Two Essays on Self-Tender Offers

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Abstract

This two chapter body of work examines empirical and theoretical aspects of self-tender offers. The first chapter is an empirical study of self-tender offers. This section gives the reader an opportunity to understand some of the simple mechanics and issues regarding self-tender offers in the context of closed-end funds. This section also introduces the reader to the "self-tender offer anomaly". The second chapter takes the study of self-tender offers one step further. The second chapter is a theoretical study which seeks to answer questions regarding the self-tender offer anomaly.

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1 CLOSED-End Fund Self-Tender Offers*

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Abstract: *This paper examines a unique dataset of self-tender offers implemented by closed-end funds. I find evidence that self-tender offers do not lower permanent discounts; however, they create shareholder value in aggregate. Also, in contrast to the evidence of extraordinary anomalous returns in other self-tender offer papers, evidence here suggests the market is much more efficient than once thought. Finally, evidence suggests there are irrational investors in closed-end funds; this supports the controversial argument that noise traders create the discounts/premiums in closed-end funds.*

1.1 Introduction

Three independent papers document large abnormal returns in self-tender offer arbitrage strategies, which cannot be explained away by traditional limits to arbitrage or risk-based arguments. Lakonishok and Vermaelen (1990), henceforth LV, Kadapakkam and Seth (1994), henceforth KS, and Lucke and Pindur (2002), henceforth LP, find extreme abnormal returns of 9.26% per 5-8 days, 2.89% per 19 days and 8.33% per 5-8 days, respectively. Moreover, these three papers show the robustness of the self-tender arbitrage opportunity across different time periods (LV is 1962-1986, KS is 1981-1989 and LP is 1999-2001) and asset classes (LV is domestic equity, KS is domestic equity, and LP is French equity). This paper offers a unique opportunity to check the robustness of these results on a new dataset.

This paper also has a tie to the mounting behavioral finance literature. The difference in nature of closed-end funds versus traditional equity allows for a more controlled study of investor behavior in self-tender offers, allowing one to separate what is "rational" and what is "irrational" more vividly. This paper finds evidence that there are indeed irrational market participants investing in closed-end funds. The evidence supports a controversial paper by Lee, Shleifer and Thaler (1991), henceforth LST, which outlines an argument that noise traders create closed-end funds discounts/premiums.

The paper is organized as follows. Section 1.2 describes the dataset. Section 1.3 describes some of the basics of closed-end fund self-tender offers; what they are, why they are implemented and how they affect shareholder value. Section 1.4 provides some characteristics of the self-tender offer arbitrage strategy and compares the results with prior research. Section 1.5 describes the optimal investor decision when faced with a self-tender offer and subsequently shows the existence of irrational speculators. Section 1.6 ties these results to the work done by LST, which suggests that noise trader risk is a plausible reason for the existence of discounts/premiums in closed-end funds. Finally, section 1.7 concludes and provides direction for future research.

1.2 Data

Data for this study were borrowed from a database created for proprietary trading purposes by a small hedge fund. The database contains the entire population of self-tender offers implemented in the history of closed-end funds[1]. The self-tender offers this paper analyzes are specific to closed-end funds who will continue to operate as closed-end funds. For this reason, self-tender offers which are publicly known to be a precursor to a liquidation or major restructuring of a closed-end fund to an open end fund have been eliminated from the dataset. Ultimately, the database contains 22 observations starting in March 1999 and leading to February 2003, distributed relatively uniformly across time. Table 1 presents some descriptive characteristics of the data. The descriptive characteristics show that closed-end fund self-tender offers generally occur in country funds selling at large discounts.

[INSERT TABLE 1]

1.3 Closed-End Fund Self-Tender Offers and Shareholder Value

1.3.1 Background

Self-tender offers in closed-end funds are a straightforward event that can be easily confused with other tender events occurring in closed-end funds. The self-tender offers discussed here are made by closed-

[1]The author searched through Lexis-Nexis and SEC documents verifying the entire database and checked for any closed-end fund self-tender offers that may have been overlooked – none were found.

end funds for varying amounts of total shares outstanding at a price equal to a percentage of net asset value (NAV) at a designated time in the future. For example, on August 30, 2002 *The India Fund* announced a self-tender offer for up to 10% of the fund's common stock at a price equal to 95% of NAV as determined on September 27, 2002.

1.3.2 Why are they implemented?

Evidence suggests self-tender offers appear to be implemented in funds which are trading at the steepest discounts to NAV. Closed-end fund management sometimes claim that self-tender offers give their long-term investors an opportunity to cash out at or near NAV or they claim that it is the tool that can maximize shareholder value the most. However, these explanations do not explain why they have chosen the self-tender offer format over the traditionally implemented open market repurchase offer, nor does it help us understand why closed-end fund management teams have only recently implemented self-tender offers. However, casual empiricism suggests a potential answer is an increase in shareholder activism[2]. Studying the theoretical underpinnings of the self-tender offer decision from a managerial perspective might be a worthwhile pursuit; however it is not the focus of this paper.

1.3.3 Self-tender offers and shareholder value

Closed-end fund self-tender offers can create value for shareholders in three ways: 1) The self-tender offer itself (by immediately eliminating discount on tendered shares), 2) permanent discount effects, and/or 3) increase in NAV effect. The first avenue to value creation, through the self-tender offer itself, will be studied more rigorously later in this paper and is found to create shareholder value. However, the other two claims are not strongly supported by the evidence.

1.3.3.1 Permanent Discount Effects

There are a variety of reasons why the market should see permanent discounts DECREASE after the self-tender offer expiration. First, closed-end fund managers who implement self-tender offers send a signal to the market that they are serious about increasing shareholder value. The literature cites agency costs as a possible explanation for closed-end funds selling at a discount (Boudreaux 1973). One would think that any signal to the market that agency costs may be reduced beyond what was already expected would decrease permanent discounts. Second, self-tender offers can potentially save money because management can spend less time and fund resources dealing with disgruntled shareholders and fighting takeover attempts. Takeover attempts are very real prospects for closed-end funds with characteristics similar to the closed-end funds in our sample (large discount, liquid assets, liquid market for shares, etc.).

Self-tender offers may also INCREASE permanent discounts in a closed-end fund. The market may see increasing permanent discounts after a self-tender offer's expiration because decreasing the assets under management leads to lower economies of scale and thus the fund's operating cost per dollar invested increases. As pointed out in Lee, Shleifer and Thaler (1990), closed-end funds management fees can have large effects on discounts.

The arguments above can be empirically tested by seeing what actually happens to discounts after a self-tender offer's expiration. Table 2 demonstrates that the discount after the self-tender offer expires is not significantly different from the discount before the self-tender offer is announced. However, point estimate evidence supports the argument that permanent discounts do indeed decrease after the implementation of a self-tender offer.

[INSERT TABLE 2]

1.3.3.2 Increasing NAV effect

[2] See the Harvard University vs. Templeton China World Fund, Inc., Templeton Dragon Fund, Inc. and Templeton Asset Management Ltd lawsuit (2003) which lead to eventual self-tender offers.

The potential to increase the current NAV by purchasing shares at less than NAV also creates shareholder wealth. For example, let's say we have a stock XYZ with 10 shares, book value of $100 and a market price equal to $10. If the company has a self-tender offer for 5 shares at $9, after the self-tender offer we will have a book value of $55 ($100-5*$9). Assuming the shares still sell at book value, they will be worth $55/5=$11 per share. This argument is correct in principle. However, the "percentage of NAV received" variable in Table 1 shows that the discount at which most closed-end funds buyback shares is very close to NAV. Moreover, the transaction costs associated with the closed-end fund's implementation of the self-tender offer can be large and eliminate any benefit from buying shares slightly below NAV. For example, closed-end fund management sometimes clarify that the shares are bought at a slight discount to NAV in order to cover implementation costs. Regardless, buying back shares at slightly less than NAV has a marginal affect on increasing shareholder value.

1.3.3.3 Conclusion

The evidence does not support an unequivocal statement that self-tender offers create value by decreasing permanent discounts or increasing NAV. We shall see that most of the value created by a self-tender offer is created through the self-tender offer itself. However, only certain shareholders receive this value; those shareholders (and arbitragers) who tender in a self-tender offer.

1.4 The Self-Tender Offer Arbitrage Strategy

1.4.1 Trading Strategy and Results

The trading strategy implemented in this paper parallels those implemented in LV, KS and LP. I assume the investor buys shares three days before the self-tender offer expires, tenders his shares and then sells non-accepted shares five days after the self-tender offer. The abnormal returns are adjusted for the market movement of the S&P 500. This method was chosen for simplicity; however, Brown and Warner (1985) show that in a short holding period, the results are not sensitive to the underlying process generating returns. This adjustment to returns only effects those shares not accepted in the tender offer. The simple trading strategy generates an average abnormal return of 1.79% during the holding period. The t-stat, under the null that the average abnormal return is zero, is 1.68, suggesting we cannot reject the null of market efficiency. These results are very different than other studies on self-tender offer arbitrage, which have much higher returns and stronger t-stats.

1.4.2 Comparison with other papers

In LV, the dataset consist of 221 self-tender offers in US traded equities from 1962-1986. They implement a "trading screen" which only invests in offers where the tender offer price exceeds the market price at expiration by 3% or more. This screen brings their sample to 109. The trading strategy in these 109 observations is to buy shares one day before the self-tender offer expires, tender shares and then sell out remaining shares four days after expiration. This strategy generates an abnormal return (raw return minus return of EW CRSP index) of 9.26% for the holding period. The t-stat, under the null of the abnormal return being zero, is 7.58 – a highly significant result.

The KS dataset consist of 76 Dutch style self-tender offers in US traded equities from 1981-1989. The KS trading strategy is to buy shares two days after the self-tender offer is announced, tender shares and then sell out remaining shares two days after expiration. This strategy generates an abnormal return (return risk adjusted using market model) of 2.89% for the holding period. The t-stat, under the null of the abnormal return being zero, is 3.58.

The LP dataset consist of 22 observations of self-tender offers in the French equity market from 1999-2001. The trading strategy implemented is very similar to LV: buy shares day before expiration, tender shares and then sell out remaining shares five days after expiration. This strategy generates a raw return of 8.33% for the holding period. Abnormal returns are not reported, however, the authors claim the results are virtually identical to the raw returns reported. A t-stat is not reported for their results.

Table 4 summarizes the results for easy comparison. The robustness of the LV, KS and LP extraordinary abnormal returns is brought into question. The 1.79% abnormal return found in the closed-end fund sample is statistically insignificant and carries a lot less "shock value" then the abnormal return results found in the other papers.

[INSERT TABLE 3]

1.5 Irrational Closed-End Fund Speculators

Past evidence from LST suggests the existence of irrational speculators in closed-end funds, who are apparently unaware of public information. Public information in modern financial markets is easily accessible and transparent to market participants, thus one would think that the existence of irrational speculators would be a market fairytale, as those who are involved in the market should be able to (or have someone on their behalf) decipher public information and act accordingly. However, the evidence presented here complements other work done by behavioralists, who study investor behavior in experimental and real world settings and find evidence of irrational financial choices (Thaler and Johnson 1990, Thaler, Tversky and Kahneman 1997, Tversky and Kahneman 1979 and Barber and Odean 2000)[3]. A discussion of the optimal investor decision and the existence of irrational speculators follows.

1.5.1 Optimal Investor Decision

The optimization decision at hand is whether or not an investor should tender his shares in a self-tender offer. The following outlines why an individual investor may or may not tender his shares despite the chance to cash out at higher prices in the tender offer.

1.5.1.1 Why an investor may NOT tender

1.5.1.1.1 Transaction Costs

An individual may choose to not tender in an offer if there are excessive transaction cost in tendering. However, generally this is not the case. All an individual needs to do to tender shares is contact his reorganization department at their brokerage and tell them to tender his shares. The fee for this service is not substantial.[4]

1.5.1.1.2 Signaling

Alternatively, an investor may not partake in a self-tender offer because the value of the firm will be higher after the tender. According to the work by Vermaelen (1981) on stock repurchases and signaling, it could be the case that shares repurchases provide a signal to the market that the value and prospects of the firm are much higher than the market believes. This could create a situation where a rational shareholder may believe his shares to be more valuable after the tender than before the tender. These shareholders have no incentive to tender to the acquirer at a price below fundamental value. However, with closed-end self-tender offers this argument does not hold. Management cannot signal any "inside" information because they are managing a portfolio of assets which are marked to market every day and the discount to fundamental value is publicly known. Evidence supporting this is presented in Table 2. The discount after the self-offer tends to revert to the original discount which prevailed in the marketplace before the self-tender offer. If discounts exist for economic reasons (noise trader risk, taxes, fees, etc) this should come as no surprise.

1.5.1.1.3. Tax effects

Tax incentives may also provide a rational reason for shareholders to not tender. For example, if an investor is nearing the one year holding period in the closed-end fund which is implementing the self-tender offer, tendering may trigger a detrimental short-term gain on the shares accepted. In this case, it may be optimal to forgo the self-tender offer for tax purposes.

[3] See "A Survey of Behavioral Finance" by Nicholas Barberis and Richard Thaler for more examples of irrational behavior in both experimental and marketplace settings.
[4] $25 one time fee at Ameritrade for voluntary reorganization participation fee

Another tax argument could be that shareholders have a large capital gain locked in and do not want to realize this gain on tendered shares. Table 4 presents regressions which test if the difference in what is actually tendered and what is willing to be accepted for tender ($\%X_a - X$) is related to different holding period returns of 3 months, 6 months, 1 year and 2 years (R_3, R_6, R_{12} and R_{24}). The regression model is $(\%X_{a,i} - X_i) = \alpha + \beta(R_{n,i}) + \varepsilon_i$, where n=3, 6, 12, or 24. If capital gains matter and affect tendering decisions, one should see $\hat{\beta} > 0$. If the individual's holding return is positive, it is more likely he will have to realize a capital gain and thus less likely he will tender, hence $\%X_a - X$ will be larger than what it would be if there was no tax burden. The results for this simple regression are mixed and inconclusive. For 3 month and 1 year holding periods a negative relationship exists. In contrast, for 6 month and 2 year holding periods there is a positive relationship that supports the hypothesis that taxes may be influencing some investor's tendering decisions. Given the best case for the rational tax argument, in which all holders are the 6 month holders, we still find the beta to be marginally significant at a 10% rejection level. Furthermore, the R^2 on the regression is only 17%, suggesting taxes are only partially explaining why some shareholders are not tendering. In all fairness with such a small sample size and a simple proxy for tax effects drawing any inference is difficult, however, it seems reasonable to claim that non-participation cannot be completely explained by tax incentives.

[INSERT TABLE 4]

1.5.1.1.4 Influence

A final argument suggests that by not tendering, a shareholder can affect a final outcome (not allowing a raider to takeover, sending a signal to the market, etc.). However, in the case of self-tender offers, this argument is moot as the actions (or inactions) taken by shareholders have zero effect on the implementation of the self-tender offer.

1.5.1.2 Why an investor will tender

The argument FOR tendering is quite simple: Shareholders are given the opportunity to sell out shares at a price exceeding current market prices. All of the self-tender offers are implemented in closed-end funds in which the discount is large to extremely large (7.4%-26.5% min-max range) and in 100% of the self-tender offers the percentage of NAV is very close to 100% (90%-100% min-max range). In all cases investors who tender are able to sell at prices that are higher than current market prices. Moreover, most times odd-lot shareholders (holding 99 shares or less) are given an exemption to pro-rationing and allowed to have 100% of their shares accepted in the tender. The rational decision should be quite clear!

1.5.2 Existence of irrational speculators

1.5.2.1 Evidence

The discussion above suggests that in a world with rational speculators tendering rates in closed-end fund self-tender offers should be quite high. However, evidence indicates that some closed-end fund speculators are irrational. Table 5 provides further evidence on the matter.

[INSERT TABLE 5]

Non-participating shareholders are not taking advantage of the chance to sell out at prices above market. A small difference in the $\%X_a - \%X$ measure might be expected for a number of reasons (trading error, too complicated, tax incentives, etc). However, in the history of closed-end funds self-tender offers there have been few cases where $\%X_a \approx \%X$ (see Figure 1). Moreover, for a vast majority of the self-tender offers the deviation $\%X_a$-$\%X$ is quite substantial - the mean difference is nearly 26%. LV, KS and LP find similar results with regard to lack of shareholder participation in self-tender offers. Non-tendering shareholders effectively throw away a substantial amount of money, diverting those funds to those who take part in the self-tender offer. These deviations are hard to explain in a marketplace filled with rational investors.

