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Tender offer outcome prediction based upon efficient market hypothesis

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TENDER OFFER OUTCOME PREDICTION BASED UPON EFFICIENT MARKET HYPOTHESIS

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Tender Offer Outcome Prediction Based Upon Efficient Market Hypothesis

ABSTRACT

A significant portion of firms' capital expenditures in the recent past have been accomplished through the acquisition of the assets of other firms by tender offers. While the majority of tender offers are successful, a significant number of tender offers fail for various reasons. The accurate prediction of the success or failure of a tender offer would provide investors with valuable information upon which to base their investment decisions. The target firm shareholders could use the information as a base for their tendering decision. For the arbitrageur, a predictive model would reduce the uncertainty associated with their investment activity and, thereby, increase their expected return.

This study derives and tests an efficient market theory-based hypothesis for the prediction of inter-firm cash tender offer outcomes. This new hypothesis incorporates salient features from the Efficient Markets Theory, Contingent Claims Theory/Option Price Modeling, Capital Asset Pricing Theory and Event Study Methodology. The tender offer outcome prediction model is tested against a broadbased sample of tender offers to determine the formulation's accuracy and robustness. The study results are assessed in terms of how well the model predicts cash tender outcomes and whether or not market participants are rational and efficient in assessing the wealth-related consequences of investing in the securities of firms which are the target of tender offers.

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Finely I give my most heartfelt thanks to my wife, Linda, and my children, Megan and James. Their understanding and forbearance has been beyond human expectation. Any honors and achievements that I have received or will receive are truly the result of their efforts as much as mine. I dedicate this dissertation to my wife and children in loving recognition of their vital contribution.

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CHAPTER 1

PROBLEM STATEMENT

Recently a significant portion of firms' capital expenditures has been accomplished through the acquisition of the assets of other firms by mergers and tender offers.[1] Ingham, Kran and Lovestam (1992) studied acquisition expenditures in the United Kingdom and found that during the mid-1980s the level of merger and tender offer expenditures more than doubled in real terms. While the majority of tender offers are successful,[2] [3] [4] a significant number of tender offers fail for various reasons. The accurate prediction of the completion or withdrawal and the financial returns of a tender offer would give investors valuable information upon which to base their investment decisions. The target firm shareholders could use the information as a basis for their tendering decision. For the arbitrageurs, a predictive model would reduce the uncertainty associated with their investment activity and, thereby, increase their expected return.

A tender offer can fail for any one of many reasons, but there are three broad classes of reasons for tender offer failure:

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[1]Conn (1980) reports that during the period from 1966 to 1976 assets acquired by merger accounted for between 8 to 46% of new annual assets created by gross private Canadian investment in the manufacturing and mining sectors.

[2] Fabozzi et.al.. (1988) found that over the period 1977-1983 87% of tender offers were successful.

[3]Fabozzi, et.al.. 1988 found that for the period from 1977 through 1988 between 8 and 26% of all tender offers failed.

[4] Hunt 1990 found that half of the acquisitions in the United Sstates and United Kingdom corporate market since 1985 failed.

1. The shareholders of the target firm do not perceive the offer as increasing their personal wealth and, therefore, reject the offer by refusing to tender their shares.

2. An external government or regulatory body blocks the consummation of the offer on legal or political grounds.

3. Management initiates action that prevents either the accomplishment of the merger or raises the costs to the acquiring firm to such an extent that the acquisition is no longer attractive to the purchasing firm.

For a tender offer to be successful it must be wealth-enhancing for a sufficient number of the target shareholders for them to tender their shares triggering the execution of the tender offer. Brown (1988) describes the success of tender offers as depending on changes in individual wealth resulting from the acceptance or rejection of the tender offer. ". . . the change in after-tax wealth depends on (1) the price that each investor paid for his or her shares and (2) the investor's tax rate, both of which differ across investors. Thus, shareholder unanimity does not hold and the outcome of shareholder voting depends on the preferences of a majority coalition."[5] Fishman (1989) considers the acceptance of an offer to be certain whenever the tender price is greater than a known reservation price. Fishman used the price of the target firm immediately following the offer as the reservation price in testing his model. In a similar vein, Browne and Rosengren (1987) state that success for a tender offer can be considered a certainty when ". . . once a bidder has indicated a willingness to pay substantially above the market price for a company's shares, target shareholders - or at least a substantial fraction of them - expect to receive this higher price. They will not be persuaded to pass up this

[5] See Brown (1988, p. 195-196).

opportunity by management assurances that a better day and a still higher share price are around the corner."[6]

An ability to predict the financial consequences of takeover attempts and by that earn abnormal economic rents would refute the theory of efficiency in the capital markets. The ability to earn abnormal economic rents simply by buying the stocks of firms that are sure bets and selling short the stocks of firms that will not be acquired would be favorable evidence that the market for corporate control is inefficient. If capital markets are efficient, then either the prediction of tender offer contest outcomes cannot be accomplished at a significant level of accuracy or, if prediction is possible, the market must establish prices in such a manner that the market price is the rational expected return. The price is an unbiased predictor that is the sum of the value of each possible outcome times the probability of the occurrence of the outcome. This study will test the hypothesis that the market price for target firm's shares during the tender period is an efficient Arrow-Debreu security price that spans all possible states of nature.[7] In terms of investor wealth, tender offer contests are not limited to just two states of nature. At the time of announcement the states of nature include:

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[6]See Browne and Rosengren (1987, p.17).

[7]An Arrow-Debreu market security is defined as the sum of the prices of a series of primitive securities which span the totality of possible states of nature, and where the primitive security is a security which pays one dollar in one state of nature and nothing in all other states of nature. An efficient Arrow-Debreu price is a price which is the sum of the state prices times the state probability. In the case of tender offers there are two primary states of nature- success where the payoff is the tender offer price and failure where the payoff is the fallback price which is the present value of the expected cash flows of the target firm as a-going-concern. Secondary states of nature include but are not limited to cessation of trading due to any of a range of additional tender or merger offers, employee or insider buyouts, or continued trading at prices which are less than, equal to or greater than levels that would have been forecast based on knowledge available to investors prior to the announcement of the tender offer. See Arrow (1964), Debreu (1959), and Heston (1993).

1. Completion at the initial tender offer price.

2. Completion at a higher price through tender to the original bidder or a third party bidder.

3. Withdrawal and subsequent trading at a going concern fallback price that is indeterminate at the time of announcement.

4. Withdrawal with future trading prices based upon new information revealed during or after the tender offer period.

This study will examine both the abilities of the capital allocation market to predict the outcome of tender offers and to forecast investor wealth effects over a near term period lasting approximately four months. To ensure that the observations reflect effects associated with only a single tender offer contest, all events that exhibit evidence of the existence of competing tenders will be excluded from the database sample.

The results in previous studies that sought to establish methodologies for predicting takeover activities have been mixed. Jensen and Ruback (1983) found that "It is difficult, if not impossible, for the market to predict future targets."[8] Wansley, Lowe, and Yang (1983) showed that historical cost data Multivariate Discriminate Analysis (MDA) predictive models could beat the market. However, Palepu (1986) found no evidence of predictive capabilities. In his work Palepu addressed several methodological and statistical problems that he believed biased previous findings. Barnes examined takeover prediction and market efficiency and found that ". . . the prediction of takeovers by

[8]See Jensen and Ruback (1993, p. 29).

means of statistical models and accounting ratios would appear to have had some success." "All this is in stark contrast to the random walk and efficient market hypotheses that are equally at the heart of the theory of stock markets and share price behavior."[9]

Theoretical Approach

This study's theoretical approach is based primarily upon the efficient market hypothesis (EMH). The EMH holds that the market's aggregation of the financially motivated actions of all participants results in market prices fully incorporating all relevant information about the nature and prospects of an investment. The primary operational and theoretical EMH concerns are the following:

1. Are market prices sufficiently accurate predictors of future value to preclude an investor from earning abnormal economic rents due to exploitation of incorrect pricing?

2. How is new information incorporated into the price determination?

3. How rapid is the price adjustment relative to the arrival of new information?

4. What types of information are incorporated into market price determinations?

5. Is some level of inefficiency necessary to provide the "lubrication" that permits markets to function?

Primary works that have contributed to the development of the efficient market hypothesis are presented below:

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[9]See Barnes (1990, p. 17).

From the 1930's through the early 1960's the interpretation of the EMH was that if markets are efficient then it is impossible to earn economic profits through the exploitation of available information. During this phase of the EMH development it was believed that price movements were best described by a random-walk.

In the early 1960's rational expectations hypothesis (expectations are the best predictors of future events) became the accepted economic formulation of the EMH. (Muth 1961) In 1965 Samuelson presented the hypothesis that price changes in a speculative market must behave as independent random drawings if the market is competitive and economic trading profits are zero. (Samuelson 1965) This statement of the hypothesis is predicated on the rationale that if unexpected price changes reflect the arrival of new information, then the price changes associated with the previously unknown information must, of necessity, be unpredictable.

Fama, Fisher, Jensen and Roll (FFJR 1969) shifted the focus of EMH testing to examination of the speed with which markets adjust to specific types of information. This type of investigation has become known as "event study methodology." This study will use FFJR event study methodology as a means to isolate factors associated with the outcome of a tender offer from factors associated with other sources of price change.

Fama (1970) addressed the question of "what information" is reflected in market prices. Fama established three levels of market efficiency:

1. Weak Form Efficiency -- historical information is incorporated into securities prices.

2. Semi-Strong Form Efficiency -- securities prices incorporate all publicly available information.

3. Strong Form Efficiency -- securities prices fully reflect all information, both public and private.

Black's article "Noise" (Black 1986) proposes that for a market to be efficient there must be some level of inefficiency that gives traders an economic incentive to trade. Price provides a distribution around the security's value in this context. Black proposes that "information trading" will drive the price of securities toward their value. Furthermore, value will fluctuate only with the arrival of new information.

During a tender offer period both the investor and the risk arbitrageur have unique investment opportunities. Again the key considerations are the types of information incorporated into the market's price determination mechanism and the speed with which the price changes. The central investment question is -- Does the market price for the target firm's shares fully incorporate all relevant information, and, if not, can an economically significant return be earned through exploitation of the pricing inefficiency? In the context of this study, Black perhaps best describes the application of the efficient market hypothesis when he discusses the function of "information trading." Black asserts that trades based upon information will force the price of an asset toward its value since "almost all" markets are indeed efficient. (Black 1986)

One approach to answering the central investment question would be to identify all items of "relevant information" and then use appropriate methodologies to assign a value to the economic effect of the information. The econometric modeling literature discussed in Chapter 2 exemplifies this approach. Two major difficulties exist with econometric modeling. First, the number of relevant types of information that influence the market price of an asset is vast and their measurement is difficult. Furthermore, the exact contribution of any single bit of information on the overall price determination is dynamic and difficult to quantify.

A second approach to the central investment question is to accept the modern post-Samuelson efficient market hypothesis that the market price is the best indicator of value. Investors must be careful in relying on an efficient market hypothesis decision support process. The market may be only partially efficient (some but not all information is fully reflected in the market price), the methodology used to arrive at the investment decision support metric might be flawed, or that the market may be efficient to a degree that prevents earning more than an economically justifiable return when the cost of developing and carrying out the decision support system is considered.

Fama provides a syntax for discussing the market efficiency of any economic activity. (Fama 1970) In terms of Fama's three forms of market efficiency this study is primarily a test of the semi-strong form of market efficiency -- a test of the market's ability to incorporate all publicly available information into the market price of the target firm's shares. This study will test the outcome prediction model's economic efficiency, the ability to earn abnormal rates of return and the operational efficiency, and the ability to correctly predict the outcome of a tender offer without regard to the economic consequences.

The theoretical work of Lewellen and Ferri (1983) and the practitioner oriented work of Brown and Raymond (1986) provide the genesis for the development of this study's efficient market hypothesis methodology. Lewellen and Ferri's investigation analyzed corporate mergers as an alternative form of capital investment. The goal of their work was to test if mergers provide "value enhancement." Brown and Raymond sought to develop a methodology by which participants in risk arbitrage investment strategies could arrive at a prediction of the outcome of an announced tender offer. The key insight provided by these foundation articles and the basis for this study is that arbitrage mechanisms will drive the market to some level of pricing efficiency. The shortfalls of Lewellen and Ferri and Brown and Raymond are that they did not provide a testable

construct for implementing and testing the hypothesis or a means to adjust for the effects of general market price movements during the tender offer.

The operative hypothesis in both Lewellen and Ferri and Brown and Raymond are that during a tender period a target firm's share price represents a composite portfolio composed of a portion representing the fundamental asset-based value that would endure should the tender offer fail and a portion that represents the expected value of the tender offer premium. The concept in both Lewellen and Ferri and Brown and Raymond is that one can infer the probability of success for a tender offer from the ratio of the gain recognized during the tender period to the potential gain.[10] The operational deficiency in both the Lewellen and Ferri and Brown and Raymond approaches is that their methodologies are *ad hoc* assumptions that are not subjected to a rigorous theoretical proof. [11,12]

Bhagat, Brickley, and Loewenstein (1987) (BBL) provide an option pricing model based methodology that will be adapted to provide a value that will be adopted to overcome some shortcomings of prior approaches. BBL model the price of a target firm share during the tender period as the price for a two-security portfolio. In the BBL portfolio the share price is the sum of the present values of the ownership share of the firm as a going concern and the value of a fractional option-like claim on the firm making

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[10]See Eq. 3-2 and Eq. 3-3.

[11]The primary assumption made but not tested by Lewellen and Ferri is that the pre-announcement price is an accurate predictor of the failure price.

[12]Brown and Raymond's questionable operational assumptions are concerned with the ability to construct a risk arbitrage portfolio which has an expected return of zero under all states of nature, arbitrary selection of a fall back price, and a failure to recognize that rational investors will require that the investment earn at a minimum the risk free rate of return. See chapter 3 for a detailed discussion of these concerns.

the tender offer. The exercise price of this pseudo-option is the tender offer price. The exercise date is the date of expiration of the tender offer. This ability to break the market price into its two component parts permits the development of a robust yet mathematically-testable method of tender offer outcome prediction. The major shortcoming of the BBL procedure is that they do not account for the effect of general market movements on the price of the composite portfolio represented by the target firm's stock.

