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**The impact of management resistance on the outcome of hostile
tender offers**

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City University of New York, 1988

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THE IMPACT OF MANAGEMENT RESISTANCE ON
THE OUTCOME OF HOSTILE TENDER OFFERS

by

ANNE-MARIE ZISSU

A dissertation submitted to the Graduate Faculty in
Economics in partial fulfillment of the requirements
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INTRODUCTION

Tender offers have expanded in the last few years. Although hostile tender offers represent a small percent of the entire tender offer activity, they have a significant impact on the return of outstanding shares. We are interested to find the determining element in the outcome of hostile tender offers and particularly the impact of management resistance.

The first chapter is a survey of the literature in the area of tender offers. The survey will underline the weaknesses of the research applied to the determinants of the outcome of tender offers. The survey will also give the motivations for pursuing and developing subsequent research which appears in the following chapters.

In particular, chapter II is an attempt to show that in the context of hostile tender offers managers of target company affect the outcome. The analysis will be applied to the price movement of outstanding shares after the announcement of the offer.

Chapter III will emphasize the impact of investment banks on the outcome of hostile tender offers. It will be shown, with the introduction of investment banks, that managers of the target company do affect the outcome of a tender offer.

CHAPTER I

Introduction

The survey on the literature of takeovers will consist of four sections:

The first section will summarize papers which model the choice that owners of the target company must make when a tender offer is made for their shares.

The second section examines papers which analyze the role of manager resistance as a determinant of a hostile tender offer. In this section two elements of management behavior will be discussed: 1) The reasons for management's resistance to a tender offer. 2) The impact of management's resistance on the outcome of a tender offer and on stockholders' return.

The third section will discuss the tactic used by management known as corporate greenmail. Some of the papers argue that greenmail benefits all shareholders while other argue that it is a method which only benefits the current management team.

The fourth section analyzes the role of investment banks prior to the announcement of tender offers, and their impact on the outcome of tender offers.

I. Shareholders' behavior in the context of a tender offer.

The first paper in this section to analyze the shareholders' behavior in the context of a tender offer is entitled " Takeover Bids, the Free-Rider Problem, and the Theory of the Corporation" written by Sanford J. Grossman and Oliver D. Hart. Grossman and Hart discuss the idea that the proper management of a common property is a public good to all the owners of the property. Their fundamental hypothesis is that there are significant costs in ensuring that directors/managers act in interest of the owners (shareholders). If one small shareholder devotes resources to improving management, then all shareholders benefit. This is the externality that the takeover bid mechanism attempts to "internalize". A simple takeover bid does not exclude shareholders from benefiting from the improvements in their property. Any profit a raider can make through the price appreciation of the shares he purchases can also be made by a shareholder who free rides and does not sell his shares to the raider. Thus, a raider faces the same sort of externality that any shareholder would face if he devoted resources to improving management. To avoid the free-rider problem, the dilution of the remaining non-tendered shares is

being suggested. In order to demonstrate the efficiency of the dilution technique, Grossman and Hart develop a model in which they determine the key elements affecting the shareholders' decision to tender or not to tender. The key elements of this decision is the difference between the profits realized under the new management and the profits earned under the old management and the price the acquirer is bidding for control of the target. Shareholders do not know what the profits of the company under new management will be, therefore they must base their decision on the expected value of their property under the management.

In modelling the outcome of the tender offer, management of the target company is being ignored in the determination of the outcome.

The next paper is "Large Shareholders and Corporate Control" written by Andrei Shleifer and Robert W. Vishny. The central idea in the paper is that in a corporation with many small owners, it may not be rational for any one of them to monitor the performance of the management. Vishny and Shleifer explore a model in which the presence of a large minority shareholder provides a partial solution to the free-rider problem. The large shareholder (the raider) would make a tender offer and remove the current managers with new managers if successful. In their model the determinant of the outcome of the tender offer is the decision of the owners' of a controlling interest in the corporation. They

may choose to tender or not to tender their shares. this choice is based on the following inequality:

$$P - E[Z/.5Z - (.5 - a)P - C] > 0$$

where P is the tender price, E is shareholders' expectation of Z, the actual increase in discounted profits resulting from replacement of inefficient management, a is the percent of share owned by the raider (large minority shareholder) prior to the tender offer and C represents the different types of costs involved in the tender offer that the raider has to face.

A third paper with a very similar approach is "A model of the Outcome of Takeover Bid" by Lucian Arye Bebchuck. The concern of this paper is with the outcome of takeover bids. First, the paper presents a game-theoretic analysis of the factors that determine shareholders' tender decisions. This analysis identifies the likely outcome of a bid, as a function of the bid's terms, the distribution of shareholders' estimates of the independent target's value, and the other parameters involved. The model's analysis of shareholders' tender decisions proceeds as follows: Supposing that the bid is going to succeed, a shareholder's best course of action will be to tender, as the post-takeover value of minority shares is generally expected to be lower than the bid price, due to controlling shareholders' ability to dilute the value of the interests of minority shareholders. Supposing that the bid is going to fail,

however, either tendering or holding out might be preferable, depending on whether or not the bid price exceeds the value of a share in the independent target. Thus, a shareholder's best course of action will depend on his expectations concerning other shareholders' decisions, and in forming these expectations the shareholder will recognize that other shareholders reason in a way similar to his. The paper goes on to identify the shareholder's equilibrium strategy.

According to Bebchuk a takeover will occur if the number of tendered shares is sufficient for the bidder to gain control. The analysis identifies the conditions for the bid's success and for its failure, as a function of the bid's terms, of the distribution of the shareholders' estimates of the independent target's value, and of the other parameters involved.

The preceding three papers have an idea in common. They all model the outcome of the tender offer as a function of the decision to tender or not to tender by the owners of a controlling interest in the target. This decision is based on the shareholders rational expectations of the value of the company under the control of the new management.

None of these papers examine management resistance to a tender offer as a possible determinant of the outcome.

II. Management Resistance.

A paper which does discuss the role of management resistance as a determinant of a tender offer is, "Tender Offers and Management Resistance" by David P. Baron. The model of target resistance to tender offers that he develops is based on the private information of target management about the true value of the firm and about their own preference for control. Baron suggests three reasons for Target management's rejection of an offer in the context of this model. "First, the offer may be inadequate compared to the true value of the target. Second, the offer may be adequate in this sense, but target management may prefer to await for a possibly higher offer in the next period. Third, target management may reject an offer in order to maintain their control over the target." As offers are made and rejected, however, some targets develop a reputation for having a preference for control and their market value falls. Baron also suggests that degree of management resistance is determined by the percent of shares that they own. His hypothesis is that management resistance is an decreasing function of the percent of the company that they own.

"The Market for Corporate Control" written by Michael C. Jensen and Richard S. Ruback is a paper that reviews much of the empirical literature on the market for control. The aim of their paper is to analyze the impact of management resistance on the return to the shareholders of the target company and of the company making the acquisition. The

questions addressed in this paper are the following:

1. How large are the gains to shareholders of bidding and target firms?
2. Does opposition to takeover bids by managers of target firms reduce shareholder wealth?
3. Do takeovers create market power in product markets?
4. Does antitrust opposition to takeovers impose costs on merging firms?
5. Is shareholder wealth affected by proxy contests?
6. Are corporate voting rights valuable?

The answers to these questions are covered with the results of thirteen different empirical studies. It seems though, that a common results to all the different studies is the big wealth effect obtained in the context of tender offers: shareholders of a target company benefit of a high return on their shares.

III. Greenmail.

Although "A Theoretical Analysis of Corporate Greenmail" by Jonathan R. Macey and Fred S. McChesney is a paper which analyzes both the conditions supporting greenmail and the objections to greenmail, the paper is clearly defending the technique. Macey and McChesney expose the general objections to greenmail which are the following: "The first objection is that management pay greenmail only to

protect their jobs (the agency cost objection). The second objection is that negotiated repurchases benefit the majority shareholder more than the majority of shareholders. (the unfairness objection)."

The advantages of greenmail discussed in this paper are: " Like a tender offer, a greenmail transaction informs the market that the target firm's stock is undervalued. Greenmail allows the firm to make unwanted suitors go away without discouraging them from producing information about the target firm in the first place. Other defensive tactics (i.e., locating a white knight, selling off key assets, installing shark-repellent amendments) apply against any and all potential acquirers. Greenmail does not; it signals "open season" for successive waves of purchasers to acquire substantial minority blocks of shares in order to be bought off". Another advantage of greenmail according to Macey and McChesney is that there may be costs of bargaining over the exact terms between the firm and the greenmailer, but these are trivial compared to the costs of litigation or other defensive tactics.

A similar view of greenmail is a paper written by Sanjai Bhagat and Richard Jefferis: "Why Good Managers Pay Greenmail: The Economics of Targeted Share Repurchases". In this paper, they argue that if greenmail is necessarily contrary to the interest of shareholders, shareholders would contract with managers to not engage in practice. The

authors develop a model of resistance to takeovers that may culminate in greenmail, in an environment where managers have private information about the value of the firm, and shareholders have a rational perception of managerial incentives for resistance. They agree with the fact that greenmail is always in the interest of the incumbent management but could be in the interest of shareholders: Greenmail may transmit information about the value of corporate resources that results in an increase in wealth of shareholders.

"A Theory of Acquisition Markets-Mergers Vs. Tender Offers" by Elazar Berkovitch and Naveen Khanna is another paper supporting greenmail. The main concern of that paper is to find the elements that will determine a merger instead of a tender offer. However they emphasize that greenmail is a good technique because it reveals the value of the target which (usually) was undervalued, and the shareholders benefit from it.

A paper which seems to disagree with those supporting greenmail is "Standstill Agreement Privately Negotiated Stock Repurchases and the Market for Corporate Control" by Larry Y. Dann and Harry DeAngelo. Their paper is an analysis of standstill agreements. They write "Standstill agreements are voluntary contracts which limit a substantial stockholder's ownership interest in a corporation for a specified number of years. They are often accompanied by repurchase of the

stockholder's share at a premium above the market price. Standstills and premium buybacks reduce competition for corporate control and provide differential treatment of large block stockholders. The analysis of this paper indicates a statistically significant negative average effect on non-participating stockholders wealth associated with standstill agreements. Negotiated premium repurchases are also associated with negative, but less significant, stockholder returns. The evidence is inconsistent with the hypothesis that these management actions are in the best interests of non-participating stockholders.

IV. The role of investment banks.

It seems that none of the studies on takeovers, published in academic journals, has taken into account the role of investment banks. John J. Clark, in his book "Business Merger and Acquisition Strategies" emphasizes, in the chapter on takeovers, the important role of investment banks in the market for corporate control. He writes "if the first order of business in implementing an acquisition strategy is to set up a merger team, then the second order is to assure the participation of a well-connected investment banking house to identify target companies, devise a bidding strategy, and structure the deal. Some investment banking houses have become so adept at tender offers that success or

failure of the offer depends on who retains them first, the acquiring company or the target firm."

Ernest Bloch wrote "Inside Investment Banking".

According to him there has not been any books on investment banks prior to the one he wrote. In chapter 7, Merger and Acquisitions I: Market Making as a Circus, Bloch lists the role of investment banks for the bidding firm as follows:

- "1. Forecasting gain for some time in the future.
2. Planning and transactions cost associated with a tender proposal (friendly or unfriendly) or a merger. This also requires the preparation of legal and financial documents.
3. Estimate of probability (and/or cost) of potential for antitrust action by the Department of Justice or another relevant government agency (FTC, FCC, SEC, 50 states).
4. Estimates of prices per share of the target firm following the announcement of the takeover, merger, and so forth. This is a strategic impact on cost.
5. Estimates of prices per share of the bidding firm following the announcement. From the bidding firm's view, this will affect gain.
6. Estimate types and amounts of additional financing needed to execute the deal.

The target firm will seek investment banking advice especially if the merger or takeover is neither sought nor wanted: Suppose a firm's board members and management find they are the target of an unwanted and unanticipated takeover bid. The first shock has worn off, the panic, anger, and other emotional reactions have been talked out. The next policy step is to evaluate an appropriate response policy with board and management participants who have had prior experience with such events. In most cases, and especially if a board member happens to be an investment banker, there will be call for experts in the following area:

1. Defense: poison pill, crown jewel sale, and so forth.
2. Implementation of defense and/or other strategies that are designed to lead to higher premiums on the target firm's stock.
3. Alternative reorganization: leveraged buyout and so forth.

For most of this activities investment banks are being hired."

Bloch explains differences in investment banks which

induce board members and management to go with well-known, as opposed to newer, entrants even if the latter offer more competitive fees. The experience and therefore the quality of the investment bank is what determines the management's choice of the bank as advisor.

CHAPTER II

A CRITIQUE OF THE PRICE MOVEMENTS AS INDICATORS OF TENDER
OFFERS SUCCESS IN THE CONTEXT OF HOSTILE TAKEOVERS.

Introduction

This study is a critique of a paper entitled "Price Movements as Indicators of Tender Offer Success"¹. William Samuelson and Leonard Rosenthal examine, in their joint paper, movements in the prices of target stocks as predictors of the ultimate success or failure of tender offers. An empirical investigation of 100 % cash tender offers during the years 1976 to 1981 leads to the conclusion that, with a few exceptions, market prices are well-calibrated, i.e., the current target price during the offer period measures the expected (discounted) stock price at the conclusion date. The market's probability predictions improve monotonically over time. If the tender offer is successful, the target stock will trade at (or very near) the tender price before being delisted. If the tender proves to be unsuccessful, the stock will trade at a significantly lower value. Prior to the conclusion date of the offer, daily movements in the target stock price represent the collective opinion of the market participants as to the success or failure of the offer. Consequently, these price movements, one might expect, would presage the

¹W. Samuelson and L. Rosenthal. "Price Movements as Indicators of Tender Offer Success." *The Journal of Finance*, Vol. XLI, NO. 2. (June 1986), 481-499.

ultimate outcome of the offer. In particular, the greater the increase in the target stock price, the greater the "market odds" of a successful tender offer.

The model used in their paper, however, would be appropriate if only applied to friendly tender offers without incorporating in the sample to be analyzed hostile tender offers. It seems in fact, that in the particular case of hostile tender offers, the daily movements in the target stock price representing the collective opinion of the market participants is not fully representative of the outcome being success or failure.

The purpose of this study is to test whether the movements in the prices of target stocks can be a good predictor of the ultimate success or failure in the particular case of hostile tender offers using their same technique. We believe to have good reasons to expect market prices not to be well-calibrated for hostile tender offers.

Section I supplies the motivation for the empirical analysis. The remainder of the essay treats the data and statistical methods employed (Section II), the empirical results obtained (Section III), and the main implication of those results (Section IV).

I. Motivation of the Empirical Study

The model that Samuelson and Rosenthal use in "Price

Movements as Indicators of Tender Offer Success"

implicitly assumes the existence of a perfect market. "A perfect market is one characterized by perfect knowledge on the part of the traders. Or stated differently, in a perfect market no buyer ever pays more than any seller will accept, and no seller accepts less than any buyer will pay", Stigler (21).

If the price movements after the announcement of a tender offer is considered to be a good predictor of the outcome of the tender offer, it is then believed that shareholders have perfect knowledge of the market. Assuming that shareholders do know the stream of profits under new management and that each individual shareholder knows each other's individual choice of tendering or not tendering, then we can accept the fact that shareholders have perfect knowledge of the market, therefore that the price movements are good indicators of the outcome of a tender offer. It is important, though, to emphasize that this would function only under the condition of friendly tender offers.

In the case of hostile tender offer, the shareholders do not have perfect information of the market as there is an agency problem.

The basic arguments for managers resisting a tender offer are that the offer is inadequate relative to the true value of the target and that a higher offer can likely be obtained in the future. These arguments, however, provide a

cover for target managements that seek to maintain control to protect their jobs. The central issue for shareholders is then to distinguish between the management's resistance because the offer is inadequate and the management's resistance in the attempt to maintain their independence and control. The question to be asked is whether shareholders do know when managers have interests that diverge from their owns. In the case of passivity rule² the target management would simply advise its shareholders not to tender if they consider the offer inadequate, and would not use any device to prevent the offer to be successful.

Often in the situation of a hostile tender offer passivity rule is inexistant and defensive tactics are being used by the target management as greenmail, white knight, selling off key assets, installing shark-repellent amendments, pac-man, and many other strategies. In such a framework, shareholders do not have perfect information of the market, therefore the price movements, after announcement of a tender offer, might not be good indicators of the outcome.