[INSERT FIGURE 1]

1.5.2.2 Value transfers

The absolute cash value of tendering versus not tendering can be tested in a perfectly controlled experiment by seeing if a strategy of tendering is more valuable than not tendering. The exact transfer of wealth that irrational and rational non-tendering shareholders give to tendering shareholders can be quantified. See Figure 2.

[INSERT FIGURE 2]

The creation of Figure 2 was based on a very simple strategy. TENDER is a strategy where an investor starts with $1. He invests the same amount a NON_TENDER can put in every deal (this ensures the exact same dollar amount of market risk exposure in both deals), buys shares 3 days before the self-tender offer expires, in order to ensure participation in the offer, and sells 5 days after the self-tender offer in order to eliminate worries about liquidity immediately following the expiration of the self-tender offer. All self-tender offer gains receive zero interest. RATIONAL_TENDER is completely analogous to the TENDER strategy, with the exception that the percentage of shares accepted in the self-tender offer is the amount that an investor would have had accepted if everybody was rational and tendered their shares. NON_TENDER is a strategy which invests 100% of the available wealth in each deal and follows the exact same strategy as TENDER, without participating in the self-tender offer. In periods where self-tender offer investments are not available, the investment sits under a mattress. This creates a perfectly controlled experiment where the only variables being changed are whether the investor tenders or not and the amount an investor can tender. All market fluctuations affect all strategies in exactly the same manner. The conclusions are not unique to this particular portfolio formation strategy. Deviations from this specific methodology, which similarly ensure the only variables allowed to change are the tender decision and the amount accepted in the tender, provide the exact same result - tendering is optimal 100% of the time!

An investor who was in a "TENDER" strategy ended up with $1.21, opposed to a "NON-TENDER" strategy, which would have netted $.45 - an enormous difference. The investor is only invested for approximately 22 weeks (~1 week holding period per deal) out of the total 203 week (3/1/99-1/24/03) investment period analyzed. Finally, we also see the exact value transferred from non-tendering shareholders to tendering shareholders – the difference in the TENDER and the RATIONAL_TENDER strategy. Moreover, none of these results rely on a single offer. In 100% of the individual offers entering into the self-tender offer was the more profitable decision.

Extremely low tendering rates cannot be explained in a marketplace where everyone is operating rationally, defined here as trading based on maximizing wealth. These investors are not maximizing wealth, but are maximizing their unique utility functions, as can be seen in the transfer of wealth occurring between tendering shareholders and non-tendering shareholders. Moreover, LP note this same phenomenon of wealth transfer from non-tendering shareholders to tendering. Perhaps, these "irrational" traders are technical analysis traders, momentum traders or "buy and hold" investors who check on their portfolio only 3-4 times a year. Whatever the reason, one thing is clear – some investors are not choosing a profit maximizing strategy.

1.6 Irrational Speculators in the Closed-End Fund Marketplace

A theoretical work by DeLong, Shleifer, Summers and Waldmann (1990), henceforth DSSW, shows how the existence of noise traders in a marketplace can increase the risk of holding securities for rational speculators with finite investment horizons. In a subsequent paper, Lee, Shleifer and Thaler (1991) borrow the theoretical predictions of the DSSW paper and apply them in the context of closed-end funds. LST argue that irrational noise traders in closed-end funds create the existence of discounts and premiums in closed-end funds. Their work on the discount/premium puzzle is one of the most convincing arguments to date and summarizes why other reasons cited for closed-end fund mispricing are unsatisfactory. In order to provide evidence that irrational traders are involved in closed-end funds and that the risk is systematic, they show how the level of discounts/premiums correlates with the returns of small-capitalization stocks – a favorite hideout for irrational traders. This evidence has inspired spirited debate from Chen, Kan and Miller (1993) who claim their correlation to be a chance event and their methodology flawed.

The evidence throughout this paper is more consistent with the story told by LST and not Chen, Kan and Miller (1993). This paper provides empirical evidence of the existence of irrational speculators in the closed-end fund marketplace. The existence of irrational speculators substantiates the claim by LST that there are indeed investors in closed-end fund who speculate irrationally and could potentially be the "noise traders" who buy closed-end funds at a premium in IPOs and subsequently create market prices where large discounts can be the norm.

1.7 Conclusions

Using a unique dataset of closed-end fund self-tender offers, this paper has provided insight into the following issues: 1) General information on self-tender offers in closed-end funds and their effects on shareholder value, 2) a robustness check for the shocking results of other self-tender offer arbitrage papers, 3) evidence there are indeed irrational speculators in the closed-end fund marketplace and 4) how this evidence for irrational investors supports the arguments set forth in LST.

Going forward, it would be interesting to investigate why there are abnormal expected returns to investing in self-tender offers – even though the abnormal returns in this paper are much smaller then other studies they are still positive. Do irrational investors create a limit to arbitrage in self-tender offers? If irrational investors have no clue a self-tender is in effect and do not tender, arbitragers could potentially profit from this irrationality. However, guessing how irrational speculators may be is risky and might create a limit to arbitrage in self-tender offer arbitrage. Studying the limits to arbitrage in self-tender offer arbitrage may shed some light on the self-tender offer puzzle.

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1.9 Tables and Figures

Table 1

This table provides descriptive statistics on salient aspects of the database under examination. Deal characteristics contain statistics on the Offer Length, % Buyback, and % NAV Received. Offer Length is defined as the number of days between announcement day and the self-tender offer expiration. % Buyback is the maximum percentage of common shares outstanding the closed-end fund will buyback. % NAV Received is the percentage of the NAV value tendering shareholders will receive. Fund characteristics contain statistics on Market Capitalization of the closed-end fund on the announcement date, Shares Outstanding ('000's) at the announcement date, and Price per Share at the announcement date. Discount Before Deal contains statistics on discounts that prevailed in the market place before the announcement of a self-tender offer. Country refers to where the closed-end fund invests a large majority of their capital. Fund Specific provides details on the number of unique firms (fund administrators) in the database. Exchange is the exchange where the closed-end fund is traded.

N=22			

Deal Characteristics	Offer Length	% Buyback	%NAV Received
Median	29	20	95
Mean	50.6	22.2	94.8
Min	21	10	90
Max	395	80	100
Fund Characteristics	**Market Capitaliza-tion ($'s)**	**Shares Outstanding ('000's)**	**Price**
Mean	182,990,926	20,035	9.26
Median	144,820,461	14,954	8.72
Min	48,975,701	6,509	6.38
Max	555,748,063	63,971	18.63
Discount Before Deal	**t=-1**	**Average of t=-50,...,-1**	
Average	17.02	18.11	
Median	18.09	19.39	
Min	7.36	8.78	
Max	25.61	30.34	
Country	**Number in Sample**		
Mexico	3		
Italy	2		
India	5		
Pacific Rim	12		
Fund Specific	**Number in Sample**		
Unique Firms	11		
Exchange	**Number in Sample**		
NYSE	22		

Table 2		
This table presents descriptive statistics for the difference in discounts before the self-tender offer announcement and after self-tender offer expiration. Db-Da is defined as the difference in the discount before the self-tender offer announcement at t=-1 (Db) minus the discount after self-tender offer expiration (Da). Db-Da_AVG is defined as the discount before the announcement at t=-1 (Db) minus the average 50 day discount after self-tender offer expiration (Da_AVG).		
	Db-Da	**Db-Da_AVG**
Mean	0.94	0.68
Median	1.59	0.09
StDev	3.13	2.71
T-stat (Mean=0)	1.41	1.19
% Positive	0.64	0.86

TABLE 3

This table compares the descriptive characteristics and abnormal returns with the Lakonishok and Vermaelen (1990) Kadapakkam and Seth (1994), and Lucke and Pindur (2002) papers.

Paper	***Finding: Return (T-Stat)***	***Strategy***	***Sample Size***	***Sample Trading Rule***	***Sample Specifics***
Lakonishok, Vermaelen 1990 (LV 1990)	9.26% (7.58) abnormal return (return minus return of EW CRSP index) per 5-8 days	Buy 1 day before expira-tion, sell 4 days after expiration	N=109	trading rule such that $P_T > .97 P_{m,t=0}$	1962-1986 domestic equity self-tender offers
Kadapakkam, Seth 1994 (KS 1994)	2.89% (3.58) abnormal return (return risk adjusted using market model)~per 19 day abnormal return	Buy 2 days after announcement, sell 2 days after expiration	N=76	None	1981-1989 domestic equity Dutch-auction stock repur-chases
Lucke, Pindur 2002 (LP 2002)	8.33% (not re-ported) abnormal return (no adjust-ment for risk, performed but was shown to not affect results) per 5-8 days	Buy 1 day before expira-tion, sell 5 days after expiration	N=22	None	1999-2001 French equity self-tender offers
Gray 2003 (G 2003)	1.79% (1.68) abnormal return (minus S&P 500 return) per 5-8 days	Buy 2-3 days before expira-tion, sell 5 days after expiration	N=22	None	1999-2003 Closed end fund self-tender offers

Table 4

This table presents regression estimates for the model: $(\%X_{a,i} - X_i) = \alpha + \beta(R_{n,i}) + \varepsilon_i$, where n=3, 6, 12, or 24. $(\%X_{a,i} - X_i)$ is defined as the percentage of shares a tendering actually has accepted in the tender minus the percentage of shares a tendering would receive if every shareholder tendered. $R_{n,i}$ is defined as the n holding period return where n=3, 6, 12, or 24

Estimates	**3-Month (n=3)**	**6-Month (n=6)**	**12-Month (n=12)**	**24-Month (n=24)**
Beta	-1.03	51.93	-1.15	2.03
T-stat (Mean=0)	-0.02	2.03	-0.03	0.16
R^2	0	0.17	0	0
***No results are significant at the 5% level**				

Table 5	
Difference(%Xa-%X) is defined as the difference in the actual percentage of shares the fund accepts on a pro-rated basis and the maximum percentage of shares the fund would accept in the self-tender offer.	
Statistics	**Difference (%Xa-%X)**
Mean	25.6
Median	12.6
Min	2.5
Max	90
T-stat (Mean=0)	44.74

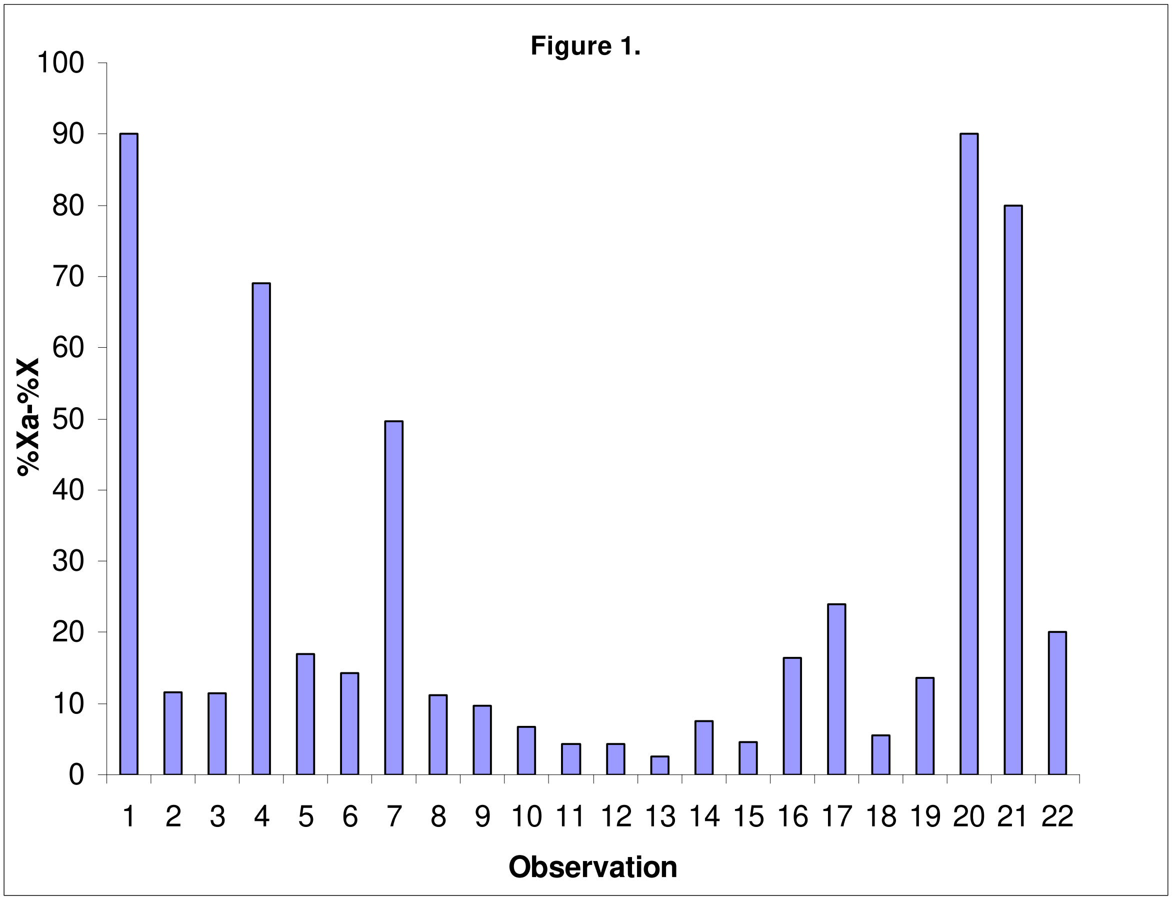

Figure 1 plots the 22 observations and their corresponding %Xa-X value. %Xa-X is the spread between the percentage of shares tendering shareholders actually had accepted for tender and the percentage of shares tendering shareholders should have had accepted for tender if everyone tendered their shares.

Figure 2.

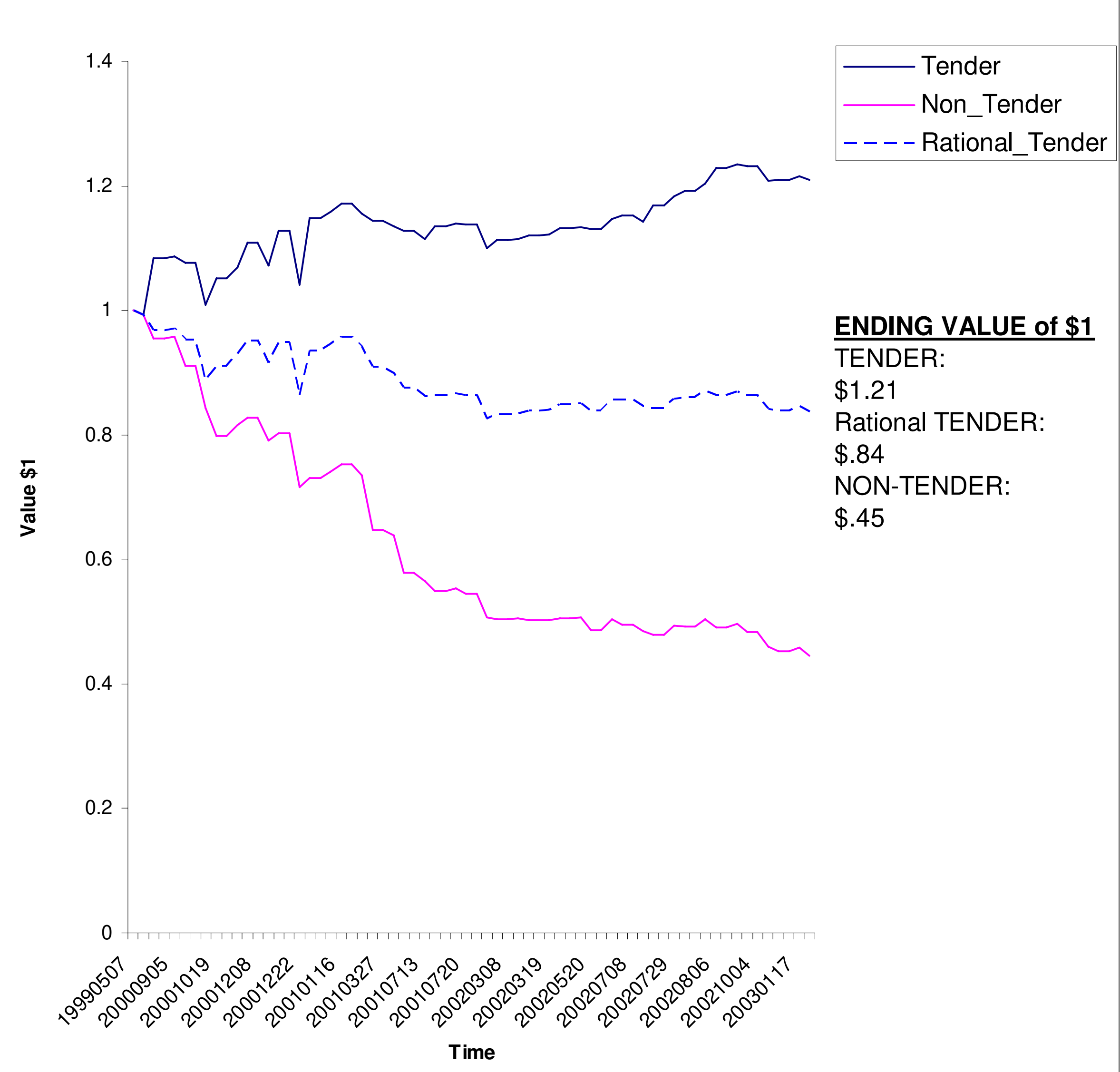

Figure 2 shows the value for 3 different strategies which invest in all the closed-end self-tender offers as described in the paper. Tender is a strategy which invests in all the closed-end funds and tenders in all the self-tender offers. Non_Tender is a strategy which invests in the closed-end funds but does not tender in the self-tender offers. Rational Tender is a strategy that invests in all the closed-end funds and tenders in all the self-tenders, however, it is assumed everyone tenders their shares.