In summary, the efficient market hypothesis provides an environment that defines a frame of reference, identifies what factors are important, and provides measures for evaluating success. The next chapter develops the literature of tender offer outcome prediction.

CHAPTER 2

LITERATURE SUMMARY

Previous takeover prediction studies provide mixed results. Jensen and Ruback found that "It is difficult, if not impossible, for the market to predict future targets." [13] Wansley, et al, (1983) believed that they demonstrated that the market could be beaten by predictive models when they achieved positive results with an MDA model based upon historical cost data. In a contra vein, Palepu (1986) found no evidence of predictive capabilities. In his work Palepu addressed several methodological and statistical problems that he believed biased previous findings. Barnes examined takeover prediction and market efficiency and found that ". . . the prediction of takeovers by means of statistical models and accounting ratios would appear to have had some success." "All this is in stark contrast to the random walk and efficient market hypotheses which are equally at the heart of the theory of stock markets and share price behavior." [14]

Bankruptcy Prediction

The prediction of tender offer success is a part of the continuum of the financial research analyzing the outcome of dichotomous business events. This body of literature has its methodological origins in the prediction of a firm's probability of entering

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[13]See Jensen and Ruback (1983, p. 23).
[14]See Barnes (1990, p. 17).

bankruptcy. The bankruptcy prediction literature generally used combinations of variables representing firm-specific, industry, or economy-wide measures of factors that theoretically contribute to a firm's solvency. The analytical techniques in bankruptcy prediction studies developed over time from linear regression analysis, through linear dichotomous event analysis, to nonlinear dichotomous event analysis. The sophistication of the analytical tools and the distribution assumptions used have followed the increasing power and availability of digital computers and statistical software programs.

Takeover Target Prediction

The second thrust in the predecessor literature was predicting which specific firms in a population would be the target of an acquisition attempt. The predictor variables used were generally firm and industry specific financial and economic variables. These variables appeared to be of either theoretical or analytical value in predicting a firm's vulnerability to being a takeover candidate. Again the sophistication of the analytical tools and distribution assumptions advanced in pace with the power and availability of computers and statistical software packages.

Econometric Modeling

The penultimate link in the research background leading to the current effort was *a priori* econometric modeling efforts to predict the success of acquisition attempts. If firms that initiate takeover attempts are acting rationally, then the factors that make a firm a good takeover target will in turn result in a high probability of acquisition success. The characteristic that distinguishes the *a priori* econometric modeling research efforts from the final phase of the literature and from this study is the failure to use market efficiency-based arguments. Examples of this research are Ebeid (1974), Pelligrino (1972), Hoffmeister and Dyl (1981), Walkling (1985), and Stone and Zissu (1991).

Walkling (1985) is perhaps the most illuminating effort in the econometric modeling branch of tender offer outcome research. Walkling developed and tested a supply and demand model for tender offer outcome prediction. Walkling's model used variables that would increase the supply of "obtainable shares." He used both linear and logistic techniques to test the theoretical constructs. A specific finding in Walkling was that previous results showing insignificance for tender offer premium variables was erroneous. Walkling demonstrated that the studies before his had suffered from a misspecification bias in estimating the magnitude of the tender offer premium. This bias resulted from a failure to account for pre-tender offer announcement price increases that occur because of leakage of information concerning impending takeover attempts.

Stone and Zissu (1991) provide a recent review and update of the econometric modeling based tender offer prediction literature. While supporting the overall methodologies and findings of the econometric model-based literature, Stone and Zissu present a methodology that they believe overcomes a "basic flaw" in previous works. The flaw that they believe had been ignored is that the ". . . variables that determine the outcome of a tender offer are endogenous." Stone and Zissu address the problem of endogenous variables through a system of simultaneous equations. The endogenous variable problem arises as follows: "The endogeneity problem exists due to the following relationships: (1) The outcome of a tender offer is a function of the bid premium and the mood of the deal; (2) The bid premium is a function of the mood of the deal; and (3) the mood of the deal is a function of the bid premium." [15] Stone and Zissu define the "mood of the deal" as whether the terms are "friendly" or "otherwise." The simultaneous

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[15]See Stone and Zissu (1991, P. 18).

equation variables included share ownership by both target and bidder firm management, agency considerations, and the composition (cash or securities) of the bid premium being offered.[16]

Efficient Market Hypothesis Modeling

The common characteristic and single greatest weakness of the research described above is that all of the predictions were based solely on a theoretical hypothesis that did not include reference to or reliance on the market's perception of the offer's outcome. Recent research in the field of tender offer success prediction overcomes the failure to consider EMH. Along with the more realistic theoretical assumptions the most current research also uses a higher level of sophistication in the analytical tools used and the distribution assumptions.

> An early market efficiency-based merger outcome study is the theoretical work of Lewellen and Ferri (1983). The stated objective of the Lewellen and Ferri research was the study of corporate mergers as an alternative form of capital investment and whether or not mergers provide "value enhancement." Specifically, Lewellen and Ferri showed ". . . how observable share prices in an efficient market can reveal the synergistic payoff from a business combination, how they can simplify the task of acquisition valuation appraisal, and -- of particular significance -- how the uncertainty that a proposed acquisition will go through can be accommodated in the measurement process."[17]

Lewellen and Ferri examined the situation where the compensation to the target shareholders is entirely newly issued common shares of the acquiring firm. The analysis recognizes the possibility that the takeover attempt may not be successful with the statement ". . . immediate post-offer-announcement stock prices will typically contain

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[16]See Stone and Zissu (1991, p. 20).
[17]See Lewellen and Ferri (1983, p. 25-26).

some 'discount' for the possibility that the deal may not go through . . ."[18] Lewellen and Ferri hypothesized that they could estimate the probability of tender offer success as the ratio of observed market price immediately following the announcement of the merger attempt to the prices that would prevail given certainty of success. This hypothesis requires that the pre-announcement price for the shares of both firms be an unbiased predictor of the value of the firms if the acquisition attempt were to fail and the firms remained independent going concerns. Lewellen and Ferri state that a weakness in their hypothesis is that the pre-announcement prices may not be valid estimates of the post failure prices of the separate firms. The primary areas for additional research left unanswered by Lewellen and Ferri were the following:

1. Probability of success prediction for mergers in which the tender compensation is other than newly-issued common shares of the acquiring firm.

2. The proper choice of a proxy for a post-failure price for the target and acquiring firms.

3. The effect of general market price movements during the tender offer period.

The next research in the efficient market hypothesis literature is Brown and Raymond (1986). This article is an example of practitioner oriented quantitative research. The intent of Brown and Raymond was to provide a model for managing day-to-day risk arbitrage investments. The primary finding of Brown and Raymond's work was that ". . . it is shown that an ongoing prediction as to the eventual success of the merger can be inferred from the prices set in the post-announcement period." Takeover arbitrage

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[18]See Lewellen and Ferri (1983, p. 27).

is described as a mechanism in which competition between participants will result in a situation where " . . . the prevailing prices of the firms involved will reflect the consensus view of whether or not the deal will eventually be consummated."[19]

Bhagat, Brickley, and Loewenstein (BBL) (1987) present a methodology that will be used to provide a starting point to overcome some shortcomings pointed out in the previously reviewed research. The objective of BBL's research was to use option pricing theory to examine the wealth effects of interfirm cash tender offers. BBL modeled the market price of a share of stock in a target firm as the price for a two-security portfolio. The price of this portfolio is the sum of the present values of the ownership share of the firm as a going concern and the value of a fractional option-like claim on the firm making the tender offer. The exercise price of the BBL pseudo-option is the tender offer price. The exercise date is the date of expiration of the tender offer.

When BBL investigated the sources and nature of the observed gains associated with tender offers they obtained results that differed from the Capital Asset Pricing Model (CAPM) predictions. BBL found that the portfolio standard deviation decreases during the tender period and that there were significant positive abnormal returns during the tender period for a 'universe' of offers.[20] BBL attribute the unexplained upward shift in returns to ". . . increased likelihood of important announcements concerning the target firm (i.e., other bids, legal actions, etc.)." [21] BBL conclude from their empirical results

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[19]See Brown and Raymond (1986, p. 55).
[20]See Bhagat, Brickley, and Loewenstein (1987, p. 967).
[21]See Bhagat, Brickley, and Loewenstein (1987, p. 967).

that the market price for a target firm during a tender contains compensation for "some type of information risk" which CAPM is not pricing.[22]

The latest article in the efficient market hypothesis tender offer outcome prediction literature is Hathaway's 1990 article entitled "Partial Takeovers as Put Options." This article proposes that during a takeover attempt the takeover premium may be modeled as a put option. Hathaway states ". . . that takeovers, both full and partial, are attempts to secure control of the target firm to implement value-increasing strategies."[23] Hathaway's model uses the Grossman and Hart (1980) decision model. This model states that for a takeover to be successful the offer price must be greater than the price expected to prevail in the market immediately after the expiration of the takeover offer. Hathaway further states that the Grossman and Hart condition will normally be true because many offers are offers for only part of the outstanding shares; ". . . only part of the stockholder's equity can realize the offer price, owing to the very nature of a partial takeover attempt. Hence, after a successful takeover attempt, the shares of the target firm are typically priced below the offer price."[24]

In his model Hathaway assumes that ". . . all option holders act rationally and in the same manner. Hence, if it is optimal for one person to accept the offer (exercise the put), then it is optimal for all."[25] This is in contrast to Grossman and Hart (1980) and Brown (1988) where the accept-or-reject decision is described as being based upon the effect on the individual investor. According to Grossman and Hart and Brown, the

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[22]See Bhagat, Brickley, and Loewenstein (1987, p. 968).
[23]See Hathaway (1990, p. 28).
[24]See Hathaway (1990, p. 28).
[25]See Hathaway (1990, p. 28).

investor unique wealth effect is dependent on the investor's individual situation. Hirshleifer and Titman (1990) conclude that for a tender offer to fail the bidder must be uncertain as to the prices at which shareholders will tender. The bidder uncertainty arises if shareholders have personal costs of tendering. Examples of these personal costs include transaction costs, taxes, and liquidity considerations. Grossman and Hart also postulate a free rider problem. Hirshleifer and Titman define the nature of the problem as being that shareholders may rationally turn down bids that offer substantial premium over the current market price if they can share in the post-takeover price without tendering. Therefore, success depends on there being a price that "equals or exceeds the post-takeover value of the shares."[26] Bradley characterizes target stockholders as a "diffuse group of homogeneous, wealth-maximizing price takers. 'It follows that the target shares will flow to the firm (management team) that makes the best offer in terms of the price offered for the sought-after or controlling shares and the expected post-execution market price for the target shares that are not demands." As a consequence of his model Bradley states the following implication, ". . .Successful bidding firms will be forced to pay a premium--relative to the pre-announcement as well as the post-execution market price--for the target shares that they purchase."[27] Samuelson and Rosenthal (1986) provide a probability expectations model. This model postulates the following tender period behavior.

> "At any time during this period, the investor observes the current price of the target shares and infers the corresponding market odds of success. Based on whatever information is at his or her disposal, the investor formulates an assessment of the odds of tender success. If the investor's own odds of success are

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[26]See Hirshleifer and Titman (1990, p. 296).
[27]See Bradley (1980, p. 347).

greater (less) than the market odds, one can earn an excess rate of return by purchasing (selling short) the target shares."[28]

Jensen and Ruback define the investor's tender offer decision as being primarily played out in the managerial labor market as described by Fama (1980). In this context the stockholder plays a "relatively passive, but fundamentally important judicial role." [29] The shareholders' decision rule is that they "simply choose the highest dollar value offer from those that are presented to them in a well-functioning market for corporate control."[30]

Hathaway models the shareholder's choice as a rational expectations decision. In a full takeover the comparison is between the tender offer price and the expected post-takeover share price if current management maintains control. For partial takeovers Hathaway uses the Bradley(1980) model. Bradley models the investor's decision variable as the sum of the tender offer price for that proportion sought and the expected ex-takeover price for the remainder of the shares owned. In Hathaway's model the post-takeover price used in all instances is the price that is expected to prevail if current management retains control of the target firm. A unique aspect of Hathaway's formulation of a takeover prediction model is his hypothesis of the existence of a "temporary market support" factor during the life of the tender offer. According to Hathaway, "This support is usually assumed to be sourced from parties that are said to be 'friendly' to the existing management group for whatever reason (presumably self interest). The objective of this support is to attempt to reduce the probability of stock

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[28]See Samuelson and Rosenthal (1986, p. 482).
[29]See Jensen and Ruback (1983, p. 587).
[30]See Jensen and Ruback (1983, p. 587).

being delivered to the bidding party. It can be interpreted as attempting to reduce or eliminate the probability of the put option being exercised."[31] Hathaway further states that the effect of the "temporary" support is to encourage the sale of the stock on the open market. Hathaway decomposes the market price for the shares of a target firm during an open tender offer is as follows:

$$S^*(t) = \begin{cases} S(t) + P(t) + XS(t) & 0 <= t <= T \\ S(T) & t > T \end{cases} \qquad \text{Eq. 2-1}$$

Where:

S(t) = the expected stock price during an open tender offer period,

S(T) = the expected price immediately after the expiration of the tender offer,

S*(t) = the observed market price during the open tender offer period,

XS(t) = the temporary excess price support,

P(t) = the implicit put option price,

X = tender offer price,

α = proportion of the firm's securities sought,

t = the instant time during the tender offer period,

T= the time of expiration of the tender offer.

The following pair of equations provides the value, V, of the stockholder's portfolio at the instant the stocks go ex-takeover.

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[31]See Hathaway (1990, p. 30).

$$V = \begin{cases} (1 - \alpha)\, S(T) + \alpha X & \text{if accepted} \\ S(t) & \text{if rejected} \end{cases} \qquad \text{Eq. 2-2}$$

The ex-takeover value of a successful offer is the sum of proportion of shares sought times the tender offer price and one minus the proportion sought times the ex-takeover price. The ex-takeover value for a failed offer is the ex-takeover price.

