to the effective merger date, and ends approximately ten months prior to the effective merger date. The postmerger period begins two months after the effective merger date and ends approximately fourteen months after the effective merger date. This results in a gap of approximately one year between the end of the premerger period and the beginning of the postmerger period. The reason for allowing this time gap is that common stock prices are known to frequently behave erratically during a transition period beginning with the time that investors first recognize the merger attempt by revising their expectations of future performance, and ending with the time that investors are aware that the merger has been completed with some known terms of consideration (used in the legal sense) and have some initial impression of the newly combined organization. Prior researchers have estimated the premerger part of the transition period described above as typically beginning about six to eight months before the effective merger date,[6] making the ten months allowed likely to be adequate for most cases. The selection of two months after the effective date to

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[6]Thomas F. Hogarty, "The Profitability of Corporate Mergers," Journal of Business, XLIII (July, 1970), 317-327.

represent the postmerger part of the transition period is relatively arbitrary. It is selected because it "seems" to be a reasonable length of time after the merger data for the criteria described above to be essentially fulfilled.

The effect of individual firm events, other than the test merger, on the market value distributions within the total test period will be ignored, except for the occurrence of other individual mergers or combinations of mergers which would cause a 50 percent total asset expansion. To the extent that other individual factors (such as announcements of new internally generated product lines, management changes, and product obsolescence) are not related to the merger, but have long-run effects on market value distributions during the test period, measurement of success for an individual case could be confounded. However, it is assumed herein that such extraneous individual effects are not systematically related such that the aggregate data would also be confounded.

The random variable in the distributions being studied is the market value of common stockholders' equity. The market value at time t, V_t, is defined as the product of the common stock market price per share at time t, P_t, and the total number of perceptibly outstanding shares of common stock at time t, n_t; i.e., $V_t = P_t n_t$. In one of the test runs, the market value at the ex-cash-dividend period for each firm is adjusted by adding an amount equal to the total dollars of cash dividends paid. Previous research has verified that market price is usually lowered at the ex-dividend date by at least a substantial

percentage of the cash divident paid.[7]

By "perceptibly outstanding" shares is meant the sum of the shares currently outstanding and those that are perceived by investors to be likely to become outstanding at some imminent, albeit uncertain, point in time. Accountants use such a conceptual measure of shares outstanding to compute "primary" and "fully-diluted" earnings per share figures for reporting purposes. However, the computational methods suggested in the Accounting Principles Board APB No. 15[8] are not used in this study for the following reasons:

(1) The APB No. 15 methods do not include unspecified treasury stock holdings, which also represent issued shares which could be (and often are) publicly resold at any time.

(2) The methods used to decide which convertible securities to use in the computation of "primary" common stock equivalents are quite controversial.[9] Even the number of shares used for "fully-diluted" earnings per

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[7]See Durand and May, "The Ex-Dividend Behavior of American Telephone and Telegraph Stock," Journal of Finance, XV, (1960), 19-31.

[8]Accounting Principles Board of the American Institute of Certified Public Accountants, "Earnings Per Share," Opinion No. 15, (AICPA, 1969).

[9]See W. Frank and J. Weygandt, "Convertible Debt and Earnings Per Share: Pragmatism vs. Good Theory," The Accounting Review, XLV (April, 1970), 280-289.

share figures are "based on neither the probability of conversion or exercise nor on their imminence. They are rather, computations based on arbitrary rules and assumptions, without evidence that either computation is necessarily relevant for investment decisions."[10]

(3) While the suggested methods might be acceptable for a study covering a time period beginning 1969 because estimates of the number of "primary" and "fully-diluted" shares have since that time been an item of information readily accessible to investors, they would not be of such value in this study because they were not in general use during seven of the ten years that are covered.

Two other methods of computing perceptibly outstanding shares are usedin this study. The first method is called the "naive" method and uses only the currently outstanding shares, thus representing the minimum value for this measure (if one ignores the possibility of pending stock repurchases). The sources used to obtain the number of outstanding shares are the quarterly volumes of ISL Price Lists for the New York[11] and American[12] Stock Exchanges. Although daily observations

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[10]Eldon S. Hendriksen, Accounting Theory, Revised Edition (Homewood, Ill.: Richard D. Irwin, Inc., 1970), 553.

[11]Investment Statistics Laboratory, ISL Daily Stock Price Index, New York Stock Exchange (New York: Standard and Poors Corporation, 1962-70).

[12]Investment Statistics Laboratory, ISL Daily Stock Price Index, American Stock Exchange (New York: Standard and Poors Corporation, 1962-70).

of market prices are available in these volumes, the number of outstanding shares is updated on a quarterly basis. Thus, the first method employs quarterly updated figures for shares outstanding, except for interim updatings occurring because of stock splits and stock dividends.

While the first method of computing the number of perceptibly outstanding shares assumes that investors are generally naive and unperceptive, the second method makes the directly oppostie implicit assumption, i.e., that investors are very sophisticated and perceptive. Therefore, the second method is called the "sophisticated" method and assumes that stockholders are not only aware of common stock share equivalents through imminent conversions, exercises of options, etc., but actively take these share equivalents into account in their market price determinations. The number of share equivalents at each market price observation is not computed because of data unavailability. The specific procedure used is as follows:

(1) From annual volumes of Moody's Industrial Manual, data is obtained for the number of shares outstanding, the total number of unspecified treasury shares, and the total number of treasury and/or unissued shares specified as reserves for such contingencies as conversion of convertible securities, exercise of warrants, exercise of options, and accumulation for acquisitions. This data was obtained for each test firm for a period extending from the last reporting date prior to the test period to the first reporting date after the test period.

(2) These share figures are summed for each firm at each reporting date and used to represent the perceptibly outstanding shares for the sophisticated method.

Since the figures are only available for all the test firms on an annual basis, the updating includes only the test period beginning date (using the perceptibly outstanding shares from the last previous reporting date) and any reporting dates that occurred within the test period. However, interim updatings are used at stock split dates, stock dividend dates, and convertible security issuance dates. There are only two of the thirty-two firms studied that have a convertible issue outstanding without a treasury stock reserve for its conversion contingency. In both of these cases the convertible issue involved is a postmerger carryover originated by the acquired firm.

The rationale for using managements' estimates of share equivalents, represented by their specified treasury stock reserves, seems clear. It is in managements' best interest to maintain treasury stock reserves that would adequately cover any imminent or potentially imminent contractual demands. The classification of unspecified treasury stock as perceptibly outstanding shares is not as clearly relevant, but is used in this study in order to estimate a maximum number of shares that might be considered imminently outstanding. Unissued authorized shares which are not specified as reserves do not meet the imminence requirement and are not used. Announcements of new common stock issues and announcements of common stock repurchase plans would certainly affect the number of perceptibly outstanding shares during the period between such an announcement and its completion.

However, because of the difficulty of obtaining accurate first-announcement dates for all of the firms studied and the likelihood that the ignoring of this information would not have a systematic effect on the comparison of premerger and postmerger market value distributions, these announcements are not considered in the computations.

The market price data is obtained from the ISL Price Lists for the New York and American Stock Exchanges. Friday closing prices are used as the weekly market price observations. When Friday closing prices are not available, the just previously available daily closing price is used. For consistency, the Friday closing values for the Standard and Poors 500 Composite Index are used in the market adjustment process described earlier. These index values are also obtained from the ISL Price Lists.

The total test period over which market values are collected for this study is from 1962 to 1971--a ten year period which shows considerable diversity of common stock price movements.

Since each point in the premerger and postmerger aggregate market value distributions represents a summation of market values occurring at different points in time, the adjustment for general market index movements is clearly necessary. However, this necessity is alleviated somewhat by the fact that both the premerger and the postmerger data aggregate points cover a common time period beginning in 1964 and ending in 1969, which represents sixty percent of the total period.

The stochastic dominance criterion (which is further described in Appendix A) is the technique used to compare the aggregate premerger and postmerger market value distributions. The aggregate premerger distribution consists of a series of sixty weekly market value observations during the previously defined premerger test period. Each observation is adjusted for general stock market-related and general time-related common stock price movements. Each point in this distribution is a sum of sixty-four individual firm premerger market values (thirty-two acquiring firms plus thirty-two acquired firms). Although the actual sixty-week test periods for these firms differ in time from merger-to-merger, the time period is identical for acquiring and acquired firms within each merger. The common bases for each of the sixty-four summands making up a single point in the aggregate premerger distribution are:

(1) Each is an observation taken at a specified number of weeks prior to one of the test mergers.

(2) Each is an observation that has been adjusted for the change that has occurred in a general stock market index since the last previous observation.

This adjustment includes allowance for general time-related trends. The aggregate postmerger distribution is similarly defined except that observations for only thirty-two firms make up each distribution point. Each merger firm is the postmerger counterpart of the premerger combination of acquiring and acquired firms from which it derived.

As will be discussed more fully in Chapter III, both first and second degree stochastic dominance criteria are applied to the

aggregate distributions being compared. The first degree stochastic dominance (hereafter referred to as FSD) criterion iteratively compares the cumulative frequency distributions from lowest to highest market values and signifies dominance for one of the distributions if its cumulative frequency is always less than or equal to (with at least one point less than) the other distribution. Investors' utility is assumed in this study to be directly related to that portion of their wealth which can be measured by the market value of their common stock holdings. Thus, if investors are assumed to prefer more wealth to less, the only utility function specification necessary for the FSD criterion is that of monotonically increasing utility with increasing market value. Because the FSD criterion compares the entire distributions, no parametric specifications of the market value distributions are required. In other words, the shape or type of the market value distributions is irrelevant.

The second degree stochastic dominance (hereafter referred to as SSD) criterion iteratively compares the areas under the cumulative frequency distributions from lowest to highest market values and signifies dominance for one of the distributions if its area is always less than or equal to (with the area being less at least one point) the other distribution. The FSD criterion does not allow a dominance determination if the cumulative distributions being compared cross at any point. Such crossings occur due to differences in market value variability between the distributions. For example, for distributions having equal mean market values, the one with the lower variability would have a smaller area under its cumulative

distribution. Thus, by allowing the comulative distributions to cross and by determining dominance in terms of the areas under these distributions, general variability is taken into consideration. Assuming that general market value variability is an acceptable measure of the general riskiness of the shareholders' wealth positions, it can be seen that the SSD criterion adds the utility function specification that investors are risk averse in a general sense, i.e., they prefer less risk to more risk. Since the SSD criterion also requires no parametric specifications, there is still no need to specify the shape or type of the market value distributions.

RATIONALE FOR METHODOLOGY

To conclude this introductory chapter, a summarized rationale will be offered for the methodology used in this study, i.e., the comparison of market value distributions by means of stochastic dominance criteria. The selection of market value as the measure for comparison has previously been shown to be necessary given the definition of merger success being used. It can be further shown that this measure is also sufficient for the purpose of shareholder wealth maximization through an explanation of the "market value rule" used in a recent work by Eugene Fama and Merton Miller.[13] The market value rule for making investment decisions is defined as the maximization of the market value of those securities of the firm that are outstanding at the time the investment decision is to be made. This rule is the basis of virtually all financial decision theories and, as used by Fama

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[13]Eugene F. Fama and Merton H. Miller, The Theory of Finance (New York: Holt, Rinehart and Winston, 1972).

and Miller, implies a separation of investment and financing decisions through assumption of perfect capital markets. More importantly, through the combination of market value maximization and the perfect market assumption, the investment decision is effectively separated from the requirement of specifying stockholders' utility functions. By employing decision models designed to maximize the market value of common equity, the management can effectively leave the utility satisfaction decisions up to the individual shareholders. That is, given the stockholders' wealth, the firm's investment decisions do not affect the consumption--investment opportunities that are available to the stockholders in the market. Therefore, the only thing that the firm can affect by their investment decisions is the stockholders' wealth, as represented by the market value of their equity.

The problem with the application of the market value rule to an empirical situation is the fact that capital markets are not perfect. However, there is considerable evidence that capital markets are reasonably efficient,[14] which is another way of saying that common stock prices fully reflect all <u>available</u> information. This is assumed to be sufficient for the separation of the investment and financing decisions but is not assumed to be necessarily sufficient for the separation of investment decisions from the necessity to specify stockholder utility functions. This latter requirement of specifying

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[14]See Eugene F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," <u>Journal of Finance</u>, XXV (May, 1970), 383-417.

utility functions is rendered unnecessary by use of the first and second degree dominance criteria described above. Thus, the comparison of premerger and postmerger common equity market value distributions by means of stochastic dominance criteria can be used to provide a valid measure of merger success in terms of the maximization of both the wealth and the utility functions of common shareholders.

CHAPTER II

PRIOR RESEARCH OF MERGER PROFITABILITY

Many merger research studies have considered such questions as the effect of mergers on competition, the determination of exchange ratios, and proposed reasons for merging. However, the only studies that will be considered here are those relating to measurement of merger performance. Until fairly recently, there had not been many studies in this area, and those that had been done had usually contrasted postmerger performance measures for merging and nonmerging firms in general, rather than comparing performance data before and after merger for the specific firms involved. In 1966, Alberts and Segall[1] pointed out that there had been a noticeable lack of empirical research into the profitability of growth by merger. In fact, they were unable to find a single published study of any kind on the results of post-World II mergers. Since that time, however, there have been a number of published studies dealing to some extent with empirical profitability results from more recent time periods. The most consistent conclusion of these studies has been that mergers have not generally been successful for the acquiring firms. Both accounting-and market-based profitability measures have indicated this to be true. However, there has been evidence presented that stockholders of firms that were acquired during this period have benefited

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[1]William W. Alberts and Joel E. Segall, eds., The Corporate Merger (Chicago: The University of Chicago Press, 1966).

significantly due to merger effects.[2] The combination of these results found for acquiring and acquired firms has led to the apparently logical conclusion that premiums paid by acquiring firms in order to consumate mergers have been excessive and therefore detrimental to investors holding shares of their stock prior to the merger effect on the value of these shares.

This summary statement of results of prior merger research does not represent an irrefutable body of evidence. Merger success has not been measured within an integrated risk/return framework in which total synergistic effects can be properly evaluated. Total synergy is defined herein as the measure of performance superiority for the merged firm over the combined measure of performance of the acquiring and acquired firms before the merger. Except for a study by Gort and Hogarty,[3] synergy measurements have been inappropriately attempted by either comparing postmerger results with the premerger results of the acquiring firm only or by comparing postmerger results of merged firms with some postmerger control sample.

Although Gort and Hogarty properly measured synergistic effects by comparing combinations of acquiring and acquired firms premerger with the merged firms postmerger, they did not incorporate a risk measure into their analysis.

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[2]For example, see Stanley Block, "The Merger Impact on Stock Price Movements," MSU Business Topics, Vol. 17, No. 2 (Spring, 1969), 7-12.

[3]Michael Gort and Thomas F. Hogarty, "New Evidence on Mergers," Journal of Law and Economics, XIII (April, 1970), 167-184.

A few researchers did specifically analyze risk as well as return in their merger evaluations. A study by Lev and Mandelker[4] is a notable example. However, they limited their premerger data to that of the acquiring firms. In addition, they like others who have attempted to include a risk measure, represented riskiness by the standard deviation of the periodic return measurements. While this may be adequate for accounting return measures, recent examinations of common stock price change distributions have indicated that variance and standard deviation are unreliable measures of the variability of these distributions.[5] Since only market-based return measures can be used in decision models for which the objective is the maximization of shareholder wealth, this does represent a serious limitation to the measurement of merger success.

With the exception of the previously mentioned Gort and Hogarty[6] study, an earlier study by Hogarty,[7] and a more recent work by Anson, Blandenburg, Portner and Radosevich,[8] little attention has been accorded to changes in the market valuation level of common

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[4]Baruch Lev and Gershon Mandelker, "The Microeconomic Consequences of Corporate Mergers," Journal of Business, XLV (January, 1972), 85-104.

[5]For a more detailed discussion, see Chapter III.