2 THE SELF-TENDER OFFER ANOMALY*

Abstract: *Four independent studies show that self-tender offer arbitragers (arbitragers who buy a few days before an offer's expiration, tender, and then sell remaining shares in the open market after offer expiration) can earn expected abnormal returns. In light of these findings, one must ask a fundamental economic question: why are the empirically observed trading profits in self-tender offers not eliminated by arbitragers? I find three characteristics of the "arbitrage" opportunity in a perfectly frictionless market: 1) previous self-tender offer papers overstate ex-ante implementable expected abnormal returns, 2) arbitrage profits decrease in ownership leading to scalability issues and 3) the strategy is risky. These findings help explain the existence of the self-tender offer anomaly by showing it is empirically overstated, there is a limit to arbitrage and the ex-ante implementable expected abnormal returns may compensate for risk.*

2.1 Introduction

What exactly is the self-tender offer anomaly? To summarize, the self-tender offer anomaly is a label for a phenomenon found in a group of self-tender offer research papers. These papers document expected abnormal returns available to short term traders in self-tender offers (henceforth known as self-tender offer arbitragers), which cannot be explained away by traditional risk-based arguments. These four papers are outlined in Table 1. Lakonishok and Vermaelen (1990), henceforth LV, and Lucke and Pindur (2002), henceforth LP, find extreme expected abnormal returns of 9.26% per 5-8 days and 8.33% per 5-8 days respectively. LV's sample consists of 109 domestic equity self-tender offers from 1962 to 1986. LP's sample contains 22 French equity self-tender offers, occurring between 1999 and 2001. Kadapakkam and Seth (1994), henceforth KS, and Gray (2003) find less extreme expected abnormal returns: 2.89% per 19 days and 1.79% per 8-12 days respectively. The KS sample contains 76 domestic equity Dutch-auction style self-tender offers from 1981 to 1989. Gray's sample consists of 22 self-tender offers occurring in closed-end funds between 1999 and 2003. Although varying in magnitude, all of the expected abnormal returns are substantial (these are not annualized returns, but are holding period returns). Additionally, these results are robust across multiple time periods (1962-1986, 1981-1989, 1999-2001, 1999-2003), various implementation schemes (standard self-tender offer vs. Dutch style self-tender offer) and asset classes (Domestic equity, French equity and Closed-End Funds). The mounting evidence for the existence of a self-tender offer anomaly is intriguing and warrants investigation.

INSERT TABLE 1

* I would like to thank participants in the Asset Pricing workshop held at the University of Chicago. Special thanks to Arek Ohanissian, Tony Vernon, Lucasz Pomorski, Steve Crawford, Jared Hullick and Lauren Cohen. Eugene Fama has provided excellent commentary and ideas. Finally, many thanks to Katie Jorgensen for her help in editing and composition.

I find three characteristics of the "arbitrage" opportunity in a perfectly frictionless market: 1) previous self-tender offer papers overstate ex-ante implementable expected abnormal returns (empirical estimates are simply misleading), 2) arbitrage profits decrease in ownership leading to scalability issues (limits to arbitrage) and 3) the strategy is risky (this can explain why there appears to be expected abnormal returns which were calculated without controlling for the proper risk exposure). To quantify these findings, I use the empirically observed parameters from the four papers cited above (see Table 1), insert these parameters into a model which accounts for the logistics of implementing self-tender offer arbitrage and then back out the ex-ante implementable returns that an arbitrager could have realized. I show that the ex-ante implementable expected abnormal returns are substantially lower than the reported abnormal returns in the four respective papers. Moreover, with the addition of any reasonable sort of transaction costs, ex-ante implementable expected abnormal returns diminish or become negative. These findings help explain the existence of the self-tender offer anomaly.

2.2 Self-Tender Offer Anomaly

In order to intricately understand the self-tender offer anomaly, one must understand a self-tender offer. A self-tender offer is an offer made by the issuing company to buy back a fixed amount of shares outstanding, at a fixed price and at a set date (a Dutch style self-tender offer is nearly identical except that the company buys back stock at a price defined in some set range). It is important for the reader to understand the difference between self-tender offers and a closely related phenomenon called open-market repurchases. In an open market repurchase, the issuing company announces they will be creating the option, but not the obligation, for the company to buy back a certain amount of shares at market prices over an extended time interval. In contrast, a self-tender offer is a more definitive way for the company to buy back shares, at a price that exceeds market value, and in a time interval that is typically much shorter (usually <2 months). For example, Keynote Systems announced a self-tender offer on March 12, 2003. In this offer, Keynote Systems offered to buy back 32.6% of outstanding shares at a price of $9.50. The offer was set to expire March 24, 2003 (see appendix B for press release and more details). See Figure 1 for a graphical timeline.

INSERT FIGURE 1

The expected abnormal returns earned by an arbitrager who implements this short-term strategy in a self-tender offer like that of Keynote Systems is what this paper labels the self-tender offer anomaly.

The typical self-tender offer arbitrage strategy "implemented" in the four empirical papers is roughly as follows: 1) buy shares immediately before the self-tender offer expiration, 2) tender the shares and wait for expiration, 3) once offer expires, receive cash for tendered shares, and 4) sell remaining shares which were not accepted for tender on the open market immediately after expiration[5].

2.3 Model

This section will outline a model which will help us better understand the implementation of the self-tender offer arbitrage from the point of view of someone actually trying to take advantage of this apparent "anomaly." Figure 2 outlines the logistics of how self-tender offer arbitrage is modeled throughout this paper.

INSERT FIGURE 2

The notation for expectations warrants explanation. Throughout this paper the correct expectation has no subscript, $E(\bullet)$, the arbitrager's expectation has an "a" subscript, $E_a(\bullet)$, and the markets expectation has a "m" subscript denoted $E_m(\bullet)$. Conditional expectation, given an information set at t, follows a common notation of $E(\bullet \mid I_t)$. Finally, while the concepts are quite simple in this model, the sheer amount of notation can quickly become confusing. For a complete table of terms and definitions used throughout this paper refer to Table 2.

INSERT TABLE 2

2.3.1 Model for Self-Tender Offer Arbitrage

2.3.1.1 Analysis at time t=-1

At t=-1, the market makes an announcement of a self-tender offer. The tender offer price (P_T) and the market expectation for the fraction of shares outstanding the company will purchase ($E_m(F_p \mid I_{t=-1})$), immediately become known. Following the Keynote Systems example, t=-1 would correspond to March 12, 2003 which was the date for the announcement of the Keynote self-tender offer. The tender offer price in this case would be $P_T = 9.50$ and the market expectation for the fraction of shares outstanding the company will repurchase would be $E_m(F_p \mid I_{t=-1}) = 32.6\%$.

2.3.1.2 Analysis at time t=0

[5] This is not merely an academic invention. A few special situation hedge funds known to the author implement similar strategies. The

At t=0, the market price after the announcement is known. The market sets the market clearing price at $P_{t=0} = P_T E_m(\alpha \mid I_{t=0}) + (1 - E_m(\alpha \mid I_{t=0}))E_m(P_{t=3} \mid I_{t=0})$. $E_m(\alpha \mid I_{t=0}) = \dfrac{E_m(F_P \mid I_{t=0})}{E_m(F_T \mid I_{t=0})}$ is the fraction of shares the market expects a tendering shareholder will have accepted for tender. The components of $E_m(\alpha \mid I_{t=0})$ are as follows: $E_m(F_P \mid I_{t=0})$ is the conditional market expectation for the fraction of shares outstanding the company will repurchase and $E_m(F_T \mid I_{t=0})$ is the conditional market expectation for the fraction of shares which will be tendered. So for example, if the market expects that 50% of the shares outstanding would be repurchased by the company and the market also expects that 80% of the shares outstanding would be tendered, a tendering shareholder would expect to have 5/8th (50%/80%) of their tendered shares accepted for purchase in the self-tender offer. $E_m(P_{t=3} \mid I_{t=0})$ is the conditional expectation for the price the market believes the stock will sell at after the offer has expired. The intuition behind this pricing relationship is that the price which exists in the marketplace after the announcement should equal the expected value of a tendered share ($P_T E_m(\alpha \mid I_{t=0})$) and the expected value of the share that will remain after expiration of the self-tender offer ($(1 - E_m(\alpha \mid I_{t=0}))E_m(P_{t=3} \mid I_{t=0})$). If this were not true an arbitrage opportunity presents itself (Vermaelen 1981). In the Keynote example, t=0 would correspond to March 12, 2003, and $P_{t=0}$ would be the price Keynote Systems is selling at after the announcement.

2.3.1.3 Analysis at time t=1

During period t=1, an arbitrager would enter the market and decide to buy shares. Continuing with the Keynote Systems example, t=1 is any time between March 21, 2003 to March 24, 2003, depending on the exact way the arbitrager wanted to implement the strategy. In some of the self-tender offer anomaly papers, the arbitrager buys shares the day of expiration and in other papers the arbitrager buys shares a few days before. Moreover, in this paper's model there is only one arbitrager who buys the optimal percentage of outstanding shares (S^*_a) and leaves a percentage $S_{m,t=1} = 1 - S^*_a$ of remaining shares which are owned by other shareholders in the marketplace. The arbitrager's probability of tendering shares is equal to 1. The remaining shareholders $S_{m,t=1}$ have an expected probability, $E(T_m)$, of tendering their shares in the self-

exact number of practitioners who implement this sort of strategy is unknown.

tender offer. After the arbitrager has purchased their shares, the true expectation for the fraction of shares outstanding that will be tendered will be

$$E(F_T \mid I_{t=1}) = E(T_a \mid I_{t=1})S^*_a + E(T_m \mid I_{t=1})S_{m,t=1} = S^*_a + E(T_m \mid I_{t=1})S_{m,t=1}\,.$$

2.3.1.4 Analysis at time t=2

The self-tender offer expires at t=2, which in the Keynote Systems example corresponds to March 24, 2003.

2.3.1.5 Analysis at time t=3

Finally, t=3 is the date each tendering shareholders finds out the percentage of his shares accepted for purchase in the tender offer (α) as well as the date he sells off all non-accepted shares ($1-\alpha$) in the open market. t=3 could conceivably be March 25, 2003 to March 28, 2003 in our example, depending on whether or not the arbitrager sells out immediately after the expiration or waits a few days afterwards. In the self-tender offer literature, the stock not accepted for tender is sold anywhere from 2 days after expiration (KS) to 5 days after expiration (Gray and LP).

INSERT TABLE 2

2.4 Propositions

The framework developed above for thinking about self-tender offer arbitrage allows one to better understand the setting for implementing the self-tender offer arbitrage. We also need to state some assumptions in order to simplify the analysis and to derive some interesting insights. The following assumptions are not in place to "force" results, but rather, represent institutional details and robust empirical findings in the marketplace. The first assumption is that both the market and the arbitrager have the correct conditional expectation for the percentage of shares outstanding the company will purchase and the correct conditional expectation for the price which will prevail in the marketplace once the self tender offer expires. Assumption one can be represented mathematically: $E_a(F_p \mid I_t) = E_m(F_p \mid I_t) = E(F_p \mid I_t)$

and $\mathrm{E_a}(P_{t=3} \mid I_t) = E_m(P_{t=3} \mid I_t) = E(P_{t=3} \mid I_t)$. To simplify the matter even more, we will assume the conditional expectations are equal to the unconditional expectations, $E(F_p \mid I_t) = E(F_p)$

and $E(P_{t=3} \mid I_t) = E(P_{t=3})\ \forall\ t$. The second assumption is that the expected percentage of non arbitrage shareholders who tender does not vary with time, $E(T_m \mid I_t) = E(T_m)\ \forall$ t. The third and fourth assumptions are as follows: 3) the market is mis-pricing shares because it consistently under-estimates the conditional expected percentage of tendered shares that will be accepted for a shareholder who chooses to partake in an offer (assumption based on the robust empirical observation in the four self-tender offer anomaly empirical papers) and 4) the arbitrager, unlike the market, knows the correct conditional expectation for the expected percentage of tendered shares that will be accepted for a shareholder who chooses to partake in an offer . These two assumptions can be formally expressed as $E_m(\alpha \mid I_t) < E(\alpha \mid I_t) = E_a(\alpha \mid I_t)$. It directly follows from these assumptions that the arbitrager also knows the correct expectation for the expected percentage of non-arbitrager shares which are tendered, i.e. $E(T_m) = E_a(T_m)$ (see appendix A). This could happen because of advanced information, knowledge of self tender offer studies, etc. The fifth assumption is that the marketplace is perfectly frictionless, more specifically, an arbitrager can buy and sell at the given price in unlimited quantities without moving prices. The sixth assumption is that the tender offer price exceeds the price expected to prevail in the marketplace i.e. $P_T > E(P_{t=3})$. The final assumption is that the arbitrager does not expect every single shareholder to tender their shares, i.e. $E_a(T_m) < 1$. Using these seven assumptions we can derive some interesting insights regarding the self-tender offer arbitrage trading opportunity.

2.4.1 Proposition 1

Even in a perfectly frictionless marketplace, empirically observed abnormal expected returns will overstate the implementable expected returns available to a self-tender offer arbitrager.

$E(R \mid I_{t=0}) > E(R \mid I_{t=1})$. **Proof.** Please see Appendix A. ■

The intuition behind this proposition is tricky to see. From the assumptions, we know the market has a poor average estimate for α because shareholders are tendering at rates the market is incorrectly forecasting. We also know from the assumptions that the arbitrager has the advantage of knowing the true expectation of how many shares they will be able to tender and the market does not, i.e.

$E_m(\alpha \mid I_t) < E(\alpha \mid I_t) = E_a(\alpha \mid I_t)$. The arbitrager is able to take advantage of this ability by having more shares accepted for tender in the self-tender offer than is justified by market prices. However, the arbitrager faces a problem. As the arbitrager buys shares from shareholders, who originally had a positive probability of not tendering, and then turns around and tenders those shares with a probability of 1, the arbitrager erodes away the abnormal returns they will receive by taking advantage of the non-tendering shareholders, i.e. $E(\alpha \mid I_{t=1})$ starts to converge to $E_m(\alpha \mid I_{t=1})$ and their advantage withers away[6].

Here is a simple example. Say there are ten shares in the world for company XYZ and currently one shareholder. XYZ has announced a self tender offer for 5 of the shares at $15 a piece. The current price of XYZ stock is $10. The current shareholder is only tendering 2 shares out of their 10. The arbitrager comes into the market and buys 2 shares at $10 from the shareholder. At expiration the shareholder tenders 2 shares and the arbitrager tenders 2 shares. Because the company is buying back up to 5 shares the shareholder receives $15 for his 2 shares and the arbitrager receives $15 for his 2 shares. The return to the arbitrager is $\left[\frac{2*\$15\text{-}2*\$10}{2*\$10}\right]=\frac{10}{20}=50\%$. Now, say instead of the arbitrager buying 2 shares, the arbitrager buys a total of 6 shares. 8 shares are now being tendered in total and the company will buy back 5/8th of the shares from the shareholders. The arbitrager return will now be

$$\frac{6*\frac{5}{8}*\$15+6*\frac{3}{8}\$10-6*\$10}{6*\$10}=\frac{18.75}{60}=31.25\%$$, which is less than 50%.