Hathaway describes the effect of this equation as implying that " . . . the stockholder's position is equivalent to being long in both a share and a partial put option."[32] Hathaway's set of indeterminate equations shown above can be solved if there is a mechanism by which one can determine the price for the ex-takeover shares. Hathaway's hypothesis is that if a firm has outstanding warrants with exercise dates after the ex-takeover date, then an implied share price may be found by solving an option pricing model in which the particulars of the warrant-based option condition are used as inputs to the option pricing model. The rationale provided for the ex-takeover share price being based upon the warrant's price is that if the warrant holders cannot exercise their warrants before the expiration of the tender offer, then the only value accessible to them is the ex-takeover share price.

Hathaway illustrated his hypothesis with a case study that provides limited details on a single takeover attempt that satisfies his unique requirement of there concurrently being both an outstanding warrant and a tender offer. The specifics of the case study are that in February of 1986 an offer was made to acquire approximately 43% of the outstanding shares of ACI International, Ltd. At the time of the tender offer ACI had warrants

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[32]See Hathaway (1990, p. 31).

outstanding that represented 11.8% of the firm's equity. The warrants could only be exercised during a two-month window commencing some four months after the expected ex-takeover date. The volatility of daily stock price was estimated from a pre-takeover announcement period to be 30.0% per annum. The inferred volatility from the solution of the Black and Scholes (1973) option pricing model using the market price of the warrants before the announcement was estimated to be 60.0% per annum. Hathaway's comment on the difference between the long term historical daily share price volatility and the twice as high implied volatility from the solution of the warrant-based option pricing model was that the investors in the warrants may have perceived greater volatility and priced the warrants accordingly. Hathaway found that the takeover premium ranged from 10 to 17 cents per share and that ". . . there was evidence of extra price support for the stock ranging up to about 25 cents."[33]

The basic inadequacy in Hathaway's hypothesis is his failure to account for the uncertainty created by the fact that the ex-takeover price will be at one of two distinct levels depending upon the outcome of the takeover contest. In the event of a failure of the takeover attempt, the ex-takeover share price will be the present value of the expected cash flow under current management given all information revealed by the fact that a tender offer has been made and failed. Should the takeover be successful, the ex-takeover share price will be the present value of the expected proportional future cash flows of the combined firm accruing to the shareholders of the target firm given that the new management will implement their "value-increasing strategies." The determination of the specific level of the ex-takeover share price is an empirical question that is outside

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[33]See Hathaway (1990, p. 37).

the scope of this study. If the takeover attempt is successful and a rational value-increasing act on the part of the acquiring firm, then the ex-takeover share price should have a median value that approximates the tender offer value. Similarly, in the case of a failed takeover the ex-takeover share price distribution should have a median value which is centered on the present value of the firm's cash flows as the perception of those cash flows has been influenced by the knowledge of an attempted but failed takeover attempt. The effect of failing to properly account for the uncertainty associated with the success or failure of the takeover is to understate the ex-takeover share price.

Using this literature survey and background information as a foundation, the next chapter will develop the overall architecture and methodologies used in this study. This architecture will combine the three diverse but supporting areas of risk arbitrage, option pricing theory, and event studies.

CHAPTER 3
METHODOLOGY

The quantitative analysis in this study is based upon the combination of three separate but related methodologies. The first underlying support comes from Brown and Raymond (1986) who develop a risk arbitrage portfolio methodology for predicting the outcome of corporate takeovers. The key to this methodology is the formation of a portfolio that is assumed to have an expected return of zero. The second methodology supporting this study is the work of Bhagat, Brickley and Loewenstein. BBL develop the premise that during a tender offer period the value of a target firm's securities is based upon holding a portfolio composed of an ownership share in the firm and a call like claim on the firm making the tender offer. The third supporting area is the Event Study body of literature established by the seminal article by Fama, Fischer, Jensen, and Roll.

Risk Arbitrage

The Brown and Raymond study is very attractive conceptually but contains a number of theoretical shortcomings. The first deficiency in the derivation of the Brown and Raymond procedure is that they do not provide a mathematically-provable construct for the basis of their methodology. Rather, they assume that they can construct a risk arbitrage portfolio that has an expected return of zero. In the Brown and Raymond model the expected return on the target firm's shares is the weighted sum of the gain to be realized if the offer succeeds and the loss that is incurred if the offer fails. The weighting factor is the market's perceived probability of the tender offer being successful.

If the tender offer is successful, the risk arbitrage investor will receive a positive rate-of-return equal to the difference between tender offer price and the market price divided by the market price.

$$(P_T - P_m) / P_m >= 0 \qquad \text{Eq. 3-1}$$

If the tender offer fails, the rate-of-return is negative and equal to the difference between the market price and the price to which the share will fall after failure divided by the market price.

$$(P_s - P_m) / P_m < 0 \qquad \text{Eq. 3-2}$$

Brown and Raymond used a pre-tender offer share price as a proxy for the fallback price. The hypothesis presented by Brown and Raymond is that the market price during the tender offer period is established in such a manner that the expected risk arbitrage return is zero.

$$E(\Pi) = p[(P_T - P_m)/P_m] + (1 - p)[(P_s - P_m)/P_m] = 0 \qquad \text{Eq. 3-3}$$

Where:

$E(\Pi)$ = expected risk arbitrage return,

p = period t merger success probability,

P_s = ex-tender or fallback price of a share if the acquisition is unsuccessful,

P_m = market price of a share during the tender period,

P_T = period t tender offer price.

Solving Eq. 3-3 for p and simplifying yields:

$$p = \frac{1 - (P_s / P_m)}{\left[\frac{P_T}{P_m} - \frac{P_s}{P_m}\right]} \qquad \text{Eq. 3-4}$$

$$p = \frac{(P_m - P_s)}{(P_T - P_s)} \qquad \text{Eq. 3-5}$$

In Eq. 3-4 (P_T / P_m) and (P_s / P_m) are defined as the tender success and failure premiums, respectively. Brown and Raymond explain Eq. 3-4 as follows: ". . . it is straightforward to see that the market as a whole sets the likelihood that the takeover will be successful as the percentage of the incremental tender offer that has already been assimilated into the market price as of period t."[34] Brown and Raymond restate Eq. 3-5 as shown in Eq. 3-6 to insure the characteristics of a probability . The effect of Eq. 3-6 is that the value for the probability of tender offer completion will fall between the bounds of zero and one.

$$p = \text{Min}\ \{\ 0, [\ \text{Max}\ \{\ (P_m - P_s) / (P_T - P_s)\}], 1\ \} \qquad \text{Eq. 3-6}$$

An offer would be considered to be a certain success if the period t market price is equal to or greater than the tender offer price and, conversely, the offer would be considered to be a certain failure if the market price should fall below the estimated fallback price.

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[34]See Brown and Raymond (1986, p. 57).

The second shortcoming of the Brown and Raymond methodology is their method of selecting a fallback price (P_S) at which it is expected that a share of the target firm will trade after an unsuccessful takeover attempt. Brown and Raymond select their post-expiration fallback proxy in an *ad hoc* manner which is not supported in any manner other than by an appeal to ex-post quantitative analysis. The Brown and Raymond fallback price is the market price for the target firm's shares at one of four pre-tender offer times. They use the market price one, two, three, or four weeks before the announcement of the tender offer as the fallback proxy. The difficulty with the use of the Brown and Raymond proxy is that the price of the target firm's shares before the actual announcement of a tender offer is an indeterminate quantity. The price is the sum of the present value of the firm's future earnings as a going concern and the value of any information about the possibility of a takeover attempt. Amoako-Adu and Yagil (1986) discuss the effect of pre-announcement information leakage on target firm share prices. They found that the actual date at which information concerning an impending merger starts to be included in the firm's price can only be determined *ex post*. However, there were statistically significant abnormal positive average returns for more than 50% of target firms two months before the actual announcement of the merger attempt. Fabozzi and Ferri (1988) showed that the positive average excess returns resulting from an unannounced takeover attempt are small until one month before the announcement. In contrast to the relative late appearance of abnormal positive returns found by Amoako-Adu and Yagil and Fabozzi *et al*, Halpern (1983) used a two-parameter regression formula containing both industry and market indexes to determine a point in time when information of an impending merger is seen in the returns of a large proportion of the

firms. Halpern's conclusion was ". . . that the majority of companies have the news of an impending merger discounted from 7 months before the announcement date forward to the announcement date." [35]

In addition to not being able to segregate pre-announcement information leakage effects from the pre-tender offer target firm stock prices, the Brown and Raymond proxy also fails to consider the value of the information revealed by the tender offer announcement. Halpern (1983) recognized two possible influences on the target firm's stock prices during the period between the dates of announcement and the date upon which uncertainty regarding success or failure is resolved. Halpern's first effect was the fluctuation in the market and/or industry that affect the security prices of the merging companies. Halpern's second influence is concerned with price influences resulting from the market's prediction of the success or failure of the takeover attempt. Malatesta and Thompson (1985) address the cause and effect of what they call the announcement effect. 'The announcement resolves uncertainty about the event's timing. The announcement effect is the change in firm value attributable to this resolution of uncertainty."[36] Rappaport (1987) describes the effect of takeover announcements as eliminating uncertainty about management's actions. It is the resolution of uncertainty that accounts for much of the gain from mergers and acquisitions. Bradley (1980) comments on the post-execution market price as follows: 'Since an offer price higher than the post-execution market price is a necessary condition for a successful tender offer, and the interim price is a weighted average of the two, the analysis implies that the post-execution market price will be less than the interim price. This predicted price drop

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[35]See Halpern (1983, p. 568).
[36]See Malatesta and Thompson (1985, p. 238).

reflects the elimination of the offer premium that accompanies the competition of a successful tender offer."[37]

Brown and Raymond tested their success prediction model with a sample of weekly observations from successful and failed mergers collected from the 1980-1984 period. The study findings were consistent with their hypothesis in that the calculated average probability of success never fell below 70% for successful acquisitions nor did it rise above 50% for failed attempts. Brown and Raymond also tested to determine if the market's prediction capability improved during the tender-offer-period. Their results showed that the accuracy of only the predictions for the completed mergers improved over time. They attributed the absence of an increasing accuracy of prediction capability for the failed sub-sample to a biased estimate of the fallback price if the offer should fail and to investors' beliefs that there might be other successful mergers if the instant offer should fail.

The final deficiency in the logic of the Brown and Raymond methodology is the failure to ensure that the investment has an expected return that is at least equal to the risk-free return. Without this return a risk neutral investor would not invest in the risk arbitrage strategy that they propose. Failure to recognize the requirement to earn a return, which is at a minimum equal to the risk-free rate of return, causes the Brown and Raymond takeover outcome prediction metric to overstate the probability of success.

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[37]See Bradley (1980, p. 361).

Tender Offers as Portfolios

The second area of methodological support for this study comes from Bhagat, Brickley and Loewenstein (1987) (BBL). The hypothesis developed and tested in BBL is that during the tender period the market price of a target firm's shares is the price of a virtual portfolio. The price of the portfolio is the sum of the ex-takeover going concern value and the value of an option-like claim on the firm making the tender offer. The option-like portion of the market price arises because during the tender offer period the investors have the right, but not the obligation, to tender their shares in exchange for the tender offer price. Exhibit 1 shows the time phased nature of the components of a firm's share price. The formal statement of the BBL relationship is shown in Eq. 3-7:

$$P_m = P_s + C \qquad \text{Eq. 3-7}$$

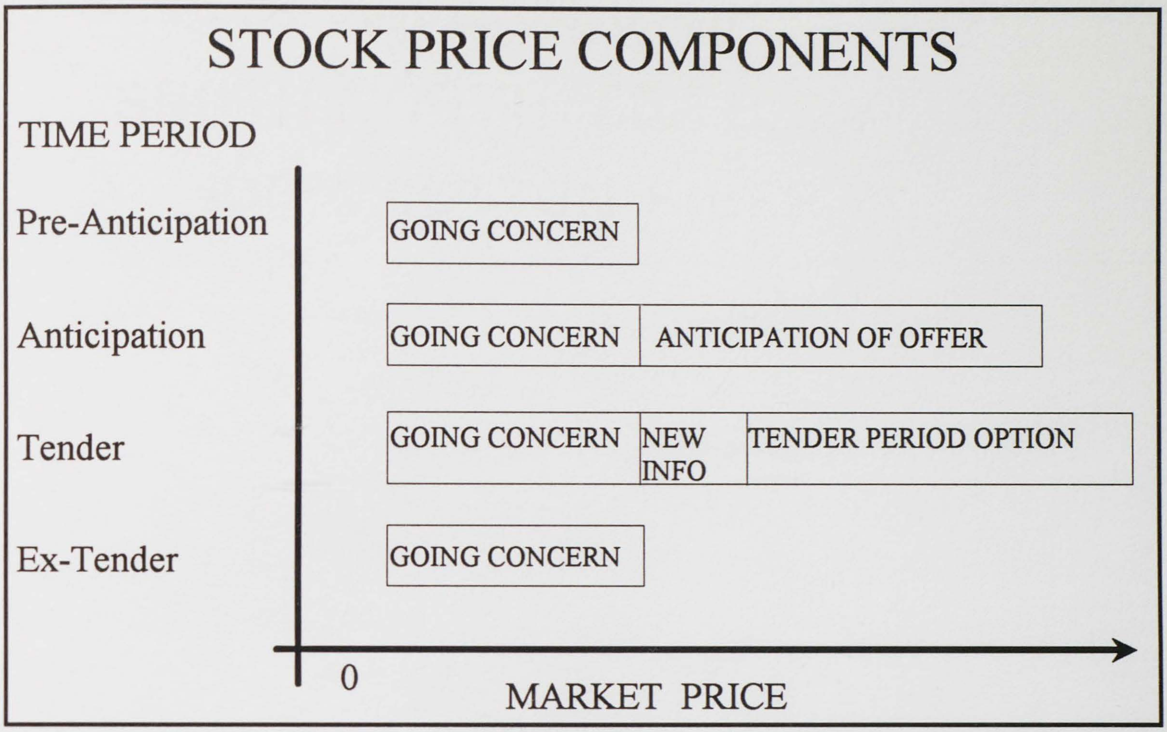
Where:

P_m = the market price for the target firm's shares during the tender offer

P_s = the fallback price of the target firm's shares

C = the value of the option like portion of the tender period portfolio

EXHIBIT 1



The use of Eq. 3-7 presents a difficulty in that both of the terms on the right-hand-side of the equation are unknown and not directly measurable. This study uses BBL iterative price decomposition methodology to overcome the indeterminate variable problem in Eq. 3-7. BBL assume that they can price the option-like portion of the tender-period portfolio accurately using the Black and Scholes Option Pricing Model. The Black and Scholes Option Pricing Model (OPM) when used in this manner poses a difficulty in that neither the prices of the underlying stock nor the standard deviation of the stock's returns are observable. BBL overcome the unobservable variable problem with a three-step iterative procedure. The first step uses historical values from the pre-tender offer period for the missing OPM inputs. The second step substitutes the OPM-derived option value into Eq. 3-7 to produce a trial value for 'P_S.' The third and final step in each iteration is to compare the trial value of 'P_S' to the value used in step one of the iteration. If the difference between initial and calculated values of 'P_S' are within

\$0.0625 of each other, they accept the calculated value as the correct value for 'P_S." If the calculated and initial values for 'P_S" are not within \$0.0625 of each other, then the calculated value is used as the starting point for the next iteration continuing until the difference between the initial and calculated value is less-than-or-equal-to the acceptable variance. [38]

Market Price Decomposition

The central hypothesis in the present study is that the market is efficient in establishing prices for the shares of firms that are the targets of a tender offer and that this pricing efficiency provides an unbiased prediction of the outcome of the tender offer. To test this hypothesis it is first necessary to separate the market price of the firm's shares into the component parts as shown in Eq. 3-7 and then to use appropriate methods to derive the market's perception of the outcome of the tender offer. This study will accomplish the decomposition of the market price in two steps: The value of the ex-tender equity rights will be calculated, and then the resulting intrinsic share value, 'P_S," will be subtracted from the market price, 'P_m," to arrive at a value for the option-like portion of the market priced portfolio.