[6]Gort and Hogarty, op. cit.

[7]Thomas F. Hogarty, "The Profitability of Corporate Mergers," Journal of Business, XLIII (July, 1970), 317-327.

[8]H. Igor Ansoff, Richard G. Blandenburg, Fred E. Portner, and Raymond Radosevich, Acquisition Behavior of U. S. Manufacturing Firms, 1946-1965, (Nashville: Vanderbilt University Press, 1971).

stockholders' investment. Most other studies have concentrated solely on a comparison of stockholder return measures. It is pointed out in Chapter I of this study that both level and growth rate of market value must be compared for an adequate measure of the total benefit accruing to common stockholders of merging firms.

The methodology and general approach to the measurement of merger success outlined in the succeeding chapter of this study is designed to measure the total synergy effect of large corporate mergers within a framework which simultaneously considers both the level and the variability of total benefit to the common stockholders of the merging firms. The primary emphasis of this merger success measurement is concerned with the comparison of the performance of an aggregate premerger population with the same population's performance after merger; thus hopefully providing an answer to the question as to whether mergers in general have been successful in terms of contributing positively to the overall market value of common stockholders' investment.

CHAPTER III

METHODOLOGY

THE MODEL

The model used in this study is separated into two sub-models, the Data Preparation Model (Figures 1 and 2) and the Performance Measurement Model (Figure B-1 in Appendix B). The intent of the data preparation process is to remove the systematic nonmerger-related trends from both the premerger and the postmerger distributions so that the aggregation and subsequent comparison of these distributions can be validly accomplished.

The actual market values used in the model are computed by multiplying the sum of the market price per share at time t (Pt) and the dividend per share received during the period from t-1 to t (D_t) by the number of shares perceptibly outstanding at time t (n_t).

$$V_t = (P_t + D_t)(N_t)$$

In the terminology used in the Data Preparation Model, an important axiom is:

$$v_{bij} = v_{bij_r} + v_{bije}$$

where v is the total market value of the common stockholders' equity;

b signifies premerger period;

i signifies the merger identification number, i = 1, 2, ...32;

j signifies the observation number, j = 1, 2, ...60;

r signifies the acquiring firm;

e signifies the acquired firm.

This axiom is not necessary for the primary comparison of the aggregate adjusted distributions, but is is necessary for the secondary comparison of individual merger distributions. Its use assumes that the expected postmerger market value is equal to the sum of the acquiring and acquired firms' market values.

$$E(V_A) = V_{Br} + V_{Be}$$

This also represents the aggregate market value of the two firms before the merger and, as used in this study, is a measure of the aggregate wealth and thus the aggregate utility of the firms' stockholders before the merger. The conclusion drawn from the individual comparisons must then be limited to statements concerning the aggregate utility of the stockholders involved in each merger analyzed. Although it is true that the dominant distribution in a stochastic dominance comparison is also preferred by <u>each</u> stockholder regardless of his utility function, it is not possible to generalize to other pairs of combinations.

Limitation of the potential investment combinations to the market-weighted aggregate in a world of imperfect capital markets and heterogeneous investor expectations, also precludes the feasibility of setting up a realistic <u>ex ante</u> decision model for the individual investor.[1] Thus <u>expost</u> performance measurement on an aggregate basis is the proper focus for this study.

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[1]Even if the assumptions of the capital asset pricing model could be accepted for this empirical study, it is not clear that this model can be transformed from the mean-variance framework, in which its relevance has been established, to the stochastic dominance framework.

Similarly, conclusions drawn from the comparison of the aggregate premerger and postmerger adjusted distributions must be limited to statements concerning the aggregate utility of all investors in the test populations.

Returning to the computation of the actual premerger market values,

$$v_{bijr} = (P_{bijr})(n_{bijr}), \text{ and}$$

$$v_{bije} = (P_{bije} + d_{bije})(n_{bije}).$$

The comparison of the aggregate premerger and postmerger adjusted distributions is accomplished through the use of first degree (FSD) and second degree (SSD) stochastic dominance. An intuitive explanation of how and why these criteria can be used to determine preference ordering with unspecified (FSD) and minimally specified (SSD) investor utility functions and unspecified market value distributions can be found in Chapter I. A detailed stochastic dominance performance measurement submodel is illustrated in Appendix B. The input data used are the aggregate premerger and postmerger adjusted market value distributions which are the output of the data preparation submodel (See Figure 2). The comparison process for the individual mergers is identical and is not separately illustrated.

AXIOMS FOR THE DATA PREPARATION MODEL

1. Removal of market-related and time-related trends from both premerger and postmerger market value distributions will make

these distributions directly comparable. Any systematic differences which then show up in the distributions can be attributed to the merger occurrences.

2. The total market value of the premerger equivalent of the merged firm is the sum of the market values of the acquiring and acquired firms.

DATA SOURCES

Lack of adequate data concerning mergers has been noted by at least one researcher [2] to be a factor which helps explain what has been until recently a dearth of empirical research into merger profitability. (A survey of merger research can be found in Chapter II). However, one source which has proved to be quite useful is the one used in this study--the annual Federal Trade Commission (FTC) statistical report on large manufacturing and mining mergers, which includes data extending back to 1948. For a merger to be included in this report, the acquired firm must be involved in mining or manufacturing and possess total assets of at least ten million dollars at the time of acquisition. All of the data included must also be available in public sources. For the 1948-1970 period, the FTC estimates that over 70 percent of the total number of all large mergers and over 86 percent of total acquired assets are included.

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[2]Samuel R. Reid, Mergers, Managers, and the Economy, New York: McGraw-Hill, Inc., 1968, p. 20.

Figure 1

Verbal Description - Data Preparation Model

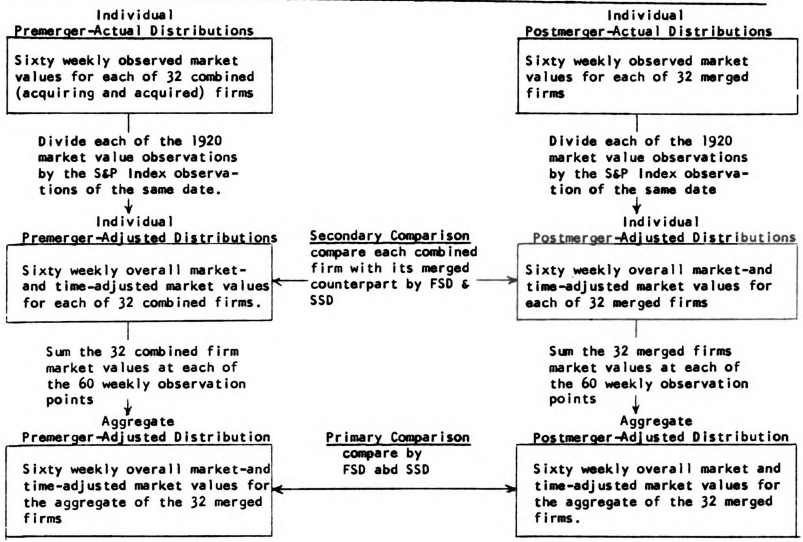


Figure 2

Symbolic Description - Data Preparation Model

Individual Premerger Actual Distributions

$$V_B = (V_{B1}, \ldots V_{Bi}, \ldots V_{BI}) \quad I = 32$$

where

$$V_{Bi} = (V_{bi1}, \ldots V_{bij}, \ldots V_{biJ}) \quad J = 60$$

for all i = 1,2,. . . 32

and

$$V_B = \begin{bmatrix} V_{b11} & \ldots & V_{b1j} & \ldots & V_{b1J} \\ \vdots & & \vdots & & \vdots \\ V_{bi1} & \ldots & V_{bij} & \ldots & V_{biJ} \\ \vdots & & \vdots & & \vdots \\ V_{bI1} & \ldots & V_{bIj} & \ldots & V_{bIJ} \end{bmatrix} \quad \begin{matrix} I = 32 \\ J = 60 \end{matrix}$$

$$x_{bij} = \frac{V_{bij}}{I_{bij}} \quad \text{for all } i=1,2,\ldots 32 \text{ and all } j=1,2,\ldots 60$$

Individual Postmerger Actual Distributions

$$V_A = (V_{A1}, \ldots V_{Ai}, \ldots V_{AI}) \quad I = 32$$

where

$$V_{Ai} = (V_{ai1}, \ldots V_{aij}, \ldots V_{aiJ}) \quad J = 60$$

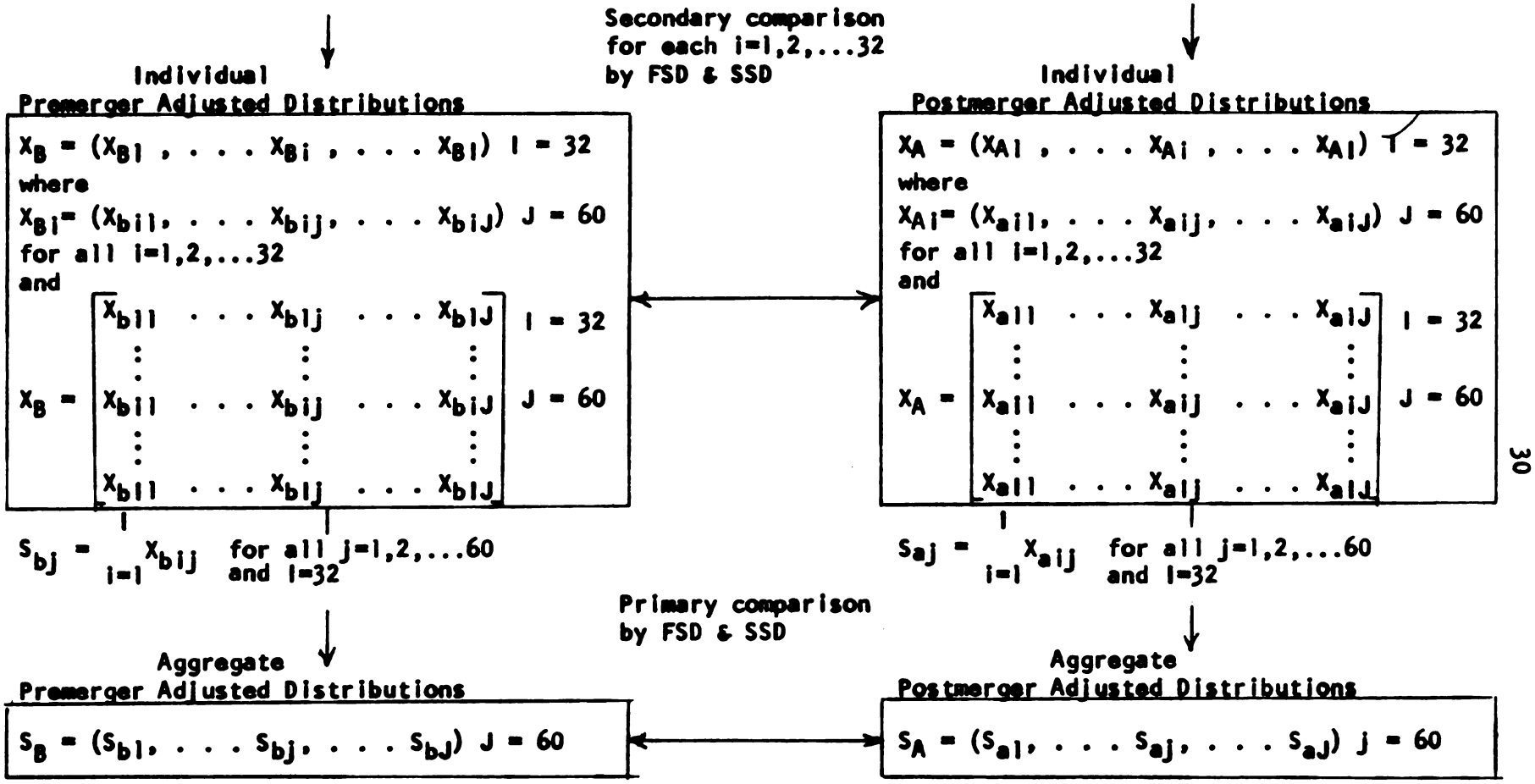
for all i = 1,2, ... 32

and

$$V_A = \begin{bmatrix} V_{a11} & \ldots & V_{a1j} & \ldots & V_{a1J} \\ \vdots & & \vdots & & \vdots \\ V_{ai1} & \ldots & V_{aij} & \ldots & V_{aiJ} \\ \vdots & & \vdots & & \vdots \\ V_{aI1} & \ldots & V_{aIj} & \ldots & V_{aIJ} \end{bmatrix} \quad \begin{matrix} I = 32 \\ J = 60 \end{matrix}$$

$$x_{bij} = \frac{V_{aij}}{I_{aij}} \quad \text{for all } i=1,2,\ldots 32 \text{ and all } j=1,2,\ldots 60$$

Figure 2 -- Continued



The FTC data explicitly used in this study includes:

1) The names of the acquiring and acquired firms,
2) the merger completion dates,
3) the total asset figures for the acquiring and acquired firms, and
4) the extent of acquisitions (whole or partial).

MERGER SELECTION-CRITERIA

There are several criteria used for the selection of mergers in this study.

(1) The merger must have been completed within the time period from January 1, 1964 to December 31, 1969. This period is selected because the resulting data collection period, i.e., 1962 to 1971, is a reasonably long period containing considerable diversity of common stock price movements.

(2) The total asset size of the acquired firm at the time of the merger must be between fifty and one-hundred percent of the total asset size of the acquiring firm. While this relative size range is somewhat arbitrary, the intent is to use only mergers for which the merger-related effects are definitely measureable. Merger-related effects may well result, for example, from mergers in which the size of the acquired firm is only a small fraction of the size of the acquiring firm, but it is not nearly as likely that they will be measureable.

(3) Only mergers involving one complete acquiring firm and one complete acquired firm are selected. Use of partial firm acquisitions and multifirm mergers would not add anything of importance to the total aggregate analysis and would considerably complicate the collection and analysis of the premerger market value data.

(4) Only mergers in which the acquired firms were involved in mining or manufacturing and had total assets of at least $10 million at the time of acquisition are selected. Lack of adequate data availability prevented expansion of the scope of the study beyond these boundaries.

(5) Mergers for which either the acquiring or the acquired firm is involved in another merger or a cumulative series of mergers which fulfilled the previously mentioned relative asset size criterion within the total test period (premerger period plus transition period plus postmerger period) are eliminated. While this effectively eliminates most of the merger-active conglomerate firms from the analysis, an unconfounded measurement of merger success is dependent on isolation of the merger event being studied from other major events within the test period.

MARKET VALUE DISTRIBUTIONS

The principal reason for using market value is that it is necessary to consider the level of the performance measure as well as

its change from period to period. For example, a comparison of the percentage changes in market value from period to period after the merger compared with the same changes before the merger would give explicit consideration to the rate of growth in market value, but would not take into consideration any revaluation made by stockholders when they first perceived the likelihood of the merger. By using market value, the resultant change in the valuation level from the end of the premerger period to the beginning of the postmerger period is also given explicit consideration. Since this market valuation is based on stockholders' expectations of the future performance of the firm, the benefit of the merger as seen by the stockholders is fully reflected if the markets are efficient as assumed in this study.