2.4.2 Corollary 1.

Implementable abnormal expected returns decrease in a convex fashion with respect to ownership, hence leading to a scalability issue for an arbitrager. Moreover, to maximize return, an investor should buy zero shares. ***Proof.*** *Please see Appendix A.* ■

This corollary is related to proposition 1. The intuition behind the diminishing returns with respect to ownership is more clearly seen when one looks at the limiting situations; buy no shares, or buy all shares outstanding. In the case that the arbitrager buys no shares, his return will paradoxically be maximized, because $E(\alpha \mid I_{t=1})$ will be maximized. In the alternate case, when the arbitrager buys all outstanding shares, the return will be minimized because $E(\alpha \mid I_{t=1})$ will be minimized. The optimal arbitrager investment will lie between these extrema. How this result affects real world arbitragers will be discussed in later sections.

2.4.3 Proposition 2

[6] This is of course ignoring the fact that in a realistic marketplace price pressure from the arbitrager would also push prices back in line.

The optimal percentage of shares outstanding the arbitrager will buy is

$$S^*_a = \frac{\left[\frac{E(F_p)(P_T - E(P_{t=3}))E_a(T_m)}{(P_{t=0} - E(P_{t=3}))}\right]^{1/2} - E_a(T_m)}{1 - E_a(T_m)}$$

. **Proof.** Please see Appendix A. ■

2.4.4 Proposition 3

The optimal percentage of shares outstanding the arbitrager will buy when they face a flat percentage transaction cost (C) is

$$S^*_{a,c} = \frac{\left[\frac{E(F_p)(P_T - E(P_{t=3}))E_a(T_m)}{(P_{t=0}(1+C) - E(P_{t=3}))}\right]^{1/2} - E_a(T_m)}{1 - E_a(T_m)}$$

. **Proof.** Please see Appendix A. ■

Propositions 2 and 3 solve a simple maximization problem. The solution is the value which maximizes the expected profit for the arbitrager. We maximize profit as opposed to maximizing return because we saw from corollary 1 that maximizing return makes no economic sense for a profit minded arbitrager; buying zero shares maximizes return, whereas buying all shares minimizes return.

2.4.5 Proposition 4

Self-tender offer arbitrage is not riskfree .**Proof.** Please see Appendix A. ■

An arbitrager has a better expectation than the market with regard to realized values of the percentage of the other shareholders who will tender i.e. $E(T_m) = E_a(T_m) < E_m(T_m)$. However, if realized values of the percentage of shareholders who tender is greater than the markets original expectation of the percentage of shareholders who tender, $T_{m,t=3} > E_m(T_m)$, the arbitrager may face a negative return. Moreover, there are other random variables that could cause a negative return, despite the market and arbitrager agreement. These variables include the expected amount of shares the company will repurchase, $E(F_p)$, and the expected market price of shares after the self-tender offer expires, $E(P_{t=3})$). An arbitrager may see $F_{p,t=3} < E(F_p)$ because the general market may experience an adverse turn or an intrafirm disaster could happen and the deal could be canceled. $P_{t=3} < E(P_{t=3})$ may occur because market fundamentals have changed. All else equal, if one of the realized values for these uncertain variables ends up being below expectations the arbitrager may experience a negative return, hence making this strategy a potentially risky one!

2.5 Applied Example

The following setup will help the reader grasp the propositions above in a concrete context. For example, say at t=0 arbitragers know the true probability distribution of T_m (.1 probability of $T_m = 75\%$ and .9 probability of $T_m = 25\%$) and thus the true expectation of T_m:

$E_a(T_m) = P(T_m = .75)(.75) + P(T_m = .25)(.25) = 30\% = E(T_m)$. Also, assume $E(F_p) = 17\%$, $\mathrm{P_T} = 1.2$, $\mathrm{E_m}(T_m) = 60\%$ and $\mathrm{E}(\mathrm{P}_{t=3}) = 1$; values which are quite typical in real world self-tender offers. These parameters would imply the market clearing price

is $P_{t=0} = P_T E_m(\alpha \mid I_{t=0}) + (1 - E_m(\alpha \mid I_{t=0}))E(P_{t=3}) = 1.2(\frac{17\%}{60\%}) + (1 - \frac{17\%}{60\%})1 = 1.056$. Given this information, the arbitrager's optimal investment with no transaction costs at t=1 is to purchase 17.75% of outstanding shares – this is shown in equation 1.1.

$$1.1 \quad S^*_a = \frac{\left[\dfrac{E(F_p)(P_T - E(P_{t=3}))E_a(T_m)}{(P_{t=0} - E(P_{t=3}))}\right]^{1/2} - E_a(T_m)}{1 - E_a(T_m)} = \frac{\left[\dfrac{17\%(1.2-1)(30\%)}{1.056-1}\right]^{1/2} - 30\%}{1 - 30\%} = 17.75\%$$

The expected abnormal return at t=0 is 5.4% (Please see Appendix A). This expected abnormal return will be the figure reported in the four empirical papers, which document the self-tender offer anomaly. However, the optimal implementable expected abnormal return at t=1 is 2.2% (Please see Appendix A). This is the ex-ante implementable expected abnormal return an optimally investing arbitrager would achieve if he were to try and take advantage of the self-tender offer anomaly. The 2.2% value is more than 50% less than the 5.4% expected abnormal return an empirical paper would have reported and illustrates the point of proposition 1.

We can also gain some insight into corollary 1 from this example. The basic point of corollary 1 is that there is decreasing returns to scale and thus limited arbitrage in self-tender offer arbitrage. We can see from Figure 3 that the maximum expected abnormal return occurs at 0% ownership and produces an expected abnormal return of 5.4%. It is obvious the expected abnormal return decreases in a convex fashion with ownership, just as corollary 1 states. Eventually, expected abnormal returns fall below zero suggesting a profit maximizing ownership percentage exists.

INSERT FIGURE 3

Proposition 2 formally derives what the profit maximizing percentage ownership should be for a self tender offer arbitrager in the case of no transaction costs. Figure 4 uses the data from this example to show this maximum in the base case of no transaction costs. In the example I assume the market capitalization of the company is \$1,000. At the self-tender offer arbitrager's profit maximizing percentage ownership of 17.75% there are expected abnormal profits available of \$3.94. In order to achieve these profits, we would need to purchase 17.75% (\$177.5) of all outstanding shares in a matter of days, assume there would be no price pressure from such action, assume no transaction costs, assume no risk, etc.

INSERT FIGURE 4

To further illustrate proposition 4, I will continue with this example. For simplification, let us assume away the risk inherent in the $P_{t=3}$ and F_p variables and set $P_{t=3} = E(P_{t=3}) = 1$ and $F_{p,t=3} = E(F_p) = 17\%$. At t=3, if the realized value for the percentage of non arbitrage shareholders who tender shares is $T_m = .25$ then the realized arbitrager return is $R = 3.0\%$, however, if $T_m = .75$ then the realized arbitrager return is $R = -1.3\% < 0$. Figure 5 graphically shows the trading strategies profit numbers for different ownership levels and under the two realized T_m outcomes. In the case that $T_m = .25$ there is a range of values where there are profit opportunities available, whereas in the case that $T_m = .75$ no position is profitable. As one can see, this strategy is not riskfree and does not offer a free lunch to arbitragers who may be short-sighted or unable to diversify (Shleifer and Vishny, 1997). If one were to factor in the risk associated with the random variables $P_{t=3}$ and F_p, which we assumed to be known in this example, this strategy would become even more risky and make the arbitragers lunch even more expensive.

INSERT FIGURE 5

2.6 Empirical Results

2.6.1 Methodology

In this section, I test to see what happens to the empirically observed expected abnormal returns of the four papers under investigation once one takes into account the logistics of self-tender offer arbitrage. For simplicity, I assume away the uncertainty involved in the $E(P_{t=3})$ and $E(F_p)$ variables and set values such that $P_{t=3} = P_{t=-1}$ and $F_{p,t=3} = F_{p,t=0}$ respectively. These assumptions are based on empirical observations from Gray's dataset. In Gray's dataset the $F_{p,t=3}$ realized is always equal to the stated F_p which is given at the announcement of the self-tender offer. Moreover, setting the post self-tender offer price[7] equal to the pre-self-tender offer price is a reasonable assumption based on evidence from Gray's sample, which finds a statistically insignificant difference in prices. Next, I solve for the arbitrager's expectation for the percentage of tendering shareholders at t=0, $E_a(T_m)$ which is obtained from the ex-post α observed from the samples. This is possible because $\alpha = \frac{E(F_p)}{E_a(T_m)} = \frac{F_{p,t=3}}{E_a(T_m)}$ which implies $E_a(T_m) = \frac{F_{P,t=3}}{\alpha}$. With this value for $E_a(T_m)$ and knowledge of the observed ex-post reported expected abnormal returns from the papers, $E_a(R \mid I_{t=0})$, I can use equation 1.2 to find the market's expectation for the percentage of tendering shareholders, $E_m(T_m)$.

1.2 $$E_a(R \mid I_{t=0}) = \frac{\left[P_T \frac{E(F_p)}{E_a(T_m)} + (1 - \frac{E(F_p)}{E_a(T_m)}) E(P_{t=3}) \right] - \left[P_t \frac{E(F_p)}{E_m(T_m)} + (1 - \frac{E(F_p)}{E_m(T_m)}) E(P_{t=3}) \right]}{\left[P_T \frac{E(F_p)}{E_m(T_m)} + (1 - \frac{E(F_p)}{E_m(T_m)}) E(P_{t=3}) \right]}$$

With some simple algebra work we find that $E_m(T_m)$ can be described by equation 1.3 (see appendix A).

1.3 $$E_m(T_m) = \frac{E(F_p)\left[(E_a(R \mid I_{t=0}) + 1)(P_T - E(P_{t=3})) \right]}{\left[P_T \frac{E(F_p)}{E_a(T_m)} + (1 - \frac{E(F_p)}{E_a(T_m)}) E(P_{t=3}) \right] - E(P_{t=3})\left[E_a(R \mid I_{t=0}) + 1 \right]}$$

Finally, with values for the self-tender offer price, P_T, the expectation for the post tender offer price, $E_m(P_{t=3})$, the expectation for the percentage of shares the company will be repurchasing, $E_m(F_p)$, and the markets expectation for the percentage of tendering shareholders, $E_m(T_m)$, I can then plug these variables into the market-clearing price equation, $P_{t=0} = P_T \frac{E_m(F_p)}{E_m(T_m)} + (1 - \frac{E_m(F_p)}{E_m(T_m)}) E_m(P_{t=3})$, and come to an approximate price, $P_{t=0}$, that would have held in the marketplace at t=0. This information then allows one to get a

[7] Price is represented as discounts in the paper to control for portfolio moves which are assumed to be attributed to beta or other

value for the optimal percentage outstanding shares (S^*_a) that an arbitrager with perfect foresight regarding α would buy in the absence of transaction costs. Using all this information, one can then figure out the ex-ante implementable expected abnormal returns and profits a perfect foresight arbitrager would receive by plugging values into equation 1.4.

$$1.4 \quad E(R \mid I_{t=1}) = \frac{\left[P_T \frac{E(F_p)}{(1-S^*_a)E_a(T_m)+S^*_a} + \left(1-\frac{E(F_p)}{(1-S^*_a)E_a(T_m)+S^*_a}\right)E(P_{t=3})\right] - \left[P_T \frac{E(F_p)}{E_m(T_m)} + \left(1-\frac{E(F_p)}{E_m(T_m)}\right)E(P_{t=3})\right]}{\left[P_T \frac{E(F_p)}{E_m(T_m)} + \left(1-\frac{E(F_p)}{E_m(T_m)}\right)E(P_{t=3})\right]}$$

Finally, in order to show how self-tender offer arbitrage is not riskfree, I present a "what if" scenario, which shows what happens to the arbitrager's return if the realized percentage of non-arbitrager shares T_m is the correct expectation plus a shock of 20% additional tendering shareholders, i.e. $T_m = E_a(T_m) + 20\%$.

2.6.2 Results with no transaction costs

Table 3 presents the four papers' observed averages for their respective variables as well as the key results. One can see that the reported expected abnormal returns vastly overstate the ex-ante implementable expected abnormal returns a profit maximizing arbitrager would achieve. LV's 9.26% expected abnormal return sinks to 3.77%, KS's expected abnormal return of 2.89% sinks to 1.35%, LP's expected abnormal return of 8.33% drops to 3.75% and Gray's expected abnormal return of 1.78% falls to .84%. The t-stats (calculated with the ex-ante implementable expected abnormal return in place of the reported expected abnormal return in the numerator and reported standard errors in the denominator) all become insignificant, except one – LV 1990. Figure 6 shows the profits available for self-tender offer arbitragers with respect to differing levels of ownership.

INSERT FIGURE 6

Figure 7 shows the returns available to self-tender offer arbitragers with respect to differing levels of ownership.

INSERT FIGURE 7

systematic moves.

Moreover, in all cases there is a real chance for an arbitrager to experience a negative return. In each of the four cases a substantial negative return is associated with incorrectly assessing the realized T_m variable. Figure 8 and Figure 9 show this more vividly and over a wide range of ownership levels.

INSERT FIGURE 8

INSERT FIGURE 9

This evidence suggests that, for the most part, the samples cannot reject market efficiency because ex-ante implementable returns are not significantly different from zero – even in a completely frictionless marketplace. This is not-withstanding the fact that there is real risk involved in self-tender offer arbitrage which can be seen when the realized T_m variable deviates from expectations.

INSERT TABLE 3

2.6.3 Results with Simple Transaction Costs

In this scenario, a flat transaction cost of 2% is introduced. Table 4 presents the key results. In the face of even the simplest transaction costs, the empirically observed abnormal returns vastly overstate the returns a profit maximizing arbitrager would receive. LV's 9.26% expected abnormal return sinks to 3.14%, KS's expected abnormal return 2.89% sinks to .44%, LP expected abnormal return 8.33% drops to 2.93%, and in Gray's sample the arbitrager would not participate. The t-stats become even less significant; nonetheless, the t-stat for the LV result still remains significant at 2.59. However, the expected abnormal returns are by no means riskless. Once again, in each of the four cases there is a negative return associated with not correctly assessing the T_m variable. These results show further evidence for a reasonably efficient market in self-tender offer arbitrage in the presence of a simple transaction cost.

INSERT TABLE 4

2.7 Other Explanations

Throughout this paper we have put a lot of time into understanding the logistics and risks involved in self-tender offer arbitrage to help explain this "anomaly." There are other reasons to believe this anomaly has potentially been overstated in the research. If one looks at Table 1 we notice an interesting fact: In the samples that involve buying the day before expiration, there are extremely high expected abnormal returns. LV finds a 9.26% expected abnormal return and LP find an 8.33% expected abnormal return. In contrast, the

KS and Gray samples have a trading strategy that involves buying at least 2-3 days in advance of the expiration date and have expected abnormal returns of 2.89% and 1.79% respectively.

Insights from discussions with practitioners suggest a reason for expected abnormal returns being lower for the trading strategies which buy very close to expiration. There may be risk/additional costs in waiting till the last day of the self-tender offer for a self-tender offer arbitrager. The following is an exert from Ameritrade's policy regarding non-mandatory reorganizations (self-tender offers would be included in this definition) – "It is imperative that we receive your instructions no later than 3 business days prior to expiration of the offer. Any instructions received after that time will be processed on a 'best efforts' basis only." (Ameritrade 2004). This suggests that it may not even be possible to implement the strategies suggested in LV and LP papers (papers with most absurd expected abnormal returns), especially for smaller arbitragers or individuals. Moreover, if it is possible to gain title and tender shares immediately through some sort of cash settlement procedures, it no doubt comes at a higher cost to the arbitrager for this service. Finally, there is further evidence in LV that this phenomenon has a substantial affect. Their 9.26% expected abnormal return number falls to 6.18% expected abnormal return when they have a trading rule that buys share six days before the expiration period versus one day before the expiration period. All of this evidence leads one to believe that this institutional detail may play a part in understanding the self-tender offer anomaly.