II. Data and Statistical Method

²A passivity rule such as that proposed by Easterbrook and Fischel would prevent the target from doing anything other than making statements to its shareholders about the value of the offer and the value of the target itself.

A. Data

The data consists of a sample of 49 hostile tenders during the period December 1980 to June 1986. In that sample, 30 tender offers are successful and 19 are unsuccessful. All members of the sample had the following characteristics³.

- (a) The offer was a cash tender offer for 100% of the target's outstanding shares.
- (b) The tender price was at least 15% higher than the target's average stock price two weeks prior to the offer announcement date.
- (c) There were no competing tender offers.
- (d) The target firm was not a bank, insurance company, or utility.
- (e) The target firm's common stock was traded on the New York, American stock exchange, and Over The Counter⁴.

For each target firm in the sample, the following information was compiled: the tender price, the success or failure of the tender offer, and the daily trading prices of the target stock during the offer period. Tender prices and

³The characteristics are the same used in Samuelson and Rosenthal's paper.

⁴Samuelson and Rosenthal do not use Over The Counter companies in their study.

outcome, and offer dates were taken from Securities Data Company. The rates of return were obtained from the daily CRSP file.

The data was organized both by looking forward from the announcement date and backward from the conclusion date. Thus, the daily time series was constructed for forward days $d = 1, 2, 3, \dots, 20^s$ and backward days $d = -20, -19, -18, \dots, -1$, where the minus indicates days before the resolution of the offer.

B. Model

The following model is the description by Samuelson and Rosenthal of the assumptions and methodology applied to the movements in the prices of target stocks to predict the ultimate success or failure of tender offers. The same method will be applied to our sample of hostile tender offers.

"Consider first the impact on value resulting from the tender. If the offer is successful, the target will trade at the tender price (before the stock is delisted). If the tender is unsuccessful, the target shares will settle at a new market-determined "fallback" price. Analysis of the unsuccessful offers shows that the target price

^sTwenty business days represent a period of time of four weeks.

following the expiration of the offer can be relatively well-predicted, settling above the market price prevailing before the offer but below the tender price.

Given the value consequences of these twin outcomes, it is possible to infer the market's probabilistic prediction of success (or failure) from movements in the target's stock price. Let P_d denote the target stock price at day d during the offer period which begins at announcement date $d = 0$ and extends through the conclusion date, $d = D$. If after the announcement, the stock price immediately jumps to the tender price, P_T , one can infer that the market predicts the tender to be successful with certainty. Alternatively, a minimal movement to a level no higher than the fallback price, P_F , implies that the market assesses a zero probability of success. In general, the larger is the price increase in the interval $[P_F, P_T]$, then the greater is the market's probability of success.

The main test of the predictive value of stock price changes rests on the following hypothesis.

On any day during the offer period, the current price of the target stock measures the expected value of the stock price at the conclusion date.

Since at date D the target stock will be worth P_T or P_F , depending on the success or failure of the tender, the simplest version of the expected value hypothesis predicts

$$P_a = qP_T + (1 - q) P_F, \quad (1)$$

where q denotes the probability that the offer is successful. Probability q , of course, is not directly observable. The point is that with a known value of P_T and an estimate of P_F , the market probability of success can be easily inferred. Rearrangement of (1) yields

$$q = [p_a - P_F] / [P_T - P_F]. \quad (2)$$

The inferred probability of success is measured by the percentage amount that the stock price increases above the fallback price and toward the tender price. If, after the tender announcement, the stock price immediately jumps to the tender price, the market probability of success is one. On the other hand, if there is no movement above the fallback price, the inferred probability of success is zero. In general, an $x\%$ relative price increase implies an $x\%$ probability of success.

Since the offer period can extend over a significant period of time, Equation (1) needs to be modified slightly to account for the time value of money:

$$P_a = [qP_T + (1 - q) P_F] / [1 + r_f], \quad (1')$$

where r_f is the required rate of return to be earned over

the holding period d to D . If the success or failure of the tender offer is uncorrelated with market movements, then r_f would be the prevailing risk-free rate of return. The inferred market odds become

$$q = [(1 + r_f) P_D - P_F] / (P_T - P_F). \quad (2')$$

Samuelson and Rosenthal use the Brier Score to test whether the probabilities obtained from the application of their model to tender offers are well calibrated. The same test will be applied to the probabilities obtained using their model in the context of hostile tender offers. In the case of only two outcomes, success or failure, the Brier score is defined as

$$B = [(q_i - s_i)^2] / I, \quad (3)$$

where I is the number of forecast, q_i is the predicted probability that the i^{th} tender offer will be successful, and s_i is the offer's actual outcome, $s_i = 1$ for success and $s_i = 0$ for failure. In simplest term, the Brier score represents a standardized measure of the mean-squared error associated with the forecast.

The more accurate are the forecasts on average over the sample, the lower the Brier score. Thus "perfect" market forecasts always quote $q = 1$ for successful tenders

and $q = 0$ for unsuccessful ones implying $B = 0$. At the opposite extreme, forecasts which are always dead wrong ($q = 1$ when $s = 0$ and $q = 0$ when $s = 1$) generate a maximum score, $B = 1$.

In order to apply model (2') it is necessary to generate estimates of P_F , the price of the target stock in the event that the tender offer is unsuccessful. It is only in the case of unsuccessful tender offers that we have the fallback price P_F ⁶. Samuelson and Rosenthal construct an estimate equation for the fallback price using the sample of unsuccessful tender offers and apply this equation to the successful targets. By doing this, they assume that the fallback behavior of the unsuccessful targets is representative of the behavior for the sample of successful targets, had tenders for those targets failed.

"The simple estimation equation posits that the fallback price depends linearly on P_T , the tender price, and on P_I ⁷, the initial stock price prevailing prior to the tender announcement. Thus,

$$P_F = a_0 + a_1P_I + a_2P_T \quad (4)$$

In addition, it was posited that this relationship should be

⁶The fallback price P_F is measured as the stock price at the end of the second week following the failure of the tender.

⁷The initial price P_I is measured two weeks prior to the announcement date.

independent of the nominal levels P_T and P_x (i.e., the market does not suffer from money illusion) and that P_F should lie in the interval $[P_x, P_T]$, implying the restriction $a_0 = 0$ and $a_1 + a_2 = 1$. In short, the prediction is that the fallback price will be a weighted average of the initial stock price and the tender price." Therefore to generate estimates of P_F , the following equation will be applied:

$$P_F = a_1 P_x + a_2 P_T \quad (4')$$

III. Empirical Results.

The estimation equation (4') for the fallback price using the unsuccessful offers is:

$P_F = .944 P_x + .208 P_T$ with t-ratios respectively equal to 1.789 and .612, and $R^2 = .747$. The restriction $a_1 + a_2 = 1$ is not verified here as $.944 + .208 > 1$. This implies that P_F does not always lie in the interval $[P_x, P_T]$.

As expected, the results obtained by the application of formula (2') are not very satisfactory (appendix:Table I to XI)^a. The obtained probabilities are not good predictors

^aThe first 20 observations are the estimated probabilities for the 20 first business days after announcement of the tender offer. Observations 21 to 40 are the estimated probabilities for

of the outcomes: we sometimes find probabilities close to zero in the case of successful tender offers (i.e Table I to VI: $q_1, q_{12}, q_{15}, q_{30}$) and probabilities close to or above one in the case of unsuccessful tender offers (i.e. Table VII to XI: $q_{31}, q_{33}, q_{36}, q_{39}, q_{40}, q_{46}, q_{49}$), while we should obtain the reverse. Besides the fact that the probabilities are not good predictors of the outcome, they are, in 36 cases out of 49, above one in absolute value, and negative for 19 cases out of 49 under the restriction $0 < q < 1$.

The Brier score was calculated at the end of each week of the first month after announcement of the tender offer, and at the end of each week of the month preceding the expiration of the offer.

| <u>Week</u> | <u>Brier Score</u> |
|-------------|--------------------|
| 1 | 100.545 |
| 2 | 27.142 |
| 3 | 63.866 |

the last 20 business days prior to the conclusion of the tender offer, therefore observation 40 represents the day prior to conclusion. The columns q_1 to q_{30} are the columns of daily probabilities for the 30 successful tender offers, and columns q_{31} to q_{49} represent the 18 unsuccessful tender offers.

| | |
|----|--------|
| 4 | 84.551 |
| -4 | 51.868 |
| -3 | 72.668 |
| -2 | 54.599 |
| -1 | 27.800 |

As can be seen from the table of Brier scores the results are bad. First, the Brier score is supposed to be between zero and one, the closer to zero the better calibrated are the estimated probabilities q . Here each score is way above one. Second, Samuelson and Rosenthal believe that the Brier score should improve monotonically as we get closer to the end of the tender offer. According to our results the Brier score does not have a specific pattern, but rather, fluctuates.

IV. Interpretation and Implications

The restriction $0 < q < 1$ implies that

$$0 < [(1 + r_f) P_a - P_F] / (P_T - P_F) < 1.$$

Case 1:

$q = 1$ implies $(1 + r_f) P_a = P_T$, in such case the daily price after announcement of the offer converges to the tender price.

Case 2:

$q = 0$ implies $(1 + r_f) P_a = P_F$, in such case the daily price after announcement of the offer will converge to

the fallback price which is assumed to be less than the tender price and above the price two weeks prior the announcement.

Case 3:

$q > 1$ implies $(1 + r_f) P_a > P_T$. This means that the daily price after announcement of the tender offer goes above the tender price. This is not a surprising phenomena as often, in the case of a hostile tender offer, the management of the target company will advise its shareholders not to tender because they consider the real value of a share to be higher than the offered premium. If shareholders believe in the management's statement, they will probably expect to get a better offer from a different bidder and therefore not tender.

Case 4:

$q < 0$ implies two subcases:

Case 4a:

$q > |1|$ implies $(1 + r_f) P_a > P_F > P_T$

According to Samuelson and Rosenthal there could not be such case as they assume that the fallback price is less than the tender price. However we cannot accept such an assumption as we actually have cases where the fallback price is greater than the tender price. This can be explain by the fact that if the tender offer was not successful, shareholders still expect another acquirer to make an offer higher than the previous one.

Case 4a is a natural case that would follow after case 3: in case 3 the daily price, after announcement of the tender offer, goes above the tender price because shareholders expect a better offer from the same or from a different bidder, therefore do not tender. This causes the tender offer to be unsuccessful with a fallback price higher than the tender price if shareholders expect a better offer.

Case 4b:

$$-1 < q < 0 \text{ implies } (1 + r_f) P_D < P_F < P_T$$

According to Samuelson and Rosenthal, the daily price P_D after announcement of the offer remains between P_F and P_T , it will not fall below the fallback price P_F . The results obtained from the application of their model to hostile tender offers show that P_D can fall below P_F .

Conclusion

The attempt of this paper is to provide evidence for the impact of the management resistance on the outcome of a hostile tender offer. This was achieved with success through the analysis of stock price movement after announcement of the tender offer.

The model introduced by Samuelson and Rosenthal estimates the probability of success or failure of a tender offer based on the price movement of a stock after the

announcement of the tender offer. They found that price movements are good predictors of the outcome. Their sample consisted of 109 tender offers from 1976 to 1981, without distinction between friendly and hostile tender offers. Historically the percent of hostile tender offers has been very small, Clark (6). This can explain the good results obtained in their study. When the same model, though, is applied exclusively to a sample of hostile tender offers, the price movement becomes a bad predictor of the outcome. Price movement of a stock after the announcement of a tender offer is supposed to represent shareholders' perception of the market given "perfect" information. In the contest of a hostile tender offer, though, shareholders do not have full information of management's behavior, therefore their perception of the market is biased. In the case of passivity rule, the management would simply limit himself to advise shareholders not to tender. Passivity rule is very rare in the contest of hostile tender offers, this implies that managers are active in pursuing defensive strategies to prevent themselves from losing their independence from the raider, therefore affect the outcome of a tender offer.

CHAPTER III**THE IMPACT OF INVESTMENT BANKS ON THE OUTCOME OF HOSTILE
TENDER OFFERS.**

THE IMPACT OF INVESTMENT BANKS ON HOSTILE TENDER OFFERS

Introduction

A tender offer is a public bid for a specified quantity of a firm's outstanding stock at a specific price. The minimum time period for which the tender offer is valid is set by the federal and state statutes governing tender offers. The maximum time period for which the offer is valid is determined by the company who is making the tender offer (the acquirer). The bid is presented to all individuals and institutions that own shares of stock in the target company.

The tender offer may or may not be solicited. In the case where the directors of a company solicit bids for their company's outstanding stock, the terms of the offer are negotiated between the directors of the two companies before the tender offer is presented to the shareholders of the target company. When presented with a tender offer, stockholders have two alternatives: to tender their shares or retain ownership.

An unsolicited tender offer is categorized as friendly or hostile depending on how it is received by the directors of the target company. If the directors agree to the terms of the tender offer or are willing to negotiate a revised offer the tender offer is classified as "friendly."

If the terms of an unsolicited tender offer are rejected by the directors of the target company and they advise their shareholders not to tender their shares to the acquirer, the tender offer is classified as "hostile."

There are two major theories concerning the outcome of tender offers. The first asserts that what determines the outcome is essentially the premium offered; therefore management resistance is largely dismissed and the decision whether or not to tender resides with the shareholders. Those supporting this theory model the decision-making process of the shareholders when a tender offer is announced. They agree that the shareholders' decision is a function of their expectations regarding the value of their company under the new management. The comparison of the premium being offered with the expected improvement under new management and the individual shareholder's expectation of the other shareholders' decisions are the determinants of the outcome of the tender offer. It should be noted that such models are entirely theoretical and have yet to be tested (Scharfstein (19), Grossman and Hart (11), Vishny and Shleifer (20), Bebchuk (2), etc.)

The second theory sees management resistance as the major determinant of the outcome of a tender offer. Empirical studies of the effects of management resistance on the value of stocks have been conducted (Jensen and Ruback (12), Dann and De Angelo (7), etc.), but models of

management resistance and its impact on the outcome of a tender offer remain wholly theoretical.

In this paper we propose to combine the two theories and test them simultaneously in the context of a hostile tender offer. Some of the variables suggested in the literature are not incorporated in our model, however, as they cannot be quantified (for example, shareholders' expectations concerning the value of the target under new management.) This paper is thus the first attempt to conduct an empirical study of the elements determining the outcome of hostile tender offers. In particular we introduce the hitherto-neglected but highly significant factor of the investment banks advising both sides in a hostile tender offer, and evaluate the performance of the leading investment banks.

Section I supplies the motivation for our empirical analysis. The remainder of the essay treats the data and statistical methods employed (Section II), the empirical results obtained (Section III), and the main implication of those results (Section IV).

I. Motivation of the Empirical Study

The objective of the company making the tender offer is the acquisition of a controlling interest in the target company. By attaining such an interest, the acquirer will

gain the right to allocate the resources of the target. In the case of a hostile offer the objective of the directors of the target company is to maintain their control over their company's assets for the following three reasons (Baron (1)): "First, the offer may be inadequate compared to the true value of the target. Second, the offer may be adequate in this sense, but target management may prefer to await a possibly higher offer in next the period. Third, target management may reject an offer in order to maintain control over the target ." To retain control of their company's assets they must maintain their independence from the acquirer.

A successful tender offer depends on the selection and valuation of the target and the terms of the offer, both of which are the responsibilities of the investment bank hired to advise the company making the tender offer. A successful defense requires the strategic and tactical advise of an investment bank retained by the target management.

Preserving the independence of the target company from the hostile bidder can be achieved if a majority of the shares of the target company are not tendered or if the acquirer withdraws the offer. Increasing the alternatives available to the shareholders, and increasing the cost of the acquisition above the value the hostile bidder places on control of the target's assets are the two main lines of

defense used by target companies. Specific defensive tactics require the human and monetary capital of an investment bank.

We propose to test the hypothesis that differences in the quality of the investment banks advising the acquirer and the target company have a significant impact on the outcome of the hostile offer.

Shleifer and Vishny, in their paper "Large Shareholders and Corporate Control," 1986, argue that outside atomistic shareholders who as a group own a controlling share of the target company will tender their shares only if they believe that the premium being offered to them for their shares is at least as great as the increase in profits generated by the target's assets when these assets would be controlled by the acquirer. Shleifer and Vishny call this increase in the present value of the target's profit z . The probability of finding a value of z such that $z - q > 0$, where q is the discounted value of the target's profit prior to the tender offer, is an increasing function of research intensity (I). The costs associated with higher levels of research intensity $C(I)$ go up at an increasing rate.