The variable 'P_S" represents the market's expectation of the present value of the equity rights to the firm's assets and future cash flows should the tender offer be unsuccessful and the target firm continues to operate as a going concern. Various standard methodologies could estimate the value of the continuing equity interest in the target firm. Possible methodologies include CAPM, the Arbitrage Pricing Model (APM)

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[38]The selection of \$0.0625 as the allowed difference value is selected because most listed stocks have a 1/16 of a point minimum price movement.

or a market index model. The underlying basis of these pricing models is that the return on an asset is the sum of a minimum required risk-free rate of return and a return to the risk-averse investor for bearing the risk associated with the cash flows of the firm. The models differ in the definitions of how they compensate risk bearing and the types of risks considered. Each pricing model has its own theoretical appeal, assumptions and data requirements. These model assumptions determine the appropriateness of using a model in a given situation. The valuation of the going concern equity presents significant challenges that the pricing model must overcome if the results are to be accurate and robust.

New Information and Its Consequences

The announcement of a takeover by a tender offer provides an array of information for the market's valuation of the target firm. Obvious new information provided by the announcement is the tender offer premium that the bidder is willing to pay to obtain control of the assets and cash flows of the target. The tender premium is available to the target firm shareholders only if the deal is consummated. This section will discuss the valuation of the portion of the tender period portfolio that is contingent on the outcome of the tender offer. The option-like portion of the portfolio is evaluated in the next section. The second category of information revealed by the announcement of a tender are those returns not contingent on the outcome of the tender offer. The new information provided by the announcement of the tender offer includes:

1. The bidder's private information concerning the value of the target firm's assets and expectations of future cash flows of the target firm.

2. The market's perception of the probability of future takeover attempts.

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1. The bidder's private information concerning the value of the target firm's assets and expectations of future cash flows of the target firm.

2. The market's perception of the probability of future takeover attempts.

3. The nature of the expected actions that the target firm's management will take in response to this and future tender offers.

A factor that the literature does not address and that has had an impact on the results in this study is how to account for the new information that arrives during the tender offer period but before day zero. The nature of this new information can include increased tender offer bid prices, competing tender or merger offers, governmental actions, managerial actions, and any of a multitude of similar announcements. This study has attempted to mitigate the impact of the effects of these contemporaneous information revelations by designing the sample database to identify and eliminate observations that show a high probability that extraneous data has arrived. Samuelson and Rosenthal discusses this problem and in a manner similar to this study restrict their sample to noncompeting tender offers. Their conclusion is ". . . it is impossible to estimate the probability of the initial tender's success without a prior estimate of the level and likelihood of subsequent tender(s)."[39]

Event Studies

The third area of support addresses the facts that at any given moment there are many factors besides the event being examined that could affect the value of a financial asset. Though some of these factors are almost universal in their effects, other factors pertain to specific industries or sectors of the market, and some factors are unique to a single firm. To test the hypothesis of this study it is necessary to segregate the effects from the tender offer outcome and those that are more universal in their effect. The procedures to isolate

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[39]See Samuelson and Rosenthal (1986, footnote 3).

the effects associated with an event from the universal market wide effects were first explicitly stated by Fama, Fischer, Jensen and Roll (FFJR) 1969. The fully developed FFJR procedure is known technically as the "Residual Prediction Error Methodology" or more commonly as "Event Study Methodology." Researchers have used these procedures to study the unique effects associated with many different types of events. In the original FFJR article the event of interest was the way in which the prices of common stocks adjusted to the announcement of a stock split. The full FFJR Event Study Methodology is composed of the following steps.

1. Collect data on the actual stock market returns for the target firm's stock for a period before the event being studied.

2. Calculate a relationship that uses the historical data to define the correlation or relationship between broad-based market returns and the returns on the stock of the firm being studied.

3. Use a returns-generating methodology and the calculated historical relationship to determine what the returns "should-have-been" given the state of the overall market.

4. Compare the actual returns and the "should-have-been" returns to calculate the unique or residual returns that resulted from the occurrence of the event.

Even though this analysis is not a traditional "Event Study" it does require that all variables except that of the probability of the tender offer outcome be held constant. This research will only use the first three steps of the event study procedure. The theoretical intrinsic value of the target firm's shares calculated by Eq. 3-7 in the previous section will be normalized to account for general market movements with FFJR (1969) event study techniques. This methodology will produce a series of target firm stock prices for

days one through 123. This study uses the characteristic line as its returns generating model.[40]

$$R_{it} = a_i + B_i R_{mt} + e_{it} \qquad \text{Eq. 3-8}$$

Where (See Exhibit 2 for definitions of specific variables used in this study):

R_{it} = return on asset i in period t,

R_{mt} = return on the market portfolio in period t,

a_i = intercept for asset i,

B_i = coefficient for the return of the market portfolio for asset i,

e_{it} = error term for asset i in period t.

The actual procedure used on all days except Day 0 was to adjust the previous day's price by the amount that results when the current day's market return is substituted into the characteristic line. On Day 0 the unadjusted fallback price obtained by Eq. 3-7 was used as the adjusted daily price.

Tender Offer Outcome Prediction Model Derivation

The derivation of this study's outcome prediction model is an adaptation of the classic Cox, Ross and Rubinstein (1979) and Rendelman and Bartter (1979) development and

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[40] BBL (1986) found that the use of a Capital Asset Pricing Model (CAPM) returns generation procedure is not appropriate. They found an information uncertainty during the tender-offer-period and that ". . . this 'information risk' is a risk that is priced by the market and that is not captured in the standard CAPM; i.e., the traditionally measured 'excess return' can reflect the compensation required by investors during the tender-offer event period for higher information uncertainty."

proof of the Binomial-Option Pricing Model (B-OPM). During the tender offer period the price of the target firm's stock can rise by the multiplier amount "u" to the tender offer price "P_T" or fall by the multiplier amount d to the intrinsic underlying stock price "P_S." The variable "q" is the probability of experiencing an upward price movement and "(1-q)" is the probability of experiencing a downward price movement. Exhibit 2 shows the definitions for the symbology used throughout the derivation of the tender offer outcome prediction model. Exhibit 3 depicts the possible target firm stock price movements.

In the derivation of this outcome prediction model, as in the B-OPM, the objective is to construct a portfolio that has a perfectly hedged constant return under all states of nature. Exhibit 4 displays the option-like payoffs that provide the constant return situation. As can be seen from Exhibit 4, if the tender offer succeeds the return from owning the option-like portion of the virtual portfolio is equal to the tender offer price minus the ex-tender fallback price. If the offer fails the return is zero. A portfolio is developed which is composed of one share of the target firm's stock "P_S" and "m" calls. The value of "m" is a positive number that may be a fraction and is defined as the number of calls necessary to fully hedge the portfolio.

EXHIBIT 2

VARIABLE DEFINITIONS

Pricing Variables

C = market determined price of the option-like call portion of the tender period portfolio.

P_s = price that a share of a target firm is expected to trade at immediately after going ex-tender. This is the intrinsic value of the target firm given all information revealed by the occurrence of the tender offer.

P_m = market price of a target firm share during the tender period. This price represents the price of a portfolio composed of the intrinsic value of the firm as a going concern plus the price of an option-like call component. That is $P_m = P_s + C$

P_T = tender offer bid price.

Computational Variables

u = the upward multiplicative price movement that will occur upon the success of the tender offer. $u = 1 + \text{yield} = 1 + ((P_T - P_s) / P_s) = P_T / P_s$

d = the downward multiplicative price movement that will occur upon the failure of the tender offer.

$$d = 1 + \text{yield} = 1 + ((P_s - P_s) / P_s) = P_s / P_s = 1$$

C_u = payoff on the option-like call if the tender offer is successful.

$$C_u = uP_s - P_s = ((P_T - P_s) / P_s) - P_s = (P_T - P_s)$$

C_d = payoff on the option-like call if the tender offer is unsuccessful.

$$C_d = dP_s - P_s = ((P_s - P_s) / P_s) - P_s = (P_s - P_s) = 0$$

q = probability of an upward price movement.

m = the hedging ratio or number of calls necessary to arrive at a risk-free hedged portfolio.

p = probability of a tender offer being successful.

r_f = risk-free rate of return over the term of the tender offer.

T = term of the tender offer.

The theoretical rate of return, "d", and payoff, C_u, for failed tender offers are one and zero respectively. This is the result of the option's truncation of downside risk and the definition of the fallback price from Eq. 3-7. However, for actual auction market situations with imperfections the realized downside rate of return and payoff may be less than, greater than, or equal to zero. This study will use the actual variables for "d" and "C_d" ((P_s / P_s) and (P_s - P_s)) rather than their lowest common denominators in recognition of the market imperfections and for traceability to previous research.

EXHIBIT 3

TARGET FIRM STOCK PRICE POSSIBILITIES DURING THE TENDER PERIOD

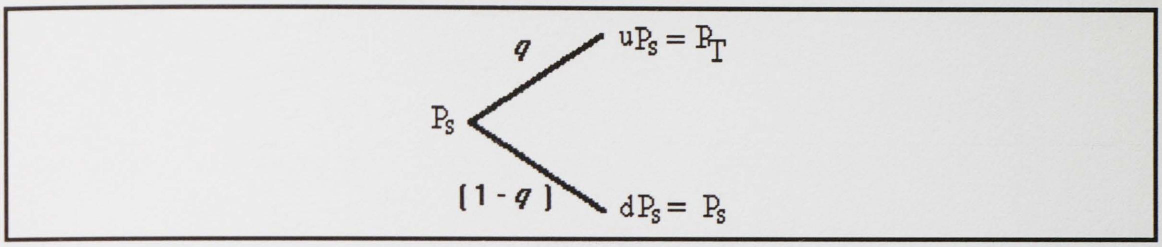
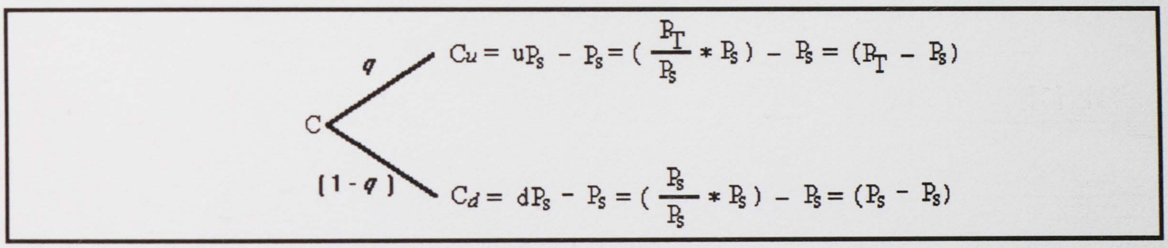


EXHIBIT 4

OPTION-LIKE PAYOFFS DURING THE TENDER PERIOD



A risk-free hedged portfolio is developed which is composed of one share of the target firm's stock "P_S" and "m" calls,[41] where "m" is a positive number that may be fractional and is defined as the number of calls necessary to arrive as a fully hedged portfolio position that has constant returns under all states of nature. Exhibit 5 shows the composition and returns of the hedged portfolio.

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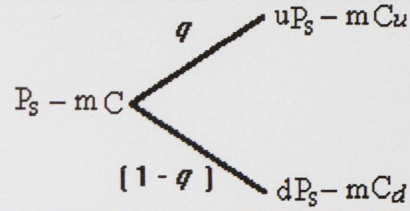
[41]In BBL (1987) the tender offer period portfolio is defined as consisting of one share of stock "P_S" and F partial puts. Where F is defined is the "... proportion of the target firm's common stock (not already owned by the bidder) sought in the tender offer." In the primary analysis of this dissertation it will be assumed that the pricing mechanism in the risk arbitrage market is based on the arbitrageur believing that all shares tendered will be accepted. This position is supported by the BBL finding that for those cases where shares were actually tendered the number of shares purchased was 2.61 times the stated F.

EXHIBIT 5

HEDGED PORTFOLIO CONSTRUCTION AND RETURNS



Given that the outcome under each possible state of nature is the same, the outcomes may be set equal to each other and the resulting equation may be solved for the hedging quantity "m" as shown in Exhibit 6. Exhibit 7 proves that the portfolio composed of the stock and calls is fully hedged and therefore risk-free.