2.8 Conclusions

This paper set out to answer why self-tender offer arbitrager's expected abnormal returns are not arbitraged. A deeper look into the logistics of self-tender offer arbitrage suggested there was a large overstatement in previous research of the expected abnormal returns an arbitrager could actually achieve, the strategy was not scalable, and the strategy was not riskfree.

In light of these results, the market appears to be reasonably efficient with regard to self-tender offers. The only remaining statistically significant result is LV 1990, which could be compensation for risk-bearing or, as was discussed, may not even be an implementable or cost efficient trading strategy. Furthermore, when the perfectly frictionless market is relaxed and factors such as price pressure, bid/ask spreads, margin interest, execution risks, discovery costs, etc. become real, any remaining expected abnormal returns in the self-tender offer arbitrage strategy can reasonably be expected to disappear or fairly compensate an arbitrager for his efforts. All in all, I believe the results in this paper will sadden aspiring self-tender offer arbitragers. Nonetheless, I believe those interested in understanding the asset pricing aspects of the self-tender offer anomaly will have some of their questions answered. In conclusion, I hope this research will inspire future financial market researchers to appreciate the various tools available from the rational, behavioral and institutional approaches when trying to understand financial market anomalies.

2.9 Appendix A

2.9.1 Proof of Proposition 1

This is a two part proof. Part 1 derives a needed result. Part 2 uses the result from part 1 to prove the proposition.

Part 1.

We know $\mathrm{E_a}(\alpha \mid I_{t=0}) = \dfrac{E_a(F_p)}{E_a(F_T \mid I_{t=0})}$ and $\mathrm{E_a}(\alpha \mid I_{t=1}) = \dfrac{E_a(F_p)}{E_a(F_T \mid I_{t=1})}$ by definition.

We also know that $\mathrm{E_a}(F_T \mid I_{t=0}) = E_a(T_m)S_{m,t=0} = E_a(\mathrm{T_m})$ and

$\mathrm{E_a}(F_T \mid I_{t=1}) = E_a(T_a)S^*_{\ a} + E_a(T_m)S_{m,t=1}$, which is equivalent to

$\mathrm{E_a}(F_T \mid I_{t=1}) = E_a(T_a)S^*_{\ a} + E_a(T_m)(1-S^*_{\ a}) = S^*_{\ a}(1-E_a(T_m)) + E_a(T_m)$ because $E_a(T_a)=1$ by assumption and $S_{m,t=1} = (1-S^*_{\ a})$ by construction. This implies the following inequality holds:

$$\mathrm{E_a}(\alpha \mid I_{t=0}) = \frac{E_a(F_p)}{E_a(F_T \mid I_{t=0})} = \frac{E_a(F_p)}{E_a(T_m)S_{m,t=0}} = \frac{E_a(F_p)}{E_a(T_m)} > \frac{E_a(F_p)}{S^*_{\ a}(1-E_a(T_m)) + E_a(T_m)} = E_a(\alpha \mid I_{t=1})$$

because $S_{m,t=0} = 1$ at t=0, $S^*_{\ a} > 0$, and $E_a(T_m) < 1$ by assumption. This leads us to the first result that

$\mathrm{E_a}(\alpha \mid I_{t=0}) > \mathrm{E_a}(\alpha \mid I_{t=1})$.

Part 2.

We know $P_T > E_a(P_{t=3})$ by assumption. Because of the results found in Part 1, this implies

$P_T\left[E_a(\alpha \mid I_{t=0}) - E_a(\alpha \mid I_{t=1})\right] > E_a(P_{t=3})\left[E_a(\alpha \mid I_{t=0}) - E_a(\alpha \mid I_{t=1})\right]$ This equation is equivalent to

$P_T(E_a(\alpha \mid I_{t=0}) - E_a(\alpha \mid I_{t=1})) + E_a(P_{t=3}) - E(P_{t=3})E_a(\alpha \mid I_{t=0}) > E(P_{t=3}) - E(P_{t=3})E_a(\alpha \mid I_{t=1})$ which is also equivalent to

$P_T E_a(\alpha \mid I_{t=0}) + (1-E_a(\alpha \mid I_{t=0}))E_a(P_{t=3}) > P_T E_a(\alpha \mid I_{t=1}) + (1-E_a(\alpha \mid I_{t=1}))E_a(P_{t=3})$ which by definition implies $P_{a,t=0} > P_{a,t=1}$. With this result we know $\frac{\mathrm{P}_{\mathrm{a,t=0}} - P_{m,t=0}}{P_{m,t=0}} > \frac{P_{a,t=1} - P_{m,t=0}}{P_{m,t=0}}$ which is

equivalent to $E_a(R \mid I_{t=0}) > E_a(R \mid I_{t=1})$. Q.E.D.

2.9.2 Proof of Corollary 1

Part 1.

We know,

$E_a(R \mid I_{t=1}) = \frac{P_{a,t=1} - P_{m,t=0}}{P_{m,t=0}}$ which is equal to

$$= \frac{\left[P_T\left(\frac{E_a(F_p)}{S^*{}_a(1-E_a(T_m)) + E_a(T_m)}\right) + \left(1 - \frac{E_a(F_p)}{S^*{}_a(1-E_a(T_m)) + E_a(T_m)}\right)E_a(P_{t=3}) \right] - P_{m,t=0}}{P_{m,t=0}}.$$

Taking the first derivative with respect to ownership we have

$\frac{dE_a(R \mid I_{t=1})}{dS^*{}_a} = -\left[\frac{\overbrace{(1-E_a(T_m))(P_T - E_a(P_{t=3}))E_a(F_p)}^{+}}{\underbrace{(S^*{}_a(1-E_a(T_m)) + E_a(T_m))^2 P_{m,t=0}}_{+}} \right] < 0$. Next, taking the second derivative with

respect to ownership we have $\frac{d^2E_a(R \mid I_{t=1})}{(dS^*{}_a)^2} = \underbrace{-2}_{-} \underbrace{\left[\frac{(1-E_a(T_m))^2(P_T - E_a(P_{t=3}))E_a(F_p)}{(S^*{}_a(1-E_a(T_m)) + E_a(T_m))^3 P_{m,t=0}} \right]}_{+} > 0$. These

two results, $\frac{dE_a(R \mid I_{t=1})}{dS^*{}_a} < 0$ and $\frac{d^2E_a(R \mid I_{t=1})}{(dS^*{}_a)^2} > 0$ imply a decreasing convex function. Q.E.D.

Part 2.

We want to find the ownership level which will maximize expected abnormal returns,

$$\underbrace{\mathrm{Max}}_{\mathrm{S_a}}\ E_a(R \mid_{t=1}) = \frac{P_{a,t=1} - P_{m,t=0}}{P_{m,t=0}} = \frac{\left[P_T\left(\frac{E_a(F_p)}{S_a(1-E_a(T_m)) + E_a(T_m)}\right) + \left(1 - \frac{E_a(F_p)}{S_a(1-E_a(T_m)) + E_a(T_m)}\right)E_a(P_{t=3}) \right] - P_{m,t=0}}{P_{m,t=0}}$$

This equation can be simplified as follows

$$= \left[\left(\frac{E_a(F_p)}{S_a(1-E_a(T_m)) + E_a(T_m)}\right)\frac{(P_T - E_a(P_{t=3}))}{P_{m,t=0}} + \frac{E_a(P_{t=3})}{P_{m,t=0}} \right] - 1, \text{ s.t } 0 \le S_a \le 1.$$

This function will be maximized when $S_a(1-E_a(T_m))+E_a(T_m)$ is at a minimum – when S_a approaches its minimum value $S_a = 0$. Likewise, this function will be minimized when $S_a(1-E_a(T_m))+E_a(T_m)$ is at a maximum – when S_a approaches its maximum value $S_a = 1$.

2.9.3 Proof of Proposition 2

The arbitrager will choose an S^*_a which will maximize his profits

$\underbrace{\text{Max}}_{\text{S}_\text{a}}$ $\text{F=S}_\text{a}\text{N}_\text{o}\left[\text{P}_\text{T}E_a(\alpha \mid I_{t=1})+(1-E_a(\alpha \mid I_{t=1})E_a(P_{t=3})-P_{m,t=0}\right]$ which simplifies to

$\text{S}_\text{a}N_o\left[P_t(\frac{E_a(F_p)}{S_a(1-E_a(T_m))+E_a(T_m)})+(1-\frac{E(F_p)}{S_a(1-E_a(T_m))+E_a(T_m)})E_a(P_{t=3})-P_{m,t=0}\right]$. Taking the first derivative with respect to ownership and setting this equal to zero we have

$$\frac{\partial F}{\partial S_a}=N_o(E_a(P_{t=3})-P_{m,t=0})+N_oE_a(F_p)(P_T-E_a(P_{t=3}))\left[\frac{1}{S_a(1-E_a(T_m))+E_a(T_m)}-\frac{S_a(1-E_a(T_m))}{\left[S_a(1-E_a(T_m))+E_a(T_m)\right]^2}\right]=0$$

We then set $Q=\left[S_a(1-E_a(T_m))+E_a(T_m)\right]$ which implies

$(E_a(P_{t=3})-P_{m,t=0})Q^2+E_a(F_p)(P_T-E_a(P_{t=3}))(Q-S_a(1-E_a(T_n)))=0$ which is equivalent to

$(P_{m,t=0}-E_a(P_{t=3}))Q^2=E_a(F_p)(P_T-E_a(P_{t=3}))(E_a(T_m)$, which implies

$Q^2=\frac{E_a(F_p)(P_T-E_a(P_{t=3}))(E_a(T_m))}{(P_{m,t=0}-E_a(P_{t=3}))}$ which implies

$S^*_{a,c}=\frac{\left[\frac{E_a(F_p)(P_T-E_a(P_{t=3}))(E_a(T_m))}{(P_{m,t=0}-E_a(P_{t=3}))}\right]^{1/2}-E_a(T_m)}{1-E_a(T_m)}$. We next take the second derivative with respect to ownership to ensure this is a maximum.

$$\frac{\partial^2 F}{\partial S_a^{\ 2}} = -N_o E_a(F_p)(P_T - E_a(P_{t=3}))(\frac{1}{\left[S_a(1-E_a(T_m)) + E_a(T_m)\right]^2})$$

$$-N_o E_a(F_p)(P_T - E(P_{t=3}))(1-E_a(T_m))(\frac{1}{\left(S_a(1-E_a(T_m)) + E_a(T_m)\right)^2} - \frac{2S_a}{\left(S_a(1-E_a(T_m)) + E_a(T_m)\right)^3})$$

$$= -A\left[(\frac{1}{Q^2}) + (\frac{1}{Q^2} - \frac{2S_a}{Q^3})\right] = \underbrace{-\frac{A}{Q^2}}_{-}\underbrace{\left[2-2S_a)\right]}_{+} < 0$$

where $A = N_o E_a(F_p)(P_T - E_a(P_{t=3}))$. As long as $S_a < 1$, $\frac{\partial^2 F}{\partial S_a^{\ 2}} < 0$, which implies a maximum. Q.E.D.

2.9.4 Proof of Proposition 3

The arbitrager will choose an $S^*_{\ a}$ which will maximize his profits

$$\underbrace{\text{Max}}_{\text{S}_\text{a}} \ \text{F=S}_\text{a}\text{N}_\text{o}\left[\text{P}_\text{T}E_a(\alpha \mid I_{t=1}) + (1-E_a(\alpha \mid I_{t=1})E_a(P_{t=3}) - P_{m,t=0} - CP_{m,t=0}\right]$$ which simplifies to

$$\text{S}_\text{a}N_o\left[P_t(\frac{E_a(F_p)}{S_a(1-E_a(T_m)) + E_a(T_m)}) + (1 - \frac{E(F_p)}{S_a(1-E_a(T_m)) + E_a(T_m)})E_a(P_{t=3}) - P_{m,t=0} - CP_{m,t=0}\right].$$

Taking the first derivative with respect to ownership and setting this equal to zero we have

$$\frac{\partial F}{\partial S_a} = N_o(E_a(P_{t=3}) - P_{m,t=0}) + N_o E_a(F_p)(P_T - E_a(P_{t=3}))\left[\frac{1}{S_a(1-E_a(T_m)) + E_a(T_m)} - \frac{S_a(1-E_a(T_m))}{\left[S_a(1-E_a(T_m)) + E_a(T_m)\right]^2}\right]$$
$$-N_o P_{m,t=0}C = 0.$$

We then set $Q = \left[S_a(1-E_a(T_m)) + E_a(T_m)\right]$ which implies

$(E_a(P_{t=3}) - P_{m,t=0} - N_o C)Q^2 + E_a(F_p)(P_T - E_a(P_{t=3}))(Q - S_a(1-E_a(T_m))) = 0$ which is equivalent to

$(P_{m,t=0}(1+C) - E_a(P_{t=3}))Q^2 = E_a(F_p)(P_T - E_a(P_{t=3}))(E_a(T_m))$, which implies

$Q^2 = \dfrac{E_a(F_p)(P_T - E_a(P_{t=3}))(E_a(T_m))}{(P_{m,t=0}(1+C) - E_a(P_{t=3}))}$ which implies

$S^*_{\ a,c} = \dfrac{\left[\dfrac{E_a(F_p)(P_T - E_a(P_{t=3}))(E_a(T_m))}{(P_{m,t=0}(1+C) - E_a(P_{t=3}))}\right]^{1/2} - E_a(T_m)}{1 - E_a(T_m)}$. We next take the second derivative with respect

to ownership to ensure this is a maximum

$$\frac{\partial^2 F}{\partial S_a{}^2} = -N_o E_a(F_p)(P_T - E_a(P_{t=3}))(\frac{1}{\left[S_a(1-E_a(T_m)) + E_a(T_m)\right]^2})$$
$$-N_o E_a(F_p)(P_T - E(P_{t=3}))(1-E_a(T_m))(\frac{1}{\left(S_a(1-E_a(T_m)) + E_a(T_m)\right)^2} - \frac{2S_a}{\left(S_a(1-E_a(T_m)) + E_a(T_m)\right)^3})$$
$$= -A\left[(\frac{1}{Q^2}) + (\frac{1}{Q^2} - \frac{2S_a}{Q^3})\right] = \underbrace{-\frac{A}{Q^2}}_{-}\underbrace{\left[2-2S_a)\right]}_{+} < 0$$

where $A = N_o E_a(F_p)(P_T - E_a(P_{t=3}))$. As long as $S_a < 1$, $\frac{\partial^2 F}{\partial S_a{}^2} < 0$, which implies a maximum. Q.E.D.

2.9.5 Proof of Proposition 4

This proof has three parts. In each part there is a different set of known variables and random variables.

Part 1.

Setup:

F_T is a random variable with mean $E_a(F_T)$ and F_p and $P_{t=3}$ are known with certainty.