Since market value is computed as the product of the common stock market price and the number of shares of common stock outstanding, market value distributions have essentially the same attributes as common stock price distributions. The expected market value in period t + 1 is equal to the market value in period t plus the expected return R, on the common stock investment, V_t.

$$V_{t+1} = V_t + R_t V_t = V_t(1+R_t)$$

The stockholder return, R, being computed on a weekly basis in this study, is simply equal to the change in market value divided by the previous periods market value,

$$R_t = \frac{V_{t+1} - V_t}{V_t}$$

except for the periods in which cash dividends are paid. When cash dividends are paid during a period, R includes both dividend yield and capital gains yield and is computed by dividing the sum of the change in market value and the cash dividends by the previous period's market value

$$\frac{R_t = (V_{t+1} - V_t) + D_t}{V_t}$$

Previous empirical studies have shown that market price usually falls at the ex-dividend date so that V_{t+1} plus D_t tends to approximate the V_{t+1} value just before the dividend payment.[3]

Probably the greatest deficiency in a comparison of market value distributions occurring at different points in time is their lack of stability. If a firm is growing, its market value is expected to be higher at some future date. The purpose of the adjustment process described in Chapter I is to remove the general time related trends from both the premerger and postmerger market value distribution. Thus, the remaining market value change from premerger to postmerger can be attributed to specific firm-related causes. Since the test firm selection process for this study attempts to isolate a major merger occurrence with the test period, it is postulated that the primary firm-related cause is the merger.

An advantage of using market value rather than market price is that through the multiplication of market price by the number of shares outstanding, the market value distributions are automatically adjusted for stock splits and stock dividends.

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[3]Durand and May, op. cit.

CHAPTER IV

RESULTS AND CONCLUSIONS

The aggregate population of thirty-two mergers shows both first and second degree stochastic dominance for the postmerger market value distribution. This is true for both the "naive" (outstanding shares only) and the "sophisticated" (outstanding shares plus all issued and reserved shares that are imminently outstanding) methods of determining the perceptibly outstanding shares. This means that, in general, the frequency of relatively low market values is greater for the premerger distribution and the frequency of relatively high market values is greater for the postmerger distribution. It also means that the aggregate wealth of the shareholder of the merging firms was greater after the merger than it was before the merger. This is an ex post evaluation and is only directly applicable to the merger population and related time period that are specified in this study. There are, however, some generalizations that should be made beyond these specific statements of results for the test population. For example, since the requirement that the acquired firm must be at least half the size of the acquiring firm at the time of acquisition is made primarily so that any effects of the merger on profitability would be easily measurable, it is further suggested here that smaller scale mergers (smaller in terms of the relative size of participants) could be expected to provide similar results, albeit not as easily measurable.

To the extent that future influencing factors surrounding mergers are not significantly different, ex post relative frequency distributions used in this study can be assumed to be reasonable approximations of the probability distributions that are relevant to the ex ante merger decisions. Thus, given the qualifications mentioned, it can be stated that based on the results of this study, mergers contribute to the aggregate wealth position of the participating firms' shareholders. It is also true that the dominant postmerger distribution would be preferred in an ex ante sense by all individual investors that limit their portfolio choices to the aggregate distributions studied or their equivalents.

The results look somewhat different when the stochastic dominance comparisons are made for each individual merger. As can be seen in Table 2 when only outstanding shares are considered in the computation of market values, more mergers are premerger dominant than postmerger dominant. This is consistent with the results of prior

TABLE 2

SUMMARY OF STOCHASTIC DOMINANCE COMPARISONS FOR INDIVIDUAL MERGERS

	Naive		Sophisticated	
	FSD	SSD	FSD	SSD
Premerger	14	15	6	6
Postmerger	6	9	17	17
Indeterminate	12	8	9	9

merger researchers who have consistently found premerger mean return to be higher than postmerger mean return. However this conclusion is completely reversed when all imminently outstanding shares are considered in the computation of market value. Thus, if one were to sum the premerger and postmerger dominance results for the individual mergers (a common practice in prior research), the conclusion would depend upon the assumed level of investor sophistication.

The discrepancy in results between the aggregate and individual comparisons when only outstanding shares are taken into consideration is caused by generally stronger dominance for the dominant postmerger distributions than for the dominant premerger distributions. The aggregate results were not biased toward postmerger dominance by a relatively few strongly dominant postmerger distributions.

In order that a direct comparison can be made between the results of prior researchers using the mean-variance comparison framework and the results of the stochastic dominance comparison framework used in this study, a stochastic dominance comparison of the premerger and postmerger return distributions is also carried out. The definition of return used is as follows:

$$R_t = \frac{(MV_t - MV_{t-1}) + D_t}{MV_{t-1}}$$

where R_t = rate of return on common stockholders' investment in period t, MV_t = the market value of common stockholders' equity at the end of period t, MV_{t-1} = the market value of common stockholders' investment at the end of period t-1, and D_t = the total amount of dividends paid

to common stockholders during period t.

As pointed out earlier in this study, a comparison of premerger and postmerger return distributions is not adequate to decide whether the common stockholders' wealth position has improved. The premerger and postmerger level of market value must also be taken into consideration. The results that were obtained from the stochastic dominance comparisons of the aggregate premerger and postmerger return distributions indicated second degree dominance for the premerger distribution with indeterminance for the first degree dominance comparison. Again, this is consistent with the results of prior researchers using comparisons of mean return. It falls short of the total comparison required for the same reason as did the prior studies, i.e., it fails to take into account the market value level before and after the merger. It is useful for this study, however, in that it points out clearly that the aggregate postmerger dominance is a result of a market value level increase rather than an increase in the rate of return to stockholders. That is, aggregate stockholders' investment has increased in value because of the mergers, but the rate of return on aggregate stockholders' investment has not increased. In fact, when general risk aversion is assumed, as in the second degree stochastic dominance comparison, the premerger return distribution is dominant. Thus, comparison of longer time periods might show aggregate premerger dominance even when the market value level is taken into account. While this is true, it is also true that the use of longer postmerger periods is self-defeating

in that it becomes more difficult to attribute performance changes to an isolated merger effect.

TABLE 3

RESULTS OF INDIVIDUAL STOCHASTIC DOMINANCE COMPARISONS
NAIVE METHOD OF COMPUTING OUTSTANDING SHARES

Merger No.	Acquiring Firm	Acquired Firm	Completion Date	Dominant Distribution FSD	Dominant Distribution SSD
1	Interlake Iron	Acme Steel	02-17-64	Postmerger	Postmerger
2	Hoffman Electronics	Trav-Ler Industries	08-18-64	Premerger	Premerger
3	U.S. Smelting	Mueller Brass Co.	09-24-65	Indeterminate	Indeterminate
4	Union Oil of California	Pure Oil	08-01-65	Indeterminate	Indeterminate
5	Fairchild Heller	Republic Aviation	09-30-65	Indeterminate	Indeterminate
6	Pfaudler Permutit	Ritter Corp.	11-01-65	Postmerger	Postmerger
7	Assoc. Brewing	Drewery's	01-01-66	Indeterminate	Indeterminate
8	Atlantic Refining	Richfield Oil	01-03-66	Premerger	Premerger
9	Globe Wernicke	Sheller Mfg. Corp.	12-30-66	Premerger	Premerger
10	Standard Forgings	Transue & Williams	05-15-66	Indeterminate	Indeterminate
11	U.S. Plywood	Champion Papers	03-01-67	Indeterminate	Premerger
12	SCM Corp.	Glidden Co.	07-22-67	Indeterminate	Indeterminate
13	Dresser Ind., Inc.	Harbison Walker	10-29-67	Premerger	Premerger
14	General Signal	N.Y. Air Brake	09-20-67	Premerger	Premerger
15	N. Am. Aviation	Rockwell Standard	09-22-67	Premerger	Premerger
16	Diamond Alkali Co.	Shamrock Oil & Gas	12-18-67	Premerger	Premerger
17	Reliance Electric	Toledo Scale Corp.	12-29-67	Postmerger	Postmerger
18	Cudahy Co.	Allied Kid Co.	12-02-68	Indeterminate	Postmerger
19	Bunker-Ramo Corp.	Amphenol Corp.	06-03-68	Postmerger	Postmerger
20	Kawecki Chemical	Beryllium Corp.	10-21-68	Premerger	Premerger
21	Both. Ind.	Congoleum Corp.	09-30-68	Premerger	Premerger
22	Colt Ind.	Crucible Steel Co.	10-22-68	Indeterminate	Indeterminate

TABLE 3--Continued

Merger No.	Acquiring Firm	Acquired Firm	Completion Date	Dominant Distribution FSD	Dominant Distribution SSD
23	Amerace Corp.	Elastic Stop Nut	08-30-68	Premerger	Premerger
24	Allied Products	Fulton Ind.	05-02-68	Premerger	Premerger
25	Loew's Theaters	Lorillard Corp.	12-02-68	Indeterminate	Postmerger
26	CCI Corp.	Marquardt Corp.	06-12-68	Premerger	Premerger
27	American Standard	Westinghouse Air Br.	06-07-68	Postmerger	Postmerger
28	Sunshine Mining	Anchor Post Prod.	05-29-69	Indeterminate	Postmerger
29	Gould Natl. Battery	Clevite Corp.	07-31-69	Indeterminate	Indeterminate
30	Amerada Petroleum	Hess Oil and Chem.	06-20-69	Premerger	Premerger
31	Victoreen Inc.	Leece-Neville Co.	02-01-69	Premerger	Premerger
32	Atlantic Richfield	Sinclair Oil Corp.	03-04-69	Postmerger	Postmerger

TABLE 4

RESULTS OF INDIVIDUAL STOCHASTIC DOMINANCE COMPARISONS
SOPHISTICATED METHOD OF COMPUTING OUTSTANDING SHARES

Merger No.	Acquiring Firm	Acquired Firm	Completion Date	Dominant Distribution FSD	Dominant Distribution SSD
1	Interlake Iron	Acme Steel	02-17-64	Postmerger	Postmerger
2	Hoffman Electronics	Trav-Ler Industries	08-18-64	Premerger	Premerger
3	U.S. Smelting	Mueller Brass Co.	09-24-65	Indeterminate	Indeterminate
4	Union Oil of California	Pure Oil	08-01-65	Postmerger	Postmerger
5	Fairchild Heller	Republic Aviation	09-30-65	Indeterminate	Indeterminate
6	Pfaudler Permutit	Ritter Corp.	11-01-65	Postmerger	Postmerger
7	Assoc. Brewing	Drewery's	01-01-66	Indeterminate	Indeterminate
8	Atlantic Refining	Richfield Oil	01-03-66	Postmerger	Postmerger
9	Globe Wernicke	Sheller Mfg. Corp.	12-30-66	Postmerger	Postmerger
10	Standard Forgings	Transue & Williams	05-15-66	Indeterminate	Indeterminate
11	U.S. Plywood	Champion Papers	03-01-67	Postmerger	Postmerger
12	SCM Corp.	Glidden Co.	07-22-67	Indeterminate	Indeterminate
13	Dresser Ind., Inc.	Harbison Walker	10-29-67	Indeterminate	Indeterminate
14	General Signal	N.Y. Air Brake	09-20-67	Premerger	Premerger
15	No.Am.Aviation	Rockwell Standard	09-22-67	Postmerger	Postmerger
16	Diamond Alkali Co.	Shamrock Oil & Gas	12-18-67	Postmerger	Postmerger
17	Reliance Electric	Toledo Scale Corp.	12-29-67	Postmerger	Postmerger
18	Cudahy Co.	Allied Kid Co.	12-02-68	Postmerger	Postmerger
19	Bunker-Ramo Corp.	Amphenol Corp.	06-03-68	Postmerger	Postmerger
20	Kawecki Chemical	Beryllium Corp.	10-21-68	Premerger	Premerger
21	Both Ind.	Congoleum-Nairn	09-30-68	Postmerger	Postmerger
22	Colt Ind.	Crucible Steel Co.	10-22-68	Postmerger	Postmerger

TABLE 4--Continued

Merger No.	Acquiring Firm	Acquired Firm	Completion Date	Dominant Distribution FSD	Dominant Distribution SSD
23	Amerace Corp.	Elastic Stop Nut	08-30-68	Premerger	Premerger
24	Allied Products	Fulton Ind.	05-02-68	Indeterminate	Indeterminate
25	Loew's Theaters	Lorillard Corp.	12-02-68	Postmerger	Postmerger
26	CCI Corp.	Marquardt Corp.	06-12-68	Indeterminate	Indeterminate
27	American Standard	Westinghouse Air Br.	06-07-68	Postmerger	Postmerger
28	Sunshine Mining	Anchor Post Prod.	05-29-69	Indeterminate	Indeterminate
29	Gould Natl. Battery	Clevite Corp.	07-31-69	Postmerger	Postmerger
30	Amerada Petroleum	Hess Oil and Chem.	06-20-69	Premerger	Premerger
31	Victoreen Inc.	Leece-Neville Co.	02-01-69	Premerger	Premerger
32	Atlantic Richfield	Sinclair Oil Corp.	03-04-69	Postmerger	Postmerger

TABLE 5

STOCHASTIC DOMINANCE COMPARISON OF AGGREGATE PREMERGER AND POSTMERGER MARKET VALUE DISTRIBUTIONS - NAIVE METHOD

CALCULATED VALUES FOR STOCHASTIC DOMINANCE COMPARISON

	XN	F	G	F1	G1	F2	G2	1ST DEG. DOM.	2ND DEG. DOM.
1	117226	1/60		.02	0.00	0.0	0.0	G1	
2	118493	1/60		.03	0.00	21.0	0.0	G1	G2
3	118760	1/60		.05	0.00	30.1	0.0	G1	G2
4	118997		1/60	.05	.02	41.9	0.0	G1	G2
5	119600		1/60	.05	.03	72.1	10.0	G1	G2
6	119741	1/60		.07	.03	79.1	14.7	G1	G2
7	119993	1/60		.08	.03	95.9	23.1	G1	G2
8	120183		1/60	.08	.05	111.8	29.5	G1	G2
9	120194	1/60		.10	.05	111.8	29.5	G1	G2
10	120340	1/60		.12	.05	127.4	37.3	G1	G2
11	120410	1/60		.13	.05	135.6	40.8	G1	G2
12	120606		1/60	.13	.07	161.7	50.6	G1	G2
13	120655	1/60		.15	.07	169.7	54.6	G1	G2
14	120773	1/60		.17	.07	185.8	61.8	G1	G2
15	120922	1/60		.18	.07	210.6	71.7	G1	G2
16	121031	1/60		.20	.07	230.6	79.0	G1	G2
17	121390		1/60	.20	.08	300.4	102.2	G1	G2
18	121406	1/60		.22	.08	305.6	104.4	G1	G2
19	121487	1/60		.23	.08	323.2	111.1	G1	G2
20	121501	1/60		.25	.08	326.4	112.3	G1	G2
21	121566		1/60	.25	.10	342.7	117.7	G1	G2
22	121841		1/60	.25	.12	411.4	145.2	G1	G2
23	121987		1/60	.25	.13	447.9	162.3	G1	G2
24	122163		1/60	.25	.15	493.2	186.4	G1	G2
25	122203		1/60	.25	.17	501.9	191.6	G1	G2
26	122259	1/60		.27	.17	515.9	201.0	G1	G2
27	122273	1/60		.28	.17	519.7	203.3	G1	G2
28	122290		1/60	.28	.18	524.5	206.1	G1	G2
29	122453		1/60	.28	.20	570.7	236.0	G1	G2
30	122474		1/60	.28	.22	576.5	240.2	G1	G2
31	122501		1/60	.28	.23	584.3	246.1	G1	G2
32	122714		1/60	.28	.25	658.8	307.4	G1	G2
33	123424	1/60		.30	.25	34[illegible].1	467.4	G1	G2
34	123446		1/60	.32	.27	868.1	477.4	G1	G2
35	123545	1/60		.32	.27	882.7	504.6	G1	G2
36	123596		1/60	.32	.28	898.5	518.0	G1	G2
37	123624	1/60		.33	.28	907.4	525.3	G1	G2
38	123871	1/60		.35	.28	989.7	595.9	G1	G2
39	124114	1/60		.37	.28	1074.8	664.7	G1	G2