EXHIBIT 6

HEDGING RATIO CALCULATION

$$\frac{P_T}{P_S} * P_S - m(P_T - P_S) = \frac{P_S}{P_S} * P_S - m(P_S - P_S)$$

$$-\frac{P_T}{P_S} * P_S + m(P_T - P_S) = -\frac{P_T}{P_S} * P_S + m(P_S - P_S)$$

$$m(P_T - P_S) - m(P_S - P_S) = +\frac{P_T}{P_S} * P_S - \frac{P_S}{P_S} * P_S$$

$$m\{(P_T - P_S) - (P_S - P_S)\} = P_S\left\{\frac{P_T}{P_S} - \frac{P_S}{P_S}\right\}$$

$$m = \frac{P_S\left\{\frac{P_T}{P_S} - \frac{P_S}{P_S}\right\}}{\{(P_T - P_S) - (P_S - P_S)\}}$$

EXHIBIT 7

PORTFOLIO HEDGING PROOF

PAYOFF MATRIX

STATES OF NATURE	PORTFOLIO	PAYOFF
SUCCESS	$uP_S - mC_u$	$\frac{P_T}{P_S} * P_S - \left\{ \left\{ \frac{P_S [\frac{P_T}{P_S} - \frac{P_S}{P_S}]}{(P_T - P_S) - (P_S - P_S)} \right\} (P_T - P_S) \right\}$
		$P_T - \left\{ \frac{(P_T - P_S)}{(P_T - P_S)} \right\} * (P_T - P_S)$
		$P_T - (P_T - P_S)$
		P_S
FAILURE	$dP_S - mC_d$	$\frac{P_S}{P_S} * P_S - \left\{ \left\{ \frac{P_S [\frac{P_T}{P_S} - \frac{P_S}{P_S}]}{(P_T - P_S) - (P_S - P_S)} \right\} (P_S - P_S) \right\}$
		$P_S - \left\{ \frac{(P_T - P_S)}{(P_T - P_S)} \right\} * (P_S - P_S)$
		$P_S - 1 * 0$
		P_S

Assuming for the sake of tractability that overall the risk arbitrage tender offer market pricing mechanism is based on a risk neutral utility of wealth function, then the option defined above should, in equilibrium, be priced such that the expected return from the investment is equal to the investment times the risk-free rate of return for the term of the investment.[42] Exhibit 8 shows the full derivation of the outcome prediction model.

[42]A risk neutral utility of wealth is either explicitly declared or implicitly assumed in Lewellen and Ferri (1983), Brown and Raymond (1986) and Bhagat, Brickley and Loewstein (1987).

EXHIBIT 8

OUTCOME PREDICTOR MODEL DERIVATION

Equating the required rate on the investment to that from the fully hedged portfolio:

$$e^{r_f T}(P_S - mC) = \left(\frac{P_T}{P_S} * P_S\right) - m(P_T - P_S)$$

Solving for C, the call price:

$$(P_S - mC) = \frac{\left(\frac{P_T}{P_S} \quad P_S\right) - m(P_T - P_S)}{e^{r_f T}}$$

$$C = \frac{m(P_T - P_S) + P_S * e^{r_f T} - \left(\frac{P_T}{P_S} * P_S\right)}{e^{r_f T} * m}$$

$$C = \frac{m(P_T - P_S) + P_S\left(e^{r_f T} - \frac{P_T}{P_S}\right)}{e^{r_f T} * m}$$

Substituting for m (See Exhibit 6):

$$C = \left[\frac{\frac{P_S\left[\frac{P_T}{P_S} - \frac{P_S}{P_S}\right]}{(P_T - P_S) - (P_S - P_S)} * (P_T - P_S) + P_S\left(e^{r_f T} - \frac{P_T}{P_S}\right)}{\frac{P_S\left[\frac{P_T}{P_S} - \frac{P_S}{P_S}\right]}{(P_T - P_S) - (P_S - P_S)} * e^{r_f T}}\right]$$

$$C = \frac{P_S}{P_S}\left[\frac{\frac{\left[\frac{P_T}{P_S} - \frac{P_S}{P_S} * (P_T - P_S)\right] + \left[\left(e^{r_f T} - \frac{P_T}{P_S}\right)(P_T - P_S) - (P_S - P_S)\right]}{(P_T - P_S) - (P_S - P_S)}}{\frac{\left(\frac{P_T}{P_S} - \frac{P_S}{P_S}\right)}{(P_T - P_S) - (P_S - P_S)} * e^{r_f T}}\right]$$

EXHIBIT 8

OUTCOME PREDICTOR MODEL DERIVATION

(Continued)

$$C = \left[\frac{\dfrac{[\frac{P_T}{P_s}(P_T - P_s)] - [\frac{P_s}{P_s}(P_s - P_s)] + [e^{r_f T}(P_T - P_s)] - [\frac{P_T}{P_s}(P_T - P_s)] - [e^{r_f T}(P_s - P_s)] + [\frac{P_T}{P_s}(P_s - P_s)]}{(P_T - P_s) - (P_s - P_s)}}{\dfrac{(\frac{P_T}{P_s} - \frac{P_s}{P_s})}{(P_T - P_s) - (P_s - P_s)} * e^{r_f T}} \right]$$

$$C = \frac{(P_T - P_s)\dfrac{(e^{r_f T} - \frac{P_s}{P_s})}{(\frac{P_T}{P_s} - \frac{P_s}{P_s})} + (P_s - P_s)\dfrac{(\frac{P_T}{P_s} - e^{r_f T})}{(\frac{P_T}{P_s} - \frac{P_s}{P_s})}}{e^{r_f T}}$$

Let $\rho = \dfrac{(e^{r_f T} - \frac{P_s}{P_s})}{(\frac{P_T}{P_s} - \frac{P_s}{P_s})}$ and $(1 - \rho) = \dfrac{(\frac{P_T}{P_s} - e^{r_f T})}{(\frac{P_T}{P_s} - \frac{P_s}{P_s})}$

$$C = \frac{[\rho (P_T - P_s) + (1 - \rho)(P_s - P_s)]}{e^{r_f T}}$$

Solving for the Outcome Prediction Model

$$\rho = \frac{C e^{r_f T} - (P_s - P_s)}{(P_T - P_s) - (P_s - P_s)}$$

Substituting for C (Eq. 3-7):

$$\rho = \frac{(P_m - P_s)e^{r_f T} - (P_s - P_s)}{(P_T - P_s) - (P_s - P_s)}$$

$$\rho = \frac{(P_m - P_S)e^{r_f T}}{(P_T - P_S)}$$

Eq. 3-9

States of Nature and Model Outcomes

The outcome predictor model, Eq. 3-9, results can fall in one of three ranges depending on the relative magnitude of the components of the equation. The model results can be less than, equal to, or greater than zero. The dividend of the model, $(P_m - P_s)e^{r_f T}$, should always initially be greater than, or equal to, zero. By definition the value of a share of stock and a call are both always greater than, or equal to, zero. This is because the limited liability afforded shareholders by the corporate form of organization ensures the maximum amount a shareholder can lose is his investment. Likewise, "P_s", which from Eq. 3-7 is the market price less the price of the call is always greater than or equal to zero. This is because the call gives a right but no obligation to act, and again the maximum loss is one's investment. The divisor $(P_T - P_s)$ can be less than, equal to, or greater than zero depending on the relative magnitude of "P_T" and "P_s." The expected relationship is that "P_T" is greater than "P_s" and, therefore, the divisor would be positive. However, the divisor can be negative if the tender offer price is less than the daily computed fallback price. This condition of the fallback price being greater than the tender offer price can occur in either of two circumstances.

1. The value of the option like portion of the Day 0 market price is small and the market returns after the tender offer announcement are positive, thus causing the computed value of "P_s" to rise above the tender offer price.

2. The market price for the firm's shares on the day of announcement (Day 0) is equal to or greater than the tender offer price.

The condition of the initial market price exceeding the tender offer price can occur when there are nearly simultaneous competing announcements or there is an expectation of future competing higher-valued announcements. Even if the divisor is not negative, an elevated Day 0 market price can adversely impact the predictor model's outcome. If the

divisor is a lower valued positive real number than the dividend, the outcome prediction model result is a real number greater than one.

The range of possible outcomes provided by Eq. 3-9 was restated to the form shown at Eq. 3-10 to reflect a probability distribution from zero to plus one. Operationally this transformation ensures that Eq. 3-10 converts all negative prediction model outcomes to a zero probability and all outcomes greater than one are converted to one.

$$p = \text{Min} \{ 0 [\text{Max} \{ ((P_m - P_s) e^{r_f T}) / (P_T - P_s) \}], 1 \} \qquad \text{Eq. 3-10}$$

DATABASE DEVELOPMENT

The information contained in this section describes the methods and procedures used in the preparation of a database to support the research objectives as described in Chapter 1. The development of this database was predicated on fulfilling the requirements of the following prioritized goals:

1. Accurate and unbiased data selection

2. Large and robust sample to support both temporal and cross-sectional analysis

3. Homogeneity of observations to permit isolation of effects resulting from tender offer announcements from those arising from other causes

The methods and procedures to develop a database that supports the listed goals follow:

1. Potential Tender Offer Event Identification and Validation

In the design of this research a decision was made to use data sources that were available in electronic format. The data required for the conduct of this research falls into three main categories:

a. Information about the individual tender offer contests

b. Daily stock market trading information for the shares of the target firms

c. Risk free rates of return for the periods during which the individual tender offers are open

2. Database Selection

The Securities Data Company (SDC) file "Worldwide Mergers & Acquisitions Database" provided the sample of candidate tender offers. The tender offer sample information was collected in two phases. The first phase collected information about the initiation of the tender offer, and the second phase obtained information about the terms of the offer and its end date. Search selection criteria for both phases were as follows:

a. Date of announcement between January 1, 1984, and December 31, 1993.

b. Firms listed on either the New York or American Stock Exchanges.

c. Total value of the tender offer more than $10 million.

Five fields from the SDC Database were selected to fulfill the minimum informational requirements for defining the characteristics of the tender offers. The phase in which the information was collected is shown in parentheses after the item description.

a. Target firm CUSIP identifier [43] (Phase 1)

b. Date of tender offer announcement (Phase 1)

c. Date of the expiration of the tender offer as stated at the time of announcement [44] (Phase 2)

d. Original dollar value of the tender offer (Phase 2)

e. Tender offer outcome (Phase 1)

3. Database Validation

These selection criteria resulted in a database containing an initial total of 537 data points with the distribution as shown in Table 1. Observations were deleted from the initial sample for the following reasons:

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[43]CUSIP is an eight character alphanumeric constant which identifies the issuer of a security and the type of security. CUSIP identifiers are assigned by Standard & Poor's Corporation under the authority of the CUSIP Agency of the American Bankers Association.

[44]Initially it was believed that given a list of dates and CUSIP Identifiers it would be possible to collect additional information such as the end of offer date and tender offer price from electronic media data bases available within the University of Central Florida research community. Upon further research it was discovered that none of the data bases available, either singly or in combination, provided a reliable source for the required information. Therefore, a second output listing using the same search criteria as the initial processing was obtained from SDC. Apparently it is also difficult for professional database developers to obtain accurate data for tender offers. In eighty-three instances there were either no end dates reported (74 instances) or no tender offer prices (nine instances).

1. Requirements imposed by the non competition and non modification assumptions previously discussed during the development of the prediction model

2. Missing entries for required data elements

3. Records having data element entries that fell outside permissible data types or ranges for the field

As previously stated, the formulation of the prediction model assumes that the tender offer contest is uncontested and unmodified during the term of the tender offer. The initial data sample contained eighty-two tender offer events for firms that had previously appeared in the sample. Seventy-seven firms had one competing tender offer; four firms had three offers and one firm had four tender offers during the ten-year period covered by the sample. These duplicative tender offers reduced the initial sample by 154 events.

Another significant source of database shrinkage was the elimination of tender offers that experienced price increases that were more than the tender offer price. The criteria for elimination of a tender offer event for this cause was that the closing price on the last day of reported trading was greater than the tender offer price, or that the market price for the security on the first day of trading after the announcement of the tender offer was greater than the tender offer price. The reason for these filter rules is that bidding more than the tender offer price for a security would not be rational for an investor unless there was either an announced or expected competing tender offer. The effect of having a competing offer or expectation of additional opportunities at higher prices is that the market's pricing actions are evaluating the operational and financial probabilities associated with the higher valued opportunity rather than the initial lower priced offer. Higher valued undocumented opportunities primarily distort the predictor model results through effects on the numerator of the equation. The typical result is that the present value of the numerator will be greater than the value of the denominator and, therefore,

the resulting outcome will be greater than one. A secondary factor is that if the knowledge of additional offers or expectations of offers arrives on or before the first day of trading following the announcement of the tender offer, the denominator of the equation may be negative resulting in a negative outcome prediction value.[45] In summary, expectation of higher valued future offers can produce outcome prediction model results that are less than zero, between zero and one, and greater than one.

Significant reductions in sample size also resulted from missing or erroneous data in two of the three data sources. The only data source that was totally complete with no missing information for any one of the initial tender offers was the City-Base interest rate date base. Missing tender offer end dates from the SDC Phase 2 file also contributed to the database size reduction.[46]

An inability to establish a unique match between the CUSIP identifier contained in the SDC output files and the CUSIPs contained in the CRSP Master File also resulted in the loss of observations. In fourteen instances there was no match between the SDC CUSIP

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[45] Price effects from sources other than the tender offer under study can be reflected in the day zero sample price through either the common practice of announcing major corporate events after the close of the trading markets particularly on a Friday, and by the fact that exchange rules provide that trading may be suspended if events prevent the maintenance of an orderly market. Therefore, delays of from one to four days were common between the announcement date and the date on which the market price appeared to reflect the newly arrived knowledge provided by the tender offer announcement.

[46] In a discussion with the SDC customer service representative on February 14, 1995, it was learned that much of information in the Worldwide Mergers & Acquisitions Database was manually transcribed into the file from paper based records. When asked why the number of records in the Phase 1 and Phase 2 output files differed, the representative replied that even years after the tender offer event SDC would learn of additional events and add the events to the file.

and any CUSIP in the CRSP file. The SDC file only reported the significant digits (leading zeros suppressed) for the first six positions of the CUSIP Identifier.[47]

Other factors that caused individual tender offer contests to be eliminated from the research sample included:

1. No tender offer price- nine instances

2. No pre-tender-period initialization price- eighteen instances

3. No market price for the day of tender offer announcement- seventeen instances

TABLE 1

DATABASE DISTRIBUTION BY YEAR AND OUTCOME

YEAR	84	85	86	87	88	89	90	91	92	93	TOTAL
COMPLETED	25	35	83	63	92	57	21	8	7	7	398
WITHDRAWN	14	15	24	19	40	19	2	0	0	3	136
TOTAL	39	50	107	82	132	76	23	8	7	10	534

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[47]The CUSIP Identifier consists of two fields: a six-character firm identifier and a two-digit suffix representing the class of security. To convert the SDC output file into input which was compatible with the CRSP search routines, it was necessary to first supply leading zeros to create a six-digit primary firm identifier and then to append the appropriate two-digit suffix. Initially all CUSIPs were submitted to the CRSP routines with the suffix set to 10, the code for common stocks. After an initial screening pass all CUSIPs that were rejected with matching primary CUSIPs were edited to match the CUSIPs contained in the CRSP data base.