Result:

The arbitrager will only invest if the expected returns (profits) are positive

$E_a(R \mid I_{t=1}) = \frac{\left[P_T(E_a(\alpha \mid I_{t=1})) + (1-E_a(\alpha \mid I_{t=1}))E_a(P_{t=3})\right] - P_{m,t=0}}{P_{m,t=0}} > 0$. Moreover, we know

$P_{m,t=0} = \left[P_T E_m(\alpha \mid I_{t=0}) + (1-E_m(\alpha \mid I_{t=0})E_a(P_{t=3})\right]$ by arbitrage arguments. This implies

$$\mathrm{E_a}(R \mid I_{t=1}) = \frac{\left[P_T(E_a(\alpha \mid I_{t=1})) + (1-E_a(\alpha \mid I_{t=1}))E_a(P_{t=3})\right] - \left[P_T E_m(\alpha \mid I_{t=1}) + (1-E_m(\alpha \mid I_{t=1})E_a(P_{t=3})\right]}{\left[P_T E_m(\alpha \mid I_{t=1}) + (1-E_m(\alpha \mid I_{t=1})E_a(P_{t=3})\right]} > 0$$

which is equivalent to $\frac{E_a(\alpha \mid I_{t=1})(P_T - E_a(P_{t=3})) - E_m(\alpha \mid I_{t=1})(P_T - E_a(P_{t=3}))}{E_m(\alpha \mid I_{t=1})(P_T - E_a(P_{t=3})) + E_a(P_{t=3})} > 0$, which is also

equivalent to $\frac{(P_T - E_a(P_{t=3}))(E_a(\alpha \mid I_{t=1}) - E_m(\alpha \mid I_{t=1}))}{E_m(\alpha \mid I_{t=1})(P_T - E_a(P_{t=3})) + E_a(P_{t=3})} > 0$. If we analyze the following inequality

$$\frac{\overbrace{(P_T - E_a(P_{t=3}))}^{+}\overbrace{(E_a(\alpha \mid I_{t=1}) - E_m(\alpha \mid I_{t=1}))}^{?}}{\underbrace{E_m(\alpha \mid I_{t=1})(P_T - E_a(P_{t=3})) + E_a(P_{t=3})}_{+}} = \frac{\overbrace{(P_T - E_a(P_{t=3}))}^{+}\overbrace{(\frac{E_a(F_p \mid I_{t=1})}{S_{m,t=1}E_a(T_m) + S_a} - \frac{E_a(F_p)}{E_m(T_m)})}^{A}}{\underbrace{E_m(\alpha \mid I_{t=1})(P_T - E_a(P_{t=3})) + E_a(P_{t=3})}_{+}} > 0$$

we notice that for the statement to be true it must be the case that A>0. We know

$A = \dfrac{E_a(F_p)}{S_{m,t=1}E_a(T_m) + S_a} - \dfrac{E_a(F_p)}{E_m(T_m)} > 0$ which implies $(1 - S_a)E_a(T_m) + S_a < E_m(T_m)$, which further

implies $S_a E_a(T_m) + S_a < (E_m(T_m) - E_a(T_m))$, which finally implies

$S_a(1 - E_a(T_m)) < (E_m(T_m) - E_a(T_m))$. We now have $\overbrace{S_a(1 - E_a(T_m))}^{+} < \overbrace{(E_m(T_m) - E_a(T_m))}^{C}$ because

$S_a(1 - E_a(T_m)) > 0$. However, this implies C>0, which implies $E_a(T_m) < E_m(T_m)$. However, if realized

$T_m > E_m(T_m)$, this implies $R < 0$ which implies this strategy is not riskfree.Q.E.D.

Part 2.

Setup:

$P_{t=3}$ is a random variable with mean $E_a(P_{t=3})$ and F_p and T_m are known with certainty.

Result:

By definition $E_a(R \mid I_{t=1}) = \dfrac{\left[P_T(E_a(\alpha \mid I_{t=1})) + (1 - E_a(\alpha \mid I_{t=1}))E_a(P_{t=3})\right] - P_{m,t=0}}{P_{m,t=0}} > 0$, which is

equivalent to $E_a(P_{t=3})(1 - E_a(\alpha \mid I_{t=1})) + E_a(\alpha \mid I_{t=1})P_T - P_{m,t=0} > 0$, which is also equivalent to

$E_a(P_{t=3}) > \dfrac{P_{m,t=0} - E_a(\alpha \mid I_{t=1})P_T}{1 - E_a(\alpha \mid I_{t=1})}$. Therefore, if $P_{t=3} < \dfrac{P_{m,t=0} - E_a(\alpha \mid I_{t=1})P_T}{1 - E_a(\alpha \mid I_{t=1})}$ this implies

$R < 0$ which implies this strategy is not riskfree. Q.E.D.

Part 3.

Setup:

F_p is a random variable with mean $E_a(F_p)$ and $P_{t=3}$ and T_m are known with certainty.

Result:

We know $E_a(R \mid I_{t=1}) = \dfrac{\left[P_T(E_a(\alpha \mid I_{t=1})) + (1 - E_a(\alpha \mid I_{t=1}))E_a(P_{t=3})\right] - P_{m,t=0}}{P_{m,t=0}} > 0$, which implies

$E_a(\alpha \mid I_{t=1})(P_t - E_a(P_{t=3})) + E_a(P_{t=3}) - P_{m,t=0} > 0$ which is equivalent to

$$\frac{E_a(F_p)}{S_m E_a(T_m)+S_a}(P_t - E_a(P_{t=3})) + E_a(P_{t=3}) - P_{m,t=0} > 0$$, which finally implies

$$E_a(F_p) > \frac{P_{m,t=0} - E_a(P_{t=3})}{P_T - E_a(P_{t=3})}(S_{m,t=1}E_a(T_m)+S_a)$$. Therefore, if

$$F_{p,t=3} < \frac{P_{m,t=0} - E_a(P_{t=3})}{P_T - E_a(P_{t=3})}(S_{m,t=1}E_a(T_m)+S_a)$$ this implies $\mathrm{R} < 0$ which implies this strategy is not

riskfree. Q.E.D.

2.9.6 Explanation of calculations in section 2.5

Calculation for the reported expected abnormal return is as follows

$$E_a(R \mid I_{t=0}) = \frac{\left[P_T(E_a(\alpha \mid I_{t=0})) + (1-E_a(\alpha \mid I_{t=0}))E_a(P_{t=3})\right] - \left[P_T(E_m(\alpha \mid I_{t=0}) + (1-E_m(\alpha \mid I_{t=0}))E_a(P_{t=3})\right]}{\left[P_T(E_m(\alpha \mid I_{t=0}) + (1-E_m(\alpha \mid I_{t=0}))E_a(P_{t=3})\right]}$$

$$= \frac{\left[P_T(\frac{E(F_p)}{E_a(T_m \mid I_{t=0})} + (1-\frac{E(F_p)}{E_a(T_m \mid I_{t=0})})E(P_{t=3})\right] - \left[P_t(\frac{E(F_p)}{E_m(T_m \mid I_{t=0})} + (1-\frac{E(F_p)}{E_m(T_m \mid I_{t=0})})E(P_{t=3})\right]}{\left[P_T\frac{E(F_p)}{E_m(T_m \mid I_{t=0})} + (1-\frac{E(F_p)}{E_m(T_m \mid I_{t=0})})E(P_{t=3})\right]}$$

$$= \frac{\left[1.2(\frac{17\%}{30\%}) + (1-\frac{17\%}{30\%})1\right] - \left[1.2(\frac{17\%}{30\%}) + (1-\frac{17\%}{30\%})1\right]}{\left[1.2(\frac{17\%}{30\%}) + (1-\frac{17\%}{30\%})1\right]} = 5.4\%$$

Calculation for the ex-ante implementable expected abnormal return is as follows:

$$E(R \mid I_{t=1}) = \frac{\left[P_T(E_a(\alpha \mid I_{t=1})) + (1-E_a(\alpha \mid I_{t=1}))E(P_{t=3})\right] - \left[P_T(E_m(\alpha \mid I_{t=0}) + (1-E_m(\alpha \mid I_{t=0}))E(P_{t=3})\right]}{\left[P_T E_m(\alpha \mid I_{t=0}) + (1-E_m(\alpha \mid I_{t=0}))E(P_{t=3})\right]}$$

$$= \frac{\left[P_T(\frac{E(F_p)}{(1-S^*{}_a)E_a(T_m \mid I_{t=1})+S^*{}_a} + (1-\frac{E(F_p)}{(1-S^*{}_a)E_a(T_m \mid I_{t=1})+S^*{}_a})E(P_{t=3})\right] - \left[P_T(\frac{E(F_p)}{E_m(T_m)} + (1-\frac{E(F_p)}{E_m(T_m)})E(P_{t=3})\right]}{\left[P_T\frac{E(F_p)}{E_m(T_m)} + (1-\frac{E(F_p)}{E_m(T_m)})E(P_{t=3})\right]}$$

$$= \frac{\left[1.2(\frac{17\%}{(1-17.75\%)30\%+30\%}) + (1-\frac{17\%}{(1-17.75\%)30\%+30\%})1\right] - \left[1.2(\frac{17\%}{30\%}) + (1-\frac{17\%}{30\%})1\right]}{\left[1.2(\frac{17\%}{30\%}) + (1-\frac{17\%}{30\%})1\right]} = 2.2\%$$

2.9.7 Explanation of how to calculate $E_m(T_m)$ in section 2.6.

First by definition we know,

$$E_a(R \mid I_{t=0}) = \frac{\left[P_T(\frac{E(F_p)}{E_a(T_m)} + (1-\frac{E(F_p)}{E_a(T_m)})E(P_{t=3})\right] - \left[P_T(\frac{E(F_p)}{E_m(T_m)} + (1-\frac{E(F_p)}{E_m(T_m)})E(P_{t=3})\right]}{\left[P_T\ \frac{E(F_p)}{E_m(T_m)} + (1-\frac{E(F_p)}{E_m(T_m)})E(P_{t=3})\right]}$$

which implies,

$$E_a(R \mid I_{t=0})\left[P_T\ \frac{E(F_p)}{E_m(T_m)} + (1-\frac{E(F_p)}{E_m(T_m)})E(P_{t=3})\right] + \left[P_T(\frac{E(F_p)}{E_m(T_m)} + (1-\frac{E(F_p)}{E_m(T_m)})E(P_{t=3})\right] =$$
$$\left[P_T(\frac{E(F_p)}{E_a(T_m)} + (1-\frac{E(F_p)}{E_a(T_m)})E(P_{t=3})\right]$$

which also implies,

$$\frac{1}{E_m(T_m)}\left[E_a(R \mid I_{t=0})(P_T)E(F_p) - E_a(R \mid I_{t=0})E(F_p)E(P_{t=3}) + P_T E(F_p) - E(P_{t=3})E(F_p)\right] =$$
$$\left[P_T(\frac{E(F_p)}{E_a(T_m)} + (1-\frac{E(F_p)}{E_a(T_m)})E(P_{t=3})\right] - E(P_{t=3})\left[E_a(R \mid I_{t=0}) + 1\right]$$

which further implies,

$$\frac{E(F_p)}{E_m(T_m)}\left[(E_a(R \mid I_{t=0}) + 1)(P_T - E(P_{t=3}))\right] = \left[P_T(\frac{E(F_p)}{E_a(T_m)} + (1-\frac{E(F_p)}{E_a(T_m)})E(P_{t=3})\right] - E(P_{t=3})\left[E_a(R \mid I_{t=0}) + 1\right]$$

which finally implies,

$$E_m(T_m) = \frac{E_a(F_p)\left[(E_a(R \mid I_{t=0}) + 1)(P_T - E_a(P_{t=3}))\right]}{\left[P_T(\frac{E_a(F_p)}{E_a(T_m)} + (1-\frac{E_a(F_p)}{E_a(T_m)})E_a(P_{t=3})\right] - E_a(P_{t=3})\left[E_a(R \mid I_{t=0}) + 1\right]}.$$

2.9.9 Derivation of result that $E(T_m) = E_a(T_m)$, which follows from assumptions 3 and 4.

Statement is that $E(T_m) = E_a(T_m)$.

This follows from the fact $E_a(\alpha \mid I_{t=1}) = E(\alpha \mid I_{t=1})$, which can be expressed as

$\frac{E(F_p)}{E(F_T \mid I_{t=1})} = \frac{E_a(F_p)}{E_a(F_T \mid I_{t=1})}$. We also know from assumption 1 that $E(F_p) = E_a(F_p)$, which implies $E(F_T \mid I_{t=1}) = E_a(F_T \mid I_{t=1})$. It is also true that $E(F_T \mid I_{t=1}) = S^*_a + E(T_m) = E_a(F_T \mid I_{t=1}) = S^*_a + E_a(T_m)$, which implies $E(T_m) = E_a(T_m)$. Q.E.D.

2.10 Appendix B

PRESS RELEASE

Keynote To Make Self Tender Offer To Purchase Up To 7.5 Million Shares At $9.50 Per Share.

Keynote Reaches Agreement with Stockholders to End Potential Proxy Fight.

SAN MATEO, California — March 12, 2003 — Keynote Systems, Inc. (NASDAQ: KEYN), today announced that it will commence an issuer tender offer in the near future, currently anticipated to be on or about March 24, 2003, for 7.5 million shares, or approximately 32.6% of its outstanding common stock as of January 31, 2003, at a purchase price of $9.50 per share in cash. In the quarter ended December 31, 2002, Keynote repurchased approximately 4.3 million shares at a purchase price of $8.00 per share pursuant to a Dutch auction tender offer. As of December 31, 2002, Keynote had total cash, cash equivalents and short-term investments of approximately $203.4 million.

The offer will afford tendering stockholders liquidity for some or all of their shares and will permit them to have their shares repurchased at a 7.0% premium over the closing price per share of $8.88 on March 11, 2003, the last full trading day before the date of this announcement. Stockholders who elect not to tender their shares in the offer will increase their relative percentage ownership in Keynote following completion of the offer. Keynote has been informed that none of its executive officers or directors, who beneficially owned approximately 15.9% of Keynote outstanding common stock as of January 31, 2003, intend to tender any shares in the offer.

Keynote and the stockholder group led by Barington Companies Equity Partners, L.P. jointly announced that they had reached an agreement to resolve a potential proxy fight by the Barington Companies group to replace Keynote's board with its proposed slate of directors at Keynote's 2003 Annual Meeting of Stockholders to be held on March 25, 2003. Barington has agreed to withdraw its preliminary proxy statement and its proposed slate of directors.

Keynote also announced that it will form an independent nominating committee of the Board of Directors, which will conduct a search as soon as practicable for an additional outside director to join the Board of Directors. Keynote agreed that it will consult with the Barington Companies group and its other major stockholders with respect to the selection of the additional independent member.

Source: http://www.secinfo.com , Schedule 13 TO-C, SYMBOL: KEYN

2.11 References

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2.12 Tables and Figures

TABLE 1

This table summarizes the four empirical papers which have documented expected abnormal returns investing in self-tender offers. Information about the specific finding, specific strategy, and specific details on the sample is included.

Paper	***Finding: Return (T-Stat)***	***Strategy***	***Sample Size***	***Sample Trading Rule***	***Sample Specifics***
Lakonishok, Vermaelen 1990 (LV 1990)	9.26% (7.58) abnormal return (return minus return of EW CRSP index) per 5-8 days	Buy 1 day before expiration, sell 4 days after expiration	N=109	trading rule such that $P_T > .97 P_{m,t=0}$	1962-1986 domestic equity self-tender offers
Kadapakkam, Seth 1994 (KS 1994)	2.89% (3.58) abnormal return (return risk adjusted using market model)~per 19 day abnormal return	Buy 2 days after announcement, sell 2 days after expiration	N=76	None	1981-1989 domestic equity Dutch-auction stock repurchases
Lucke, Pindur 2002 (LP 2002)	8.33% (not reported) abnormal return (no adjustment for risk, performed but was shown to not affect results) per 5-8 days	Buy 1 day before expiration, sell 5 days after expiration	N=22	None	1999-2001 French equity self-tender offers
Gray 2003 (G 2003)	1.79% (1.68) abnormal return (minus S&P 500 return) per 5-8 days	Buy 2-3 days before expiration, sell 5 days after expiration	N=22	None	1999-2003 Closed end fund self-tender offers

TABLE 2

This table provides information on terms and definitions used throughout the paper.

Term	***Definition***
$E(F_p)$	Expected fraction of shares company purchases
N_o	Number of shares outstanding before offer expiration
$E(T_m)$	Market expectation of $\%N_o$ who actually tender
S_a	$\%N_o$ arbitrager owns
$S_{m,t=i}$	$\%N_o$ other shareholders own at t=i
$E(F_T \mid I_{t=i})$	Expectation of $\%N_o$ tendered conditional on information at t=i.
$E(\alpha \mid I_{t=i}) = \dfrac{E(F_p)}{E(F_T \mid I_{t=i})}$	Expectation of the % of shares tendering shareholders will have accepted for tender conditional on information at t=i
P_T	Tender offer price
$P_{m,t=i}$	Market price at t=i
$E(P_{t=3})$	Expected market price after expiration of self tender offer
$P_{a,t=i}$	Arbitrage price at t=i
$E(R \mid I_{t=i})$	Expected arbitrage return at t=i

TABLE 3

This table provides the summary statistics found in the four respective papers. The variable definitions can be found in Table 2.

Parameters	Paper			
	LV 1990*	**KS 1994**	**LP 2002**	**G 2003**
F_p	16.41%	15.77%	28.00%	22.20%
Premium to $P_{t=-1}$	22%	14%	38%	17%
P_T	1.22	1.14	1.38	1.17
$P_{t=-1}$	1.00	1.00	1.00	1.00
α	86.61	93.96	82.40	48.84
$E_a(T_m) = E(T_m)$	18.94%	16.78%	33.98%	45.45%
Standard Error (taken from papers)	1.208	.807	N/A	1.07
Results				
$E_m(T_m)$	40%	22%	50%	58%
S^*_a	10.70%	2.99%	11.01%	11.40%
$E(R \mid I_{t=0})$	9.26%	2.89%	8.30%	1.79%
$E(R \mid I_{t=1})$	3.77%	1.35%	3.75%	.84%
T-stat $H_o : E(R \mid I_{t=1}) \neq 0$	3.12	1.67	N/A	.79
$T_m = E_a(T_m) + 20\%$	-.94%	-3.88%	-2.66%	-.92%

*LV only report descriptive statistics for their entire sample and not the specific sample. The full sample parameters are used in the model.