TABLE 5--Continued

40	124156	1/60		.38	.23	1090.2	670.5	G1	G2
41	124252		1/60	.38	.30	1127.0	703.8	G1	G2
42	124330		1/60	.38	.32	1156.9	727.2	G1	G2
43	124597	1/60		.40	.32	1259.2	811.8	G1	G2
44	124654	1/60		.42	.32	1282.0	829.8	G1	G2
45	124688	1/60		.43	.32	1296.2	840.6	G1	G2
46	124864		1/60	.43	.33	1372.5	896.3	G1	G2
47	124868	1/60		.45	.33	1374.2	897.7	G1	G2
48	124969		1/60	.45	.35	1419.7	931.3	G1	G2
49	125049		1/60	.45	.37	1455.7	959.3	G1	G2
50	125303		1/60	.45	.33	1570.0	1052.5	G1	G2
51	125713	1/60		.47	.39	1754.5	1209.6	G1	G2
52	125761	1/60		.48	.38	1776.9	1228.0	G1	G2
53	125809		1/60	.48	.40	1800.1	1246.4	G1	G2
54	126102	1/60		.50	.40	1941.7	1363.6	G1	G2
55	126578	1/60		.52	.40	2179.7	1554.0	G1	G2
56	126606		1/60	.52	.42	2194.1	1565.2	G1	G2
57	126642		1/60	.52	.43	2212.7	1580.2	G1	G2
58	126763	1/60		.53	.43	2275.3	1632.7	G1	G2
59	126800	1/60		.55	.43	2295.0	1648.7	G1	G2
60	126821	1/60		.57	.43	2306.5	1657.8	G1	G2
61	126990		1/60	.57	.45	2402.3	1731.0	G1	G2
62	127148		1/60	.57	.47	2491.8	1802.1	G1	G2
63	127218	1/60		.58	.47	2531.5	1834.8	G1	G2
64	127282	1/60		.60	.47	2568.8	1864.7	G1	G2
65	127471	1/60		.62	.47	2682.2	1952.9	G1	G2
66	127541	1/60		.63	.47	2725.4	1985.5	G1	G2
67	127644		1/60	.65	.45	2791.3	2034.3	G1	G2
68	127821	1/60		.65	.45	2902.7	2119.1	G1	G2
69	127966	1/60		.67	.45	2997.0	2189.2	G1	G2
70	128034		1/60	.67	.50	3022.3	2207.6	G1	G2
71	128075		1/60	.67	.52	3069.7	2243.1	G1	G2
72	128378		1/60	.67	.53	3271.7	2399.6	G1	G2
73	128527		1/60	.67	.55	3371.0	2479.1	G1	G2
74	128665		1/60	.67	.57	3463.7	2555.5	G1	G2
75	128816	1/60		.68	.57	3563.7	2640.5	G1	G2
76	128942	1/60		.70	.57	3649.8	2711.9	G1	G2
77	129068	1/60		.72	.57	3738.0	2783.3	G1	G2
78	129290	1/60		.73	.57	3889.9	2903.5	G1	G2
79	129401		1/60	.73	.58	3978.6	2972.0	G1	G2

TABLE 5--Continued

80	129569	1/60		.75	.58	4101.8	3070.0	G1	G2
81	129682		1/60	.75	.60	4186.6	3136.0	G1	G2
82	129976	1/60		.77	.60	4407.1	3312.4	G1	G2
83	130030	1/60		.78	.60	4448.5	3344.8	G1	G2
84	130219	1/60		.80	.60	4596.5	3458.2	G1	G2
85	130404		1/60	.80	.62	4744.5	3569.2	G1	G2
86	130725		1/60	.80	.63	5001.3	3767.1	G1	G2
87	130813		1/60	.80	.63	5071.7	3822.8	G1	G2
88	130993		1/60	.80	.67	5215.7	3939.8	G1	G2
89	131040	1/60		.82	.67	5285.3	3997.8	G1	G2
90	131088		1/60	.82	.68	5291.9	4003.2	G1	G2
91	131107	1/60		.83	.68	5307.4	4016.2	G1	G2
92	131125	1/60		.85	.68	5322.4	4028.5	G1	G2
93	131382		1/60	.85	.70	5540.8	4204.1	G1	G2
94	131443		1/60	.85	.72	5592.7	4246.8	G1	G2
95	131525		1/60	.85	.73	5663.2	4306.3	G1	G2
96	131994		1/60	.85	.75	6061.0	4649.5	G1	G2
97	132833	1/60		.87	.75	6779.3	5283.2	G1	G2
98	133053	1/60		.88	.75	6964.7	5443.7	G1	G2
99	133426		1/60	.88	.77	7294.2	5723.5	G1	G2
100	134106		1/60	.88	.79	7894.9	6244.8	G1	G2
101	134112		1/60	.88	.80	7900.2	6249.5	G1	G2
102	134677	1/60		.9[illegible]	.8[illegible]	8363.9	6669.5	G1	G2
103	134851	1/60		.92	.81	8376.5	6680.7	G1	G2
104	134865	1/60		.93	.80	8390.3	6692.7	G1	G2
105	134869		1/60	.97	.82	8393.1	6695.1	G1	G2
106	134748	1/60		.95	.82	8466.8	6759.6	G1	G2
107	134932	1/60		.97	.82	8641.6	6909.9	G1	G2
108	135224	1/60		.98	.82	8923.9	7148.3	G1	G2
109	135430	1/60		1.00	.82	9126.5	7316.6	G1	G2
110	135682		1/60	1.00	.83	9378.5	7522.4	G1	G2
111	137663		1/60	1.00	.85	11359.5	9173.2	G1	G2
112	137956		1/60	1.00	.87	11652.5	9422.3	G1	G2
113	138484		1/60	1.00	.88	12180.5	9879.9	G1	G2
114	138763		1/60	1.00	.90	12464.5	10130.7	G1	G2
115	138956		1/60	1.00	.92	12652.5	10299.9	G1	G2
116	139792		1/60	1.00	.93	13488.5	11066.3	G1	G2
117	139846		1/60	1.00	.95	13542.5	11116.7	G1	G2
118	140043		1/60	1.00	.97	13739.5	11303.8	G1	G2
119	140527		1/60	1.00	.98	14223.5	11771.7	G1	G2
120	142057		1/60	1.00	1.00	15753.5	13276.2	EQUAL	G2

TABLE 6

STOCHASTIC DOMINANCE COMPARISON OF AGGREGATE PREMERGER AND POSTMERGER MARKET VALUE DISTRIBUTIONS - SOPHISTICATED METHOD

CALCULATED VALUES FOR STOCHASTIC DOMINANCE COMPARISON

	XN	F	G	F1	G1	F2	G2	1ST DEG. DOM.	2ND DEG. DOM.
1	139389	1/60		.02	0.00	0.0	0.0	G1	
2	141283	1/60		.03	0.00	31.6	0.0	G1	G2
3	141810	1/60		.05	0.00	49.2	0.0	G1	G2
4	142673	1/60		.07	0.00	92.3	0.0	G1	G2
5	143122	1/60		.08	0.00	122.2	0.0	G1	G2
6	143321	1/60		.10	0.00	138.8	0.0	G1	G2
7	143429	1/60		.12	0.00	149.6	0.0	G1	G2
8	143588	1/60		.13	0.00	168.2	0.0	G1	G2
9	144309	1/60		.15	0.00	264.3	0.0	G1	G2
10	144505	1/60		.17	0.00	293.7	0.0	G1	G2
11	144557	1/60		.18	0.00	302.4	0.0	G1	G2
12	144655	1/60		.20	0.00	320.3	0.0	G1	G2
13	144685	1/60		.22	0.00	326.3	0.0	G1	G2
14	145217	1/60		.23	0.00	441.6	0.0	G1	G2
15	145234	1/60		.25	0.00	445.6	0.0	G1	G2
16	146322	1/60		.27	0.00	717.6	0.0	G1	G2
17	146679	1/60		.28	0.00	812.8	0.0	G1	G2
18	147674	1/60		.30	0.00	1094.7	0.0	G1	G2
19	147742	1/60		.32	0.00	1115.1	0.0	G1	G2
20	147913	1/60		.33	0.00	1169.2	0.0	G1	G2
21	148329	1/60		.35	0.00	1307.9	0.0	G1	G2
22	148628	1/60		.37	0.00	1412.6	0.0	G1	G2
23	148777	1/60		.38	0.00	1467.2	0.0	G1	G2
24	149022	1/60		.40	0.00	1561.1	0.0	G1	G2
25	149094	1/60		.42	0.00	1591.5	0.0	G1	G2
26	149237	1/60		.43	0.00	1649.4	0.0	G1	G2
27	150094	1/60		.45	0.00	2020.8	0.0	G1	G2
28	150189	1/60		.47	0.00	2063.5	0.0	G1	G2
29	150293	1/60		.48	0.00	2112.1	0.0	G1	G2
30	150556	1/60		.50	0.00	2239.2	0.0	G1	G2
31	151330	1/60		.52	0.00	2626.2	0.0	G1	G2
32	151439	1/60		.53	0.00	2682.0	0.0	G1	G2
33	151442	1/60		.55	0.00	2684.1	0.0	G1	G2
34	151538	1/60		.57	0.00	2764.4	0.0	G1	G2
35	152035	1/60		.58	0.00	3043.2	0.0	G1	G2
36	152123	1/60		.60	0.00	3071.3	0.0	G1	G2
37	152565	1/60		.62	0.00	3333.4	0.0	G1	G2
38	152572	1/60		.63	0.00	3337.7	0.0	G1	G2
39	152763	1/60		.65	0.00	3458.7	0.0	G1	G2

TABLE 6--Continued

40	152887	1/60			.67	0.00	3539.3	0.0	G1	G2
41	153653	1/60			.68	0.00	4050.0	0.0	G1	G2
42	153986	1/60			.70	0.00	4277.5	0.0	G1	G2
43	154197	1/60			.72	0.00	4425.2	0.0	G1	G2
44	154377	1/60			.73	0.00	4525.5	0.0	G1	G2
45	154918	1/60			.75	0.00	4951.6	0.0	G1	G2
46	155188	1/60			.77	0.00	5154.1	0.0	G1	G2
47	155263	1/60			.78	0.00	5211.6	0.0	G1	G2
48	155510	1/60			.80	0.00	5405.1	0.0	G1	G2
49	156393	1/60			.82	0.00	6116.3	0.0	G1	G2
50	156416	1/60			.83	0.00	6130.2	0.0	G1	G2
51	156831	1/60			.85	0.00	6476.0	0.0	G1	G2
52	158232	1/60			.97	0.00	7666.9	0.0	G1	G2
53	159787	1/60			.98	0.00	8147.9	0.0	G1	G2
54	160847	1/60			.90	0.00	9967.5	0.0	G1	G2
55	161216	1/60			.92	0.00	10299.6	0.0	G1	G2
56	161389	1/60			.93	0.00	10457.3	0.0	G1	G2
57	161485	1/60			.95	0.00	10547.8	0.0	G1	G2
58	161819	1/60			.97	0.00	10864.2	0.0	G1	G2
59	161969	1/60			.98	0.00	11010.1	0.0	G1	G2
60	162476	1/60			1.00	0.00	11508.7	0.0	G1	G2
61	175423		1/60		1.00	.02	24455.7	0.0	G1	G2
62	178422		1/60		1.00	.03	27454.7	50.0	G1	G2
63	179021		1/60		1.00	.05	28053.7	69.9	G1	G2
64	180275		1/60		1.00	.07	29308.7	132.7	G1	G2
65	180639		1/60		1.00	.08	29721.7	161.2	G1	G2
66	180635		1/60		1.00	.10	29728.7	160.8	G1	G2
67	180804		1/60		1.00	.12	29896.7	177.6	G1	G2
68	180873		1/60		1.00	.13	29905.7	178.7	G1	G2
69	181427		1/60		1.00	.15	30459.7	252.5	G1	G2
70	181435		1/60		1.00	.17	30497.7	258.2	G1	G2
71	181770		1/60		1.00	.18	30802.7	309.1	G1	G2
72	181943		1/60		1.00	.20	30981.7	341.9	G1	G2
73	182563		1/60		1.00	.22	31595.7	464.7	G1	G2
74	182642		1/60		1.00	.23	31674.7	481.8	G1	G2
75	182973		1/60		1.00	.25	32005.7	559.0	G1	G2
76	183115		1/60		1.00	.27	32148.7	594.8	G1	G2
77	183201		1/60		1.00	.28	32233.7	617.4	G1	G2
78	183414		1/60		1.00	.30	32446.7	677.8	G1	G2
79	183427		1/60		1.00	.32	32459.7	681.7	G1	G2

TABLE 6--Continued

80	183956	1/60	1.00	.33	32988.7	849.2	G1	G2
81	184044	1/60	1.00	.35	33076.7	874.5	G1	G2
82	184126	1/60	1.00	.37	33155.7	936.2	G1	G2
83	184347	1/60	1.00	.38	33374.7	986.5	G1	G2
84	185224	1/60	1.00	.40	34261.7	1326.5	G1	G2
85	185955	1/60	1.00	.42	34988.7	1617.3	G1	G2
86	186046	1/60	1.00	.43	35078.7	1654.8	G1	G2
87	186073	1/60	1.00	.45	35105.7	1666.5	G1	G2
88	186621	1/60	1.00	.47	35653.7	1913.1	G1	G2
89	186676	1/60	1.00	.48	35708.7	1939.8	G1	G2
90	186769	1/60	1.00	.50	35800.7	1983.2	G1	G2
91	187500	1/60	1.00	.52	36532.7	2349.2	G1	G2
92	188509	1/60	1.00	.53	37541.7	2870.6	G1	G2
93	188993	1/60	1.00	.55	38025.7	3128.7	G1	G2
94	189540	1/60	1.00	.57	38572.7	3429.5	G1	G2
95	189963	1/60	1.00	.58	38995.7	3669.2	G1	G2
96	190847	1/60	1.00	.60	39879.7	4184.9	G1	G2
97	190899	1/60	1.00	.62	39930.7	4215.5	G1	G2
98	194926	1/60	1.00	.63	43958.7	6699.4	G1	G2
99	195891	1/60	1.00	.65	44923.7	7310.6	G1	G2
100	196516	1/60	1.00	.67	45548.7	7716.9	G1	G2
101	197679	1/60	1.00	.68	46710.7	8491.5	G1	G2
102	199773	1/60	1.00	.70	48811.7	9927.2	G1	G2
103	203104	1/60	1.00	.72	52136.7	12254.7	G1	G2
104	203756	1/60	1.00	.73	52788.7	12722.0	G1	G2
105	203935	1/60	1.00	.75	52967.7	12853.2	G1	G2
106	204675	1/60	1.00	.77	53708.7	13409.0	G1	G2
107	204748	1/60	1.00	.78	53820.7	13494.9	G1	G2
108	204971	1/60	1.00	.80	54003.7	13638.2	G1	G2
109	205454	1/60	1.00	.82	54486.7	14024.6	G1	G2
110	205701	1/60	1.00	.83	54733.7	14226.3	G1	G2
111	206027	1/60	1.00	.85	55059.7	14498.0	G1	G2
112	206201	1/60	1.00	.87	55233.7	14645.9	G1	G2
113	207276	1/60	1.00	.88	56308.7	15577.6	G1	G2
114	207433	1/60	1.00	.90	56465.7	15716.2	G1	G2
115	209425	1/60	1.00	.92	58457.7	17509.0	G1	G2
116	209576	1/60	1.00	.93	58608.7	17647.5	G1	G2
117	212983	1/60	1.00	.95	62017.7	20829.2	G1	G2
118	213255	1/60	1.00	.97	62287.7	21085.7	G1	G2
119	214025	1/60	1.00	.98	63058.7	21831.0	G1	G2
120	214373	1/60	1.00	1.00	63410.7	22177.1	EQUAL	G2