In our scenario, the company making the tender offer hires an investment bank to search for a positive improvement ($z - q > 0$). Prior to making the offer the acquirer owns a share (a) of the target company. The share

of stock held by a diffuse group of stockholders is therefore (1-a) if insiders do not own any. The revenue the raider receives from purchasing a controlling interest (50 percent) in the target and implementing the improvement z is $.5z$. His costs of the tender offer are the premium x he pays for a share of stock sufficient to give him control of the target $(.5 - a)$ plus the costs of making the tender offer c . Shareholders of the company condition their expectation of z on the following inequality: $.5z - (.5 - a)x - c > 0$. This inequality implies that shareholders believe that the acquirer will recover his takeover costs, pay a premium on a share $(.5-a)$ of the company's outstanding stock, and still have a positive return from the acquisition. In Shleifer and Vishny's model, a majority of shares will be tendered to the acquirer if $x - E\{z/[.5z - (.5-a)x - c] > 0\} > 0$, where E is expectation.

Our objective is to be able to forecast the outcome of a hostile tender offer. According to Shleifer and Vishny, larger premiums should be positively correlated with the decision of stockholders to tender their shares and negatively correlated with the share of the target owned by the acquirer prior to the tender offer. We test the hypothesis that the success of the tender offer depends on the size of the premium offered to the owners of the target company. We also test the hypothesis that the success of a hostile tender offer depends on the share of the target

owned by the acquirer prior to the hostile bid.

The inside directors of the target of a hostile tender offer clearly have different motivations than arbitrageurs, pension fund managers, and other institutional investors. By the definition of a hostile tender offer, the inside directors will not tender to the acquirer, whereas arbitrageurs who have speculated on the acquisition of the target will most likely tender their shares to the acquirer. We will test the hypothesis that the percent of the target held by inside directors decreases the probability of the success of the acquirer. The hypothesis that the larger are the institutional ownership of the target, the more likely is the success of the company making the tender offer is also tested. Finally, we test the hypothesis that the leverage of the target company is positively correlated with the probability that the target company remains independent from the raider.

II. Methods and Data

a) Model

The general model used in our study is the following:

$$Y_{1t} = B_0 + B_1 X_{11t-1} + B_2 X_{21t-1} + B_3 X_{31t-1} + B_4 X_{41t-1} + B_5 X_{51t-1} \quad (1)$$

$$+ B_6 X_{61t-1} + U_{1t}$$

where Y_i is the outcome of the tender offer i at time t ; if the tender offer i is successful Y_{it} will equal zero, if it is not successful Y_i will equal one. B_0 is a constant, X_{1it-1} is the difference between the qualities of the investment banks advising the target company and the acquiring company ($Q_{T1}-Q_{A1}$) in tender offer i at time $t-1$, X_{2it-1} is the percent of share owned by the acquirer prior to the offer i at time $t-1$, X_{3it-1} is the percent of share owned by institutions prior to the offer i at time $t-1$, X_{4it-1} is the premium offered by the acquiring company to the stockholders at time $t-1$, X_{5it-1} is the percent of share owned by insiders (management of the target company) at time $t-1$, X_{6it-1} is the long term debt divided by the owners' equity of the target company at time $t-1$, and u_{it} is the disturbance at time t .

To estimate the model we use the logit technique. By far the most widely used qualitative choice model is logit. The logit probabilities are derived under a particular assumption regarding the distribution of the unobserved portion of the utility (for our purpose the utility would be represented by the determinants of the outcome of a tender offer). Suppose a decisionmaker, denoted n , faces a set of J_n alternatives. The utility that the decisionmaker obtains from alternative i in J_n , denoted U_{in} , is decomposed into (1) a part that is known by the researcher, labeled as V_{in} ,

and (2) an unknown part that is assumed to be a random variable, labeled e_{in} . This is expressed as $U_{in} = V_{in} + e_{in}$. It is important to remember that V_{in} depends on observed data and known or estimated parameters (B). Assume that each e_{in} , for all i in J_n , is distributed independently, identically in accordance with the extreme value distribution. Given this distribution for the unobserved components of utility, the probability that the decisionmaker will choose alternative i (that the tender offer will have outcome 1 or 0) is

$$P_{in} = e^{v_{in}} / \sum_{j \in J} e^{v_{jn}} \quad \text{for all } i \text{ in } J_n.$$

Three properties of the choice probabilities are important to note. First, each of the choice probabilities is necessarily between zero and one. If alternative i were unpleasant as possible for the decisionmaker, and hence its representative utility approached negative infinity, then P_{in} would approach zero. On the other hand, if alternative i were as wonderful as possible for the decisionmaker, and hence its representative utility approached infinity, then P_{in} would approach one.

Second, the choice probabilities necessarily sum to one:

$$\sum_{i \in J_n} P_{in} = \sum_{i \in J_n} (e^{v_{in}} / \sum_{j \in J_n} e^{v_{jn}}) = 1.$$

This follows from the fact that the choice set in a qualitative choice situation is exhaustive, so that the decisionmaker must choose one of the alternatives, and the

alternatives are mutually exclusive, so that the decisionmaker cannot choose more than one alternative (the tender offer is either successful or unsuccessful).

Third, the relation of the choice probability for an alternative to the representative utility of that alternative, holding the representative utilities of the other alternatives fixed, is sigmoid, or S-shaped. If the representative utility of one alternative is very low, compared with other alternatives, a small increase in the utility of this alternative will not much affect the probability of its being chosen; the other alternatives will still be generally preferred. Similarly, if one alternative is far superior to the others, so that its representative utility is very high, an additional increase in its utility will not much affect the probability of its being chosen. The point at which an increase in the representative utility of an alternative has the greatest effect on its probability of being chosen is when its representative utility is very similar to that of other alternatives. In this case, a small increase in the utility of one alternative could induce a large increase in the probability of the alternative being chosen.

b) Data

One of the data sets (data set (1)) we used was

obtained from "Securities Data Company". Data set (1) on hostile tender offers covers the period from December 1980 to September 1986. For each tender offer the name of the target company and of the acquiring company is given, along with their respective investment banks as advisors. From this data set we have obtained the percent of share owned by the acquirer prior to the offer, the premium offered to shareholders by the acquirer, the long term debt, and the owners' equity for the target company. We used Spectrum¹ (data set (2)) to obtain the percent of share owned by institutions and the percent of share owned by insiders prior to the offer. In data set (1) a few companies involved in hostile tender offers had unknown advisors. We deleted the tender offers with unknown advisors and those advised by an investment bank that appeared fewer than five times during our sample period. The companies with unknown advisors were in most cases investors, which means they had their own team as advisors. The size of the sample was thus reduced to ninety-two hostile tender offers with the following advisors:

(1) Bear Stearns; (2) Drexel Burnham Lambert; (3) E F

¹Spectrum is a series of books which gives information about publicly owned companies. The series is updated every six months and published by CDA Investment Technologies

Hutton; (4) First Boston Company; (5) Goldman Sachs²; (6) Kidder Peabody; (7) Lazard Freres & Company; (8) Lehman Brothers Kuhn Loeb; (9) Merrill Lynch; (10) Morgan Stanley; (11) Paine Webber; (12) Salomon Brothers; (13) Smith Barney; (14) Shearson Lehman/American Express.

Our model tests the hypothesis that the target company is more likely to remain independent the larger is the difference between the quality³ of the investment bank advising the target company and that of the bank advising the acquirer.

The correlation of the percent of shares owned by the acquirer prior to the offer with the probability that the target company remains independent is directed by two opposite forces: 1) The acquirer must purchase fewer shares to control the target. 2) Large profits may be realized by the acquirer if he sells his pre-tender offer share of the target back to the management (greenmail). Institutional holdings of the target company can be substantial. Just as an individual's decision to tender depends on his subjective valuation of his shares , so does the institution's.

²Goldman Sachs is known to advise only target companies in hostile tender offers, but this should not affect our results as we assume later the symmetry of investment banks.

³The quality of an investment bank for our purpose is a measurement of its skill as an adviser to the group making a hostile tender offer, and as an adviser to the directors of the target company. The bank's quality is measured relative to the pool of all other investment banks.

Institutions do not have homogenous attitudes towards risk nor do they value shares of the target equally. We have no ex post expectations about the significance or sign of institutional holdings on the outcome of the tender offer.

We expect that the premium offered to shareholders will be an important element in the outcome of the tender offer: the higher the premium, the higher should be the probability of success of the tender offer and therefore the lower the probability of the target company management remaining independent.

We expect that the larger the percent of share held by inside directors, the higher the probability that the target remains independent.

The financial leverage of a firm has several implications. It is important to understand the cost of capital versus risk. The company's cost and risk in raising capital are related to the investor's risk and return involved in making the investment. From the viewpoint of a company needing capital, the lowest risk capital is equity, because no fixed cash outlays are required. However, equity presents the highest risk to the investor. Common stock, the most common form of equity, is a residual claim on the company's earnings and assets. The investor in common stock stands last in line behind all others in getting a share of the profits. Dividends may or may not be paid, and even if paid in one period, can be cut off the next . Because

equity is the investor's riskiest investment, the required rate of return is the highest. And since the investor's required rate of return is the company's cost of capital, the least risky capital to the company will be the most expensive.

The opposite holds for debt. Debt is more risky to the company because of the fixed obligations, but less risky to the investor because of those obligations and the higher claim in bankruptcy. The lower risk to the investor means a lower required rate of return, and therefore a lower cost of capital to the company.

As a general rule, the cost of capital is an increasing function of the risk to the investor. This means that debt will generally be cheaper than equity. However, since debt is more risky for the company, an issuer must trade off cost versus risk in deciding how to finance.

Taxes are another important element affecting the cost of capital and therefore determining in part the debt-equity ratio. Corporate debt interest is corporate-tax-deductible. This deductibility feature for corporate debt financing (relative to equity financing) induces corporations, in the aggregate, to supply more debt than in a no-tax world.

Corporations should prefer debt to equity financing if no capital market imperfections other than taxes are considered. There is asymmetry in the way the federal

government defines its corporate tax law: Payments to bondholders are tax-deductible, whereas payments to shareholders are not.

The full value of the corporate tax deductibility of interest payments would accrue to the shareholders such that the market value of equity and the market value of the entire firm would increase, the larger the amount of debt that is used to finance the assets of the firm (Miller and Scholes (15)).

So far, all these elements applied to debt versus equity seems to be in favor of companies with a high leverage. Therefore companies with a high debt-equity ratio should be more attractive targets. If they are more attractive targets, raiders should offer higher premiums. The reason for higher premiums is also related to the fact that the debt of a target company generates higher returns on equities.

We have tested whether high premium is positively correlated with high debt-equity ratio and found a positive and significant results (t -ratio=3 and a coefficient=.03).

From this result, it should follow that the higher the debt-equity ratio, the lower is the probability that the target company remains independent from the raider.

If the assumption of no capital market imperfections other than taxes is relaxed, it might not be true anymore that corporations should prefer debt to equity financing.

With market imperfection some leverage-related costs are introduced such as bankruptcy costs, contracting and monitoring costs (increasing with more leverage), information and signaling costs, incomplete markets, etc. When these leverage-related costs are very large, then the target company with high debt-equity ratio becomes less attractive for the raider. Therefore, under these circumstances, the higher is the debt-equity ratio, the higher is the probability that the target company remains independent from the raider. This result would also be supported by the fact that a high debt-equity ratio involves a higher risk for the target company, which makes it less attractive as this make it more difficult for an acquiring firm to finance a proposed merger or tender offer with much debt.

It was mentioned earlier that investment banks affect the outcome of hostile tender offers. To analyze their impact we measure the differences in the quality of the investment banks on either side of the transaction by two different methods: the first method uses dummy variables, the second applies the Elo Rating System.

a. The Dummy Variables Method

One method for measuring the differences in quality of investment banks is to assign a dummy variable for each

combination of investment banks that have confronted each other in a hostile tender-offer contest. X_{1it-1} from model (1) becomes the following:

$$X_{1it-1} = Q_{T1t-1} - Q_{A1t-1}$$

where Q_{T1t-1} is the quality at time $t-1$ of the investment bank advising the target company T in tender offer i , and Q_{A1t-1} is the quality at time $t-1$ of the investment bank advising the acquiring company A in tender offer i . The dummy variable is applied to each combination of investment banks in the following way:

$$B_1(Q_{T1t-1} - Q_{A1t-1}) = d_{12}D_{12i} + d_{13}D_{13i} + \dots + d_{21}D_{21i} + d_{m-1,m}D_{m-1,m}$$

$D_{TA} = 1$ if for tender offer i the target company's investment

bank is T and the acquirer's investment bank is A;
 $= 0$ otherwise,

such that $B_1(Q_{T1t-1} - Q_{A1t-1}) = d_{TA}$

where d is the coefficient of the dummy variable D .

The number of possible combinations of investment banks = $m*(m-1)$.

The restrictions on the combinations are

$$1) d_{TA} = -d_{AT}^4$$

$$2) d_{TA} = d_{1A} - d_{1T}$$

Example of restrictions: Number of investment banks is four: bank 1, bank 2, bank 3, bank 4.

Number of possible combinations is $m*(m-1) = 4*(4-1) = 12$.

combinations:

$$1 - 2 \quad 2 - 1$$

$$1 - 3 \quad 3 - 1$$

$$1 - 4 \quad 4 - 1$$

$$2 - 3 \quad 3 - 2$$

$$2 - 4 \quad 4 - 2$$

$$3 - 4 \quad 4 - 3$$

Consistent with the first restriction, the second column can be eliminated as it is equal to the first column, only in a different order. In the first column three of the combinations can be expressed as combinations of others using the second restriction in the following way:

$$1 - 2$$

$$1 - 3$$

$$1 - 4$$

$$2 - 3 = (1 - 3) - (1 - 2)$$

$$2 - 4 = (1 - 4) - (1 - 2)$$

$$3 - 4 = (1 - 4) - (1 - 3)$$

Once the two restrictions are applied it is possible to reduce the $m*(m-1)$ combinations to a number $m-1$. In our

⁴We have to assume symmetry of investment banks as advisers.

numerical example, only three combinations would be used instead of twelve. In a general model, then, it is possible to express the $m*(m-1)$ combinations of investment banks with only $m-1$ dummy variables:

$$B_1(Q_{T1t-1} - Q_{A1t-1}) = d_{12}D_{121} + d_{13}D_{131} + \dots + d_{1m}D_{1m1}$$

Rule: $D_{1T} = 1$ if T is acquirer's investment bank.

$= -1$ if T is target's investment bank.

$= 0$ otherwise.

$D_{13} = 1$ if 1 is target's investment bank and 3 is acquirer's investment bank.

$= -1$ if 1 is acquirer's investment bank and 3 is target's investment bank.

$= 0$ otherwise.

Suppose in tender offer i , T = target's investment bank and A = acquirer's investment bank, then

$$B(Q_{T1t-1} - Q_{A1t-1}) = d_{TA} = d_{1A} - d_{1T}.$$

Using the method of dummy variables model (1) becomes:

$$Y_{1t} = B_0 + d_{12}D_{121} + \dots + d_{1m}D_{1m1} + B_2X_{21t-1} + B_3X_{31t-1} + B_4X_{41t-1} +$$

$$B_5X_{51t-1} + B_6X_{61t-1} + U_{1t} \quad (2)$$

b. The Elo Method

The Elo Rating System is designed to provide an accurate estimate of the current playing strength of a chess player as computed from his performances in competition with other players and measured along an arbitrary arithmetical scale. This system can be applied to any pairwise competition. The numerical value of the rating of an individual is based upon his percentage score in a tournament or match. In the evaluation of any performance, however, proper adjustment is made for the strength of the competition.

In adapting the method to the present subject, it is assumed that the distribution of the performances of an investment bank in different encounters is normally distributed. (The development of the method is to be found in the appendix.) The rating of an investment bank is updated after each hostile tender offer in which it participates. We first estimate the rank of the investment banks over the period December 1980 to December 1985 based on the outcome of hostile tender offers, then with logit analysis we estimate the probability of successful tender offer for the period January 1986 to September 1986⁵, using

⁵Fifty-two tender offers in 1986 after excluding those with unknown advisers and those with an investment bank that participated less than five times from 1980 to 1986.

and the rank of the investment bank advising the acquiring company as computed in the previous tender offer in which they were involved. The rank of each investment bank is what determines its quality as adviser, and it is revised after each new encounter. Using this method, model (1) becomes

$$Y_{it} = B_0 + B_1(Q_{T_{it-1}} - Q_{A_{it-1}}) + B_2X_{2_{it-1}} + B_3X_{3_{it-1}} + B_4X_{4_{it-1}} + B_5X_{5_{it-1}} + B_6X_{6_{it-1}} + U_{it} \quad (3)$$

were:

- Y_{it} is the outcome of tender i at time t ,
- $Q_{A_{it-1}}$ is the quality at time $t-1$ of the investment bank advising the acquirer in tender offer i ,
- $Q_{T_{it-1}}$ is the quality at time $t-1$ of the investment bank advising the target company in tender offer i at time t ,
- the remaining variables are the same as in model (1) at time $t-1$.