4. Pre-Event Return and Pricing Information Collection

Price and return data for the firms and periods defined in the Tender Offer Database were developed using the CRSP data tapes. Exhibit 9 shows the CRSP field titles and definitions.[48]

Specific data handling steps were required because of the conventions used in the presentation of data within the CRSP files. The CRSP practice of designating bid/ask averages as negative numbers required that all formulas that referenced PRC(TIME) data use the absolute value of the field. In those instances for which there are missing daily price data the CRSP file conventions insert coded values for RET(TIME). The two coded RET(TIME) values encountered in the development of this database were "-88.0" and "-99.0." The documented use for the coded value "-99.0" is that the security is trading on a new exchange. The coded value "-88.0" is used to show that the security is active but a price is not available. The first instance of the "-88.0" designation within a record was used to determine the date on which active exchange-based trading in the target firm's stock ceased. This date was used as a proxy for the date on which the tender offer became effective for completed offers .

Along with the documented use, the "-99.0" value is also used to indicate that the security did not trade on a given day. The "-99.0" was detected in several records on or about the announcement date.[49] It was discovered that the "-99.0" designation for the

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[48] The above definitions are extracted from the CRSP Stock File Guide for Data Ending December 31, 1992.

[49] The use of the "-99.0" designation on and about the announcement date apparently indicates instances where the trading in the tender offer target firm s securities is suspended due to a disrupted market resulting from the announcement. The effect of the missing values was that the Day-0 date is displaced

(Continued)

RET(TIME) value appears to be used to designate days on which there was either no valid pricing information or on which trading had been disrupted. Occasionally the "-99.0" value for RET(TIME) was found on days surrounding the tender offer announcement date. When this occurred, if valid returns appeared within five days after the SDC file announcement date, the announcement date was selected to be the first day for which there was both a valid return and price. The procedure eliminated the observation if valid data did not appear before the sixth day.

EXHIBIT 9

CRSP FILE DATA DEFINITIONS

KCUSIP: Eight character alphanumeric CUSIP identifier that uniquely identifies a particular firm (first six characters) and within the firm the type of security being traded (two character suffix).

CALDT(TIME): Six character numeric date field in the Year Month Day form.

VWRETD(TIME): Real number field containing the daily returns, including all distributions, on a value-weighted market portfolio.

RET(TIME): Holding period return--change in total value of an investment in a common stock over the period since the first previous date on which the security had a valid transaction price. This return is usually for a one day period.

PRC(TIME): Closing price or bid-ask average. As a convention the PRC(TIME) value is shown as a positive number if the price is for a closing trade and as a negative number if it is an average between the bid (BIDLO(TIME)) and ask (ASKHI(TIME)) prices. PRC(TIME) is zero if no price is available.

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from the announcement date. The data definitions are from the CRSP Stock File Guide for Data Ending December 31, 1992.

5. Pre-Event Mean, Variance, and Market Model Calculations

An original computer program calculated the means, variances, and the coefficients for the characteristic line for the observations selected from the CRSP file. Along with the descriptive statistics and the characteristic line coefficients the program provided information on those observations that had inappropriate or missing data.

6. Call and Fallback Price Calculation

The iterative process to calculate the value of the call portion of the post-tender offer market price requires a value for the stock's initial fallback price. The value selected for this variable must be sufficiently close in time to the announcement date to be representative of the fallback price, yet far enough removed to minimize the impact of information leakage. The PRC(TIME) observation where TIME was equal to nineteen days before the announcement was used as the initial proxy to the fallback value to which the stock should return if the tender offer should fail.[50] A second original computer program implements the BBL iterative call valuation procedure. This program calculated the Black and Scholes Option Pricing Model using the previously derived variances and the PRC(19) observations.

The appropriateness and efficiency of the decision to use the nineteenth day before the announcement date as the fallback proxy is shown by the fact that in only three

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[50] Brown and Raymond utilize four dates (one, two, three, and four weeks prior to the announcement date) as candidates for a fallback proxy. Bhagat, Brickley and Loewenstein (BBL) utilized the day immediately prior to the announcement date as the initial input into the call calculation formula. As a compromise between the Brown and Raymond and BBL positions three weeks (21 days) prior to the announcement date was used as the date for selecting observations. Due to missing observations resulting from weekends and holidays, the nineteenth day prior to the announcement was the closest observation to twenty one days prior to the announcement date that was available for all observations.

instances did the iterative process fail to reach closure with a difference of less than $0.0625. The mean number of iterations required for closure was 6.24 with both a median and mode of 5. The standard deviation of the observations reaching closure was 14.77, and the range was from 1 to 288. Table 2 presents descriptive statistics for the fallback and call prices.

TABLE 2

FALLBACK AND CALL PRICE STATISTICS

	FALL-BACK PRICE (P_S)	CALL PRICE (C_0)
MEAN	33.077	1.4566
STANDARD ERROR	1.3597	0.0981
MEDIAN	26.5895	0.8556
MODE	19.625	0
STANDARD DEVIATION	27.2615	1.9666
SAMPLE VARIANCE	743.1817	3.8676
KURTOSIS	19.8112	14.3656
SKEWNESS	3.2025	3.4185
RANGE	262.2067	14.2523
MINIMUM	1.4867	0
MAXIMUM	263.6934	14.2523
SUM	13297.22	585.5491
LARGEST	236.6934	14.2523
SMALLEST	1.4867	0

7. Post-Event Pricing and Return Data Selection

The observations required for post-event processing were extracted from the CRSP file in the same manner as the previous selections. For this part of the process the collection period was 130 days beginning 3 days before the announcement date and running through the 127th day after announcement. After the effects of holidays and

weekends were accounted for, the final database consisted of 123 post-announcement observations for each tender offer.

8. Outcome Prediction Model Calculation and Final Database Selection

The equation at Eq. 3-9 calculates the outcome prediction model using the values developed during the previous phases. A primary consideration in the calculation of the outcome prediction model was the determination of the time each tender offer was open. The length of the tender offer period is the difference between the SDC file announcement and end dates. The shortest tender period was 8 days and the longest was 153 days. Table 3 provides detailed descriptive statistics for tender offer duration.

To permit comparisons between tender offers of varying lengths the tender offer prediction model was calculated for the observations that occurred on the offer announcement date and on the quarter points of the tender offer period.[51] Along with the Day 0, 0.75, 0.50, and 0.25 observations two additional observations were selected for each firm. The first additional selection is the last day before a security ceased trading. The last day of trading was the day before the first day that RET(TIME) was "-88.0." The second additional selection is the Day 123 observation. The last day of trading and Day 123 establish end of period values for completed and withdrawn tender offers respectively.

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[51] To insure that all appropriate selections were made, a two step selection process was used. In the first step a plus and minus .02 range around the selection points was used in the filter rule. For example, the first step filter rule for the .50 selection selected all observations which fell within the range of .48 through .52. In the second step of the selection process if multiple observations had been selected, the earliest occurrence was used.

TABLE 3

TENDER OFFER PERIOD DESCRIPTIVE STATISTICS

(Days)

Mean	21.74
Standard Error	1.3767
Median	14.667
Mode	10.667
Standard Deviation	19.371
Sample Variance	375.25
Kurtosis	13.678
Skewness	3.1823
Range	145.33
Minimum	8
Maximum	153.33
Sum	4305.3
Largest	153.33
Smallest	8

This chapter has presented the literature that provides the theoretical underpinnings for this study. The next chapter will present the results from the application of the methodologies that have been developed.

CHAPTER 4

HYPOTHESIS TESTING

Chapter 1 identified three areas of investigation in the testing of the Efficient Market Hypothesis.

1. Is it possible to earn economic rents through exploitation of market inefficiencies?
2. How is new information used?
3. How rapid is the market's adjustment to the arrival of new information?

This chapter will describe the hypotheses that arise from these theoretical questions and present the results of experiments designed to test these hypotheses in the context of tender offer outcome prediction. For ease of presentation and to permit the presentation of like tests at one time, the hypotheses are grouped into the categories of Operational Efficiency Testing and Financial Performance Testing. This grouping insuews that tests examining the same variables from slightly different aspects are addressed together. However, this segregation is not intended to infer that this or any categorization provides the totality of analysis for any one of the areas of efficient market hypothesis investigation.

Operational Efficiency Testing

The operational efficiency testing portion of this study examines the results produced by the outcome prediction model in the abstract sense without regard to the financial

returns. These hypotheses and tests examine Outcome Prediction Model results cross-sectionally between observations and temporally within observations. The tests examine the relationship between the market's pricing actions, as summarized by the Outcome Prediction Model, and the realized outcomes of the tender offer. The operational efficiency tests primarily address the second and third efficient market hypothesis questions.

Hypothesis 1. The outcome prediction model differentiates between completed and withdrawn tender offers.

$H1_O$: The mean outcome prediction model results for the several portfolios are the same.

$H1_{1O}$: μ PORT. A $=$ μ PORT. B $= \cdots =$ μ PORT. J (All portfolios tested in unison)

$H1_{2O}$: μ PORT. A $_{(\text{Predicted})}$ $=$ μ PORT. B $_{(\text{Predicted})}$

μ PORT. A $_{(\text{Predicted})}$ $= \mu \cdots$

μ PORT. A $_{(\text{Predicted})}$ $=$ μ PORT. J $_{(\text{Predicted})}$

$H1_a$: The mean outcome prediction model results for the several portfolios are not the same.

$H1_{1a}$: μ PORT. A $_{(\text{Predicted})}$ $<>$ μ PORT. B $_{(\text{Predicted})}$ $<> \cdots <>$ μ PORT. J $_{(\text{Predicted})}$

$H1_{2a}$: μ PORT. A $_{(\text{Predicted})}$ $<>$ μ PORT. B $_{(\text{Predicted})}$

μPORT. A $_{(\text{Predicted})}$ $<> \mu \cdots$

μ PORT. A $_{(\text{Predicted})}$ $<>$ μ PORT. J $_{(\text{Predicted})}$

Hypothesis 1 poses the question of whether the predicted outcomes for each of the individual portfolios are drawn from the same population or if they are drawn from different populations. The research objective in this area was to determine if the outcome prediction model was capable of differentiating the sample into portfolios with varying outcomes. The method used to test this research objective was one factor analysis of variance (ANOVA).[52]

To conduct the Hypothesis 1_1 test and subsequent tests it was necessary to divide the observations into portfolios ranked by Day 0 outcome predictor model results. The methods used to develop the portfolios are a variation on Fama and MacBeth (1973). In the current study the goal of portfolio creation is the elimination of dispersion rather than its maximization as in the original Fama and MacBeth work. The portfolios were developed by arranging all outcome prediction model observations in a one-to-n list sorted in order of ascending Day 0 outcome predictor model results and then creating ten sequential samples of approximately equal size.[53]

The Hypothesis 1_1 testing consisted of a single factor ANOVA in which the individual observation level outcome prediction model results (grouped by portfolio) were all tested in unison. This test rejected the null hypothesis of homogeneity with an F value of 1336.64 (9 and 194 degrees of freedom). The P-value for this F value and degrees of freedom is 2E-169.

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[52]All ANOVA testing in this study utilizes a significance factor of 0.05 unless a different value is specified.

[53] Six portfolios were of size 20 and four portfolios were of size 21.

Hypothesis 1_2 examines whether the inter-portfolio differences in the outcome prediction model values are significant, or if the portfolios are drawn from the same population. The procedure for conducting the Hypothesis 1_2 testing was to perform pairwise ANOVA comparisons of one portfolio's outcome prediction model results against those from another portfolio. Specifically, a single variable ANOVA test between every contiguous portfolio pair (A-B, B-C, ... I-J) was executed.[54] All tests strongly rejected the null hypothesis that the portfolios were from the same populations. The least significant individual test was between Portfolios I and J where the F value was 27.813 (1 and 38 degrees of freedom) for a P-value of 6E-06. The F values for the other pairs tested ranged upwards from this value into the hundreds.

Hypothesis 2. The prediction outcome model values have a direct relationship with the realized tender offer outcomes.

$H2_O$: The predicted and realized outcome measures are not drawn from the same population.

$H2_{1O}$: μ REALIZED < > μ PREDICTED (All observations without portfolio grouping)

$H2_{2O}$: μ PORT. A REALIZED < > μ PORT. A PREDICTED

$H2_a$: The predicted and realized outcomes are from the same population.

$H2_{1a}$: μ REALIZED = μ PREDICTED

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[54] Since the portfolios were selected based on their ordered Day 0 outcome prediction model values, if contiguous portfolio pairs were different, then all more distant portfolios would also be different.

$H2_{2a}$: μ PORT. A REALIZED = μ PORT. A PREDICTED

Hypothesis 2 testing seeks to demonstrate that there is a direct relationship between the portfolio mean outcome predictor model values and the value of the corresponding portfolio mean realized returns. Hypothesis 1 sought to demonstrate that the portfolios formed based upon outcome predictor model value rankings were heterogeneous. However, Hypothesis 2 seeks to demonstrate the nature of the relationship between the mean portfolio predictor values and the mean portfolio realized outcomes. The difference between Hypothesis 1 and Hypothesis 2 testing is that Hypothesis 1 testing is essentially qualitative while Hypothesis 2 is quantitative in nature.