TABLE 7

STOCHASTIC DOMINANCE COMPARISON OF AGGREGATE PREMERGER AND POSTMERGER RETURN DISTRIBUTIONS - NAIVE METHOD

CALCULATED VALUES FOR STOCHASTIC DOMINANCE COMPARISON

	XN	F	G	F1	G1	F2	G2	1ST DEG. DOM.	2ND DEG. DOM.
1	-.73		1/60	0.00	.02	0.0	0.0	F1	
2	-.64		1/60	0.00	.03	0.0	.0	F1	F2
3	-.49		1/60	0.00	.05	0.0	.0	F1	F2
4	-.42		1/60	0.00	.07	0.0	.0	F1	F2
5	-.31		1/60	0.00	.08	0.0	.0	F1	F2
6	-.31		1/60	0.00	.10	0.0	.0	F1	F2
7	-.26	1/60		.02	.10	0.0	.0	F1	F2
8	-.25		1/60	.02	.12	.0	.0	F1	F2
9	-.25		1/60	.02	.13	.0	.0	F1	F2
10	-.22		1/60	.02	.15	.0	.0	F1	F2
11	-.21		1/60	.02	.17	.0	.0	F1	F2
12	-.21		1/60	.02	.18	.0	.0	F1	F2
13	-.20	1/60		.03	.18	.0	.0	F1	F2
14	-.18		1/60	.03	.20	.0	.0	F1	F2
15	-.17		1/60	.03	.22	.0	.0	F1	F2
16	-.17		1/60	.03	.23	.0	.0	F1	F2
17	-.16		1/60	.03	.25	.0	.0	F1	F2
18	-.14		1/60	.03	.27	.0	.0	F1	F2
19	-.14	1/60		.05	.27	.0	.0	F1	F2
20	-.14		1/60	.05	.28	.0	.0	F1	F2
21	-.14	1/60		.07	.28	.0	.0	F1	F2
22	-.14		1/60	.07	.30	.0	.0	F1	F2
23	-.13	1/60		.08	.30	.0	.0	F1	F2
24	-.10		1/60	.08	.32	.0	.1	F1	F2
25	-.10	1/60		.10	.32	.0	.1	F1	F2
26	-.10	1/60		.12	.32	.0	.1	F1	F2
27	-.10		1/60	.12	.33	.0	.1	F1	F2
28	-.08		1/60	.12	.35	.0	.1	F1	F2
29	-.07	1/60		.13	.35	.0	.1	F1	F2
30	-.07		1/60	.13	.37	.0	.1	F1	F2
31	-.07	1/60		.15	.37	.0	.1	F1	F2
32	-.06		1/60	.15	.38	.0	.1	F1	F2
33	-.05		1/60	.15	.40	.0	.1	F1	F2
34	-.04		1/60	.15	.42	.0	.1	F1	F2
35	-.04	1/60		.17	.42	.0	.1	F1	F2
36	-.04	1/60		.18	.42	.0	.1	F1	F2
37	-.04	1/60		.20	.42	.0	.1	F1	F2
38	-.04	1/60		.22	.42	.0	.1	F1	F2

TABLE 7--Continued

39	-.03		1/60	.32	.43	.0	.1	F1		F2
40	-.03	1/60		.33	.43	.0	.1	F1		F2
41	-.02	1/60		.35	.43	.0	.1	F1		F2
42	-.02		1/60	.35	.45	.0	.1	F1		F2
43	-.02		1/60	.35	.47	.0	.1	F1		F2
44	.00	1/60		.37	.47	.0	.1	F1		F2
45	.00		1/60	.37	.48	.0	.1	F1		F2
46	.01	1/60		.38	.48	.0	.1	F1		F2
47	.01		1/60	.38	.50	.0	.1	F1		F2
48	.01		1/60	.38	.52	.0	.1	F1		F2
49	.02	1/60		.40	.52	.0	.1	F1		F2
50	.03		1/60	.40	.53	.0	.1	F1		F2
51	.03		1/60	.40	.55	.0	.1	F1		F2
52	.03		1/60	.40	.57	.0	.1	F1		F2
53	.04	1/60		.42	.57	.0	.1	F1		F2
54	.04	1/60		.43	.57	.0	.1	F1		F2
55	.05	1/60		.45	.57	.0	.1	F1		F2
56	.06		1/60	.45	.58	.0	.1	F1		F2
57	.06	1/60		.47	.58	.0	.1	F1		F2
58	.06	1/60		.48	.58	.0	.1	F1		F2
59	.08	1/60		.40	.58	.1	.1	F1		F2
60	.09	1/60		.42	.58	.1	.1	F1		F2
61	.10	1/60		.43	.58	.1	.1	F1		F2
62	.10	1/60		.45	.58	.1	.2	F1		F2
63	.10		1/60	.45	.60	.1	.2	F1		F2
64	.11		1/60	.45	.62	.1	.2	F1		F2
65	.11	1/60		.47	.62	.1	.2	F1		F2
66	.11	1/60		.48	.62	.1	.2	F1		F2
67	.12	1/60		.50	.62	.1	.2	F1		F2
68	.13	1/60		.52	.62	.1	.2	F1		F2
69	.13		1/60	.52	.63	.1	.2	F1		F2
70	.14	1/60		.53	.63	.1	.2	F1		F2
71	.14	1/60		.55	.63	.1	.2	F1		F2
72	.14	1/60		.57	.63	.1	.2	F1		F2
73	.15	1/60		.58	.63	.1	.2	F1		F2
74	.15		1/60	.58	.65	.1	.2	F1		F2
75	.15	1/60		.60	.65	.1	.2	F1		F2
76	.16	1/60		.62	.65	.1	.2	F1		F2
77	.18	1/60		.63	.65	.1	.2	F1		F2
78	.18	1/60		.65	.65	.1	.2		EQUAL	F2
79	.19	1/60		.67	.65	.1	.2		G1	F2

TABLE 7--Continued

80	.21		1/60	.67	.67	.1	.2		EQUAL	F2
81	.21	1/60		.68	.67	.1	.2		G1	F2
82	.21	1/60		.70	.67	.1	.2		G1	F2
83	.21		1/60	.70	.68	.1	.2		G1	F2
84	.21	1/60		.72	.68	.1	.2		G1	F2
85	.21		1/60	.72	.70	.1	.2		G1	F2
86	.22		1/60	.72	.72	.1	.2		EQUAL	F2
87	.24	1/60		.73	.72	.1	.2		G1	F2
88	.24		1/60	.73	.73	.1	.2		EQUAL	F2
89	.25		1/60	.73	.75	.2	.3	F1		F2
90	.26	1/60		.75	.75	.2	.3		EQUAL	F2
91	.27	1/60		.77	.75	.2	.3		G1	F2
92	.27		1/60	.77	.77	.2	.3		EQUAL	F2
93	.28	1/60		.78	.77	.2	.3		G1	F2
94	.29		1/60	.78	.78	.2	.3		EQUAL	F2
95	.29	1/60		.80	.78	.2	.3		G1	F2
96	.30	1/60		.82	.78	.2	.3		G1	F2
97	.31	1/60		.83	.78	.2	.3		G1	F2
98	.31		1/60	.83	.80	.2	.3		G1	F2
99	.33	1/60		.85	.80	.2	.3		G1	F2
100	.34	1/60		.87	.80	.2	.3		G1	F2
101	.34	1/60		.88	.80	.2	.3		G1	F2
102	.35		1/60	.88	.82	.2	.3		G1	F2
103	.35		1/60	.88	.83	.2	.3		G1	F2
104	.36		1/60	.88	.85	.2	.3		G1	F2
105	.36	1/60		.90	.85	.2	.3		G1	F2
106	.37	1/60		.92	.85	.2	.3		G1	F2
107	.39	1/60		.93	.85	.3	.4		G1	F2
108	.39		1/60	.93	.87	.3	.4		G1	F2
109	.40	1/60		.95	.87	.3	.4		G1	F2
110	.40	1/60		.97	.87	.3	.4		G1	F2
111	.41		1/60	.97	.88	.3	.4		G1	F2
112	.41		1/60	.97	.90	.3	.4		G1	F2
113	.41		1/60	.97	.92	.3	.4		G1	F2
114	.50	1/60		.98	.92	.4	.5		G1	F2
115	.59		1/60	.98	.93	.5	.5		G1	F2
116	.59		1/60	.98	.95	.5	.5		G1	F2
117	.60	1/60		1.00	.95	.5	.6		G1	F2
118	.63		1/60	1.00	.97	.5	.6		G1	F2
119	.72		1/60	1.00	.98	.6	.7		G1	F2
120	1.09		1/60	1.00	1.00	1.0	1.0		EQUAL	F2

TABLE 8

STOCHASTIC DOMINANCE COMPARISON OF AGGREGATE PREMERGER AND POSTMERGER RETURN DISTRIBUTIONS- SOPHISTICATED METHOD

CALCULATED VALUES FOR STOCHASTIC DOMINANCE COMPARISON

	XS	F	G	F1	G1	F2	G2	1ST DEG. DOM.	2ND DEG. DOM.
1	-.65		1/60	0.00	.02	0.0	0.0	F1	
2	-.62		1/60	0.00	.03	0.0	.0	F1	F2
3	-.49		1/60	0.00	.05	0.0	.0	F1	F2
4	-.46		1/60	0.00	.07	0.0	.0	F1	F2
5	-.34		1/60	0.00	.08	0.0	.0	F1	F2
6	-.31		1/60	0.00	.10	0.0	.0	F1	F2
7	-.31		1/60	0.00	.12	0.0	.0	F1	F2
8	-.31		1/60	0.00	.13	0.0	.0	F1	F2
9	-.27		1/60	0.00	.15	0.0	.0	F1	F2
10	-.26	1/60		.02	.15	0.0	.0	F1	F2
11	-.25		1/60	.02	.17	.0	.0	F1	F2
12	-.25		1/60	.02	.18	.0	.0	F1	F2
13	-.24		1/60	.02	.20	.0	.0	F1	F2
14	-.22		1/60	.02	.22	.0	.0	F1	F2
15	-.22		1/60	.02	.23	.0	.0	F1	F2
16	-.21		1/60	.02	.25	.0	.0	F1	F2
17	-.20	1/60		.03	.25	.0	.0	F1	F2
18	-.16		1/60	.03	.27	.0	.0	F1	F2
19	-.17		1/60	.03	.28	.0	.0	F1	F2
20	-.16		1/60	.03	.30	.0	.0	F1	F2
21	-.15		1/60	.03	.32	.0	.0	F1	F2
22	-.14	1/60		.05	.32	.0	.1	F1	F2
23	-.14	1/60		.07	.32	.0	.1	F1	F2
24	-.13	1/60		.08	.32	.0	.1	F1	F2
25	-.12		1/60	.08	.33	.0	.1	F1	F2
26	-.12	1/60		.10	.33	.0	.1	F1	F2
27	-.11	1/60		.12	.33	.0	.1	F1	F2
28	-.10		1/60	.12	.35	.0	.1	F1	F2
29	-.10	1/60		.13	.35	.0	.1	F1	F2
30	-.09		1/60	.13	.37	.0	.1	F1	F2
31	-.08	1/60		.15	.37	.0	.1	F1	F2
32	-.08	1/60		.17	.37	.0	.1	F1	F2
33	-.07		1/60	.17	.38	.0	.1	F1	F2
34	-.07		1/60	.17	.40	.0	.1	F1	F2
35	-.06		1/60	.17	.42	.0	.1	F1	F2
36	-.06	1/60		.18	.42	.0	.1	F1	F2
37	-.06	1/60		.20	.42	.0	.1	F1	F2
38	-.05	1/60		.22	.42	.0	.1	F1	F2
39	-.04		1/60	.22	.43	.0	.1	F1	F2

TABLE 8--Continued

40	-.03		1/60	.22	.45	.0	.1	F1	F2
41	-.03		1/60	.22	.47	.0	.1	F1	F2
42	-.03		1/60	.22	.48	.0	.1	F1	F2
43	-.02		1/60	.22	.50	.0	.1	F1	F2
44	-.02		1/60	.22	.52	.0	.1	F1	F2
45	-.02	1/60		.23	.52	.0	.1	F1	F2
46	-.01	1/60		.25	.52	.0	.1	F1	F2
47	-.00		1/60	.25	.53	.0	.1	F1	F2
48	.01	1/60		.27	.53	.0	.1	F1	F2
49	.01		1/60	.27	.55	.0	.1	F1	F2
50	.01	1/60		.28	.55	.0	.1	F1	F2
51	.01		1/60	.28	.57	.0	.1	F1	F2
52	.02	1/60		.30	.57	.0	.1	F1	F2
53	.03	1/60		.32	.57	.0	.1	F1	F2
54	.03		1/60	.32	.58	.0	.1	F1	F2
55	.04	1/60		.33	.58	.0	.1	F1	F2
56	.05	1/60		.35	.58	.0	.1	F1	F2
57	.06		1/60	.35	.60	.0	.1	F1	F2
58	.06	1/60		.37	.60	.0	.1	F1	F2
59	.08	1/60		.38	.60	.1	.2	F1	F2
60	.09	1/60		.40	.60	.1	.2	F1	F2
61	.10		1/60	.40	.62	.1	.2	F1	F2
62	.10	1/60		.42	.62	.1	.2	F1	F2
63	.10	1/60		.43	.62	.1	.2	F1	F2
64	.11		1/60	.43	.63	.1	.2	F1	F2
65	.11	1/60		.45	.63	.1	.2	F1	F2
66	.11	1/60		.47	.63	.1	.2	F1	F2
67	.12	1/60		.48	.63	.1	.2	F1	F2
68	.12	1/60		.50	.63	.1	.2	F1	F2
69	.13	1/60		.52	.63	.1	.2	F1	F2
70	.13		1/60	.52	.65	.1	.2	F1	F2
71	.15	1/60		.53	.65	.1	.2	F1	F2
72	.15		1/60	.53	.67	.1	.2	F1	F2
73	.15		1/60	.53	.68	.1	.2	F1	F2
74	.16	1/60		.55	.68	.1	.2	F1	F2
75	.16	1/60		.57	.68	.1	.2	F1	F2
76	.16	1/60		.58	.68	.1	.2	F1	F2
77	.16		1/60	.58	.70	.1	.2	F1	F2
78	.17	1/60		.60	.70	.1	.2	F1	F2
79	.17	1/60		.62	.70	.1	.2	F1	F2

TABLE 8--Continued

80	.18	1/60		.53	.70	.1	.2	F1	F2
81	.19	1/60		.55	.70	.1	.2	F1	F2
82	.20	1/60		.57	.70	.1	.2	F1	F2
83	.21		1/59	.57	.72	.1	.2	F1	F2
84	.21		1/60	.57	.73	.1	.2	F1	F2
85	.21	1/59		.58	.73	.1	.2	F1	F2
86	.22		1/57	.58	.75	.1	.2	F1	F2
87	.25		1/60	.68	.77	.2	.3	F1	F2
88	.26	1/50		.70	.77	.2	.3	F1	F2
89	.28	1/60		.72	.77	.2	.3	F1	F2
90	.28	1/60		.73	.77	.2	.3	F1	F2
91	.29	1/60		.75	.77	.2	.3	F1	F2
92	.29	1/60		.77	.77	.2	.3	EQUAL	F2
93	.29		1/60	.77	.78	.2	.3	F1	F2
94	.30	1/60		.78	.78	.2	.3	EQUAL	F2
95	.30	1/60		.80	.78	.2	.3	G1	F2
96	.32	1/60		.82	.78	.2	.3	G1	F2
97	.32		1/60	.82	.80	.2	.3	G1	F2
98	.33	1/60		.83	.80	.2	.3	G1	F2
99	.35	1/60		.85	.80	.2	.3	G1	F2
100	.35		1/60	.85	.82	.2	.3	G1	F2
101	.36	1/60		.87	.82	.2	.3	G1	F2
102	.36	1/60		.88	.82	.2	.3	G1	F2
103	.36		1/60	.88	.83	.2	.3	G1	F2
104	.36	1/60		.90	.83	.2	.3	G1	F2
105	.36	1/60		.92	.83	.2	.4	G1	F2
106	.36	1/60		.93	.83	.2	.4	G1	F2
107	.37	1/60		.95	.83	.2	.4	G1	F2
108	.38	1/60		.97	.83	.2	.4	G1	F2
109	.39		1/60	.97	.85	.3	.4	G1	F2
110	.39		1/60	.97	.87	.3	.4	G1	F2
111	.42		1/60	.97	.88	.3	.4	G1	F2
112	.42		1/60	.97	.90	.3	.4	G1	F2
113	.44	1/60		.98	.90	.3	.5	G1	F2
114	.51		1/60	.98	.92	.4	.5	G1	F2
115	.53		1/60	.98	.93	.4	.5	G1	F2
116	.56	1/60		1.00	.93	.4	.5	G1	F2
117	.63		1/60	1.00	.95	.5	.6	G1	F2
118	.64		1/60	1.00	.97	.5	.6	G1	F2
119	.66		1/60	1.00	.98	.5	.6	G1	F2
120	.67		1/60	1.00	1.00	.7	.8	EQUAL	F2

CHAPTER V

LIMITATIONS, IMPLICATIONS AND RECOMMENDATIONS

LIMITATIONS

Using the results of ex-post data to make ex-ante generalizations is known to be of limited value. Specifically, the fact that mergers were beneficial in terms of aggregate market value of common equity during the time period used in this study does not assure that this will be true in any future time period. However, the measurement of merger performance in the past is not a trivial exercise. For, while it is true that decisions can only be made in ex-ante framework, the results of these decisions are also of obvious importance and must by necessity be measured ex-post. Managers of giant corporations are rewarded or dismissed based on the results of their decisions.