Inasmuch as the primary task of the acquirer's investment bank is played out in the formulation of general strategy, and specifically of deciding on the offer price, once the tender offer is announced, the acquirer's investment bank thereafter becomes less important. After the announcement of the tender offer the main player becomes

the investment bank advising the target company. It has to find the best strategies to keep the management independent. The weakness of the acquirer's investment bank and the strength of the target's investment bank can be shown in the following model, in which the qualities of investment banks of target and acquiring companies are separated:

$$Y_{1t} = B_0 + B_{11}Q_{T1t-1} + B_{12}Q_{A1t-1} + B_2X_{21t-1} + B_3X_{31t-1} + B_4X_{41t-1} + B_5X_{51t-1} + B_6X_{61t-1} + U_{1t} \quad (4)$$

Finally, if our hypothesis on the weakness of the investment bank advising the acquiring company after announcement of the tender offer is correct, the model becomes:

$$Y_{1t} = B_0 + B_1Q_{T1t-1} + B_2X_{21t-1} + B_3X_{31t-1} + B_4X_{41t-1} + B_5X_{51t-1} + B_6X_{61t-1} + U_{1t} \quad (5)$$

where the quality of the investment bank advising the acquiring company has been removed from the model.

III. Empirical Results

Models (2), (4), and (5) are estimated for the period 1986 (fifty-two observations). The small size of the sample is due to the constraint imposed by the Elo method: we first have to compute the quality of the investment banks over a period of time large enough (December 1980 to December 1985) to give us reliable results, then used the estimated qualities as independent variables in model (4) and (5) for the remaining period, January 1986 to September 1986. Using the same sample period allows us to compare model (2) with model (4) and (5)

Model (2):

Table I

| <u>Variable</u> | <u>Coefficient</u> | <u>T-ratio</u> | <u>Sig.Lvl</u> | |
|-------------------------------|--------------------|----------------|----------------|--------------------------|
| B ₀ | 1.32 | .52 | .60 | log-likelihood=-13.471 |
| D _{1,2} | -2.3 | -1.31 | .19 | restricted Log-L=-35.076 |
| D _{1,3} | 9.65 | .16 | .86 | chi-square(17)=43.209 |
| D _{1,4} | 2.27 | 1.06 | .28 | significance lvl=.44E-03 |
| D _{1,5} | 1.23 | .57 | .56 | R= .616 |
| D _{1,6} | -3.57 | -1.41 | .15 | |
| D _{1,7} ⁶ | .49 | .49 | .62 | |
| D _{1,9} | -6.65 | -1.17 | .24 | |

⁶Bank 8 is Lehman Brothers Kuhn Loeb. It does not appear in any hostile tender offer in 1986 because it merged with Shearson/American Express.

| | | | |
|-------------------|---------|-------|-----|
| D _{1,10} | -4.67 | -1.86 | .06 |
| D _{1,11} | -11.80 | -.16 | .86 |
| D _{1,12} | .55 | .25 | .79 |
| D _{1,13} | -1.28 | -.43 | .66 |
| D _{1,14} | -1.48 | -.48 | .62 |
| X ₂ | .49E-01 | 1.05 | .29 |
| X ₃ | -.76 | -.41 | .67 |
| X ₄ | -1.63 | -.56 | .57 |
| X ₅ | -.38 | -1.41 | .15 |
| X ₆ | 4.36 | 1.61 | .10 |

After removing the dummy variables representing the combination of investment banks, the log-likelihood is equal to -28.917. Therefore, by taking twice the difference between the log-likelihood of model (2) and the log-likelihood of model (2) without the dummy variables we obtain (in absolute value) $2(13.471-29.917)=32.892$, which is greater than 28.3, the value we obtain from the chi-square table with twelve degrees of freedom statistically significant at the .5 percent level in a one-tail test. This important result supports our theory of the major role of investment banks in hostile tender offers.

"The likelihood ratio index is defined as

$$R = 1 - (LL (B^*) / LL (0)),$$

where $LL (B^*)$ is the value of the log likelihood function at the estimated parameters and $LL (0)$ is its value when all

"The likelihood ratio index is defined as

$$R = 1 - (LL (B^*) / LL (0)),$$

where $LL (B^*)$ is the value of the log likelihood function at the estimated parameters and $LL (0)$ is its value when all parameters are set equal to zero. The likelihood ratio index ranges from zero, when the estimated parameters are no better than zero parameters, to one, when the estimated parameters allow for perfectly predicting the choice of sampled decisionmakers". It is important to note that the likelihood ratio is not at all similar in its interpretation to the R-squared used in regression, despite both statistics having the same range. R-squared indicates the percent of the variation in the dependent variable that is "explained" by the estimated model. The likelihood ratio has no intuitively interpretable meaning for values between the extremes of zero and one. It is the percent increase in the log likelihood function above the value taken at zero parameters", (Train (22)).

In this model, however, because of the use of dummy variables to represent the combination of investment banks as advisers of target and of acquiring companies, we have eighteen explanatory variables, including the constant, with only fifty-two observations. This creates a problem of insufficient degrees of freedom. We address this problem by analyzing the impact of the remaining variables in model (4) and (5), using the Elo System.

| <u>Variables</u> | <u>Coefficient</u> | <u>T-ratio</u> | <u>Sig-Lvl</u> | |
|-------------------------------|--------------------|----------------|----------------|---------------------------|
| B ₀ | -.05 | -.03 | .96 | Log-Likelihood=-14.5 |
| D _{1,2} | -1.57 | -1.06 | .28 | Restricted Log-L=-35.076 |
| D _{1,3} | 8.42 | .20 | .84 | Chi-Square (14) = 41.16 |
| D _{1,4} | 1.17 | .68 | .49 | Significance Lvl=.168E-03 |
| D ¹ _{1,5} | .60 | .34 | .73 | R = .58 |
| D _{1,6} | -3.71 | -1.68 | .09 | |
| D _{1,7} | .35 | .46 | .64 | |
| D _{1,9} | -6.12 | -1.22 | .22 | |
| D _{1,10} | -4.45 | -1.91 | .05 | |
| D _{1,11} | -11.27 | -.22 | .82 | |
| D _{1,12} | -.60 | -.34 | .73 | |
| D _{1,13} | -.85 | -.33 | .73 | |
| D _{1,14} | -1.04 | -.40 | .68 | |
| X ₅ | -.3E-06 | -1.3 | .19 | |
| X ₆ | 3.92 | 1.66 | .09 | |

When the insignificant variables are removed from model (2), the remaining variables are not affected. We observe though a slight decrease in the likelihood ratio index from .61 to .58 which might imply that some of the explanatory power is being lost as X₂, X₃, and X₄ are removed from the model. We will, therefore maintain the original model (2).

Model (4):

Table III

| <u>Variable</u> | <u>Coefficient</u> | <u>T-ratio</u> | <u>Sig-Lvl</u> | |
|-----------------|--------------------|----------------|----------------|--------------------------|
| B ₀ | -9.33 | -1.42 | .15 | log-likelihood= -26 |
| Q _T | .11E-01 | 2.1 | .03 | restricted Log-L=-35.076 |
| Q _A | -.31E-03 | -.06 | .94 | chi-square(7) = 18.215 |
| X ₂ | .28E-01 | 1.00 | .32 | significance lvl=.11E-01 |
| X ₃ | .52 | .05 | .95 | R = .26 |
| X ₄ | 1.32 | .82 | .40 | |
| X ₅ | -.17E-06 | -2.33 | .02 | |
| X ₆ | .80 | 1.20 | .23 | |

As can be seen in Table III, the first important result is the significant impact of the investment bank advising the target company (Q_T) and the weakness of the investment bank advising the acquiring company (Q_A). This can be explained by the fact that most of the strategies including the premium to be offered and the percent of share for which the offer should be made, are planned by the acquirer's adviser before the offer is announced. Once the tender offer is announced, however, the skills of the target's investment bank are required to fight for the independence of the management. Because of the subsequent insignificance of the investment bank advising the acquiring company, we remove Q_A from model (4) and obtain:

Model (5):

Table IV

| <u>Variable</u> | <u>Coefficient</u> | <u>T-ratio</u> | <u>Sig.Lvl</u> | |
|-----------------|--------------------|----------------|----------------|--------------------------|
| B ₀ | -9.63 | -2.10 | .03 | log-likelihood=-26 |
| Q _T | .12E-01 | 2.13 | .03 | restricted Log-L=-35.076 |
| X ₂ | .28E-01 | 1.00 | .31 | chi-square (6) = 18.211 |
| X ₃ | .66E-02 | .07 | .94 | significance lvl=.57E-02 |
| X ₄ | 1.32 | .82 | .40 | R = .26 |
| X ₅ | -.17E-06 | -2.38 | .01 | |
| X ₆ | .78 | 1.21 | .22 | |

Table IV shows the results of model (5), which excludes Q_A . The two significant variables are the investment bank advising the target company and the percent of share owned by the management of the target company prior to the offer. We obtain a positive sign for Q_T , as we expected: that is, the higher the quality of the target's investment bank the higher the probability that the target company will remain independent.

We expected the percent of share owned by the insiders of the target company to be positively correlated with the success of the managers in remaining independent, based on the assumption that managers would not tender. This, however, seems not to be the case as we obtained a negative, very significant coefficient. We interpret this finding as implying behavior in favor of the stockholders. With the help of its investment bank the target company management tries to raise the value of the shares if it thinks the offer inadequate; if it succeeds getting a higher offer, it may then decide to tender. This of course would happen only if the managers own a large enough share to compensate them for the possible loss of their job. Therefore, if the percent of share owned by the management multiplied by the premium offered by the acquiring company exactly offsets the position they are giving up while being taken over, the management theoretically will be indifferent between tendering or staying independent; this is the

equilibrium point of management indifference. As soon as the product between the percent of shares owned by the management and the premium exceeds the point of management indifference, the target management would be expected to tender their shares. This explains the significant negative coefficient of the percent of share owned by the management.

The percent of share owned by the acquiring company prior to the offer is not significant. One possible explanation of this result is the payment of greenmail, which may offset the negative correlation with the independence of the target management. Further, we find that the percent of share owned by institutions is wholly insignificant.

The premium offered by the acquiring company has a low T-ratio and the wrong sign: we expected the premium to be negatively correlated with the probability that the target company remains independent, as shareholders would be more likely to tender their shares as the premium increases. The low T-ratio and positive sign may be explained by the fact that the premium was computed as the difference between the offered price and the market value the day before the offer, divided by the market value the day before the offer. Inasmuch as the market value of the shares of a target company increases by about 30 percent within the two to three weeks preceding the offer (7,12), the method used to compute the premium is biased. When the premium is

replaced with the premium over the book value, we obtain the right negative sign and a t-ratio equal to -1.64. The fact that book value is more stable than price gives us the expected result, significant at 10 percent.

Finally, the long-term debt divided by the owner's equity of the target company is not very significant. The obtained sign is positive. This would suggest that the higher is the debt-equity ratio, the higher is the probability that the target company remains independent from the raider.

When the variables which are very insignificant (X_2 , X_3 , X_4) are removed from the model, we obtain the following:

Table V

| <u>Variable</u> | <u>Coefficient</u> | <u>T-ratio</u> | <u>Sig.Lvl</u> | |
|-----------------|--------------------|----------------|----------------|---------------------------|
| B_0 | -9.42 | -2.24 | .02 | Log-Likelihood=-26.55 |
| Q_T | .11E-01 | 2.29 | .02 | Restricted Log-L=-35.076 |
| X_5 | -.14E-06 | -2.23 | .02 | Chi-Square (4) = 17.038 |
| X_6 | .78 | 1.23 | .21 | Significance Lvl.=.19E-02 |
| | | | | R = .24 |

When the insignificant variables are removed from model (5) the quality of the investment bank advising the target

company becomes the most significant variable in the model. The percent of share owned by insiders loses slightly some of its significance, and the debt-equity ratio becomes slightly more significant. However we choose model (5) with all its independent variables as the likelihood ratio index R is higher.

Table VI

Comparison between the two methods used to estimate the quality of investment banks:

| <u>Bank</u> | <u>Average Quality</u> | <u>Difference in Quality between</u> | <u>Coefficient of the Dummy Variable Used</u> |
|-------------|------------------------|--------------------------------------|---|
| | | <u>Bank 1 and Other</u> | <u>as Combination of</u> |
| | | <u>with Elo Method</u> | <u>Bank 1 and Other</u> |
| 1 | 777.33 | | |
| 2 | 793.525 | -16.195 | -2.33 |
| 3 | 691.625 | 85.7 | 9.65 |
| 4 | 742.4 | 34.93 | 2.27 |
| 5 | 732.38 | 44.95 | 1.23 |
| 6 | 914.31 | -136.98 | -3.57 |
| 7 | 759 | 18.33 | .49 |
| 9 | 868.36 | -91.03 | -6.65 |
| 10 | 845.8 | -68.47 | -4.67 |
| 11 | 912.2 | -134.87 | -11.80 |
| 12 | 798.22 | -20.89 | .55 |
| 13 | 843.66 | -66.33 | -1.28 |
| 14 | 795.5 | -18.17 | -1.48 |

The results produced by the two different methods applied to estimate the impact of investment banks on the outcome of hostile tender offers are consistent. This can be shown by comparing the coefficients of the combinations of each investment bank with investment bank 1 in model (2): sometimes we see a positive sign, sometimes a negative sign. This means that in some instances bank 1 was stronger than its opponent, in others it was weaker. To confirm that these results are reliable, we analyzed the qualities obtained using the Elo method as follows: First we took the average quality for each investment bank over the period January-September 1986 and then computed the differences between investment bank 1's average quality and each other investment bank's average quality. We then compared in Table VI the sign of each difference with the sign of the coefficient of the dummy variables in model (2); they all matched except for the combination of investment bank 1 and 12, which can be explained by the infrequent participation of investment bank 12 over the sample period. This result supports the hypothesis that some investment banks are more qualified than others in the game of hostile tender offers.

IV. Conclusion and Implications

The contribution of this paper to the literature on tender offer consists of two major results. The first is the significant impact of the investment bank advising the target company: the higher the quality of the investment bank advising the target company, the higher the probability of the target company remaining independent. It is worth mentioning that the target company's success in remaining independent is not necessarily a victory for the shareholders, as it is often part of the target's investment bank strategy to decrease the value of the company so that it becomes less attractive for the acquirer. Therefore the word "success" is used from the point of view of the target management only.

Our second important result is the negative correlation between the percent of share owned by the target management and the success of the tender offer. This suggests that there is a point at which the percent of share owned by the managers is large enough to offset the position they would give up by tendering. Beyond such a point, the larger the percent of share owned by the target managers, the more likely they will tender and therefore cause the offer to be accepted.

This paper offers a partial explanation of the factors that determine the outcome of hostile tender offers: two elements were found significant, and their impact is but a small fraction of the total field of variables, many still

unknown. This means there is need for more research in this area.

CHAPTER IV

THE ELO RATING SYSTEM: A METHODOLOGY TO ESTIMATE THE QUALITY OF INVESTMENT BANKS AS ADVISERS IN THE CONTEXT OF HOSTILE TENDER OFFERS.

THE RATING SYSTEM

1.1 Measurement of Investment Banks Performance

The purpose of a rating system is to rank the performance of individuals or groups relative to a standard. Investment bank performances vary from time to time, due to random events so a ranking list based on a single event is not reliable. In a competitive activity such as a hostile tender offer, the outcome of a series of contests provides tentative rankings. Once the rating system is estimated the competitors may be listed in the order of their strengths.

A rating system is essentially a scheme for pairwise comparison of individual players or teams. The Elo Rating System is a numerical system in which differences in rating may be converted into the probability of winning.

1.2 The Rating Scale

Each player has a range of performances. Statistical and probability theory provides a widely used measure of performance spreads which is the standard deviation. The standard deviation measures dispersion of a player's actual performance around the mean of his performances.