To facilitate the Hypothesis 2 testing, each tender offer observation was assigned a realized outcome value of either 0 or 1 depending upon whether the outcome was "Withdrawn" or "Completed." Exhibit 10 presents a graph of the means for the portfolios' realized and predicted outcomes. The "PREDICTED" bars on Exhibit 10 portray the portfolio means of the Day 0 outcome prediction model results, and the "REALIZED" bars are the portfolio means for the end-of-period outcomes for the sample. Onr gains the impression from examination of Exhibit 10 that the mean number of Completed outcomes increases as the letter of the portfolio increases. This observation is not confirmed by the ANOVA comparisons of either the total sample test or by the tests that compared only the realized and predicted outcomes within each of the several portfolios. When all observations realized and predicted outcomes were subjected to an ANOVA examination without grouping into portfolios, the null hypothesis that the predicted and realized values were drawn from the different populations was strongly supported. For the ANOVA test of all observations, the F statistic was 116.5 with 1 and 406 degrees of freedom that equates to a P-value of 4.71E-24.

The pairwise ANOVA comparisons of predicted and realized portfolio outcomes again strongly supported the null hypothesis. Table 4 presents the results from the ten intra-portfolio ANOVA tests.

TABLE 4

INTRA-PORTFOLIO ANOVA RESULTS

PORTFOLIO	F-value	P-value	F crit
A	35.03549	7.35E-07	4.098169
B	54.00395	6.16E-09	4.08474
C	73.23713	2.15E-10	4.098169
D	90.86669	7.54E-12	4.08474
E	27.38718	6.39E-06	4.098169
F	30.1116	2.48E-06	4.08474
G	41.44111	1.43E-07	4.098169
H	8.872388	0.004901	4.08474
I	27.81288	5.63E-06	4.098169
J	12.66667	0.001019	4.098169

Hypothesis 3. The capability of the outcome prediction model value to predict tender offer outcomes improves as the time remaining to the ex-tender date decreases.

$H3_O$: The relationship between the outcome prediction model values and the realized outcomes does not change, decreases, or becomes negative as the time remaining until tender offer expiration decreases.

Given: $O_{ij} = a + B_{1i} P_{0.0ij} + B_{2i} P_{0.750ij} + B_{3i} P_{0.50ij} + B_{4i} P_{0.25ij} + e_i$ Eq. 4-1

Where:

O_{ij} = The realized tender offer outcome for the *j*th observation in the *i*th portfolio,

a = The intercept term for the regression,

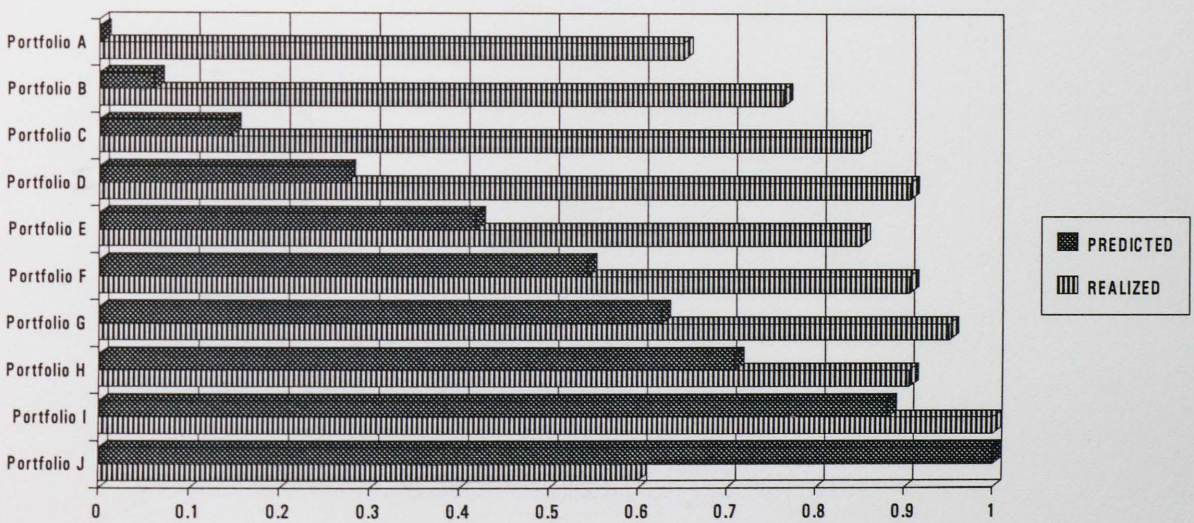
B_{1i}, B_{2i}, B_{3i}, and B_{4i} = Coefficients for the portfolio *i* 0.0, 0.75, 0.50, and 0.25 prediction outcome model values,

$P_{0.0ij}$, $P_{0.75ij}$, $P_{0.50ij}$, and $P_{0.25ij}$ = The time period outcome prediction model values for the *j*th observation in the *i*th portfolio,

e_i = error term for the *i*th portfolio.

EXHIBIT 10

PREDICTED VERSUS REALIZED OUTCOMES



$H3_O$:

1. The regression equation provided by Eq. 4-1 does not explain a significant portion of the variance of the sample.

2. The sign of one or more of the coefficients is negative and/or not significantly different from zero (T value not significant at the 0.05 level of significance).

$H3_a$: The relationship between the outcome prediction model value and the mean outcome measure changes positively as the time remaining to the ex-tender date decreases.

$H3_a$:

1. The regression equation provided by Eq. 4-1 explains a significant portion of the variance of the sample.

2. The signs of all the coefficients are positive and significantly different from zero (T value is significant at the 0.05 level of significance).

Hypothesis 3 addresses the ability of the outcome prediction model to successively provide improved outcome forecasts as the time remaining till the end of the tender offer period decreases. The premise behind Hypothesis 3 is that the arrival of new information should reduce uncertainty and, therefore, permit the market to develop more accurate forecasts of the offer's outcome and to incorporate this improvement into pricing decisions.

The computed regression (Eq. 4-1) when the portfolio is defined as all observations that have no missing values (N = 113), does not permit rejection of the null hypothesis. This equation has a significant F value, 2.5529 (4 and 108 degrees of freedom) but is of low explanatory power with a R2 of 0.0864. The independent variable coefficients are not generally significant and are of variable sign. The only exception is that the coefficient for P0.25ij, the 25 percent time remaining variable, has the proper sign, positive, and a T value of 2.0900 (P-value 0.0389). The coefficients for the other

independent variables alternate between being positive and negative and are not significantly different from zero.[55]

Financial Performance Testing

In the financial performance testing area of this study the objective is to examine the financial consequences of investment decisions based on strategies using the prediction outcome model. These tests compare the returns from the prediction outcome model selected portfolios to the returns of the other selected portfolios and to the returns of random portfolios.[56] The primary tools for analyzing the profitability of the returns from the various portfolios are univariate regression analysis and ANOVA. Table 5 displays the descriptive statistics for the returns from the ten outcome prediction selected portfolios.

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[55]When the regression is calculated with only the 0.25 predictor as an independent variable, the resulting equation is significant and of the proper sign. The coefficient for the 0.25 variable has a T value of 2.6248 (P-value of 0.00987) and the F value for the overall equation is 6.8899 (P-value of 0.0099). The R2 for this equation is 0.0584.

[56]In this study a multiplicative returns generation process is utilized. The return for the end of the tender offer period is calculated by the following equation: Return = (1 + Return Period 1) * (1 + Return Period 2) * (1 + Return Period 3) where the period returns are (Price(t) - Price(t - 1)) / Price (t - 1)

TABLE 5

RETURNS FOR OUTCOME PREDICTION MODEL SELECTED PORTFOLIOS

PORTFOLIO	A	B	C	D	E	F	G	H	I	J
Mean	1.109	1.157	1.104	1.079	1.026	1.041	1.01	0.998	1.015	0.906
Standard Error	0.053	0.052	0.023	0.01	0.012	0.01	0.005	0.013	0.011	0.034
Median	1.074	1.181	1.089	1.078	1.032	1.02	1.01	1.01	1.006	0.965
Standard Deviation	0.237	0.239	0.104	0.048	0.053	0.046	0.023	0.058	0.048	0.151
Sample Variance	0.056	0.057	0.011	0.002	0.003	0.002	5E-04	0.003	0.002	0.023
Kurtosis	0.725	2.962	2.777	4.962	7.62	5.593	8.664	13.43	8.944	5.249
Skewness	0.826	-0.47	0.029	-1.33	-2.4	2.433	-2.21	-3.51	2.715	-2.26
Range	0.971	1.162	0.5	0.231	0.244	0.175	0.119	0.276	0.234	0.625
Minimum	0.694	0.559	0.833	0.925	0.842	1.012	0.928	0.768	0.952	0.428
Maximum	1.664	1.722	1.333	1.156	1.086	1.188	1.047	1.045	1.186	1.053
Sum	22.19	24.3	22.09	22.67	20.52	21.86	20.19	20.95	20.3	18.12
Count	20	21	20	21	20	21	20	21	20	20
Largest	1.664	1.722	1.333	1.156	1.086	1.188	1.047	1.045	1.186	1.053
Smallest	0.694	0.559	0.833	0.925	0.842	1.012	0.928	0.768	0.952	0.428

A series of random portfolios were developed to facilitate the financial performance testing. Five random portfolios were generated from the database with selections being made based on random numbers. Table 6 presents the portfolio means and variances for both the outcome prediction model selected portfolios (Portfolios A - J) and the random portfolios (Portfolios R1 - R5).

TABLE 6

MEANS AND VARIANCES FOR PORTFOLIO RETURNS

RETURNS	MEAN	F-VALUE	P-VALUE
OUTCOME PREDICTION MODEL	1.0445	0.14116	0.7132
RANDOM	1.0575		
VARIANCES			
OUTCOME PREDICTION MODEL	0.01604	0.1656	0.6907
RANDOM	0.02053		

The financial performance research questions are as follows.

Hypothesis 4. The returns generated by outcome prediction model selected portfolios differ among themselves and from the random portfolios.

$H4_{1O}$: The returns for the prediction model selected portfolios do not differ among themselves.

$H4_{1O}$: μPort. A Return = μPort. B Return = ... = μPort. J Return

$H4_{2O}$: The returns for the prediction model selected portfolios do not differ from those of the random portfolios.

$H4_{2O}$: μ selected Portfolios = μ random Portfolios

$H4_{1a}$: The returns for the prediction model selected portfolios differ among themselves.

$H4_{1a}$: μPort. A Return <> μPort. B Return <> ... <> μPort. J Return

$H4_{2a}$: The returns from the prediction model portfolios differ from those of the random portfolios.

$H4_{2a}$: μ selected Portfolios < > μ random Portfolios

Testing for $H4_1$ was performed using a single factor ANOVA in which the end-of-period returns of the ten outcome prediction model selected portfolios were analyzed in unison. The test results strongly rejected the null hypothesis. The results for the test were an F value of 6.4162 (194 and 4 degrees of freedom) and a P value of 6E-8. These results provide support for the ability of Day 0 predictor values to differentiate the returns of tender offer outcomes.

Testing for $H4_{2O}$ used a single factor ANOVA in which the end-of-period returns for the outcome prediction model selected portfolios were compared to those from the random portfolios. This test did not support the reject of the null hypothesis. The F value for the ANOVA test was 0.1412 with a P-value of 0.7132.

Hypothesis 4A. There is a statistically significant relationship between the returns for the outcome prediction model selected portfolios and the Day 0 outcome prediction model value.

$H4A_O$: There is no relationship between the Day 0 prediction model value and the return provided by the outcome prediction model selected portfolios.

Given: $R_i = a + B_{1i} P_{0.0i} + e_i$ Eq. 4-2

Where:

R_i = the realized return for the i th portfolio,

a = the intercept term for the equation,

B_{1i} = coefficients for the portfolio i 0.0 prediction outcome model value,

$P_{0.0i}$ = the time period outcome prediction model value for the i th portfolio,

e_i = error term for the i th portfolio.

$H4A_o$: There is no significant relationship between the Day 0 prediction model value and the return provided by the outcome prediction model selected portfolios.

$H4A_o$: The F value for the computed Eq. 4-2 is not significant at the 0.05 level of significance.

$H4A_a$: There is a significant relationship between the Day 0 prediction model value and the return provided by the outcome prediction model selected portfolios.

$H4A_a$: The F value for the computed Eq. 4-2 is significant at the 0.05 level of significance.

Hypothesis 4A addresses the question of whether there is a relationship between the Day 0 outcome predictor value and the financial returns of the outcome predictor model selected portfolios, and, if one exists, the nature of the relationship. This analysis is more robust than the previous investigation in which the relationship between the Day 0 outcome predictor model value and the realized outcome were compared. The increased robustness is because outside investors in a firm, those whose primary interest in the firm is determined by the value of their holdings of the securities of the firm, do not

specifically care if the tender offer is successful. Their interest is how events influence their end of period wealth. This realization is further illustrated by the fact that in many instances investors may suffer wealth reductions from Completed tender offers and, conversely, increase their wealth from Withdrawn tender offers.[57]

Application of Eq. 4-2 yields a regression equation that has an R^2 of 0.86, an F value for the overall equation of 47.82, and a T value for the independent variable of -6.915 (P-value 0.00012). Thus, this test rejects the null hypothesis that there is no relationship between the Day 0 outcome predictor model value and the end of period return. An interpretation of the meaning of the negative sign of the coefficient for the independent variable will be presented in the next chapter.

Hypothesis 5. The returns generated by the Day 0 prediction model selected portfolios differ from the returns from randomly selected portfolios.

$H5_O$: There is no difference between the Day 0 prediction model portfolio returns and the returns provided by the randomly selected portfolios.

$H5_{1O}$: The returns from the outcome prediction model selected portfolios do not differ from the returns generated by the random portfolios.

$H5_{1O}$: μSelected Returns = μrandom returns.

H52o: The returns of all portfolios, are the same.

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[57] In 14.6% of Completed tender offers the Day 0 investor suffered a mean average end of period loss of 3.88%, and in 45.45% of withdrawn offers the investor received a mean positive end-of-period gain of 12.69% .

$H5_{2O}$: μPort. A Return=...= μPort. J Return= μPort.R1 Return =...= μPort. R5 Return.

$H5_a$: The outcome prediction model portfolio returns and the returns provided by the randomly selected portfolios are different.

$H5_{1a}$: The returns from the outcome prediction model selected portfolios are different from the random portfolio returns.

$H5_{1a}$: μ selected Returns $< >$ μ random Returns.

$H5_{2a}$: The returns of all portfolios are not equal.