Because the results of this study are expressed in terms of aggregate market value of common equity, portfolios representing combinations other than the market portfolio are not taken into consideration. It is possible that other available portfolio combinations would have given considerably different results. This prevents the realistic specification of an ex-ante decision model for the individual investor. Without assuming perfect capital markets and homogeneous investor expectations, the market-weighted aggregate portfolios are not necessarily the ones that will be considered by all investors. There is not even the assurance that they will be considered by any investor.

The comparison of market value distributions occurring at different points in time, while necessary in this study, is dependent on the adjustment process for its degree of meaningfulness. Without any adjustment, the market value of a firm or a group of firms would be expected to increase with time. By dividing each premerger and post-merger market value by the chronologically corresponding market value index, the effect of the time trend on the comparison is nullified. Any increase in a firm's market value relative to the market index is interpreted through use of this study's methodology as an improvement in the wealth position of the firm's stockholders. While this would not be strictly true if a firm's market value declined less than the index over a general period of declining stock prices, it would indicate relative superiority in line with the purpose of the comparison.

The strict interpretation of the results is limited according to the limitations placed on the study itself, e.g., the time period selected and the various specifications used to define the size and nature of the mergers studied.

The remaining limitations that are considered here are related to the use of the stochastic dominance criteria. While these criteria can be used to determine that one distribution has dominated, the degree of dominance cannot be quantitatively expressed except in the relatively gross differences between FSD and SSD. A related deficiency of the stochastic dominance criteria is that tests have not yet been developed to determine the degree of statistical significance for the dominance results. However, since dominance is such a strong characteristic, it seems unlikely to be incorrectly determined if

enough observation points are used so as to accurately estimate the market value distributions.

IMPLICATIONS

The primary implication derived from the results of this study is that expansion through merger can be used to further the aggregate interests of common stockholders holding shares of the merging firms. This is of particular interest because of the fact that prior studies have consistently shown that mergers are not profitable, except to stockholders of acquired firms for which excessive premiums have been paid.

Another related implication then is that synergy (in an aggregate sense) having been achieved for the population and time period used in this study, can be achieved through merger. Synergy is said to occur when the market value distribution of the postmerger firms is greater than the combined market values of the acquiring firms prior to the merger.

The fact that, individually, more mergers were unsuccessful than were successful implies that successful expansion through merger cannot be taken for granted by either managers or investors. In fact, as previously mentioned, the aggregate postmerger superiority found in this study was a result, not of superior postmerger rates of return, but of higher postmerger valuation of the common stock by investors.

RECOMMENDATIONS

The limitations and implications outlined above lead directly to several recommendations for further research beyond the scope of

this study. For example, ex-post premerger data could be used along with forecasted states of nature as a probabilistic base for a simulation of postmerger results. The actual postmerger data obtained could then be compared with the simulated data using the stochastic dominance criteria. This procedure would not, however, completely eliminate the need for the removal of time trends.

Another recommendation that seems clearly needed is a reformulated approach that will allow a realistic specification of an ex-ante decision model for individual investors. This might be able to be accomplished through a methodology in which premerger and postmerger portfolio combinations are randomly selected for stochastic dominance comparison.

APPENDICES

APPENDIX A

STOCHASTIC DOMINANCE

The specific techniques used in this study to measure merger success are the first and second degree stochastic dominance criteria. The efficiency criterion typically used to determine preference in a risk-return framework is the mean-variance (E-V) criterion, where the mean, or expected value, is used as a measure of return and the variance (or some other related variability measure) about the mean is used as a measure of risk. When using the E-V criterion for pairwise comparisons, a higher mean-lower variance combination is preferred. If the variances are equal, the choice with the higher mean is preferred. If the mean of one choice is higher, but variance is also higher, or if the mean is lower, but variance is also lower, no preference can be determined in a general sense. Each individual would have to apply his own particular utility function between risk and return to the set of mean-variance combinations available in order to establish a preference. The assumptions required for the E-V criterion include the necessity that either the investors making the choices have quadratic utility functions or that the return distributions can be considered normal in a statistical sense.

The assumption of quadratic utility functions has the unlikely implication that investors at some point, as return increases,

begin to prefer less return. The alternative assumption of normality of return distributions has been found to be incorrect by several studies[1] concerning the true nature of stock price distributions. It appears likely that the actual distributions are stable-Paretian, but not normal. The normal distribution is a special case of a stable Paretian distribution when the characteristic exponent, α, is equal to its maximum value.[2]

In response to the criticisms of the E-V approach, the more general system of preference orderings based on the principle of stochastic dominance was developed. Although several other useful efficiency criteria were specified and tested by Levy and Hanoch,[3] the following description will be limited to three stochastic dominance criteria: first-degree (FSD), second-degree (SSD) and third-degree (TSD) stochastic dominance.[4]

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[1]For a good one-volume source, see Cootner, Paul H. (ed.), The Random Character of Stock Market Prices, The MIT Press, Cambridge, Mass, 1964.

[2]This characteristic exponent is a parameter which determines the height of, or total probability contained in the extreme tails of the distribution. It can take any value between 0 and 2, i.e., $0 < \alpha \leq 2$. When α is less than 2, i.e., $0 < \alpha < 2$, the extreme tails of the distribution are higher than those of the normal distribution and do not tend to converge to produce a finite variance.

[3]Levy, Haim, and Hanoch, Giora, "Relative Effectiveness of Efficiency Criteria for Portfolio Selection," Journal of Financial and Quantitative Analysis, V (March, 1970), 68-69.

[4]Explanations of how the FSD and SSD criteria are applied in this study are found in Chapter I, Chapter III, and Appendix B.

FSD

The probability function of f(X) is said to dominate the probability function g(X) by FSD if and only if $F_1(X) \leq G_1(X)$ for all values of X defined on some interval between X_o and X_n, with strict inequality for at least one value of X. The probability functions f and g are for a random variable X varying over some defined interval. $F_1(X)$ and $G_1(X)$ are the respective cumulative probability distributions of f(X) and g(X).

This is the most general stochastic dominance criterion in that there are no restrictions on the utility functions of those making the preference ordering except that they be nondecreasing with respect to increases in X. In graphical terms, f(X) D g(X), that is, f(X) dominates g(X) if the cumulative distribution $F_1(X)$ lies below at some point and never above the cumulative distribution $G_1(X)$, i.e., without intersection.

SSD

The probability function f(X) is said to dominate the probability function g(X) by SSD if and only if $F_2(X) \leq G_2(X)$ for all values of X defined on some interval between X_o and X_n, with strict inequality for at least one value of X. $F_2(X)$ and $G_2(X)$ are the respective areas under the $F_1(X)$ and $G_1(X)$ cumulative distributions.

The only new restriction placed on the utility functions by this criterion is that of non-increasing marginal utility, i.e., the utility function is concave throughout the relevant range, so that

aversion for risk prevails for all individuals. In graphical terms, the cumulative distributions may intersect, but the area of the dominant function is less than at some point and never greater than the area under the dominated function.

TSD

The probability function f(X) is said to dominate the probability function g(X) by TSD if and only if $F_3(X) \leq G_3(X)$ for all values of X defined on some interval between X_o and X_n, with strict inequality for at least one value of X. $F_3(X)$ and $G_3(X)$ are the respective integrals of the areas under the $F_1(X)$ and $G_1(X)$ distributions.

This criterion places the following restrictions on the means and variances of F(X) and g(X). If f(X) D g(X), then:

$$\sigma_G^2 - \sigma_F^2 + (\mu_F - \mu_G)(2b - \mu_F - \mu_G) \geq 0 \text{ and } \mu_F - \mu_G \geq 0$$

This is identical in form to an efficiency criterion based on some knowledge about the third moment of a quadratic utility function by Levy and Hanoch.[5] Their criterion was derived from the existence of a maximum value X_m for which the quadratic concave function is non-decreasing, and assuming that all observed values of X are smaller than X_m for all individuals' utility. Thus, the use of TSD would require either the assumption that all $X_n \leq X_m$ of a quadratic utility function or that the X distributions of both f and g have finite values for the means and variances and would require some knowledge concerning the

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[5] Ibid.

degree of skewness. For a pairwise comparison, it would only be necessary to know which distribution had the lower skewness coefficient.[6] Because of these added restrictions, TSD will not be used as an efficiency criterion for this study.

The following example[7] will be presented to distinguish between the E-V and the SD efficiency approaches by showing graphically an ordering of three portfolios, A, B and C by both E-V and FSD.

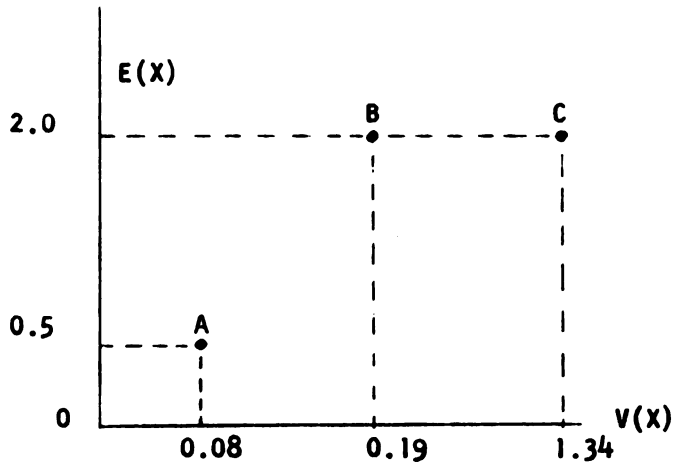

Figure A-1

E-V Ordering

Under the E-V approach, A and B would be in the efficient set, while C would be excluded because it has the same mean as B but has a higher variance. (See Figure A-1). But the FSD approach shows C to be clearly superior to A and determines the efficient set to be B and C. It

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[6] Ibid.

[7] From R. Burr Porter and Jack Gaumnitz. "Stochastic Dominance vs. Mean-Variance Portfolio Analysis," Working Paper No. 37, University of Kansas, School of Business, Lawrence: (December 1970), pp. 5-6.

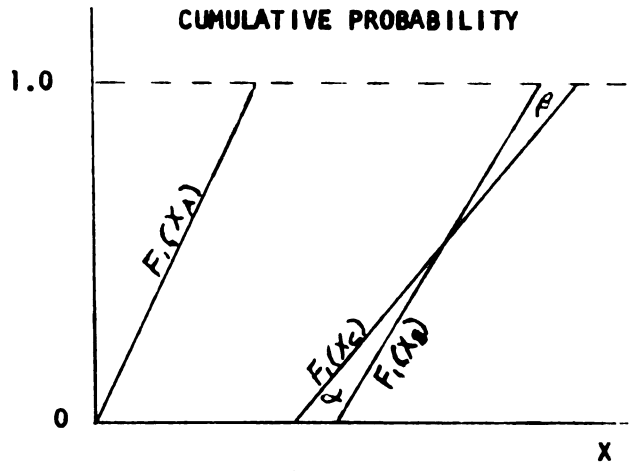

Figure A-2

FSD Ordering

can be seen in Figure A-2 that the worst outcome that can be experienced with C is better than the best possible outcome that could be obtained with A. Therefore, no rational investor would choose A over C--an example of how the SD approach produces choices which are more consistent with rational behavior than those produced by the EV approach.

Using the same example above, it can also be seen that using the SSD criterion, B would eliminate C because the area under $F(X_B)$ is consistently less than the area under $F(X_C)$. This could also be determined by comparing the non-common portions of the areas under the distributions, α and β, As long as $\alpha \geq \beta$, then $f(X_B)$ D $f(X_C)$.

A more detailed example of an empirical application[8] will also be presented in the context of a pairwise comparison of two portfolios, f and g. Monthly investor returns $\frac{D_1 + P_1}{P_0}$ will be used to develop frequency distributions on which the FSD, SSD, and TSD tests can be applied. Class intervals of return could have been used for a more extensive example instead of all available observations. The observed rates of return are indicated in Table A-1.

TABLE A-1

OBSERVED PORTFOLIO RETURNS - HYPOTHETICAL EXAMPLE

	% Return			
Portfolio	Period 1	Period 2	Period 3	Period 4
f	6	2	1.8	7
g	6	3	1	3

It is necessary to approximate the true underlying functions by means of finite discrete sets of sample observations. First, the sample observations are arranged in ascending numerical order. The distributions must be monotonically increasing regardless of chronological order. Even if two or more observations have the same numerical value, for consistency in labelling, each observation is considered to be distinct. These ordered data should be combined (but identified) data

[8]From Porter, Wart and Ferguson, "Efficient Algorithms For Conducting Stochastic Dominance Tests on Large Numbers of Portfolios," Working Paper No. 49, University of Kansas, School of Business, Lawrence: (September, 1971), pp. 6-7.

from both distributions. Given K distinct observations, for each portfolio each observation will occur with a relative frequency $f(X_i) = 1/K$. The corresponding cumulative distribution function $F_1(X_n)$ is generated directly by summing the sample frequencies for all X_i. For comparison of f(X) and g(X) there will be a total of N = 2K distinct observations. If the i th observation belongs to portfolio f, then $f(X_i) = 1/K$ and $g(X_i) = 0$. The SD criteria computations for discrete functions are:

FSD

$$F_1(X_n) = \sum_{i=1}^{n} f(X_i) \qquad n = 1, 2, \ldots N$$

$$G_1(X_n) = \sum_{i=1}^{n} g(X_i) \qquad n = 1, 2, \ldots N$$

SSD

$$F_2(X_n) = \sum_{i=2}^{n} F_1(X_{i-1})(X_i - X_{i-1}) \quad n = 1, 2, \ldots N$$

where $F_2(X_1) = 0$

$$G_2(X_n) = \sum_{i=1}^{n} G_1(X_{i-1})(X_i - X_{i-1}) \quad n = 1, 2, \ldots N$$

where $G_2(X_1) = 0$

TSD

$$F_3(X_n) = 1/2 \sum_{i=2}^{n} \left[F_2(X_i) + F_2(X_{i-1})\right] \qquad (X_i - X_{i-1}) \quad n = 2, 3, \ldots N$$

where $F_3(X_1) = 0$

$$G_3(X_n) = 1/2 \sum_{i=2}^{n} \left[G_2(X_i) + G_2(X_{i-1})\right] \quad (X_i - X_{i-1}) \quad n = 2, 3, \ldots N$$

where $G_3(X_1) = 0$

Using the test data: K = 4, N = (2)(4) = 8

TABLE A-2

COMPUTED DATA MATRIX

Value of	Observations 1	2	3	4	5	6	7	8
X_n	1.0	1.8	2.0	3.0	3.0	6.0	6.0	7.0
$f(X_n)$	0	1/4	1/4	0	0	1/4	0	1/4
$g(X_n)$	1/4	0	0	1/4	1/4	0	1/4	0
$F_1(X_n)$	0	.25	.50	.50	.50	.75	.75	1.00
$G_1(X_n)$	.25	.25	.25	.50	.75	.75	1.00	1.00
$F_2(X_n)$	0	0	.05	.55	.55	2.05	2.05	2.80
$G_2(X_n)$	0	.20	.25	.50	.50	2.75	2.85	3.75
$F_3(X_n)$	0	0	.005	.305	.305	4.205	4.205	6.630
$G_3(X_n)$	0	.080	.125	.500	.500	5.375	5.375	8.625

Sample Calculations:[9]

$F_2(X_8) = 0(1.8 - 1) + .25(2 - 1.8) + 5(3 - 2) + .5(3 - 3) + .5(6 - 3) + .75(6 - 6) + .75(7 - 6)$

$= 0 + .05 + .5 + 0\ 1.5 + 0 + .75 = \underline{2.80}$

$G_3(X_8) = .5\ \ (.2 + 0)\ (1.8 - 1) + (.25 + .2)\ (2 - 1.8) + (.5 + .25)\ (3 - 2) + (.5 + .5)\ (3 - 3) + (2.75 + .5)\ (6 - 3) + (2.75 + 2.75)\ (6 - 6) + (2.75 + 2.75)\ (7 - 6)$

$= .5\ \ .16 + .09 + .75 + 0 + 9.75 + 0 + 6.5$

$= .5(17.25) = \underline{8.625}$ **Results:** f(X) D g(X) by TSD but not by FSD or SSD.