1.3 The Normal Distribution Function

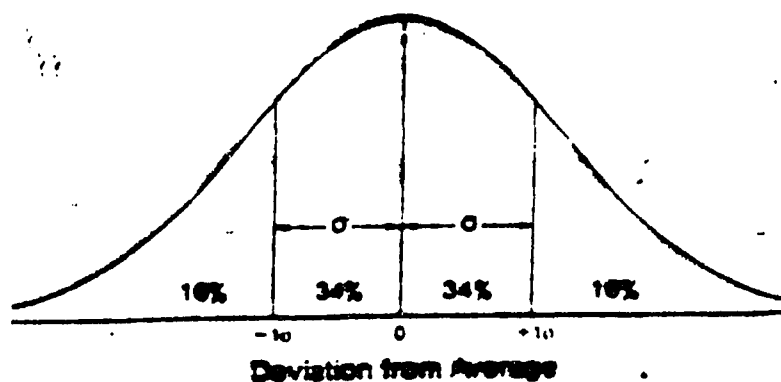
An investment bank's performances vary from hostile tender offer to another. By and large at any point in its career, an investment bank will perform around some average level. Deviations from this expected level occur, large deviations less frequently than small ones. These facts suggest that the performances of an investment bank are normally distributed. The performance rating of an investment bank resulting from many encounters is a combination of the average rating of the competition and the percent score achieved. The variability of an investment bank's performances must be recognized. A performance rating based on a large number of hostile tender offers may not accurately reflect the strength of an investment bank relative to its competition. A well designed rating system must combine performance ratings so as to provide the best possible estimate of the current relative strength of the investment bank. The player's rating will also exhibit some random variability, but not to the degree shown in the bank's individual performances.

A histogram of the deviations of performances from the mean score expresses the concept visually. If a sufficiently large number of tender offers is used, the

histogram may be enveloped by a smooth curve, the familiar "normal distribution curve". This is a symmetrical curve around the mean. Approximately two thirds (.682) of all scores fall within a range of one sigma on either side of the mean. The remaining third are found outside of the range, equally divided at the tails of the curve.

Figure 1

THE NORMAL DISTRIBUTION
OF MEASUREMENTS

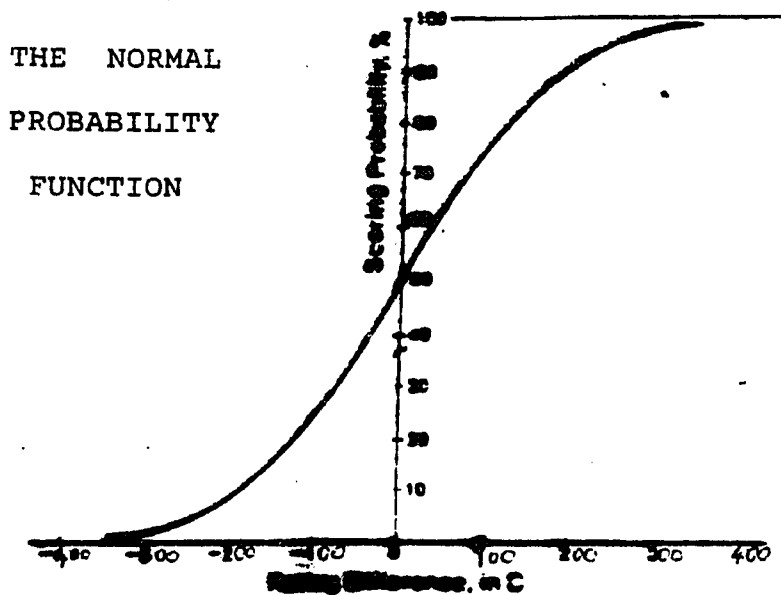


1.4 The Normal Probability Function

The performances of the banks engaged in a hostile

tender offer cannot be evaluated in absolute terms. In a single game only two possible scores will be considered: 1 and 0. In an individual encounter, the score of a player reflects only the particular outcome of the hostile tender offer. The mathematical form used to evaluate performances is based on the assumption that the performances are normally distributed. Using the calculus of statistical probability, differences in relative strengths are converted into the probability of an investment bank winning a contest. This relation is central to the rating system.

Figure 2



For rating purposes, the tabular expression of the normal distribution function becomes the percentage expectancy table shown. The graphic expression of the table is the percentage expectancy curve on the preceding page. The curve is presented on normal probability paper. It is the probability function which produce the correct combinations of expected percentage score and competition rating. The curve or table may be used to determine differences in ratings from match or tournament results or to determine expected scores from known rating differences.

1.5 The Performance Rating Formula

Periodic Measurement

The performance rating formula is the first equation of the system.

$$R_p = R_c + D(P) \quad (1)$$

R_p is the performance rating.

R_c is the (average) competition rating of the opponents.

P is the number of wins over total number of games played.
D(P) is to be read as the difference based on the
percentage score P, which is obtained from the
curve or table.

Equation (1) may be used to determine ratings on
periodic basis. In rating systems administered on periodic
basis, ratings are calculated at finite intervals, i.e. one
year, for all investment banks, using the previous ratings
of the opponents as R_c .

1.6 The Current Rating Formula
 Continuous Measurement

When a rating system is conducted on the continuous
basis, new ratings are computed after each event by the
current rating formula:

$$R_n = R_o + K(W - W_e) \quad (2)$$

R_n is the new rating after event.

R_o is the pre-event rating.

K is the rating point value of a single game score.

W is the actual game score, each win valued at 1.

W_e is the expected game score based on R_o .

This equation performs the arithmetical operation of averaging the latest performance into the prior rating so as to diminish smoothly the effect of the earlier performances, while retaining the full contribution of the latest performance. The logic of the equation is evident without algebraic demonstration: an investment bank performing above its expected value gains points, and an investment bank performing below its expected value loses points.

The coefficient K reflects the relative weight for the pre-event rating and the event performance rating. A high K gives a large weight to the most recent performance relative to the earlier performances. A low K gives more weight to the earlier performances. Thus K may be used as a sort of player development coefficient to recognize the varying rates at which change occurs in a player's performance. When rating banks engaged in hostile tender offers a high K should be used as there are often changes of personnel within an investment bank.

The expected score (W_e) in a group of games is the sum of the expected scores for each game of the group. For each opponent the winning probability $P(D)$ is taken from the percentage expectancy table, and the values are totaled:

$$W_e = \sum P_i \quad (3)$$

P_i is the bank's probable percentage score for each opponent he faces. In a rating system administered on the continuous basis, the ratings of all investment banks in the rating pool are continually readjusted by equation (2). As the number of games played increases differences in ratings will converge to the percentage expectancy curve on which the system is based (Elo). The system is self-correcting. New investment banks who enter the rating pool are processed by equation (1) for a provisional period. When sufficient data is accumulated on their performances against rated investment banks, subsequent calculation are taken over by equation (2).

1.7 The Percentage Expectancy Table

For each rating difference D , the probability of winning, $P(D)$, is derived from the normal probability table. For our purposes the critical value z is multiplied by 100. Conversion of rating point differences into the percentage expectancy of winning and the conversion of percentage points into rating point differences are the basic functions of the Elo Rating System. From the tabulation of rating point differences D and percentage scores P , one may read directly the percentage of points a bank is expected to win

for a given difference in rank, $D(P)$, indicated by a given percentage score. Conversion of percentage scores into rating differences may be illustrated by the results of the hostile tender offer in which bank A advised the acquirer and bank B the target. Assuming bank A confronted bank B five times, the results can be summarized as follows:

| Investment bank | Game score | P | D(P) |
|-----------------|------------|----|------|
| A | 3 | .6 | ? |
| B | 2 | .4 | ? |

Investment bank A's .6 score indicates a $D(P) = 25$ points. The same $D(P)$ appears for Investment bank B's .4 score. The two investment banks performed at levels 25 points apart. Conversion of a rating differences into percentage expectancy may be illustrated by the E-F investment banks' match:

| Investment bank | Rating | D | P(D) |
|-----------------|--------|----|------|
| E | 1715 | 70 | ? |

F 1645 -70 ?

For the differences D shown, the table gives a percentage expectancy of .76 for the higher-rated investment bank and .24 for the lower-rated investment bank. The respective percentage expectancies, multiplied by the number of games to be played, indicates the expected tournament score.

1.8 Example of Calculation

| | R | W | P |
|-----------------|--------|-------|-----------|
| Investment bank | Rating | Score | Pct.Score |
| A | 1635 | 10.5 | .70 |
| B | 1600 | 10 | .67 |
| C | 1600 | 9.5 | .63 |
| D | 1555 | 9 | .60 |
| E | 1575 | 8.5 | .57 |
| F | 1615 | 8.5 | .57 |
| G | 1470 | 8.5 | .57 |
| H | 1550 | 8 | .53 |
| I | 1600 | 8 | .53 |
| J | 1510 | 8 | .53 |
| K | 1560 | 7 | .47 |
| L | 1410 | 6.5 | .43 |

| | | | |
|---|------|-----|-----|
| M | 1470 | 5.5 | .37 |
| N | 1485 | 5 | .33 |
| O | 1445 | 4 | .27 |
| P | 1460 | 3.5 | .23 |

Investment bank
average 1534
Number of
investment bank 16

Example 1:

Calculation of a performance rating R_p in terms of the competition rating R_c .

Before the tournament, investment bank A's 15 opponents had an average rating $R_c = 1527$. Bank A won 10.5 hostile tender offers, a percentage score $P = .70$, for which the table indicates the rating point difference $D(P) = 52$. $P = (\text{number of tender offers won}) / (\text{number of tender offers played})$. Formula (1) gives the performance rating:

$$R_p = R_c + D(P)$$

$$=1527 + 52$$

$$=1579$$

Example 2: Calculation of a new rating R_n in terms of the competition rating R_c .

Before the tournament Investment bank A had a rating $R = 1635$, and its opponents had an average rating $R_c = 1527$, an average difference $D_c = 108$, for which the table indicates the percentage expectancy $P(D_c) = .86$. The number of tender offers was $N = 15$. Formula (4) gives investment bank's expected score:

$$\begin{aligned} W_e &= N * P(D_c) && (4) \\ &= 15 * .86 \\ &= 12.9 \end{aligned}$$

The new rating will also depend on the value of K . If $K = 10$ formula (2) gives investment bank A's rating after incorporation of its performance at the tournament:

$$\begin{aligned} R_n &= R_o + K(W - W_e) \\ &= 1635 + 10(10.5 - 12.9) \\ &= 1611 \end{aligned}$$

Example 3: Calculation of a new rating R_n in terms of the individual percentage expectancies P_i against each opponent. For each of bank A's opponents the rating R_i and the difference D_i from investment bank A's 1635 rating are presented below. A positive value for D_i indicated that bank A was rated higher than its opponents. Since all D_i are positive, all $P_i(D) > .5$.

| Opponent | R_i | D_i | $P_i(D)$ |
|----------|-------|-------|----------|
| B | 1600 | 35 | .63 |
| C | 1600 | 35 | .63 |
| D | 1555 | 80 | .79 |
| E | 1575 | 60 | .72 |
| F | 1615 | 20 | .58 |
| G | 1470 | 165 | .95 |
| H | 1550 | 85 | .80 |
| I | 1600 | 35 | .63 |
| J | 1510 | 125 | .89 |
| K | 1560 | 75 | .76 |
| L | 1410 | 225 | .98 |
| M | 1470 | 165 | .95 |
| N | 1485 | 150 | .93 |

| | | | |
|-------|------|------|-------|
| O | 1445 | 190 | .97 |
| P | 1460 | 175 | .96 |
| Total | | 1620 | 12.17 |

Investment bank A's expected score (W_e) may now be computed more precisely by formula (3), which summarizes the individual expectancies:

$$\begin{aligned} W_e &= \sum P_i \\ &= 12.17 \end{aligned}$$

Using formula (2), with K equal to 10, gives bank A's current rating after the tournament:

$$\begin{aligned} R_n &= R_o + K(W - W_e) \\ &= 1635 + 10(10.5 - 12.17) \\ &= 1635 - 16.7 \\ &= 1618.3 \end{aligned}$$

2. RATING SYSTEM THEORY

2.1 Rating System Methodology

A workable rating system, fully developed from basic

theory, includes certain principal components:

1. Rating scale
2. Performance distribution function
3. Percentage expectancy function
4. Performance rating formula
5. Continuous rating formula
6. Appropriate numerical coefficient

The system components are interrelated and interdependent in varying degree. The distribution function is the derivative of the probability function, which in turn is the integral of the distribution function.

2.2 The Rating Scale

An interval scale was selected for the application of the Elo system. The class interval for investment banks was designated C and defined as \sqrt{C} . The subdivision $C = 100E$, the scale midpoint at 1000, and the use of four-digit numbers is entirely arbitrary.

2.3 The Distribution Function

The basis for selecting the normal distribution function is given at 1.3. The formula for the normal

distribution is

$$Y = \frac{1}{\sqrt{2\pi}} e^{-\left(\frac{1}{2}\right)z^2} \quad (5)$$

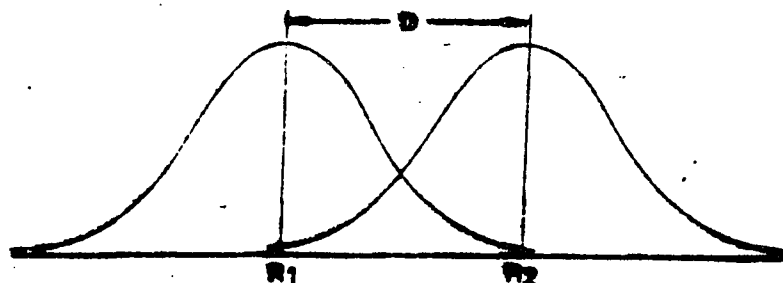
where Y represents the ordinate, e is the base of the natural logarithms, and z is the measure of the deviation from the mean in terms of standard deviation. The assumption of normal distribution of individual performances could be open to some question, as it is theoretically possible that the distribution could be skewed one way or another. In this eventuality we fall back on the important central limit theorem which indicates that differences in performances will tend to be normally distributed over the long run. A performance rating R_p is developed from game scores, usually several games, and therefor it can be considered a mean.

2.4 The Probability Function

The normal distribution function leads to normal probability function, or standard sigmoid. Consider two investment banks whose performances are normally distributed: let R_1 and R_2 be the average performances with $R_2 > R_1$, let σ_1 and σ_2 be the standard deviations of their

respective performances. Designate $(R_2 - R_1)$ by D , as in figure 3. Figure 3 illustrates the distributions of players' individual performances.

Figure 3



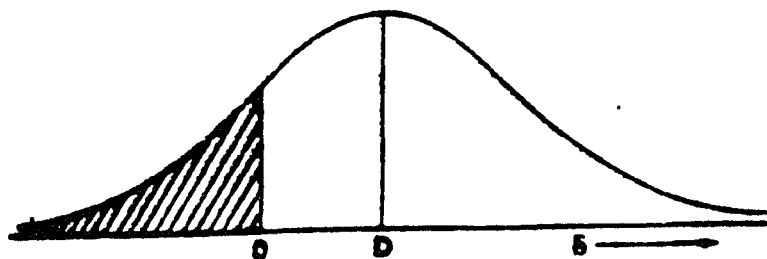
Now if these investment banks engage in a large number of contests, then the differences in the investment banks performances will also be normally distributed around the value D , with a standard deviation of $\sigma' = \sqrt{\sigma_1^2 + \sigma_2^2}$. Further, if $\sigma_1 = \sigma_2$, then $\sigma' = \sigma\sqrt{2}$. Even if σ_1 and σ_2 differ widely, the ratio of the resulting σ' to σ , the standard deviation of performances of all investment banks

of the pool, does not change significantly. If $\sigma_1 = \sigma_2$, then σ'/σ is $\sqrt{2}$ or 1.41, whereas if $\sigma_1 = \text{say } 2\sigma_2$, then σ'/σ is $\sqrt{5/1.5}$ or 1.49.

This consideration recommends the selection $c = \bar{\sigma}$, where $\bar{\sigma}$ is the average σ for the pool of investment banks.

The following graph illustrates the distribution of δ .

Figure 4



Since δ is normally distributed around D , some portion of the area under the curve will fall on the negative side of zero. This portion is shaded in the graph and represents the probability that the lower rated investment bank will outperform the higher. When the shaded area is plotted against D , one obtains the standard sigmoid with a standard of $\sigma\sqrt{2}$, see figure 2.