$H5_{2a}$: μPort A Return$<>$...$<>$μPort J Return$<>$μPort R1 Return$<>$...$<>$ μPort R5 Return.

The Hypothesis $H5_1$ testing does not permit the rejection of the null hypothesis that there are no significant differences between the returns of the outcome prediction model selected portfolios and the random portfolio returns. The Random portfolios have a higher mean return while the outcome prediction model selected portfolios have a lower mean variance. Table 7 shows the return means and variances for the outcome prediction model selected portfolios and the random portfolios.

In the testing for $H5_2$, pairwise single factor ANOVA tests were run among all fifty one-by-one combinations of the ten outcome prediction model selected portfolios and the five random portfolios. Only sixteen of the fifty tests have significant differences between the two portfolios. When the mean returns from the random and outcome prediction model selected portfolios are subjected to an ANOVA test procedure, the findings provide evidence supporting the null hypothesis that there was not a difference between the returns of the random and outcome prediction model selected portfolios.

Analysis of the means and variances shown in Table 7 reveals that four outcome prediction model portfolios and no random portfolios would fall on the Mean / Variance efficient frontier. The efficient portfolios are Portfolio B with the highest return (1.157331, 0.057156), Portfolio G with the lowest variance (1.009526, 0.000526), Portfolio C (1.104327, 0.010728), and Portfolio D (1.079296, 0.002276). All other portfolios are mean/variance inefficient. Exhibit 11 shows a scatter diagram on which the mean and variance locations for the outcome prediction model and random portfolios are plotted.

Previous research has implicitly assumed that there are fundamental differences in the characteristics of the returns earned by the completed and withdrawn samples. Table 8 provides comparative statistics for the returns of the completed and withdrawn samples. Investments in completed tender offers experienced losses in more than 14% of the observations while more than 45% of withdrawn offers resulted in gains for the investor.

EXHIBIT 11

Mean-Variance Efficient Frontier

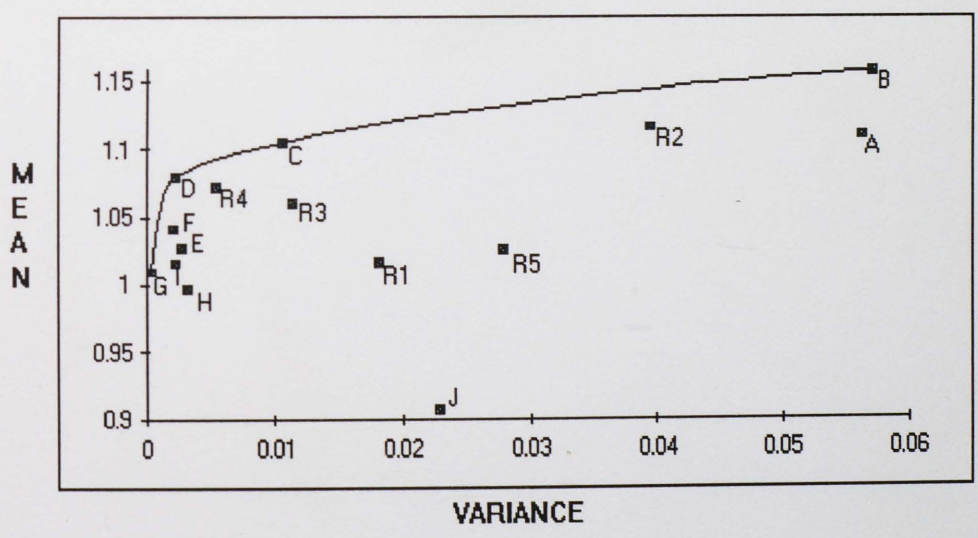

TABLE 7

PORTFOLIO LEVEL RETURN STATISTICS

	COUNT	SUM	MEAN	VARIANCE
PORTFOLIO-A	20	22.189	1.109	0.056
PORTFOLIO-B	21	24.304	1.157	0.057
PORTFOLIO-C	20	22.087	1.104	0.011
PORTFOLIO-D	21	22.665	1.079	0.002
PORTFOLIO-E	20	50.518	1.026	0.003
PORTFOLIO-F	21	21.857	1.041	0.002
PORTFOLIO-G	20	20.191	1.01	0.001
PORTFOLIO-H	21	20.948	0.998	0.003
PORTFOLIO-I	20	20.300	1.015	0.002
PORTFOLIO-J	20	18.125	0.906	0.023
PORTFOLIO-R1	21	21.336	1.016	0.018
PORTFOLIO-R2	20	22.313	1.116	0.040
PORTFOLIO-R3	20	21.201	1.060	0.012
PORTFOLIO-R4	20	21.424	1.071	0.005
PORTFOLIO-R5	21	21.512	1.025	0.028

TABLE 8

COMPLETED AND WITHDRAWN RETURNS

	WITHDRAWN	COMPLETED
Mean	0.949546031	1.06289
Standard Error	0.03743093	0.0089
Median	0.969153311	1.02688
Standard Deviation	0.211741318	0.11639
Variance	0.044834386	0.01355
Kurtosis	0.024298751	12.3004
Skewness	-0.561950832	3.01694
Range	0.881873817	0.84374
Minimum	0.427860697	0.87791
Maximum	1.309734513	1.72165
Sum	30.38547301	181.755
Count	32	171
Largest	1.309734513	1.72165
Smallest	0.427860697	0.87791

This chapter has presented the findings from testing the hypothesis that supports this research question. In the next chapter these findings will be summarized, conclusions will be drawn, and requirements for future research will be defined.

CHAPTER 5

SUMMARY OF RESULTS AND CONCLUSIONS

As stated in Chapter 1, the objective of this study was to analyze the efficiency of the capital allocation market as it pertains to cash tender offer pricing and outcome prediction assessment. The hypotheses developed and tested in the preceding chapters were all concerned with determining the market's accuracy and speed in incorporating new information into its pricing decisions. The tests performed have addressed the question from the twin aspects of operational and financial efficiencies. The results from each of these areas will be addressed separately first and then a unified interpretation will be presented.

Operational Efficiency Testing

In the operational efficiency testing area the interest was with testing how efficient and effective the outcome prediction model was in identifying the eventual outcomes of tender offers. Hypotheses were tested in three areas:

1. The qualitative ability to differentiate between completed and withdrawn tender offers

2. The quantitative relationship between the mean portfolio outcome predictor model value and the mean portfolio realized outcome

3. The ability of the market to improve its tender offer outcome assessment as the time remaining until completion of the tender offer period decreases

The Hypothesis 1 test results permit the rejection of the null hypothesis that there was no differentiation between mean outcomes of the ten portfolios. This finding indicates that at the most basic level the outcome prediction model is capable of distinguishing between completed and withdrawn tender offer contests. This finding is somewhat unexpected in that the model examines financial returns and not tender offer outcomes. The apparent driving factor behind the capability of the outcome prediction model to distinguish between completed and withdrawn tender offers is the 11.33% higher return realized from investing in completed tender offers as compared to withdrawn offers.

In Hypothesis 2 the intent was to demonstrate that there was a direct relationship between the portfolio mean outcome prediction model value and the mean portfolio outcome. In these tests it is not possible to reject the null hypothesis that the means of the predicted and realized outcomes are not the same. The failure to reject the null hypothesis in this more stringent test is attributable to the divergence between what the outcome prediction model evaluates and what the test measures.

The Hypothesis 3 tests provide mixed results. The overall regression equation has a significant F value and one coefficient is significant and with proper sign. However, the R^2 of the equation is low and the coefficients of the two remaining independent variables are not significant and have the incorrect sign. These results indicate that before the last quarter of the tender offer the market does provide pricing decisions that accurately reflect the eventual outcome.[58]

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[58]See footnote 55 for details of the regression equation where only the 0.25 variable is utilized.

In summary, the outcome prediction model is only partially efficient in forecasting the outcome of tender offers. The success that is experienced is believed to result from the differing levels of return for the completed and withdrawn samples. The failure of portions of the more stringent tests may possibly be attributed to the mixed signals presented by 45.4% of withdrawn tender offers providing a positive rate of return and 14.6% of completed tender offers experiencing a loss.

Financial Performance Testing

As stated in Chapter 4, the analysis performed in the area of financial performance testing is more robust and theoretically germane than that of operational efficiency testing. In the terminology presented by Fama (1970), the financial performance tests are semi-strong efficiency tests. The test results support a conclusion that the tender offer market is a semi-strong capital allocation market.

The Hypothesis 4 results show that the market is at least efficient to the level of being capable of *a priori* differentiating and sequencing tender offer contests by financial returns.[59] The rejection of the null hypothesis for $H4_1$ supports the view that on Day 0 the model is capable of formulating a statistically significant assessment of the financial results from investing in the securities of a tender offer target. In a somewhat paradoxical manner, the failure to reject the null hypothesis of $H4_2$, which states that there are no differences between the portfolio returns of the ten outcome prediction model selected portfolios and the randomly selected protocols, also lends support to the

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[59]The mean tender offer period for the entire sample is 21.74 days. For withdrawn tender offers the period of analysis extends out through 123 days. See Table 3 for full details on the time distribution for the tender offer periods.

efficiency of the market. The $H4_2$ results appear to indicate that the comparison of the grouped returns of the selected and random portfolios is not sufficiently specific to overcome the homogeneous nature of the overall population.

The results obtained from testing Hypothesis 4A are important both for their level of statistical significance and from the implications that they provide. Hypothesis 4A is in effect a formal restatement of the investor's primary question: "Can the use of the outcome prediction model improve the likelihood of increasing my wealth?" The statistics that describe the regression equation that results from the application of Eq. 4-2 provide the highest levels of significance of all tests conducted in this study. The Eq. 4-2 regression explains a large portion of the overall variability of the sample, $R^2 = 0.86$, and the measures of significance for the equation and the individual coefficient are both high, $F = 47.82$ and $T = -6.915$.

The interesting fact about the regression equation provided by the Hypothesis 4A testing is the negative sign of the coefficient of the independent variable, the Day 0 outcome prediction model value. The interpretation of the regression equation is that the probability of a high return is enhanced by investing in the securities of firms that have a low Day 0 outcome prediction model value. While this result is counter-intuitive, it is believed that its origin can be traced to three specific factors.

The first of these factors arises from the process by which the database was selected. The database used for hypothesis testing was developed to eliminate all observations for which there was probable cause to believe that there had been modifications to the terms

of the tender offer or that there had been competing offers.[60] The effect of these deletions is to remove all instances where the investor's expectations of modification or competition, as evidenced by a Day 0 bid greater than the tender offer price, would have been justified. Therefore, as a result of the database design all observations with Day 0 overbids result in end of period wealth reductions.

The second probable cause of the negative sign of the coefficient is that it is not possible to determine with a high level of assurance the market price for the final trade for completed tender offer contests. As stated in Chapter 4, a proxy for the market price for the last day of trading was utilized in this study. The result of the use of the proxy is that the last-day-of-trading price is on average $0.1484 less than the tender offer price. It cannot be determined whether this difference is the result of early reporting when the securities might trade at a discount due to the presence of remaining uncertainty as to the final outcome, or if the difference represents a discount which recognizes the possible existence of transactions costs associated with the tendering of the securities.[61] The effect, if any, from this difference should be slight since the mean of the difference represents only 0.47% of the mean of the tender offer price.

The third possible component that may cause the negative sign for the coefficient of the independent variable would be for investors to systematically assign unrealistically high probabilities for the successful completion of the tender offer and/or prices at which resolution will be reached.

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[60]Observations in which the market price on the final day of trading exceded the tender offer price were removed from the data base due to a presumption that the basis of the higher market price was the result of either modifications or competing tender offers.

[61]The mean of the difference between the last-day-of-trading proxy and the tender offer is $ 0.1483 with a median and mode of $ 0.125. The variance of the sample is 0.0670.

The Hypothesis 5 tests investigate the overall efficiency of the capital allocation market as it is concerned with the Day 0 price determination for the securities of firms which are the targets of tender offer contests. The inability to reject the null hypothesis that the means of the returns of the outcome prediction model and random portfolios are equal serves as affirmation of the semi-strong form efficiency of the market. This test indicates that one cannot earn economic rents through the use of the outcome prediction model as an investing decision aid.

The most interesting finding resulting from the examination of the means and variances for the selected and control portfolios is that four outcome prediction model portfolios and no random portfolios fall on the mean/variance efficient frontier. This finding is especially noteworthy when it is remembered that the outcome prediction model is derived assuming a risk neutral utility of wealth function.

Visual inspection of the Mean/Variance Efficient Frontier graph located at Exhibit 11 reveals several interesting observations. The first observation is that while the plotting locations of the randomly selected portfolios appear to be truly random in their location, the selected portfolios appear to be grouped into two distinct loci. With the exception of the one outlier, Portfolio J, the selected portfolios either fall into a high return group or a low variance group. In confirmation of the Hypothesis 4A findings of a negative coefficient for the outcome predictor variable the four portfolios with the lowest mean predictor values provide the four of the six highest returns.

COMMENTS AND FUTURE RESEARCH

The goals and objectives of this study effort have been, for the most part, achieved. The overall test results reaffirm the efficient market theory as it has been developed by Muth, Samuelson, Fama, and as modified by Black's "Noise Theory." [62] The market's overall efficiency is affirmed by the outcome prediction model's ability to differentiate between completed and withdrawn tender offers and between tender offers which are wealth enhancing and those that are not. The robustness of the development of the prediction model is supported by the highly significant regression equation relating the Day 0 outcome prediction model values to returns and by the mean/variance efficiency of the outcome prediction model selected portfolios relative to the random portfolios.

The areas in which this study has been less successful are primarily associated with deficiencies in the state-of-the-practice for the collection and processing of large databases of financial information.

Resolution of the study's most interesting and puzzling finding, the negative sign for the coefficient in the regression equation relating the predictor model values and returns cannot be resolved until the current data collection problems are overcome. The existence of an electronically accessible database containing daily reports of financial news such as tender offers and their modification would have permitted day by day updating of the tender offer price. This contemporaneous updating would have prevented many of the problems associated with the overbidding which in turn resulted in raw outcome prediction model values that were less than zero or greater than one.

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[62] Muth (1961), Samuelson (1965), Fama (1970), and Black (1986).

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