[9] $F_2(X_8)$ is the area under the cumulative frequency distribution of portfolio f return observations when n = 8 observations. $G_3(X_8)$ is the integral of the area under the cumulative frequency distribution of portfolio g return observations when n = 8 observations.

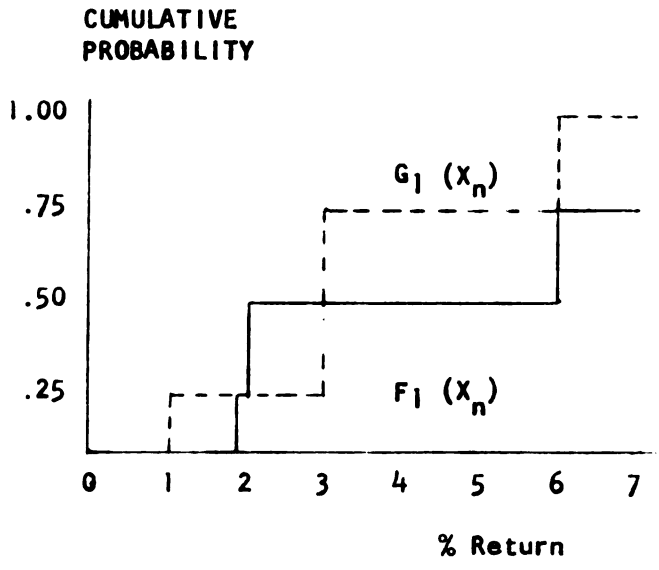

Figure A-3

Graphical Representation of Stochastic
Dominance Comparison-Hypothetical Example

APPENDIX B

PERFORMANCE MEASUREMENT MODEL

AXIOMS FOR THE PERFORMANCE MEASUREMENT MODEL

1. Common stockholders' utility (U) is directly related to that portion of their wealth (W) that can be measured by the total market value of their common equity holdings (V). That is,

$$U = f(W) \qquad \text{and} \qquad W = f(V)$$

So,

$$V_{max} \longrightarrow W_{max} \longrightarrow U_{max}$$

2. Non-satiety is assumed. That is, the shareholders prefer more wealth (in terms of market value) to less wealth.

3. Aggregate utility is the sum of the utility of all the individual stockholders involved.

$$U_{Aggregate} = \sum_{i=1}^{N} U_i .$$

N is the total combined number of stockholders of both the acquiring and acquired firms before the merger and is the total number of stockholders in the merged firm after the merger.

4. Success of a merger or a group of mergers is defined in terms of common stockholders' aggregate utility. Where U_A is the

stockholders' aggregate utility relating to the premerger distribution and U_B is the stockholders' aggregate utility relating to the postmerger distribution,

$(U_A \ D \ U_B)$ --- Merger Success

$(U_B \ D \ U_A)$ --- Merger Failure

If neither distribution dominates the other, no determination of merger success or failure can be made.

5. Since aggregate stockholders' utility is measured in terms of the aggregate market value of their common equity holdings, merger success is measured directly using stochastic dominance comparisons of premerger and postmerger aggregate market value distributions (V_B and V_A respectively).

$(V_A \ D \ V_B)$ --- Merger Success

$(V_B \ D \ V_A)$ --- Merger Failure

6. General riskiness of the shareholders' wealth valuations can be measured by the general variability inherent in the market value distributions.

Figure B-1

Performance Measurement Model

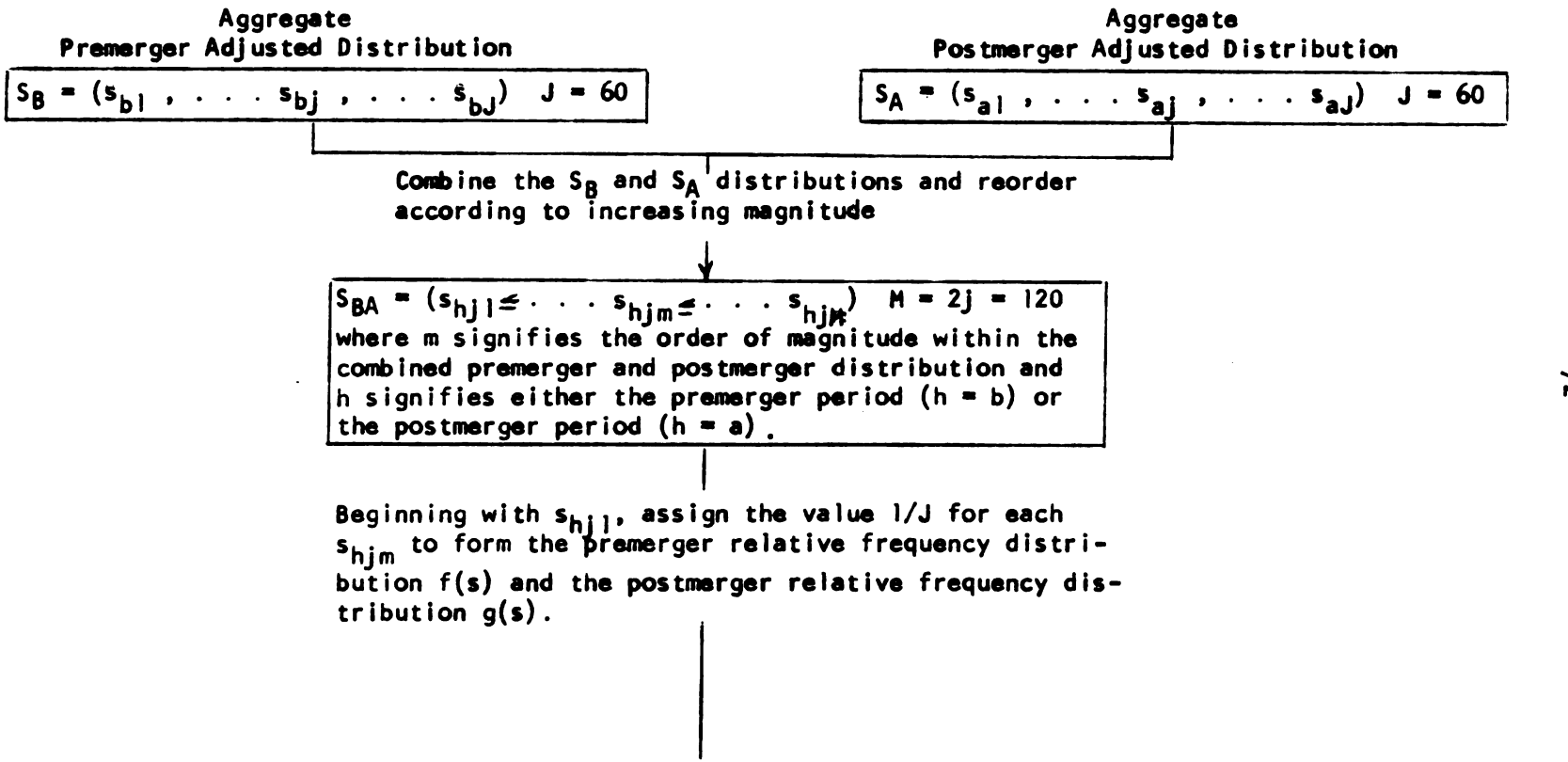

Figure B-1--Continued

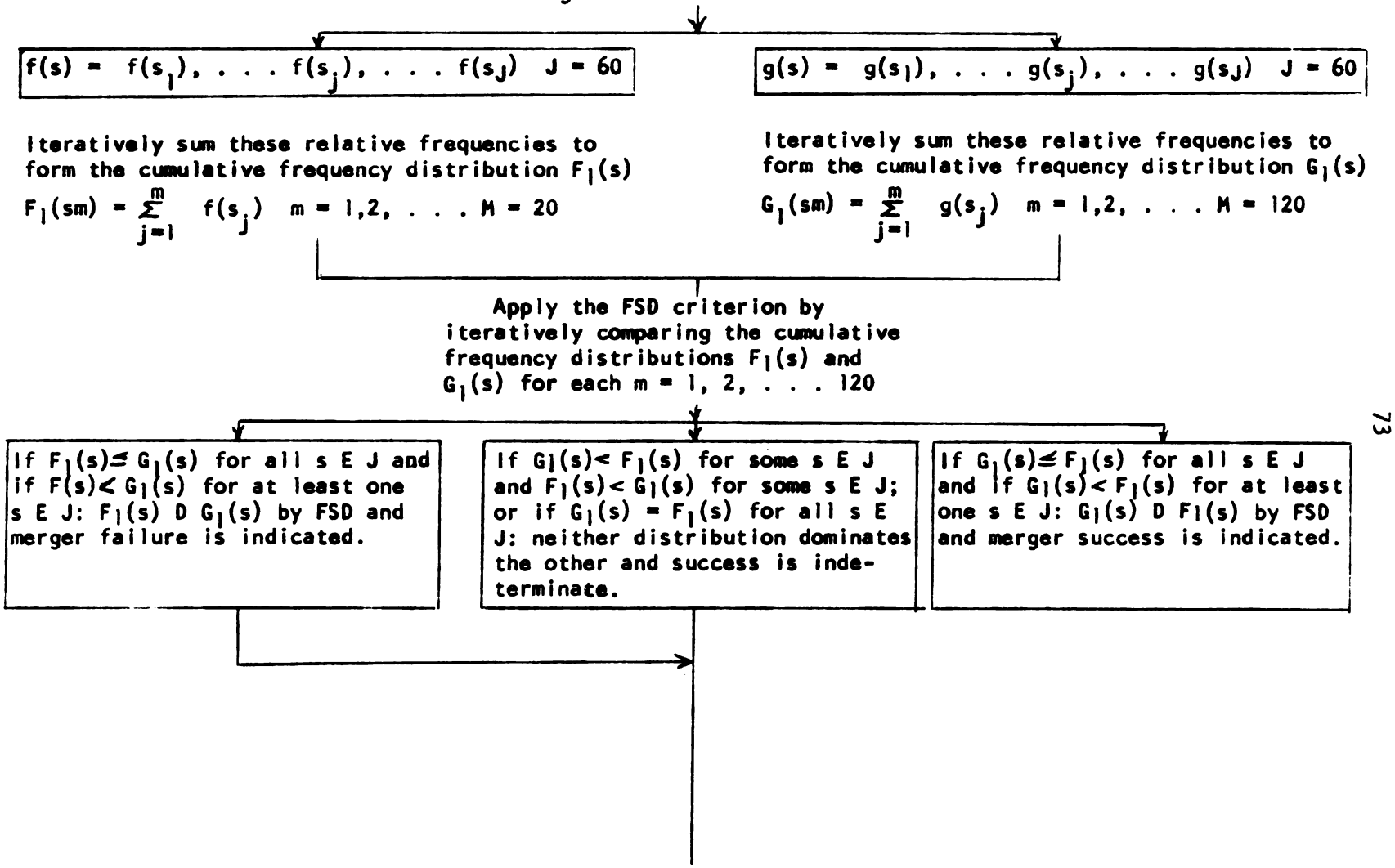

Figure B-1--Continued

Determine the distributions of $F_2(s)$ and $G_2(s)$ under the cumulative frequency distributions $F_1(s)$ and $G_1(s)$ at each observation point by iteratively summing the product of the cumulative frequency at the previous observation point and the change in market value since the previous observation.

$$F_2(s_m) = \sum_{j=2}^{m} F_1(s_{j-1})(s_j - s_{j-1}) \quad m = 1,2, \ldots M = 120, \text{ where } F_2(s_1) = 0$$

$$G_2(s_m) = \sum_{j=2}^{m} G_1(s_{j-1})(s_j - s_{j-1}) \quad m = 1,2, \ldots M = 120, \text{ where } G_2(s_1) = 0$$

$F_2(s) = F_2(s_1), \ldots F_2(s_j), \ldots F_2(s_J) \quad J = 60$

$G_2(s) = G_2(s_1), \ldots G_2(s_j), \ldots G_2(s_J) \quad J = 60$

Apply the SSD criterion by iteratively comparing the cumulative area distributions $F_2(s)$ and $G_2(s)$ for each $m = 1,2, \ldots 120$

If $F_2(s) \preceq G_2(s)$ for all $s \in J$ and if $F_2(s) \prec G_2(s)$ for at least one $s \in J$: $F_2(s)$ D $G_2(s)$ by SSD and merger failure is indicated.

If $G_2(s) \prec F_2(s)$ for some $s \in J$ and $F_2(s) < G_2(s)$ for some $s \in J$; or if $G_2(s) = F_2(s)$ for all $s \in J$; neither distribution dominates the other and success is indeterminate.

If $G_2(s) \preceq F_2(s)$ for all $s \in J$ and if $G_2(s) < F_2(s)$ for at least one $s \in J$: $G_2(s)$ D $F_2(s)$ by SSD and merger success is indicated.

BIBLIOGRAPHY

Books

Alberts, William W. and Segall, Joel E. (eds.) The Corporate Merger, Chicago: University of Chicago Press, 1966.

Ansoff, H. Igor; Blandenburg, Richard G.; Portner, Fred E. and Radosevich, Raymond, Acquisition Behavior of U. S. Manufacturing Firms, 1946-1965, Nashville: Vanderbilt University Press, 1971.

Beveridge, W.I.B., The Art of Scientific Investigation, New York: Vintage Books, 1950.

Cootner, Paul H., (ed.) The Random Character of Stock Market Prices, The MIT Press, 1964.

Dellenbarger, Lynn E. Jr., Common Stock Valuation in Industrial Mergers, Gainesville: University of Florida Press, 1966.

Fama, Eugene and Miller, Merton, The Theory of Finance, New York: Holt, Rinehart and Winston, 1972.

Feller, William, An Introduction to Probability Theory and Its Applications, Vol. I, 2nd Edition, New York: John Wiley & Sons, Inc., 1968.

Francis, Jack C., Investment Analysis and Management, New York: McGraw-Hill, Inc., 1972.

Francis, Jack C. and Archer, Stephen H., Portfolio Analysis, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1971.

Freund, John E. and Williams, Frank J., Modern Business Statistics, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1958.

Friend, Irwin; Blume, Marshall; and Crocket, Jean, Mutual Funds and Other Institutional Investors: A New Perspective, New York: McGraw-Hill, Inc., 1970.