2.5 The Continuous Rating Formula

Assume that an investment bank achieves a rating R_o on the basis of $N(o)$ hostile tender offers, with $N(o)$ large enough for reasonable confidence. Assume that it then engages in a subsequent event which provides a new sample of N tender offers. The performance rating R_p associated with the new sample might well differ from R_o , and the difference may be the result of a real change in its ability or simply a random statistical fluctuation in its performance. The question becomes which is the more likely, or rather, what is the best way to combine R_o and R_p to obtain the most accurate new rating R_n . There are several combination processes. One might simply average the result from N and N_o , obtaining a new rating for the entire sample $N_o + N$, but this preserves fully the rating contribution of the earlier samples and produces, if real changes in ability have occurred, a false statement of the current rating.

The proper method to combine R_p with R_o should attenuate the earlier performances in favor of the later ones, and at the same time it should yield results within the range of the standard deviations of both R_p and R_o . An appropriate weighting of R_o and R_p in the averaging process produces this result. If R_p is weighted by the size of its

own sample N , and R_o is weighted by $(N_o - N)$, and the total sample is treated as if it were just equal to N_o , then the expressions R_n and for ΔR become

$$R_n = \{R_o(N_o - N) + R_p N\} * 1/N_o = R_o + (R_p - R_o)N/N_o \quad (6)$$

$$\Delta R = R_n - R_o = (R_p - R_o)N/N_o \quad (7)$$

Since $R_p = R_c + D(P)$ and $R_o = R_c + D(P_o)$, where P_o is the percentage scored on the sample N_o , then ΔR may be written

$$= D(P) - D(P_o) * N/N_o \quad (8)$$

by making the simplifying assumption that R_c is the same for both samples. Now, if the percentage scores P and P_o do not differ greatly, they may be expressed in (8) as read from the percentage expectancy curve, with slope S :

$$= N/N_o * [1/S * (P - P_o)] \quad (9)$$

S varies, of course, but its average value for the most used portion of the curve may be taken as $1/4\sigma$, giving

$$= 4\sigma (P - P_o)N/N_o = 4\sigma (NP - NP_o)/N_o \quad (10)$$

NP is W, the score achieved in sample N, and NPo is We, the expected score on the basis of the earlier percentage Po. Thus, finally

$$\Delta R = K(W - We) \quad (11)$$

where the coefficient K is just $4\sigma / No$. The continuous or current rating formula becomes

$$R_n = R_o + K(W - We)$$

where $We = \sum P_i$

or $We = N * P(Dc)$

2.6 Rating Group of Unrated Investment Banks

The working formulae of the Elo system presume an existing pool of rated investment banks, or at least a few available rated investment banks for standards comparison. A special problem arises when an isolated group of investment banks is to be rated for the first time. If records are available for the investment banks to be newly rated, ratings may be computed from those data by the method of successive approximations. To develop ratings by the normal play process, with no previous data available, an

identical rating is assigned each investment bank, and ratings are adjusted after subsequent encounters by equation (2) with K set at some large value, between 32 and 50. Normal play continues, and the R_n after each event becomes R_o for the next.

2.7 The Method of Successive Approximations

When previous tournament records are available, they may be used to determine relative ratings even though each investment bank in the group has not encountered every other member of the group. The following steps are taken for each investment bank:

1. Assign an initial rating R_i , identical for all investment banks, high enough so no rating will be negative.
2. Find $D(P)$ for each investment bank, indicated by the percentage expectancy table, for its percentage score on available records of tender offer.
3. Calculate the first approximation of its rating R_1 using formula (1), with $R_c = R_i$.
4. Compute the first correction of its competition rating R_{c1} by averaging R_1 for the other investment

banks.

5. Calculate the second approximation of its rating R_2 using formula (1), with $R_c=R_{c1}$.
6. Continue the calculation cycles until successive values for R show little or no change, indicating that a set of self-consistent differences in ratings has been produced for all members of the group.

APPENDIX

DATA FILE

This data set contains fiftytwo hostile tender offers. Each row represents the characteristics of a tender offer as follows:

V1 = Outcome of the tender offer: 1 if management remains independent from the bidder, and 0 otherwise.

V2 = Quality of the investment bank advising the target company.

V3 = Quality of the investment bank advising the acquiring company.

V4 = Outstanding shares of the target company in thousands.

V5 = Thousands of shares for which the tender offer is announced.

V6 = Percent of shares owned by the acquiring company prior to the tender offer.

V7 = Price per share prior to the tender offer.

V8 = Tender Price.

V9 = Percent of shares owned by institutions prior to the tender offer.

V10 = Percent of shares owned by the management of the target company prior to the tender offer.

V11 = Dummy variable describing industry of the target company.

V12 = Book value of the target company prior to the tender offer.

V14 = Target's owner's equity.

V15 = Long term debt.

V16 = Premium over book value.

1 825 820 6550011 6550011 0 16.25 20 3.7 194410 1 18.22 9.9

119348 48212 9.77 2440018

1 815 772 73147906 70000000 4.85 44.625 60 3 416804 0 43.61

11.41

6624000 2403000 37.58 16965000

1 818.5 739 173900781 64000000 13.6 31 54 3.6 416804 0 32.78

13.4

5694300 1267900 64.73 9228000

0 839.5 718 36960450 36960450 4.4 50.375 65 6.2 564678 1

35.3

8.76 1304700 1016900 84.14 3846000

1 756 751 5088849 5088849 0 13.5 19 8.5 340816 1 11.58 14.73

62700 7700 64.08 85700

0 859 806.5 24700000 6800000 1.05 63.75 72 2.5 8696095 1

23.97

16.63 592826 276457 200.38 1163752

1 804.4 890 11598592 11598592 0 17.375 22 .3 5292051 1 18.19

8.63

211493 36799 20.95 438166
1 804 866.5 34086668 18000000 53 17.875 18 6.9 179888 0
17.56
12.33 672368 331403 2.51 1486030
1 702.6 763 29700000 29700000 0 106.25 175 6 2108164 0 51.89

23.58 1543697 369379 237.25 3312514
0 807 849 34500000 34500000 52 14.25 24 10.1 26152500 0
16.02
141.18 729402 1199221 49.81 2878887
1 884.4 789 3340512 3340512 0 29.5 52.65 0 0 0 35.7 6.81
119088
1000000 47.48 3139993
1 775 690 8069756 8069756 9.9 33.125 40 7.4 1026013 1 28.2
20.83
227600 125000 41.84 566900
0 771.5 720 57390105 31000000 0 57.375 76.5 12.6 105616 0
51.37
15.55 2948300 888800 48.92 5448100
1 787.5 855 67500000 67500000 10 48.875 78 9.4 124887 1
69.89
16.12 4924000 2362000 11.6 10518000
0 790 850 38306907 38306907 0 36.825 58 9.1 766980 1 50 25.3
156907 79677 57.6 306834
1 888.5 811.2 6586556 6586556 11 33.375 45 6.1 76370 1 26.36

12.93 193385 63998 53.27 377934
1 910 732 23353947 23353947 0 40 60 5.5 604812 1 20.48 18.93

478200 165400 192.97 926300
1 922 812.5 211190 400000 35.4 11.25 15.13 5.9 1421397 1
13.85
20.65 29248 328 2.89 37905
0 860 789 21715727 21715727 4.6 33 40 2.9 760156 0 7.58
25.32
164677 46000 427.7 255256
1 860 865 38721111 38721111 0 47 62.5 4.2 63853 1 29.12
27.29
1127500 1922600 114.63 5809900
0 772.3 863.5 113840665 113840665 0 42.25 50 3.1 634608 0
3.26
13.77 2917000 1426000 1433.74 8292000
0 795 775 34774935 34774935 0 12 19 10.3 4623745 1 5.73
29.23
199162 100000 231.59 237029
0 912 923 17903226 17903226 0 38 48.68 4 23280525 0 34.35
-31.21
1128400 620000 41.72 240500
0 737 825.7 42900000 42900000 4.7 15.5 17 5.6 10689401 1
3.92
17.35 190816 339228 333.67 679693
1 768.5 878.75 2281814 2281814 0 93.25 147 5.7 7414 1 62.43

13.64

142449 530899 135.46 830654

1 749 799 44300000 44300000 21.6 16.875 28 15.7 10950637 0

25.73

186.67 1170700 1222000 8.82 3531900

1 844 910 13600000 12869678 8.9 39.25 40 4 171509 1 25.41

-571.43

379200 1153100 57.42 2391800

1 968 814 33166835 33166835 15.1 19 23 2 791148 1 12.06

19.01

399987 117335 90.71 814445

0 753 729 3250703 3250703 14.5 26.5 34 4 395939 1 15.94

17.35

51810 6844 113.3 90377

1 699.5 808 1925241 1925241 10 25.75 41 16 68616 1 18.72

13.27

36034 300000 119.02 926416

1 836 722 12251192 12251192 15 32.375 46 0 13003405 0 33.70

-23.58 432809 226849 48.37 960172

0 784 942.5 2174827 2174827 0 46.5 56 1 192470 1 30.52 15.69

73952 39170 83.49 126106

0 736 709 10143523 10143523 0 26.5 46.5 7 562717 1 18.19

24.47

184529 22687 155.63 337338

1 861 713 21424676 21424676 9.5 37.25 49.5 2 214186 0 29.22

18.47

626000 612000 69.4 1891000

1 785 770 32100000 32100000 9.2 48.25 60 10 692960 1 28.03

-8.11

114927 658050 114.06 4036941

1 752 706 11453393 7000000 0 23 32 7 546684 0 12.34 -5.59

134194

224389 159.32 526794

0 662.5 848.7 12648354 12648354 0 28 39.5 7 4596319 1 14.86

26.69

188016 116708 165.81 454785

0 659.5 977.3 1608339 1608339 0 38.625 73 2 230071 1 26.54

16.86

42679 19809 175.06 93187

1 829 789 12207644 12207644 7.28 56.125 56 2 3285758 1 49.50

16.05 604904 12905 13.13 791498

1 851.7 700 61000000 61000000 5.9 45.125 64 3 711744 1 26.73

16.67 1633000 1431000 139.43 4835000

0 763 723 59814787 47760000 51.1 14.625 15.13 6 639850 0

12.6

38.79 786700 236600 20.08 1585300

1 716 947.5 40050000 21000000 0 46 60 11 1579500 0 24.19

19.35

969000 1000000 148.04 2406300

0 849.5 788 25700000 25700000 0 6 4.75 9 3252101 0 -5.96
-24.56
-36759 629104 -174.16 897635
1 917.5 861 44900000 44900000 0 41.125 50 10 940837 0 37.79
17.67
1683943 1572461 32.31 5025578
1 992 776 19604965 10000000 3 34.75 50 9 348226 0 18.11
46.73
355033 19785 176.09 630064
0 765 776.5 40050000 40050000 0 64.125 61.81 11 434100 0
25.85
23.97 1028287 528200 142.01 2310503
1 760 798.5 16706522 13425340 19.64 46.125 52 2 2852317 1
33.21
28.26 554903 362395 56.58 3145213
0 686 755 13284257 13284257 5 53.75 77.5 6 87034 1 38.24
-19.52
508000 46100 102.67 800800
1 661.5 832 29916850 27358500 8.5 67.125 74 8 222614 1 31.7
15.68
994700 522000 133.44 2435300
0 671 736 3266000 3266000 0 30.625 34.5 9 902200 1 13.7
41.07
44752 9910 151.82 69430
0 757.5 811 47097625 40750000 4 48.625 66 5 12922308 0 26.87

20.31 1265288 646305 145.63 2695111

1 727.5 745.5 22925000 22925000 5.6 10.5 15 13 20312 1 3.57

16.67

81637 3673 320.17 135380

TABLE I

| Number Sample | Q1 | Q2 | Q3 | Q4 | Q5 |
|------------------|-------------|--------|-------------|--------|--------|
| 1 | .38854 | 2.2089 | -.44103 | .55544 | .76843 |
| 2 | -1.5932 | 2.6534 | -.32646 | .48676 | .99768 |
| 3 | -.93498E-01 | 2.8386 | -.19006 | .44752 | 1.0192 |
| 4 | .13622E-01 | 2.9127 | -.19006 | .43771 | 1.0621 |
| 5 | .12074 | 2.9683 | -.48208E-01 | .97733 | 1.1051 |
| 6 | .28142 | 3.1535 | -.20929E-01 | .99695 | 1.0693 |
| 7 | .28142 | 3.1720 | -.37297E-01 | 1.0068 | 1.0263 |
| 8 | .17430 | 3.1165 | .99099E-01 | .98714 | 1.0335 |
| 9 | .28142 | 2.9127 | .14275 | 1.0558 | .95469 |
| 10 | .17430 | 2.8572 | .46464 | 1.0166 | .98335 |
| 11 | .17430 | 2.7275 | .41554 | 1.0362 | 1.0908 |
| 12 | -.25418 | 2.7275 | .43736 | 1.0264 | 1.0263 |
| 13 | -.30774 | 2.5793 | .43736 | 1.0166 | 1.0263 |
| 14 | -.20062 | 2.6534 | .48101 | 1.1147 | 1.0263 |
| 15 | -.30774 | 2.7275 | .80290 | 1.1147 | 1.0335 |
| 16 | .13622E-01 | 2.8942 | .85746 | 1.1147 | 1.0335 |
| 17 | -.30774 | 2.2274 | .93930 | 1.1343 | 1.0335 |
| 18 | -.20062 | 2.1719 | .93384 | 1.1147 | 1.0335 |
| 19 | -.20062 | 2.2089 | .93384 | 1.1147 | 1.0335 |
| 20 | -.30774 | 2.3200 | .83564 | 1.0656 | 1.0335 |
| 21 | -.57554 | 1.9126 | .74834 | 1.1245 | 1.0335 |
| 22 | -.39938E-01 | 1.8940 | .76471 | 1.1147 | 1.0335 |
| 23 | -.46842 | 1.8940 | .74289 | 1.1147 | 1.0335 |
| 24 | -.78978 | 1.8940 | .71015 | 1.1147 | 1.0335 |
| 25 | -.84334 | 1.9126 | .71561 | 1.1049 | 1.0335 |
| 26 | -.68266 | 1.9126 | .67742 | 1.1147 | 1.0335 |
| 27 | -.73622 | 1.8940 | .67196 | 1.0951 | 1.0263 |
| 28 | -1.0040 | 1.9126 | .66651 | 1.0951 | 1.0263 |
| 29 | -.36130 | 1.9126 | .72652 | 1.0951 | 1.0263 |
| 30 | -.14706 | 1.9126 | .69924 | 1.0853 | 1.0908 |
| 31 | -.14706 | 1.9126 | .75925 | 1.0754 | .98335 |
| 32 | -.14706 | 1.9126 | .74289 | 1.0656 | .95469 |
| 33 | .28142 | 1.9126 | .74289 | 1.0656 | 1.0335 |
| 34 | -.30774 | 1.9126 | .60649 | 1.0656 | 1.0263 |
| 35 | -.20062 | 1.9126 | .59558 | 1.0656 | 1.0693 |
| 36 | -.20062 | 1.9126 | .63923 | 1.0656 | 1.1051 |
| 37 | -.30774 | 1.8940 | .91202 | 1.0656 | 1.0621 |
| 38 | .13622E-01 | 1.8755 | 1.0266 | 1.0656 | 1.0192 |
| 39 | -.30774 | 1.8755 | 1.0757 | 1.0558 | .99768 |
| 40 | -.20062 | 1.8385 | 1.0757 | 1.0558 | .76843 |