TABLE 4

This table provides the summary statistics found in the four respective papers. The variable definitions can be found in Table 2.

Parameters	Paper			
	LV 1990*	**KS 1994**	**LP 2002**	**G 2003**
F_p	16.41%	15.77%	28%	22.2%
Premium to $P_{t=-1}$	22%	14%	38%	17%
P_T	1.22	1.14	1.38	1.17
$P_{t=-1}$	1.00	1.00	1.00	1.00
α	86.61	93.96	82.40	48.84
$E_a(T_m) = E(T_m)$	18.94%	16.78%	33.98%	45.45%
Standard Error (taken from papers)	1.208	.807	N/A	.564
Results				
$E_m(T_m)$	40%	22%	50%	58%
S^*_a	7.19%	.79%	7.72%	NO INVEST
$E(R \mid I_{t=0})$	9.26%	2.89%	8.30%	1.79%
$E(R \mid I_{t=1})$	3.14%	.44%	2.93%	NO INVEST
T-stat $H_o : E(R \mid I_{t=1}) \neq 0$	2.59	.55	N/A	N/A
$T_m = E_a(T_m) + 20\%$	-.58%	-3.69%	-2.23%	-.58%

*LV only report descriptive statistics for their entire sample and not the specific sample. The full sample parameters are used in the model.

Figure 1.

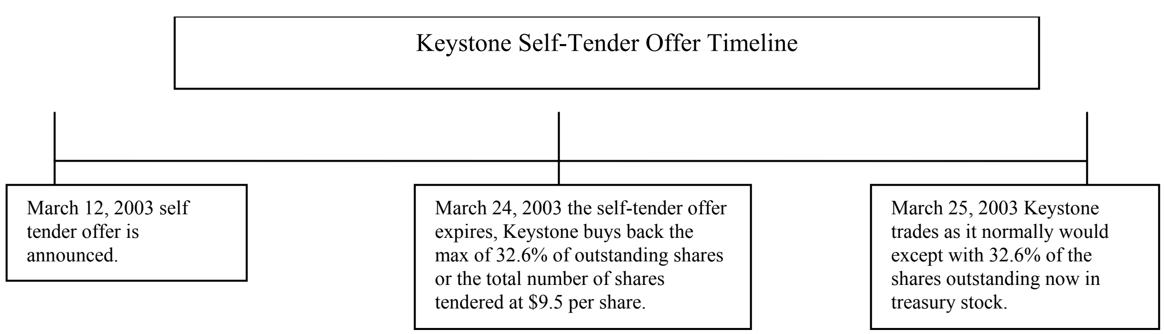

Figure 2.

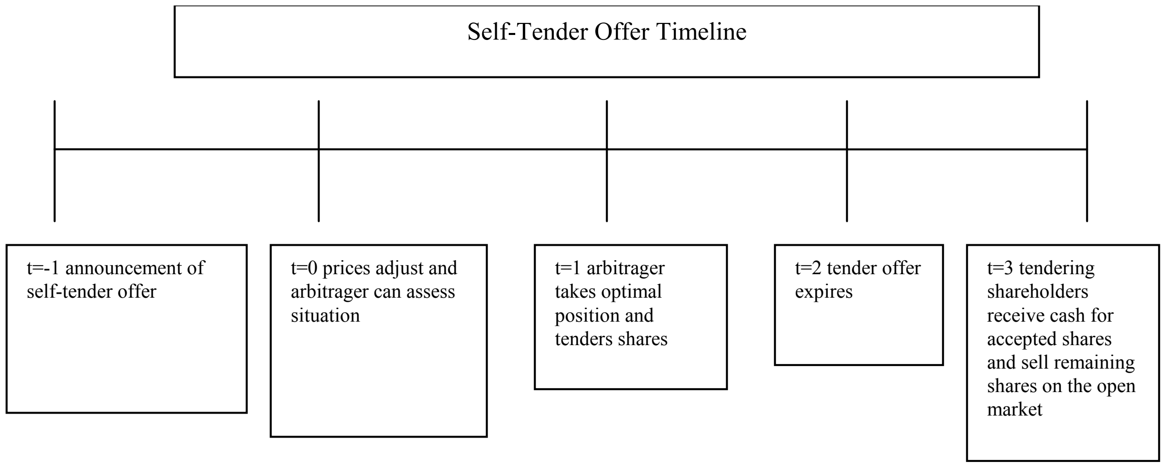
Self-Tender Offer Timeline
t=-1 announcement of self-tender offer
t=0 prices adjust and arbitrager can assess situation
t=1 arbitrager takes optimal position and tenders shares
t=2 tender offer expires
t=3 tendering shareholders receive cash for accepted shares and sell remaining shares on the open market

Figure 3.

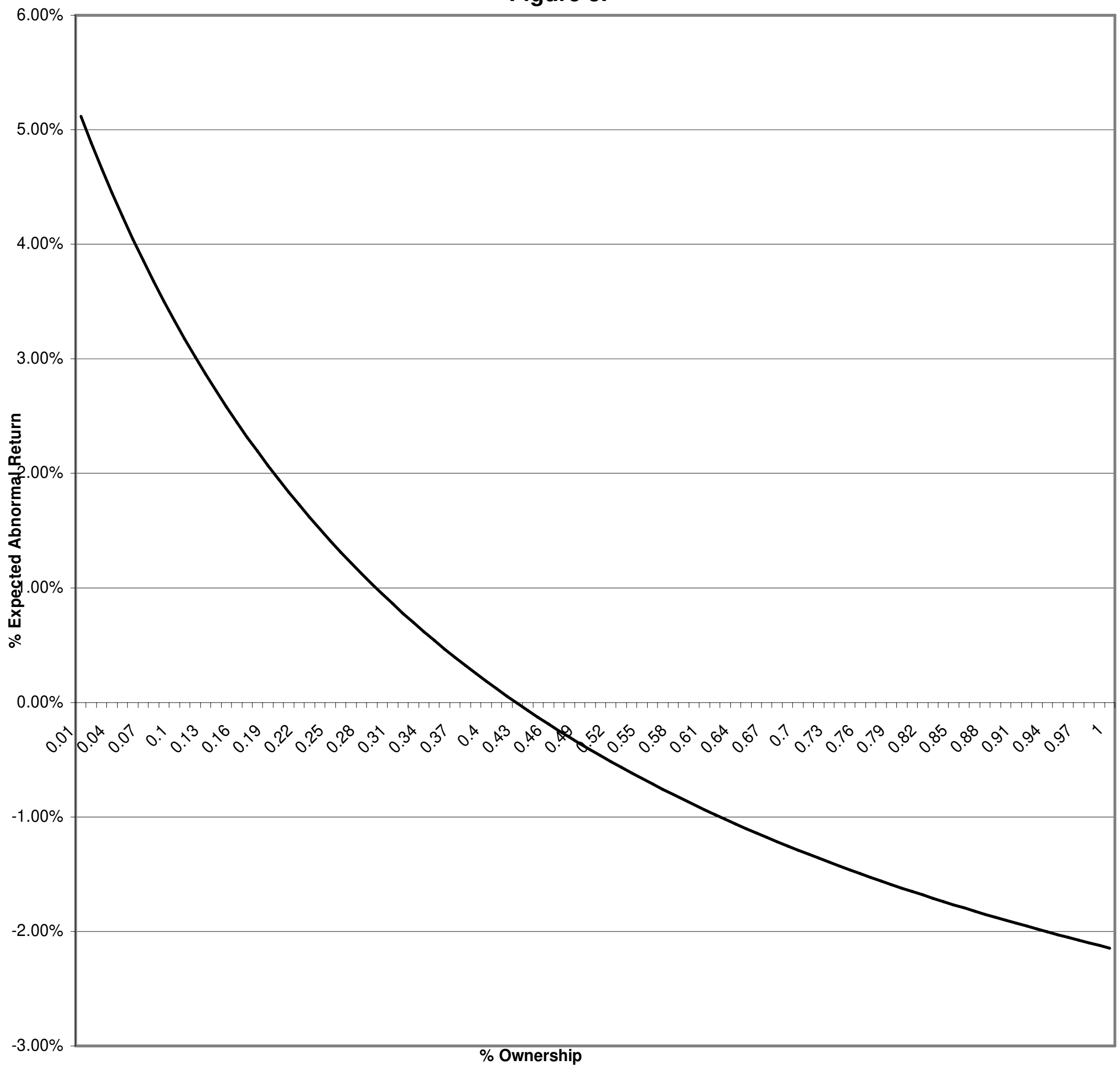

Figure 3 plots the percentage of ownership vs. the expected abnormal return. The parameters used are from the example in Section IV.

Figure 4.

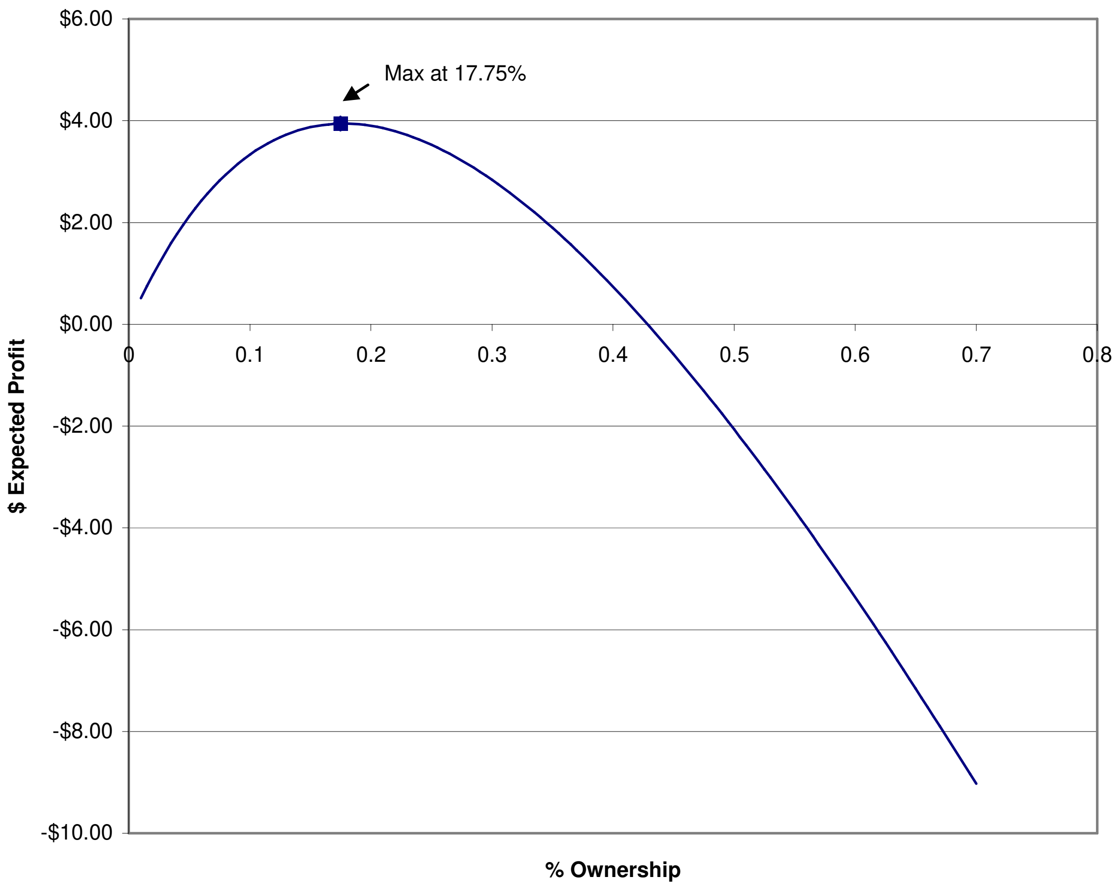

Figure 4 plots the percentage of ownership vs. the expected profits. The parameters used are from the example in Section IV. The maximum occurs at 17.75%.

Figure 5.

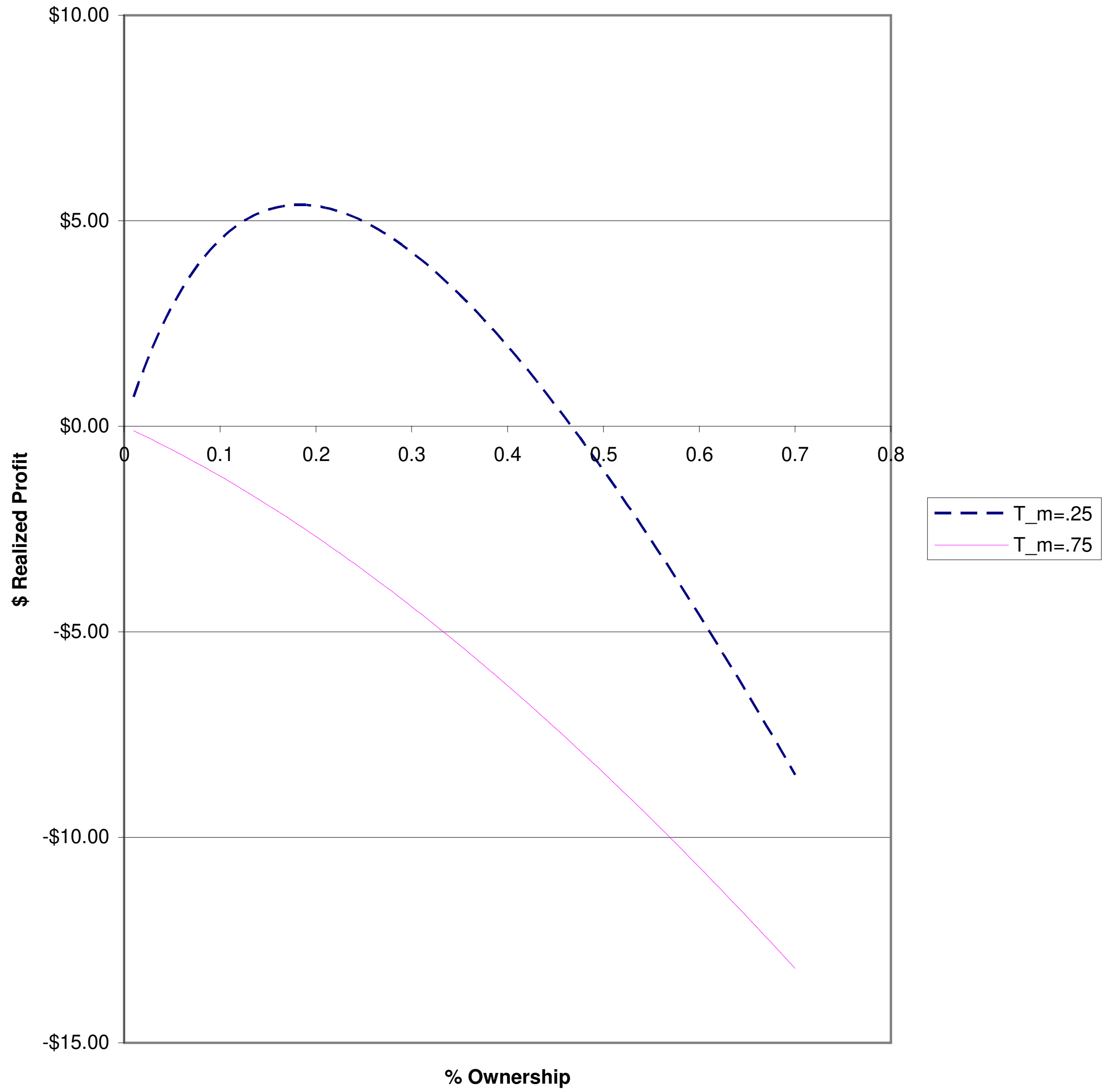

Figure 5 plots the percentage of ownership vs. realized profits. The parameters used are from the example in Section IV. The T_m=.25 plot is the plot that occurs when the realized value for the percentage of non-arbitrager shareholders who tender is 25%. Likewise, the T_m=.75 plot is the plot that occurs when the realized value for the percentage of non-arbitrager shareholders who tender is 75%.