Granger, Clive W. J. and Morgenstern, Oskar, Predictability of Stock Market Prices, Lexington: D. C. Heath and Company, 1970.

Hadar, Josef, Mathematical Theory of Economic Behavior, Reading: Addison-Wesley Publishing Company, 1971.

Hendriksen, Eldon S., Accounting Theory, Revised Edition, Homewood, Ill.: Richard D. Irwin, Inc., 1970.

Kelly, Eamon M., The Profitability of Growth Through Mergers, The Pennsylvania State University, 1967.

Latane, Henry A. and Tuttle, Donald L., Security Analysis and Portfolio Management, New York: The Ronald Press Company, 1970.

Levy, Haim and Sarnat, Marshall, Investment and Portfolio Analysis, New York: John Wiley & Sons, Inc., 1972.

Lynch, Harry H., Financial Performance of Conglomerates, Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1971.

Nelson, Ralph S., Merger Movements in American Industry, 1895-1956, Princeton: Princeton University Press, 1959.

Reid, Samuel R., Mergers, Managers and the Economy, New York: McGraw-Hill, Inc., 1968.

Rudner, Richard S., Philosophy of Social Science, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966.

Sharpe, William F., Portfolio Theory and Capital Markets, New York: McGraw-Hill Book Company, 1970.

Spurr, William A. and Bonini, Charles P., Statistical Analysis for Business Decisions, Homewood, Ill.: Richard D. Irwin, Inc., 1967.

Weston, J. Fred, The Scope and Methodology of Finance, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966.

Journal Articles

Berry, Charles H., "Corporate Growth and Diversification," Journal of Law and Economics, XIV, No. 2 (October, 1971), 371-383.

Block, Stanley, "The Merger Impact on Stock Price Movements," MSU Business Topics, Vol. 17, No. 2 (Spring, 1969), 7-12.

Bosland, Chelcie, "Stock Valuation in Recent Mergers: A Study of Appraisal Factors," Trusts and Estates (June-July-August, 1955), 516-569.

Boyle, Stanley E., "Premerger Growth and Profit Characteristics of Large Conglomerate Mergers in the United States: 1948-1968," in St. John's Law Review, Conglomerate Mergers and Acquisitions, 44 (Spring, 1970), Special Issue, 152-170.

Conrad, Gordon R. and Plotkin, Irving H., "Risk/Return: U. S. Industry Pattern," Harvard Business Review (March-April, 1960), 90-111.

Coombs, C. H.; Raiffa, H., and Thrall, R. M., "Some Views on Mathematical Models and Measurement Theory," Psychological Review, 61, No. 2 (1954).

Curley, Anthony J., "Conglomerate Earnings per share: Real and Transitory Growth," Accounting Review, XLVI, No. 3 (July, 1971), 519-528.

Curley, Anthony J., "Conglomerate Growth: The Ostrich Effect," Accounting Review, XLVII, No. 2 (April, 1972), 371-374.

Dewing, Arthur S., "Statistical Test of the Success of Consolidation," Quarterly Journal of Economics (December, 1921), 84-101.

Durand, David and May, "The Ex-Dividend Behavior of American and Telephone and Telegraph Stock," Journal of Finance, XV (1960), 19-31.

Evans, John L. and Archer, Stephen H., "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance, XXIII (December, 1968), 761-769.

Fama, Eugene F., "Portfolio Analysis In A Stable Paretian Market," Management Science, 11 (January, 1965), 404-419.

Fama, Eugene F., "The Behavior of Stock Market Prices," Journal of Business (April, 1965), 34-105.

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

Fielitz, Bruce D., "Stationarity of Random Data: Some Implications for the Distribution of Stock Price Changes," Journal of Financial and Quantitative Analysis (June, 1971), 1025-1034.

Frank, Werner G., and Weygandt, Jerry J., "Convertible Debt and Earnings per Share: Pragmatism vs. Good Theory," Accounting Review (April, 1970), 181-189.

Gort, Michael, "An Economic Disturbance Theory of Mergers," Quarterly Journal of Economics, 83 (November, 1969), 624-642.

Gort, Michael and Hogarty, Thomas F., "New Evidence on Mergers," Journal of Law and Economics, XIII (April, 1970), 167-184.

Hadar, Josef and Russell, William R., "Stochastic Dominance and Diversification," Journal of Economic Theory, 3 (1971), 288-305.

Hadar, Josef and Russell, William R., "Rules for Ordering Uncertain Prospects," Economic Review, 49 (March, 1969), 25-34.

Hanoch, Giora and Levy, Haim, "The Efficiency Analysis of Choices Involving Risk," Review of Economic Studies, 36 (1969), 335-346.

Hanoch, Giora and Levy, Haim, "Efficient Portfolio Selection With Quadratic and Cubic Utility," Journal of Business (April, 1970), 181-189.

Haugen, Robert A. and Udell, Jon G., "Rates of Return to Stockholders of Acquired Companies," Journal of Financial and Quantitative Analysis, VII, No. 1 (January, 1972), 1387-1398.

Hogarty, Thomas F., "The Profitability of Corporate Mergers," Journal of Business, 43 (July, 1970), 317-327.

Howard, Ronald A., "The Foundations of Decision Analysis," IEEE Transactions on Systems Science and Cybernetics, Vol. SSC-4, No. 3 (September, 1968), 211-219.

Jennings, Edward H., "An Empirical Analysis of Some Aspects of Common Stock Diversification," Journal of Financial and Quantitative Analysis (March, 1971), 797-814.

Jones, Charles P. and Simkowitz, Michael, "Abstract: An Exploratory Analysis of the Simultaneity of Stock Price Movements," Journal of Financial and Quantitative Analysis, VII, No. 2 (March, 1972), 1669-1672.

Joyce, Jon M., and Vogel, Robert C., "The Uncertainty in Risk: Is Variance Unambiguous?" Journal of Finance, XXV (March, 1970), 127-134.

King, Benjamin F., "Market and Industry Factors in Stock Price Behavior," Journal of Business, 39 (January, 1966), 139-190.

Lev, Baruch and Mandelker, Gershon, "The Microeconomic Consequences of Corporate Mergers," Journal of Business, 45 (January, 1972), 85-104.

Levy, Haim and Hanoch, Giora, "Relative Effectiveness of Efficiency Criteria for Portfolio Selection," Journal of Financial and Quantitative Analysis (March, 1960), 63-76.

Levy, Haim and Sarnat, Marshall, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Mergers," Journal of Finance, XXV (September, 1970), 795-807.

Levy, Haim and Sarnat, Marshall, "Alternative Efficiency Criteria: An Empirical Analysis," Journal of Finance, XXV (December, 1970), 1153-1158.

Levy, Haim and Sarnat, Marshall, "A Note on Portfolio Selection and Investors' Wealth," Journal of Financial and Quantitative Analysis (January, 1971), 639-642.

Levy, Haim and Sarnat, Marshall, "Two-Period Portfolio Selection and Investors' Discount Rates," Journal of Finance, XXVI (June, 1971), 757-762.

Lewellen, Wilbur G., "A Pure Financial Rationale for the Conglomerate Merger," Journal of Finance, XXVI (May, 1971), 521-537.

Lintner, John, "Expectations, Mergers and Equilibrium in Purely Competitive Securities Markets," American Economic Review, LXI (May, 1971), 101-111.

Livermore, Shaw, "The Success of Industrial Mergers," Quarterly Journal of Economics (November, 1935), 68-96.

Lorie, James H. and Halpern, Paul, "Conglomerates: The Rhetoric and the Evidence," Journal of Law and Economics, XIII (April, 1970), 149-166.

McDonald, J. G. and Fisher, A. K., "New Issue Stock Price Behavior," Journal of Finance, XXVII, No. 1 (March, 1972), 97-102.

Melicher, Ronald W. and Harter, Thomas R., "Abstract: Stock Price Movements of Firms Engaging in Large Acquisitions," Journal of Financial and Quantitative Analysis VII, No. 2 (March, 1972), 1469-1475.

Mead, Walter J., Instantaneous Merger Profit As A Conglomerate Merger Motive," Western Economic Journal, 7 (December, 1969), 295-306.

Michaelson, Jacob B., and Gorshay, Robert C., "Portfolio Selection in Financial Intermediaries: A New Approach," Journal of Financial and Quantitative Analysis"(June, 1967), 166-199.

Mueller, Dennis C., "A Theory of Conglomerate Mergers," Quarterly Journal of Economics, 83 (November, 1969), 643-659.

Mokkelbost, Per B., "Unsystematic Risk Over Time," Journal of Financial and Quantitative Analysis (March, 1971), 785-796.

Mumey, G. A. and Korkie, R. M., "Balance Sheet Additivity of Risk Measures," Journal of Financial and Quantitative Analysis (September, 1971), 1123-1134.

North, D. Warner, "A Tutorial Introduction to Decision Theory," IEEE Transactions on Systems Science and Cybernetics, Vol. SSC-4, No. 3 (September, 1968).

Porter, R. Burr and Gaumnitz, Jack E., "Stochastic Dominance vs. Mean-Variance Portfolio Analysis: An Empirical Evaluation," American Economic Review (June, 1972), 438-446.

Praetz, Peter D., "Australian Share Prices and the Random Walk Hypothesis," Australian Journal of Statistics, 11, No. 3 (1969), 123-139.

Quirk, James P. and Saposnik, Rubin, "Admissibility and Measurable Utility Functions," Review of Economic Studies, 29 (1962), 140-146.

Ramanathan, K. V. and Rappaport, Alfred, "Size, Growth Rates and Merger Valuation," Accounting Review, XLVI, No. 4 (October, 1971), 733-745.

Reid, Samuel R., "A Reply to the Weston/Mansinghka Criticisms Dealing With Conglomerate Mergers," Journal of Finance, XXVI (September, 1971), 937-946.

Reinhardt, U. E., "Conglomerate Earnings per Share: Immediate and Post-Merger Effects," Accounting Review, XLVII, No. 2 (April, 1970), 360-370.

Rothschild, Michael and Stiglitz, Joseph E., "Increasing Risk II: Its Economic Consequences," Journal of Economic Theory, 3 (1971), 66-84.

Russell, William R. and Smith, Paul E., "Taxation, Risk-Taking and Stochastic Dominance," The Southern Economic Journal (April, 1970) 425-433.

May, Robert G., "The Influence of Quarterly Earnings Announcements On Investors Decisions As Reflected in Common Stock Price Changes," Unpublished dissertation, Michigan State University, 1970.

Melicher, Ronald W. and Hempel, George H., "Difference in Financial Characteristics Between Conglomerate Mergers and Horizontal or Vertical Mergers," Unpublished paper, 1971.

Melicher, Ronald W. and Rush, David F., "Conglomerate Firm Performance and the Contribution of Major Acquisitions," Unpublished paper, 1972.

Oveson, Richard M., "Regression Parameter Estimation by Minimizing Absolute Deviations: Confidence Intervals and Monte Carlo Results," Unpublished paper, 1971.

Poindexter, Eugene O., "The Profitability of Industrial Merger," Unpublished dissertation, Syracuse University, 1970.

Porter, R. Burr, "Stochastic Dominance vs. Mean-Variance as a Basis for Capital Budgeting Decisions Under Risk," Working Paper No. 36. School of Business, University of Kansas, Lawrence, October, 1970.

Porter, R. Burr, "The Application of Stochastic Dominance Rules to the Financial Decision Problems of the Firm," Unpublished paper, 1972.

Porter, R. Burr, "A Comparison of Stochastic Dominance and Stochastic Programming As Corporate Financial Decision Models Under Uncertainty," Unpublished paper, 1972.

Porter, R. Burr and Gaumnitz, Jack E., "Stochastic Dominance vs. Mean-Variance Portfolio Analysis," Working Paper No. 37, School of Business, University of Kansas, Lawrence, December, 1970.

Porter, R. Burr and Wart, James R. and Ferguson, Donald L., "Efficient Algorithms for Conducting Stochastic Dominance Tests on Large Numbers of Portfolios," Working Paper No. 49,School of Business, University of Kansas, Lawrence, September, 1971.

Pinches, George E., "Financing Corporate Mergers and Acquisitions With Convertible Preferred Stock," Unpublished dissertation, Michigan State University, 1968.

Stevens, Donald L., "A Multivariate Analysis of Financial Characteristics of Acquired Firms in Industrial Mergers," Unpublished dissertation, Michigan State University, 1972.

Samuelson, Paul A., "Efficient Portfolio Selection for Pareto-Levy Investments," Journal of Financial and Quantitative Analysis (June, 1967), 107-122.

Shick, Richard A., "The Analysis of Mergers and Acquisitions," Journal of Finance, XXVII, No. 2 (May, 1972), 495-502.

Smith, Keith V. and Schreiner, John C., "A Portfolio Analysis of Conglomerate Diversification," Journal of Finance, XXIV (June, 1969), 412-427.

Smith, Keith V. and Schreiner, John C., "A Reply," Journal of Finance, XXV, No. 4 (September, 1970), 915-916.

Van Horne, James C., "New Listings and Their Price Behavior," Journal of Finance, XXV, No. 4 (September, 1970), 783-794.

Westerfield, Randolph, "A Note on the Measurement of Conglomerate Diversification," Journal of Finance, XXV, No. 4 (September, 1970), 909-914.

Weston, J. Fred and Mansinghka, Surendra K., "Tests of the Efficiency Performance of Conglomerate Firms," Journal of Finance, XXVI (September, 1971), 919-936.

Whitmore, G. A., "Third-Degree Stochastic Dominance," American Economic Review (June, 1970), 457-459.

Wippern, Ronald F., "Utility Implications of Portfolio Selection and Performance Appraisal Models," Journal of Financial and Quantitative Analysis (June, 1971), 913-924.

Working, Holbrook, "A Random Difference Series For Use in the Analysis of Time-Series," Journal of the American Statistical Association, 29 (1934), 11-24.

Unpublished Material

Gaumnitz, Jack E., "The Influence of Industry Factors in Stock Price Movements," Working Paper No. 42, School of Business, University of Kansas, Lawrence, June, 1971.

Mason, R. Hal and Goudzwaard, Maurice B., "Growth Patterns of Highly Diversified Firms: A Sample Survey, 1962-1967," Unpublished paper, 1970.

Stitch, Robert S., "Aggregate Analysis of Merger Performance, 1948-1964," Unpublished paper, 1972.

Treadway, Peter T., "An Explanation of the Conglomerate Merger Movement--The Conglomerate As a Result of Forces Arising in the Capital Markets," Unpublished dissertation, University of North Carolina at Chapel Hill, 1971.

Weston, J. Fred and Dunn, Michael F., "CAP and the Measurement of Business Risk," Unpublished paper, 1971.

Zdanowicz, John S., "Investment Risk Considering Intraperiod Liquidation: A Re-evaluation of Price Variance," Unpublished dissertation, Michigan State University, 1971.

Other Sources

Accounting Principles Board of the American Institute of Certified Public Accountants, "Earnings Per Share," Opinion No. 15, New York, 1969.

Federal Trade Commission, Economic Report on Conglomerate Mergers, Hearings on Antitrust and Monopoly, Committee of the Judiciary, U.S. Senate, 91st Congress, 1st Union, Part 8A, USGPP, 1969.

Federal Trade Commission, "Large Mergers in Manufacturing and Mining, 1948-1970," Statistical Report No. 7, Bureau of Economics, March, 1971.

Federal Trade Commission, "Current Trends in Merger Activity, 1970," Statistical Report No. 8, Bureau of Economics, March, 1971.

Investment Statistics Laboratory, ISL Daily Stock Price Index, American Stock Exchange, New York: Standard and Poors Corporation, 1962-1970.

Investment Statistics Laboratory, ISL Daily Stock Price Index, New York Stock Exchange, New York: Standard and Poors Corporation, 1962-1970.

Moodys Industrial Manual, Moodys Investors Service, Inc., New York, 1960-1971.

National Industrial Conference Board, Mergers in Industry New York: National Industrial Conference Board, 1929.