TABLE II

| Number Sample | Q6 | Q7 | Q8 | Q9 | Q10 |
|------------------|------------|---------|---------|------------|---------|
| 1 | .20207 | -.54785 | -7.9244 | -.70186 | -38.156 |
| 2 | .60238 | .44765 | -6.8608 | -.80898 | -15.919 |
| 3 | .60238 | .51875 | -10.052 | -.70186 | -21.849 |
| 4 | -.19824 | .54246 | -7.9244 | .47647 | -21.849 |
| 5 | -.39839 | .56616 | -6.8608 | .42291 | -24.814 |
| 6 | -.59854 | .54246 | -7.9244 | .26223 | -20.366 |
| 7 | -.99885 | .54246 | -10.052 | .47647 | -21.849 |
| 8 | -.59854 | .51875 | -10.052 | 1.4406 | -23.331 |
| 9 | .19173E-02 | .75578 | -4.7336 | 1.3334 | -9.9885 |
| 10 | -1.3992 | .73207 | -10.052 | 1.1192 | -8.5060 |
| 11 | -3.0004 | .75578 | -11.115 | 1.3870 | -7.0235 |
| 12 | -2.8002 | .75578 | -11.115 | .47985E-01 | -8.5060 |
| 13 | -.79869 | .70837 | -11.115 | .31579 | -9.9885 |
| 14 | .40222 | .70837 | -10.052 | .85139 | -14.436 |
| 15 | .19173E-02 | .63726 | -11.115 | .79783 | -15.919 |
| 16 | -1.9996 | .54246 | -10.052 | .69071 | -17.401 |
| 17 | -1.3992 | .58986 | -10.052 | .10155 | -24.814 |
| 18 | -2.1998 | .68467 | -6.8608 | .10155 | -30.744 |
| 19 | -1.9996 | .66097 | -7.9244 | .90495 | -32.226 |
| 20 | -1.3992 | .68467 | -7.9244 | .90495 | -33.709 |
| 21 | -2.6001 | 1.1113 | 4.8385 | 3.5294 | 30.039 |
| 22 | -2.3999 | 1.0876 | 6.9657 | 3.7972 | 31.522 |
| 23 | -2.6001 | 1.0876 | 4.8385 | 3.7972 | 31.522 |
| 24 | -2.6001 | 1.0639 | 4.8385 | 4.3328 | 31.522 |
| 25 | -2.6001 | 1.0165 | 4.8385 | 4.2257 | 34.487 |
| 26 | -2.8002 | 1.0165 | 4.8385 | 4.3328 | 33.004 |
| 27 | -2.6001 | .96910 | 6.9657 | 4.6542 | 34.487 |
| 28 | -3.0004 | .87429 | 4.8385 | 4.5471 | 34.487 |
| 29 | -3.0004 | .87429 | 4.8385 | 4.6542 | 34.487 |
| 30 | -2.8002 | .89799 | 4.8385 | 4.9756 | 35.969 |
| 31 | -3.2005 | .89799 | 4.8385 | 5.0291 | 33.004 |
| 32 | -3.0004 | .87429 | 3.7749 | 4.8684 | 33.004 |
| 33 | -3.0004 | .99280 | 3.7749 | 4.7613 | 31.522 |
| 34 | -2.6001 | .99280 | 4.8385 | 4.8684 | 37.452 |
| 35 | -2.8002 | .99280 | 3.7749 | 4.4400 | 34.487 |
| 36 | -2.6001 | .99280 | 3.7749 | 4.1722 | 10.766 |
| 37 | -2.8002 | .99280 | 5.9021 | 4.1722 | 10.766 |
| 38 | -2.8002 | .99280 | 3.7749 | 3.9579 | 15.214 |
| 39 | -3.0004 | .99280 | 3.7749 | 4.3328 | 21.144 |
| 40 | -2.8002 | .99280 | 4.8385 | 4.2257 | 13.731 |

TABLE III

| Number Sample | Q11 | Q12 | Q13 | Q14 | Q15 |
|------------------|---------|-------------|---------|---------|---------|
| 1 | -.86645 | -.31827 | -.59858 | -1.7329 | -.20345 |
| 2 | -.74735 | -.42867E-01 | -.59858 | -3.2246 | 1.1316 |
| 3 | -.98555 | .67296E-01 | -.63847 | -3.2246 | 1.2587 |
| 4 | -1.0451 | .67296E-01 | -.67835 | -3.7218 | 1.3223 |
| 5 | -.98555 | .12215E-01 | -.51880 | -4.2190 | 1.3858 |
| 6 | -1.1642 | .23254 | -.51880 | -5.2134 | 1.3858 |
| 7 | -.98555 | .34270 | -.55869 | -4.9648 | 1.3858 |
| 8 | -.95578 | .23254 | -.55869 | -5.2134 | 1.3858 |
| 9 | -.71758 | .61811 | -.67835 | -3.4732 | 1.3858 |
| 10 | -.59848 | .89351 | -.87780 | -2.9759 | 1.3858 |
| 11 | -.62825 | .83843 | -.91769 | -1.9815 | 1.0660 |
| 12 | -.77713 | 1.1689 | -.95758 | -2.4787 | .81370 |
| 13 | -.65803 | 1.2240 | -.91769 | -3.7218 | .68655 |
| 14 | -.77713 | 1.3892 | -1.0374 | -3.2246 | .68655 |
| 15 | -.59848 | .67319 | -.99747 | -3.4732 | .71834 |
| 16 | -.59848 | .78335 | -.91769 | -3.9704 | .78191 |
| 17 | -.53893 | .89351 | -.83791 | -3.9704 | 1.0362 |
| 18 | -.62825 | 1.1689 | -.83791 | -4.7162 | 1.0362 |
| 19 | -.44960 | 1.1689 | -.67835 | -5.2134 | 1.0362 |
| 20 | -.27096 | 1.0037 | -.59858 | -5.2134 | 1.0362 |
| 21 | .94981 | 1.6647 | 1.5554 | -16.400 | 1.0044 |
| 22 | 1.0094 | 1.6647 | 1.5554 | -16.649 | 1.0362 |
| 23 | .92004 | 1.6647 | 1.5554 | -15.903 | 1.0680 |
| 24 | .83072 | 1.7197 | 1.5156 | -15.406 | 1.0680 |
| 25 | .56274 | 1.6647 | 1.5156 | -16.152 | 1.0680 |
| 26 | .65207 | 1.6647 | 1.5156 | -18.886 | 1.0680 |
| 27 | .80094 | 1.7197 | 1.4757 | -19.881 | 1.1316 |
| 28 | 1.0094 | 1.6647 | 1.4757 | -17.643 | 1.1951 |
| 29 | 1.2773 | .17746 | 1.4757 | -14.660 | 1.1316 |
| 30 | 1.0689 | .17746 | 1.4757 | -13.417 | 1.1316 |
| 31 | .80094 | .17746 | 1.5156 | -11.677 | 1.0680 |
| 32 | .83072 | .23254 | 1.4757 | -13.417 | 1.0362 |
| 33 | .92004 | .23254 | 1.4757 | -14.909 | 1.0362 |
| 34 | .77117 | .23254 | 1.4757 | -14.163 | 1.0362 |
| 35 | .71162 | .23254 | 1.4757 | -12.423 | 1.0362 |
| 36 | .68184 | .12238 | 1.4757 | -13.417 | .78191 |
| 37 | .77117 | .23254 | 1.4757 | -13.417 | .71834 |
| 38 | 1.0094 | .12238 | 1.4757 | -13.417 | .68655 |
| 39 | .83072 | .23254 | 1.3959 | -11.677 | .68655 |
| 40 | .65207 | .12238 | 1.3959 | -9.6882 | .81370 |

TABLE IV

| Number Sample | Q16 | Q17 | Q18 | Q19 | Q20 |
|------------------|--------|---------|---------|--------|---------|
| 1 | 8.3026 | -1.5148 | -6.1409 | 13.271 | -.64226 |
| 2 | 1.2533 | -.37230 | -11.770 | 10.689 | -.76248 |
| 3 | 9.2425 | -.53551 | -11.770 | 12.410 | -.70237 |
| 4 | 2.1932 | -.26349 | -17.399 | 12.410 | -.82260 |
| 5 | 4.5430 | -.45390 | -30.534 | 11.550 | -.76248 |
| 6 | 2.1932 | -.37230 | -34.287 | 8.9667 | -.82260 |
| 7 | .78334 | -.29069 | -32.410 | 9.8276 | -.82260 |
| 8 | 3.6031 | -.31789 | -36.163 | 8.9667 | -.82260 |
| 9 | 2.1932 | -.37230 | -28.658 | 8.9667 | -.70237 |
| 10 | 11.592 | -.42670 | -17.399 | 8.9667 | -.64226 |
| 11 | 9.2425 | -.50831 | -28.658 | 8.1057 | -.46192 |
| 12 | 12.062 | -.50831 | -30.534 | 8.9667 | -.52203 |
| 13 | 13.472 | -.39950 | -30.534 | 8.1057 | -.49198 |
| 14 | 20.521 | -.53551 | -45.545 | 10.689 | -.28158 |
| 15 | 18.642 | -.56271 | -39.916 | 9.8276 | -.28158 |
| 16 | 23.341 | -.67152 | -39.916 | 8.9667 | -.40181 |
| 17 | 28.980 | -.61711 | -43.669 | 9.8276 | -.37175 |
| 18 | 28.041 | -.48110 | -39.916 | 8.9667 | -.40181 |
| 19 | 11.122 | -.23629 | -41.792 | 8.9667 | -.34170 |
| 20 | 9.2425 | -.23629 | -43.669 | 9.8276 | -.34170 |
| 21 | 4.5430 | .52536 | -24.905 | 5.5229 | 1.1611 |
| 22 | 16.292 | .63416 | -24.905 | 7.2448 | 1.1311 |
| 23 | 13.002 | .66136 | -28.658 | 8.1057 | 1.1311 |
| 24 | 9.2425 | .55256 | -24.905 | 9.8276 | 1.1010 |
| 25 | 11.122 | .71577 | -26.781 | 8.9667 | 1.1010 |
| 26 | 28.041 | .77017 | -28.658 | 8.9667 | 1.1010 |
| 27 | 28.980 | .98778 | -23.028 | 9.8276 | 1.1010 |
| 28 | 23.341 | 1.2598 | -23.028 | 8.9667 | 1.1311 |
| 29 | 18.642 | 1.2870 | -28.658 | 9.8276 | 1.1311 |
| 30 | 20.521 | 1.2870 | -26.781 | 10.689 | 1.1311 |
| 31 | 13.472 | 1.2598 | -23.028 | 8.1057 | 1.0709 |
| 32 | 12.062 | 1.1510 | -24.905 | 8.9667 | 1.0709 |
| 33 | 9.2425 | 1.3686 | -24.905 | 8.1057 | 1.1010 |
| 34 | 11.592 | 1.2054 | -24.905 | 8.9667 | 1.1010 |
| 35 | 2.1932 | 1.0422 | -24.905 | 8.9667 | 1.1611 |
| 36 | 3.6031 | .79737 | -24.905 | 8.9667 | 1.1010 |
| 37 | .78334 | .63416 | -24.905 | 9.8276 | 1.0409 |
| 38 | 2.1932 | .74297 | -24.905 | 8.9667 | .98073 |
| 39 | 4.5430 | .74297 | -24.905 | 11.550 | .95072 |
| 40 | 2.1932 | .82457 | -23.028 | 12.410 | .95072 |

TABLE V

| Number Sample | Q21 | Q22 | Q23 | Q24 | Q25 |
|------------------|------------|-------------|-------------|--------|---------|
| 1 | .22658E-01 | -9.3567 | .23349 | 1.8987 | -.78474 |
| 2 | .14698 | -3.1228 | .56784 | 2.6970 | 1.5129 |
| 3 | .34038 | -3.9021 | .61560 | 2.6970 | 1.3448 |
| 4 | .56140 | -3.9021 | .44843 | 2.4309 | 1.3729 |
| 5 | .54758 | -.59210E-02 | .42455 | 2.4309 | 1.3448 |
| 6 | .51995 | 3.1110 | .44843 | 2.4309 | 1.4288 |
| 7 | .46470 | 1.5525 | .59172 | 1.8987 | 1.0926 |
| 8 | .46470 | 1.5525 | .44843 | 2.1648 | 1.0085 |
| 9 | 1.0173 | 3.1110 | .28126 | 2.4309 | 1.0646 |
| 10 | 1.0173 | 1.5525 | .23349 | 1.8987 | 1.0365 |
| 11 | 1.0449 | .77331 | .18573 | 2.9631 | 1.0365 |
| 12 | 1.1278 | .77331 | .18573 | 2.6970 | 1.0085 |
| 13 | 1.1416 | .77331 | .23349 | 2.4309 | 1.0365 |
| 14 | 1.1416 | .77331 | -.38743 | 1.8987 | 1.0646 |
| 15 | 1.0863 | .77331 | -.24414 | 1.8987 | 1.0646 |
| 16 | 1.1139 | .77331 | -.24414 | 1.8987 | 1.1206 |
| 17 | 1.0863 | .77331 | -.26803 | 1.8987 | 1.0646 |
| 18 | 1.0725 | .77331 | -.76971E-01 | 1.6326 | 1.0646 |
| 19 | 1.1139 | .77331 | -.10085 | 1.6326 | 1.0926 |
| 20 | 1.0863 | .77331 | -.12473 | 1.8987 | 1.0926 |
| 21 | 1.3212 | 2.3318 | 1.1888 | 1.1004 | 1.0926 |
| 22 | 1.3212 | 2.3318 | 1.1888 | 1.1004 | 1.0646 |
| 23 | 1.3212 | 2.3318 | 1.1888 | 1.1004 | 1.0646 |
| 24 | 1.3212 | 2.3318 | 1.1888 | 1.1004 | 1.1206 |
| 25 | 1.3073 | 2.3318 | 1.1888 | 1.1004 | 1.0365 |
| 26 | 1.3073 | 2.3318 | 1.1888 | 1.3665 | 1.0926 |
| 27 | 1.3073 | 1.5525 | 1.2365 | 1.3665 | 1.0365 |
| 28 | 1.3073 | 2.3318 | 1.1888 | 1.1004 | 1.0646 |
| 29 | 1.3073 | 2.3318 | 1.1888 | 1.1004 | 1.0085 |
| 30 | 1.3073 | 2.3318 | 1.1888 | 1.1004 | 1.0646 |
| 31 | 1.3073 | 2.3318 | 1.2126 | 1.1004 | 1.0085 |
| 32 | 1.3212 | 2.3318 | 1.1888 | 1.1004 | 1.0085 |
| 33 | 1.2935 | 1.5525 | 1.1888 | 1.1004 | .98050 |
| 34 | 1.2935 | 3.1110 | 1.1888 | 1.1004 | 1.0646 |
| 35 | 1.2935 | 3.1110 | 1.1888 | 1.6326 | 1.1206 |
| 36 | 1.2935 | 3.1110 | 1.1888 | 1.3665 | 1.0646 |
| 37 | 1.2797 | 3.1110 | 1.1888 | 1.1004 | 1.0085 |
| 38 | 1.2659 | 3.1110 | 1.1888 | 1.1004 | 1.0926 |
| 39 | 1.2659 | 3.1110 | 1.1888 | 1.8987 | 1.0926 |
| 40 | 1.2245 | 2.3318 | 1.1888 | 1.6326 | 1.0926 |

TABLE VI

| Number Sample | Q26 | Q27 | Q28 | Q29 | Q30 |
|------------------|---------|---------|-------------|-------------|---------|
| 1 | .11130 | 6.5591 | -.39766 | -.35397 | .34789 |
| 2 | .11130 | 6.8556 | -.37700 | -.31244 | .36328 |
| 3 | -.27355 | 5.6697 | -1.6162 | -.14635 | .40944 |
| 4 | -.27355 | 5.0768 | -.25308 | .61266E-01 | 1.0249 |
| 5 | -.27355 | 6.8556 | -.23243 | -.21781E-01 | 1.0556 |
| 6 | -.27355 | 8.3379 | -.25898E-01 | .35193 | 1.0556 |
| 7 | -.27355 | 12.192 | -.46551E-01 | .26888 | 1.0556 |
| 8 | -.27355 | 12.785 | -.87858E-01 | .68412 | 1.0556 |
| 9 | -.27355 | 11.599 | -.67204E-01 | .80869 | -.46755 |
| 10 | .11130 | 11.895 | .13933 | .80869 | -.46755 |
| 11 | -.27355 | 12.785 | .98022E-01 | .89173 | -.45216 |
| 12 | -.27355 | 13.081 | .77368E-01 | .89173 | -.46755 |
| 13 | .11130 | 15.157 | .98022E-01 | .89173 | -.46755 |
| 14 | .11130 | 15.749 | .38717 | .93326 | -.45216 |
| 15 | .11130 | 14.860 | .59370 | .97478 | -.45216 |
| 16 | -.65839 | 16.046 | .59370 | 1.5146 | -.45216 |
| 17 | -1.0432 | 15.453 | .59370 | 1.4731 | -.42139 |
| 18 | -1.2357 | 15.749 | .67631 | 1.3070 | -.45216 |
| 19 | -3.3523 | 14.564 | .82088 | 1.4315 | -.45216 |
| 20 | -2.5826 | 14.564 | .82088 | 1.1824 | -.45216 |
| 21 | 2.6128 | -3.2242 | 1.0481 | .97478 | -.52909 |
| 22 | 2.4204 | 12.785 | 1.0481 | 1.0578 | -.52909 |
| 23 | 2.4204 | 11.599 | 1.0481 | 1.0578 | -.52909 |
| 24 | 2.4204 | 10.710 | 1.0481 | .93326 | -.52909 |
| 25 | 2.3241 | 8.9308 | 1.1100 | 1.0163 | -.43678 |
| 26 | 2.3241 | 8.6343 | 1.1100 | 1.0163 | -.43678 |
| 27 | 2.2279 | 14.267 | 1.0894 | 1.0578 | -.43678 |
| 28 | 2.2279 | 14.564 | 1.0687 | 1.3070 | -.43678 |
| 29 | 2.2279 | 14.564 | 1.0894 | 1.3900 | -.43678 |
| 30 | 2.4204 | 15.749 | 1.0894 | 1.3485 | -.52909 |
| 31 | 2.0355 | 15.453 | 1.0687 | 1.3900 | -.43678 |
| 32 | 2.2279 | 16.046 | 1.0687 | 1.3900 | -.43678 |
| 33 | 2.4204 | 14.860 | 1.0687 | 1.3485 | -.43678 |
| 34 | 2.2279 | 15.749 | 1.0687 | 1.3485 | -.43678 |
| 35 | 2.0355 | 15.157 | 1.0687 | 1.3070 | -.52909 |
| 36 | 1.6507 | 13.081 | 1.0687 | 1.3485 | -.43678 |
| 37 | 1.4582 | 12.785 | 1.0687 | 1.3070 | -.43678 |
| 38 | 1.6507 | 11.895 | 1.0687 | 1.3485 | -.43678 |
| 39 | 1.6507 | 11.599 | 1.0687 | 1.3070 | -.52909 |
| 40 | 1.6507 | 12.785 | 1.0687 | 1.2654 | -.43678 |