Figure 6.

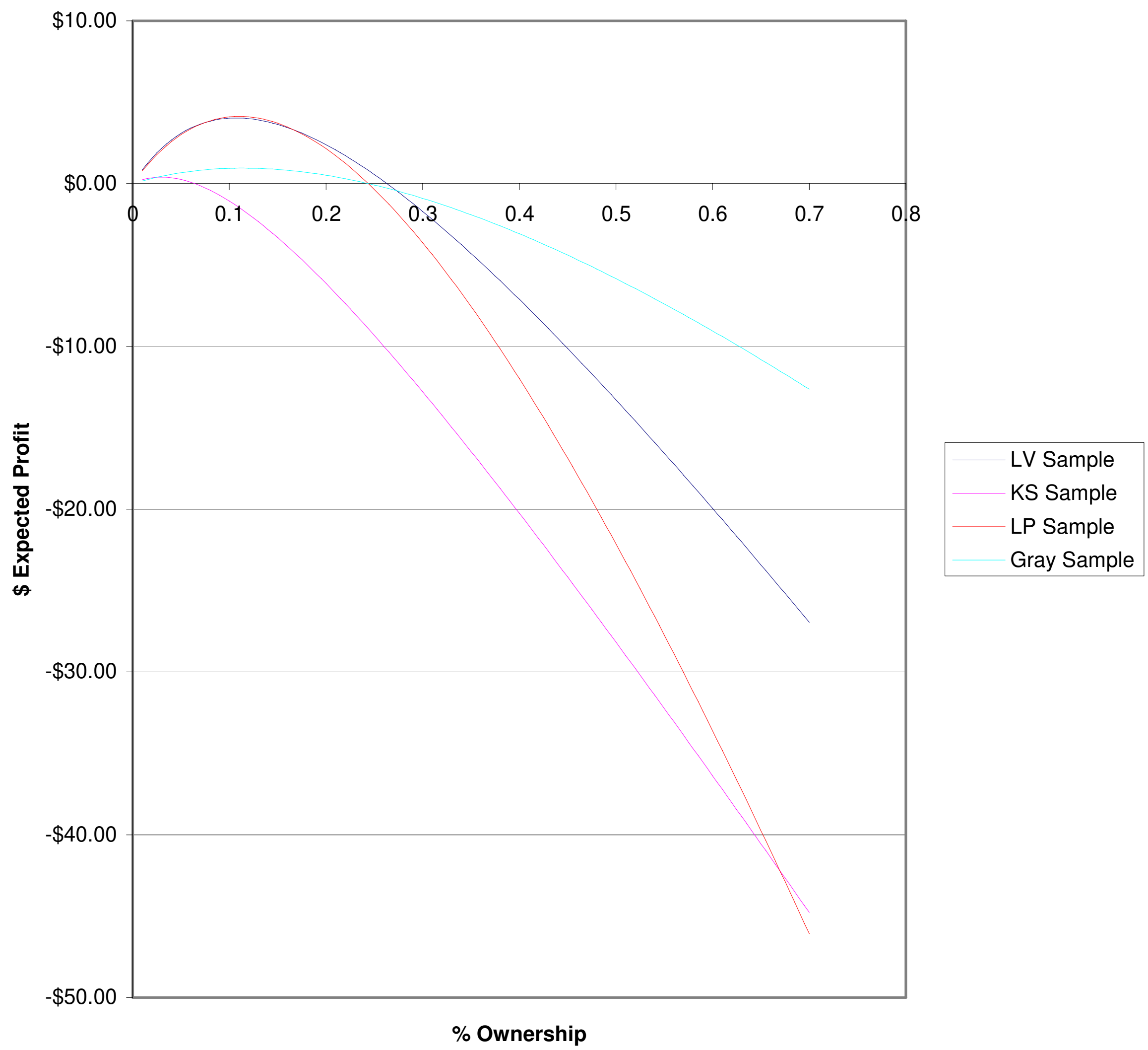

Figure 6 plots the percentage of ownership vs. expected profits. The parameters used are the actual parameters found in the LV, KS, LP and Gray papers (found in Table 3).

Figure 7

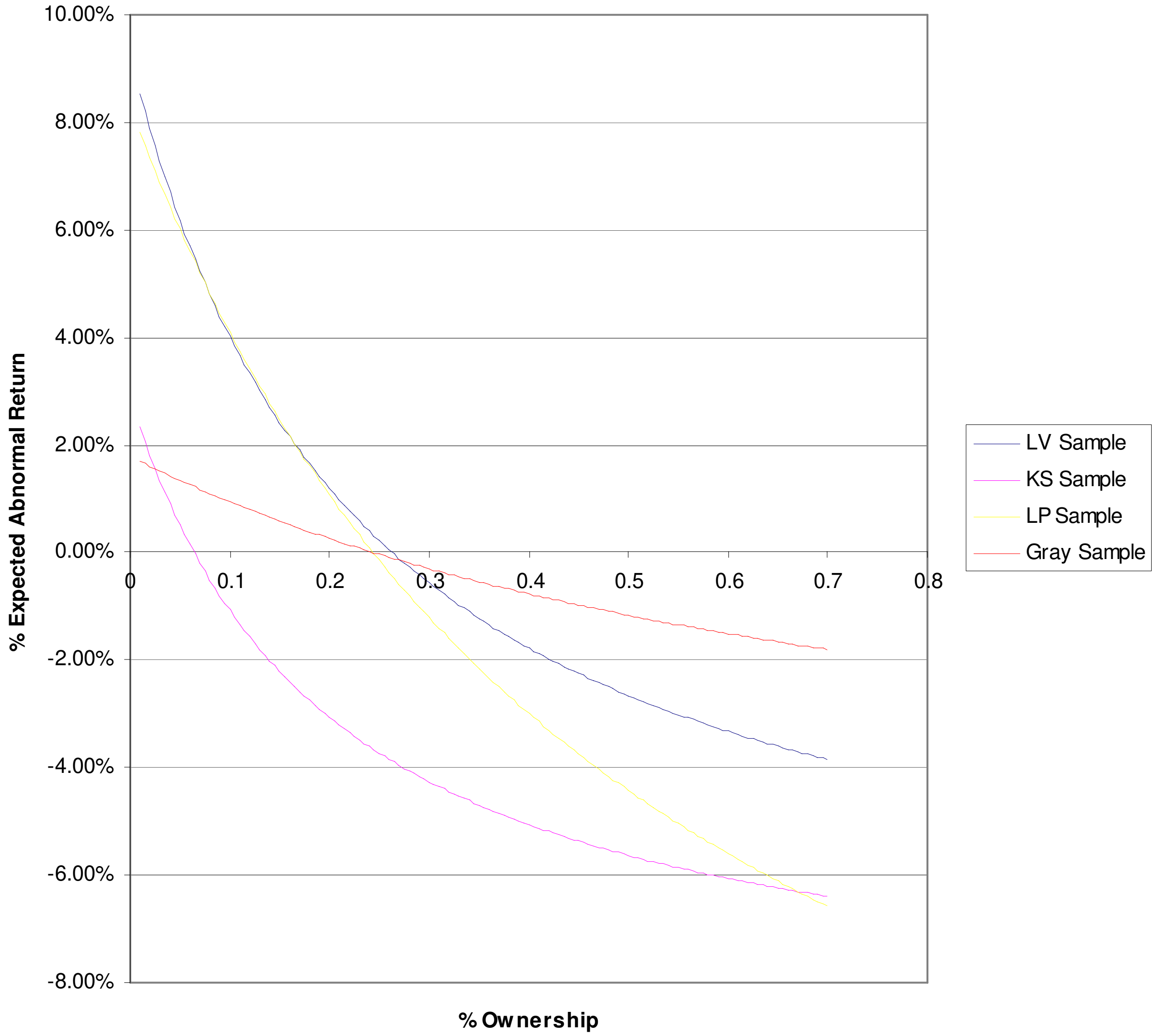

Figure 7 plots the percentage of ownership vs. expected abnormal returns. The parameters used are the actual parameters found in the LV, KS, LP and Gray papers (found in Table 3).

Figure 8.

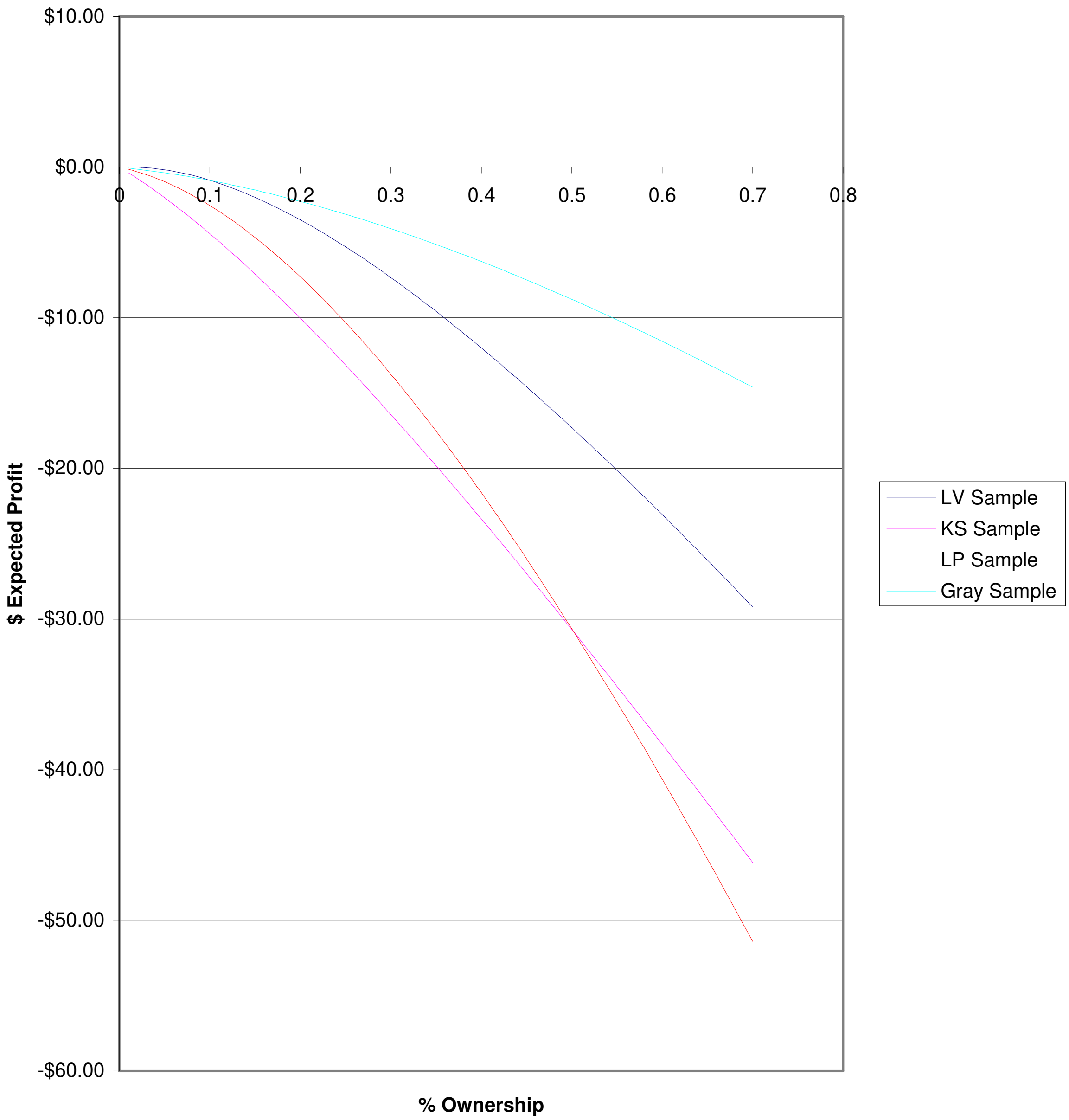

Figure 8 plots the percentage of ownership vs. realized profits. The parameters used are the actual parameters found in the LV, KS, LP and Gray papers (found in Table 3). However, in this plot the T_m variable is equal to $E_a(T_m) + 20\%$, or the correction expectation plus a shock of 20% additional tendering shareholders

Figure 9

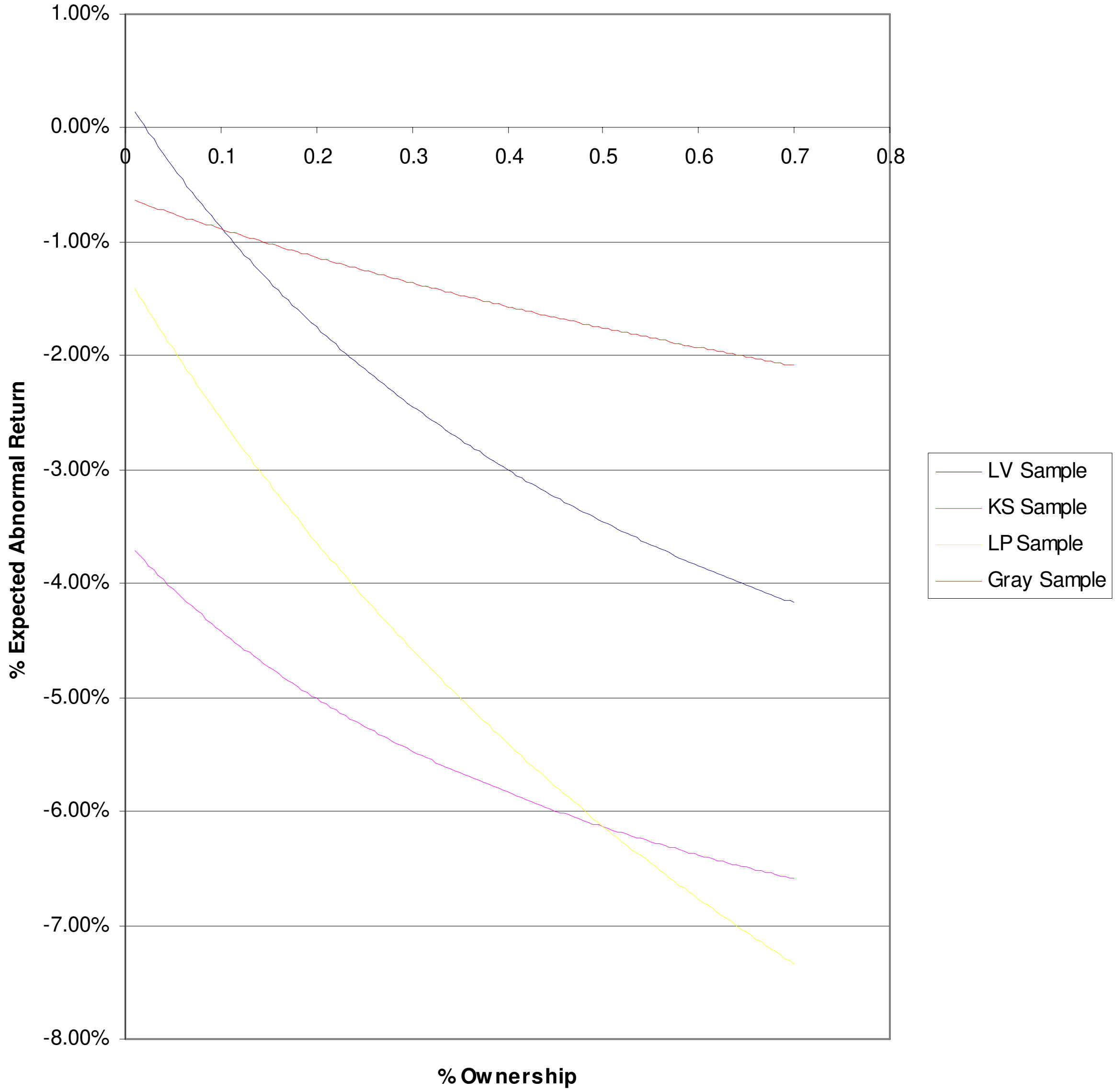

Figure 9 plots the percentage of ownership vs. realized returns. The parameters used are the actual parameters found in the LV, KS, LP and Gray papers (found in Table 3). However, in this plot the T_m variable is equal to $E_a(T_m)+20\%$, or the correction expectation plus a shock of 20% additional tendering shareholders