TABLE VII

| Number Sample | Q31 | Q32 | Q33 | Q34 |
|------------------|-------------|---------|-------------|-------------|
| 1 | 1.7143 | 1.0185 | -.38963 | .50348 |
| 2 | 2.4081 | 1.0011 | -.50636E-01 | .48883 |
| 3 | 2.2231 | 1.0011 | -.22013 | .37161 |
| 4 | 1.9455 | 1.1059 | .28836 | .45952 |
| 5 | 1.9455 | 1.1584 | .28836 | .45952 |
| 6 | .46529 | 1.0710 | .28836 | .43022 |
| 7 | .55780 | 1.0360 | .28836 | .43022 |
| 8 | .65032 | .96608 | .20361 | .43022 |
| 9 | .65032 | .89615 | .20361 | .56209 |
| 10 | .78909 | .94860 | .20361 | .63536 |
| 11 | 1.0666 | .91364 | .20361 | .50348 |
| 12 | 1.5755 | .91364 | .28836 | .45952 |
| 13 | 2.0381 | .91364 | .28836 | .56209 |
| 14 | 2.1306 | .93112 | -.38963 | .44487 |
| 15 | 2.1306 | .91364 | -.22013 | .45952 |
| 16 | 2.2231 | .93112 | .11886 | 2.9066 |
| 17 | 2.2694 | 1.0011 | 1.3901 | .57675 |
| 18 | 2.0843 | .91364 | 1.1358 | .45952 |
| 19 | 1.1592 | .96608 | 2.0681 | -.67981E-01 |
| 20 | 1.1129 | .96608 | 1.8986 | -.53328E-01 |
| 21 | .32651 | -.15283 | .62735 | -.53328E-01 |
| 22 | .14148 | -.18780 | .79685 | -.67981E-01 |
| 23 | .95221E-01 | -.15283 | .96634 | .45952 |
| 24 | -.89812E-01 | -.13535 | 1.0511 | .57675 |
| 25 | -.89812E-01 | -.11786 | 1.0511 | .56209 |
| 26 | .28025 | .77377 | 1.2206 | .45952 |
| 27 | .51154 | .79125 | 1.3053 | .44487 |
| 28 | .51154 | .75629 | 1.4748 | .56209 |
| 29 | .74284 | .75629 | 1.8986 | .45952 |
| 30 | 1.3905 | .73881 | 1.8138 | .50348 |
| 31 | 1.7605 | .70384 | 1.4748 | .63536 |
| 32 | 1.7605 | .68636 | 1.5596 | .56209 |
| 33 | 1.1129 | .56397 | 1.8986 | .43022 |
| 34 | 1.1592 | .58146 | 2.0681 | .43022 |
| 35 | 2.0843 | .44159 | 1.1358 | .43022 |
| 36 | 2.2694 | .47656 | 1.3901 | .45952 |
| 37 | 2.2231 | .56397 | .11886 | .45952 |
| 38 | 2.1306 | .63391 | -.22013 | .37161 |
| 39 | 2.1306 | .63391 | -.38963 | .48883 |
| 40 | 2.0381 | .65139 | .28836 | .50348 |

TABLE VIII

| Number Sample | Q35 | Q36 | Q37 | Q38 |
|------------------|------------|--------|--------|--------|
| 1 | .53114 | .95709 | .57893 | .76661 |
| 2 | .49933 | 1.0069 | .50245 | .75228 |
| 3 | .32437 | .98698 | .44510 | .71406 |
| 4 | .27666 | .97701 | .48334 | .69017 |
| 5 | .40390 | .94712 | .46422 | .60417 |
| 6 | .34028 | .92719 | .45785 | .56595 |
| 7 | .26075 | 1.0966 | .61079 | .57551 |
| 8 | .26075 | 1.0966 | .58530 | .55640 |
| 9 | .29256 | 1.0268 | .50245 | .57073 |
| 10 | .29256 | 1.0268 | .47059 | .61373 |
| 11 | .24485 | 1.0169 | .57255 | .59940 |
| 12 | .22894 | 1.1763 | .63628 | .61373 |
| 13 | .22894 | 1.1464 | .58530 | .61851 |
| 14 | .22894 | .68807 | .55981 | .56595 |
| 15 | .13351 | .60836 | .54706 | .54684 |
| 16 | .11761 | .73789 | .45785 | .51340 |
| 17 | .38080E-01 | .72792 | .25392 | .50862 |
| 18 | .38080E-01 | .58843 | .20932 | .52773 |
| 19 | .11761 | .67810 | .16471 | .51818 |
| 20 | .14942 | .63825 | .22206 | .54684 |
| 21 | .85795E-01 | .28952 | .20294 | .28885 |
| 22 | .14942 | .23970 | .20932 | .26974 |
| 23 | .11761 | .33934 | .19020 | .20286 |
| 24 | .38080E-01 | .39912 | .19020 | .20286 |
| 25 | .38080E-01 | .41905 | .24118 | .20763 |
| 26 | .11761 | .42901 | .19020 | .21719 |
| 27 | .13351 | .61832 | .19020 | .21241 |
| 28 | .22894 | .54858 | .21569 | .21241 |
| 29 | .22894 | .56850 | .24118 | .21719 |
| 30 | .22894 | .58843 | .21569 | .21719 |
| 31 | .24485 | .63825 | .20294 | .22197 |
| 32 | .29256 | .67810 | .17745 | .22674 |
| 33 | .29256 | .58843 | .18383 | .19330 |
| 34 | .26075 | .72792 | .23481 | .15508 |
| 35 | .26075 | .73789 | .35589 | .14552 |
| 36 | .34028 | .60836 | .38775 | .20763 |
| 37 | .40390 | .68807 | .41961 | .44173 |
| 38 | .27666 | 1.1464 | .26667 | .47040 |
| 39 | .32437 | 1.1763 | .22206 | .47996 |
| 40 | .49933 | 1.0169 | .16471 | .47996 |

TABLE IX

| Number Sample | Q39 | Q40 | Q41 | Q42 |
|------------------|--------|--------|---------|-------------|
| 1 | 3.2793 | .47255 | -50.311 | -3.4864 |
| 2 | 3.2793 | 1.2811 | -50.311 | .21795 |
| 3 | 3.5857 | 1.2573 | -50.311 | -.34331 |
| 4 | 3.4836 | 1.2097 | -50.311 | .55471 |
| 5 | 3.7900 | 1.2573 | -52.356 | -.90457 |
| 6 | 3.5857 | 1.2573 | -51.334 | .10570 |
| 7 | 3.4836 | 1.3762 | -45.198 | -.34331 |
| 8 | 3.3814 | 1.3286 | -46.221 | -.45556 |
| 9 | 3.7900 | 1.3048 | -42.131 | -.34331 |
| 10 | 3.6879 | 1.3524 | -14.523 | -.68007 |
| 11 | 3.2793 | 1.3762 | -14.523 | -1.5781 |
| 12 | 3.2793 | 1.3524 | -13.500 | -1.1291 |
| 13 | 3.1772 | 1.3524 | -10.433 | -.68007 |
| 14 | 3.1772 | 1.3524 | -13.500 | -.68007 |
| 15 | 3.1772 | 1.3524 | -12.478 | -1.1291 |
| 16 | 3.4836 | 1.3762 | -13.500 | -.79232 |
| 17 | 3.4836 | 1.3762 | -12.478 | -.34331 |
| 18 | 3.4836 | 1.3762 | -12.478 | -.56781 |
| 19 | 3.4836 | 1.3762 | -13.500 | .44246 |
| 20 | 3.4836 | 1.3762 | -13.500 | .33020 |
| 21 | 2.5643 | 1.4475 | -.20753 | 1.1160 |
| 22 | 2.5643 | 1.4475 | .81499 | 1.1160 |
| 23 | 3.2793 | 1.4475 | .81499 | 1.0037 |
| 24 | 3.2793 | 1.4951 | .81499 | 1.1160 |
| 25 | 3.2793 | 1.4475 | .81499 | 1.0037 |
| 26 | 3.4836 | 1.4475 | -.20753 | 1.0037 |
| 27 | 3.2793 | 1.4475 | -.20753 | .77921 |
| 28 | 3.3814 | 1.4713 | -.20753 | .89147 |
| 29 | 3.2793 | 1.4713 | -.20753 | .10570 |
| 30 | 3.2793 | 1.4475 | -.20753 | -.11880 |
| 31 | 3.1772 | 1.4713 | -.20753 | -.11880 |
| 32 | 3.1772 | 1.4475 | -.20753 | -.65522E-02 |
| 33 | 3.2793 | 1.4475 | -.20753 | .33020 |
| 34 | 3.0750 | 1.4475 | -1.2300 | -.65522E-02 |
| 35 | 3.0750 | 1.4237 | -1.2300 | -.23106 |
| 36 | 3.1772 | 1.4237 | -1.2300 | -.79232 |
| 37 | 3.3814 | 1.4475 | -1.2300 | -.79232 |
| 38 | 3.4836 | 1.4237 | -1.2300 | -1.0168 |
| 39 | 3.4836 | 1.4237 | -1.2300 | -1.4658 |
| 40 | 3.4836 | 1.4237 | -2.2526 | -.90457 |

TABLE X

| Number Sample | Q43 | Q44 | Q45 | Q46 |
|------------------|---------|------------|-------------|---------|
| 1 | 16.254 | .82826 | .59584E-01 | -42.251 |
| 2 | -3.9952 | .54867 | .59584E-01 | -4.4049 |
| 3 | -12.095 | .43684 | .59584E-01 | -5.9188 |
| 4 | -12.095 | .43684 | .43806E-01 | 1.6504 |
| 5 | -11.082 | .43684 | .43806E-01 | 6.6965 |
| 6 | -10.070 | .26909 | .12270 | 8.7149 |
| 7 | -11.082 | .15726 | .12270 | 7.2011 |
| 8 | -12.095 | .26909 | .91141E-01 | 6.1919 |
| 9 | -11.082 | .26909 | .91141E-01 | 6.1919 |
| 10 | -10.070 | .32501 | .75362E-01 | 6.6965 |
| 11 | -11.082 | .15726 | .91141E-01 | 7.7057 |
| 12 | -10.070 | .45430E-01 | .91141E-01 | 7.7057 |
| 13 | -12.095 | .15726 | .75362E-01 | 7.2011 |
| 14 | -10.070 | .15726 | .75362E-01 | 7.2011 |
| 15 | -9.0574 | .26909 | .28028E-01 | 7.7057 |
| 16 | -9.0574 | .26909 | .12250E-01 | 6.6965 |
| 17 | -8.0450 | .38093 | -.35282E-02 | 10.733 |
| 18 | -6.0201 | .49276 | -.35084E-01 | 10.229 |
| 19 | -8.0450 | .10135 | -.50863E-01 | 10.733 |
| 20 | -10.070 | .15726 | -.19306E-01 | 10.733 |
| 21 | 11.191 | .15726 | .75362E-01 | 3.1642 |
| 22 | -1.9703 | .10135 | .91141E-01 | 3.1642 |
| 23 | -2.9828 | .49276 | .75362E-01 | 3.1642 |
| 24 | -5.0076 | .38093 | .59584E-01 | 2.6596 |
| 25 | -5.0076 | .26909 | .43806E-01 | 2.6596 |
| 26 | -5.0076 | .26909 | .43806E-01 | 4.6780 |
| 27 | -5.0076 | .15726 | -.35084E-01 | 9.7241 |
| 28 | -5.0076 | .15726 | -.66641E-01 | 10.733 |
| 29 | -8.0450 | .45430E-01 | -.19306E-01 | 10.733 |
| 30 | -12.095 | .15726 | -.50863E-01 | 10.733 |
| 31 | -11.082 | .32501 | -.35084E-01 | 10.733 |
| 32 | -10.070 | .26909 | -.35282E-02 | 10.229 |
| 33 | -11.082 | .26909 | .12250E-01 | 10.733 |
| 34 | -11.082 | .15726 | .28028E-01 | 6.6965 |
| 35 | -12.095 | .26909 | .75362E-01 | 7.7057 |
| 36 | -11.082 | .43684 | .75362E-01 | 7.2011 |
| 37 | -13.107 | .43684 | .91141E-01 | 7.2011 |
| 38 | -10.070 | .43684 | .91141E-01 | 7.7057 |
| 39 | -8.0450 | .54867 | .75362E-01 | 7.7057 |
| 40 | -6.0201 | .82826 | .91141E-01 | 6.6965 |

TABLE XI

| Number Sample | Q47 | Q48 | Q49 |
|------------------|---------|-------------|--------|
| 1 | -14.021 | .10671 | 1.1079 |
| 2 | -13.012 | .48960E-01 | .98593 |
| 3 | -9.9862 | .17602 | 1.0774 |
| 4 | -5.9512 | .32040 | 1.0164 |
| 5 | -6.9599 | .40703 | 1.1690 |
| 6 | -8.9774 | .34928 | 1.1385 |
| 7 | -5.9512 | .31463 | 1.1995 |
| 8 | -6.9599 | .33773 | 1.1995 |
| 9 | -6.9599 | .30308 | 1.1995 |
| 10 | -7.9687 | .30885 | 1.1690 |
| 11 | -8.9774 | .27998 | 1.2910 |
| 12 | -8.9774 | .17602 | 1.3825 |
| 13 | -7.9687 | .37409E-01 | 1.3215 |
| 14 | -7.9687 | .37409E-01 | 1.3215 |
| 15 | -8.9774 | -.43446E-01 | 1.2300 |
| 16 | -12.004 | .12982 | 1.0469 |
| 17 | -14.021 | .95163E-01 | 1.0164 |
| 18 | -8.9774 | .16447 | 1.0469 |
| 19 | -5.9512 | .95163E-01 | 1.0774 |
| 20 | -9.9862 | .89388E-01 | 1.0164 |
| 21 | 1.1100 | -.78099E-01 | .49788 |
| 22 | 1.1100 | .15292 | .77241 |
| 23 | -2.9250 | .18757 | .80291 |
| 24 | -4.9425 | .16447 | .77241 |
| 25 | -3.9337 | .89388E-01 | .80291 |
| 26 | -2.9250 | .95163E-01 | .80291 |
| 27 | -1.9162 | .16447 | 1.1079 |
| 28 | -3.9337 | .95163E-01 | 1.1079 |
| 29 | -6.9599 | .12982 | 1.0469 |
| 30 | -8.9774 | -.43446E-01 | 1.0164 |
| 31 | -9.9862 | .37409E-01 | 1.0164 |
| 32 | -5.9512 | .37409E-01 | 1.0774 |
| 33 | -8.9774 | .17602 | 1.0469 |
| 34 | -14.021 | .27998 | 1.0164 |
| 35 | -12.004 | .30885 | 1.0469 |
| 36 | -8.9774 | .30308 | 1.2300 |
| 37 | -7.9687 | .33773 | 1.3215 |
| 38 | -7.9687 | .31463 | 1.3215 |
| 39 | -8.9774 | .34928 | 1.3825 |
| 40 | -8.9774 | .40703 | 1.2910 |

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